International Engineering and Technology Education Conference

IETEC'17

Engineering and Technology Education Quality Assurance: Embracing the Future

4-6 DECEMBER 2017

Hanoi, Vietnam

CONFERENCE PROCEEDINGS

All papers included in this proceeding are double blind peer reviewed.

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ISSN: 1843-6730
ISBN-13: 978-0-646-54982-8

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Preface

It gives us great pleasure to publish a scholarly proceedings volume of the fourth **International Engineering and Technology Education Conference (IETEC'17**) which was staged in Hanoi, Vietnam between 4 and 6 December 2017! The theme of IETEC'17 was "*Engineering and Technology Education Quality Assurance: Embracing the Future*".

IETEC'17 was organised to foster cooperation between a wide range of stakeholders of engineering and technology education to facilitate educational policy developments, learning, teaching and research that helps enhancing engineering and technology education. The IETEC'17 braught together international academics, professionals, researchers, students, employers and policy makers from around the world to interact with each other. IETEC'17 is jointly organised by a consortium of universities composing of the host university, Hanoi University of Science and Technology (HUST), Hanoi, Vietnam and Deakin University Australia. The conference is supported by Ho Chi Minh City University of Technology and Education, HCMC, Vietnam and Lucian Blaga University of Sibiu, Sibiu, Romania.

The International Engineering and Technology Education Conference (IETEC) is a series of conferences initiated and coordinated by a team of engineering and technology educators from around the globe which has now transformed to an open, collegial and supportive working group. The IETEC involves multiple likeminded universities and organisations from around the world. The IETEC features significant keynote addresses, plenary presentation sessions, interactive workshops, a panel discussion, exhibition stalls and opportunities for international collaborations. The IETEC provides opportunities and forum for engineering and technology educators to discuss important issues and develop strategies to foster engineering and technology education. The inaugural International Engineering and Technology Education Conference was held at Taylor's University, (Selangor), Kuala Lumpur, Malaysia in January 2011.

Several participants from countries covering the Asia Pacific, North and South America, Europe, the Indian sub-continent and the Middle East regions attended IETEC'17. This time there was substantial reprentation from local/host country, Vietnam. The conference stimulated highly productive discussion and reflection. This publication is but one of the outcomes of the conference. All papers contained in the Proceedings were presented at the conference and were refereed (double blind) by independent peer reviewers.

We would like to express our sincere gratitude to all contributors for submitting significant and quality papers. Special thanks to our reviewers, sponsors, supporters, exhibitors, conference speakers and special guests who have made this event a great success! We look forward to assembling again in 2019.

Arun Patil and Dr LE Huy Tung

Editors

February 2018

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The organising committee of IETEC'17 wishes to thank our sponsors and exhibitors for their support of our efforts to facilitate engineering education and research in Vietnam and the world.

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Exploring Participation of Students in Software Development: A Survey, Dayana Caridad Tejera-Hernández†, Arno Libotton†, Frederik Questier‡ and Febe Angel Ciudad-Ricardo*, Vrije Universiteit Brussel - University of Informatics Sciences, Brussels – La Habana, Belgium – Cuba‡; Vrije Universiteit Brussel, Brussels, Belgium‡; University of Informatics Sciences, La Habana, Cuba*.

Compuphilia: the Burgeoning Sociocultural Addiction to Computechnology, Ronald S. Laura†, Hang T. T. Truong† and Thai D. Vu‡; the University of Newcastle, Newcastle, Australia†; the University of Information and Technology Communication, Thai Nguyen, Vietnam‡

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A Dynamic Model to Identify Sensitive Data and Suggest Masking Technique, Ruby Jain†, Manimala Puri‡, and Rahul Wargad*, University of Pune, Pune, India†; JSPM Group of Institutes, Pune, India‡; Allana Institute of Management Sciences, Pune, India*.

CONFERENCE PAPERS

Application of Internet of Things (IoT) in Online Course Design for Basic Electronics

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ABSTRACT

With the aid of IoT and Blended Solution – traditional instruction combined with online interactive instruction between teachers and learners, the content of online course design for Basic Electronics is redesigned to produce a high-quality product capable of helping learners to absorb their lessons as effectively as they can. In addition, learners' positive attitude toward it is implemented after completing each chapter as required in the content.

Keywords*: Blended learning, blended solution, IoT, lms, moodle, active learning.*

INTRODUCTION

Basic Electronics is a fundamental discipline of Electrical – Electronic Engineering department. Its properties perhaps are rather abstract theory, it is very difficult to

absorb it for learners by means of traditional instruction. Hence, to enhance the ability to understand their lessons quickly and easily, we propose some instructional approaches, that is, to combine traditional instruction with online interactive instruction through the aid of IoT and Blended learning.

With the implementation of new instructional move, learners are able to achieve objectives of each chapter through computer animations to represent operation principles of electronic devices, applied circuits. At the same time, they can self-assess their learning through online tests corresponding to particular chapters. As a result, the research to build electronic communication for Basic Electronics in respect to theory and practice at present become necessary.

DESIGNS FOR ONLINE COURSE

1. Guidelines to Sign in the Course

1. Go to Web page www.hcmute.edu.vn
2. Next, go to page www. lms.hcmute.edu.vn
3. Then, go to item Course for Basic Electronics
4. Log in (*user name and password granted)*
5. Course interface

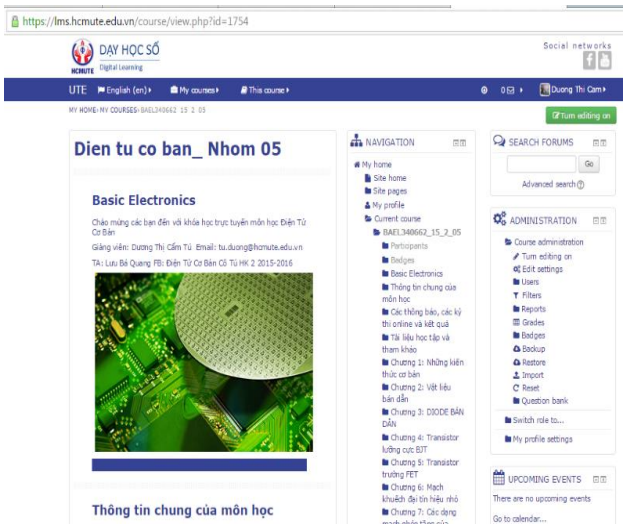


Figure 1: Course interface

1. Curriculum Design

The Tools to Teach and Learn Online Courses

2. Resource

Supporting lecturers in uploading their material into the courses of LMS through the file formats such as word, pdf, video clip, etc or the links to other addresses (URL), etc.

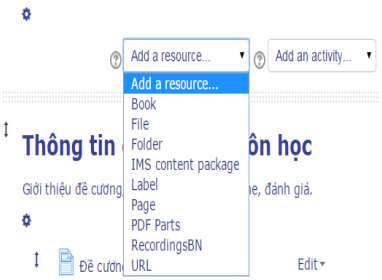


Figure 2: Resources of LMS

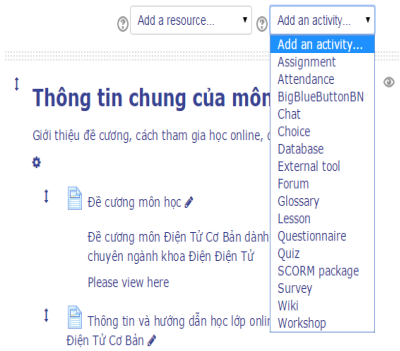


Figure 3: Activities of LMS

3. Activity

Aiming to build online interactive environment between lecturer and student. It supports lecturer to operate an online class through the activities such as testing, evaluating students' results by means of assignment, quiz, etc. As for learners, they can discuss with lecturer, classmates conveniently through forum, chat, etc, simultaneously they can self-check their knowledge through the given tests as required.

Evaluating and checking students' activities

LMS also supports lecturers to check students' general activity levels during the whole course, each student's grades, grade range of class in each test, and to self-evaluate difficult or easy classifications in questions of a test so that lecturer can adjust them next time.

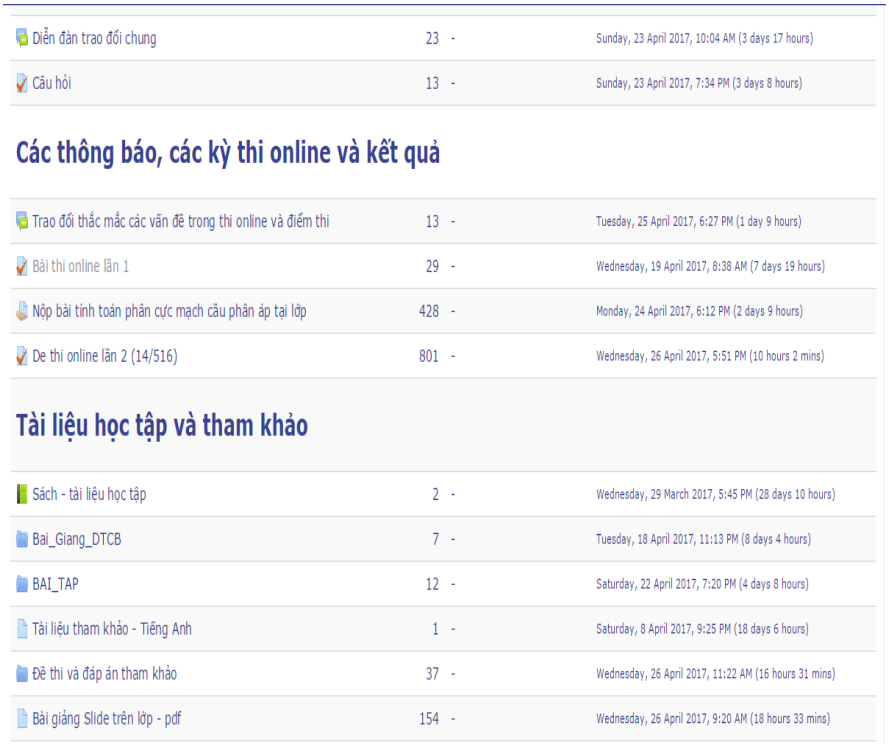
Students' activity level

i. Expected graph to teach and learn during 15 weeks (75% online)

ii. Achievements

<u>Students</u>

1. Initially they feel unfamiliar, worried but after short time the new instruction becomes inspiring.
2. It is easy to adapt online course for students.
3. After completing the course, students have the ability to promote soft skills necessary for specialized field.



Diễn đàn trao đổi chung	23	-	Sunday, 23 April 2017, 10:04 AM (3 days 17 hours)
Câu hỏi	13	-	Sunday, 23 April 2017, 7:34 PM (3 days 8 hours)
Các thông báo, các kỳ thi online và kết quả			
Trao đổi thắc mắc các vấn đề trong thi online và điểm thi	13	-	Tuesday, 25 April 2017, 6:27 PM (1 day 9 hours)
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De thi online lần 2 (14/516)	801	-	Wednesday, 26 April 2017, 5:51 PM (10 hours 2 mins)
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Figure 4: How to check Students' activity level during the course

4. Grades to evaluate test and exam papers

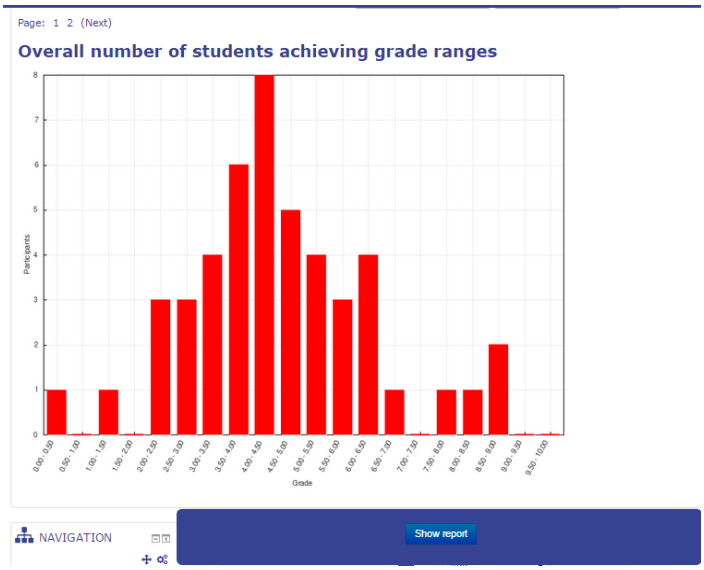

Figure 5: Grade range in student's test paper

Hence, LMS course has a good effect on ensuring students' outcome through the activities to evaluate their knowledge frequently.

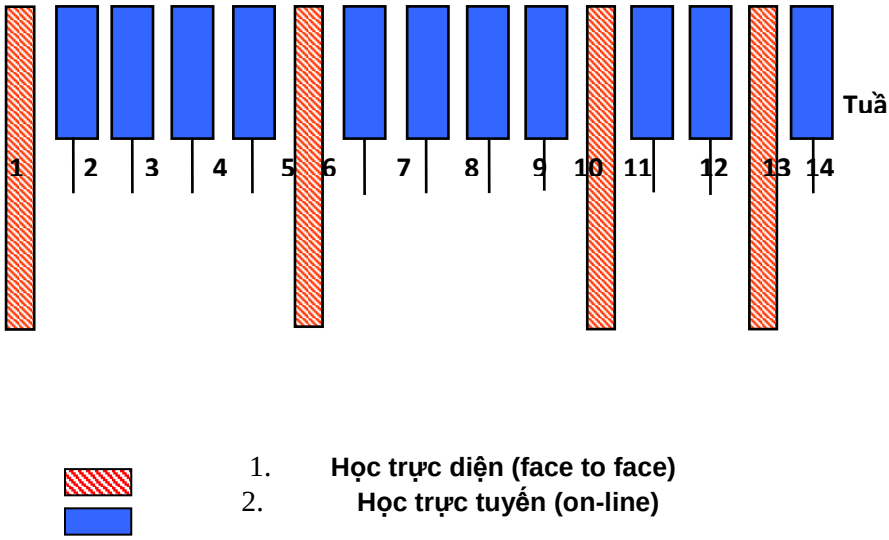

Figure 6: Graph for online course in future

5. CONCLUSION

"Designing an online course for Basic Electronics" contains the following contents:

1. Application of IoT to build an online course for Basic Electronics
2. The test questions are designed in interaction model so that learners can self-check their knowledge for each chapter of course.
3. At the same time, the online course produces new instructional pedagogy combining traditional instruction with online instruction known as Blended Learning. It helps to expand learning space, to save time and to ensure learners' outcome.

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   www.lms.hcmute.edu.vn

Innovation in Entrance Examination in Vietnam Universities, Knowledge Based Assessment into Competency Based Assessment

(Case study in Group of Technical Universities)

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ABSTRACT

This paper introduces the situation of entrance examination in Hanoi University of Science and Technology. Then, this paper evaluates the relationship between the entrance exam and the learning outcomes of HUST's students which will partly contribute to the practical fundamental of these changes. Based on analysis of advantages and disadvantages in enrollment exams, the paper proposes the model of competency based assessment and the steps for renew the entrance examination.

Keywords: *Competency Based Assessment, Enrollment Examination, Learning Competence, Learning Outcomes.*

1. INTRODUCTION TO THE ENTRANCE EXAMINATION IN VIETNAM UNIVERSITIES

All candidates, who want to be HUST students, have to attend the national exams (HUST, 2015). The national exam always is an important event of Vietnamese Education. This exam is the integration of the high school graduation exam and the college entrance exam. In this exam, candidates have to make four tests at least, such as Mathematics, Literature, Foreign Languages and one optional test in following subjects (Physics, Chemistry, Biology, History and Geography).

However, the entrance examinations are supposed to not meet the requirements of the training process at HUST.

1.1. The Relationship Between the Enrollment Grade and the Training Process in HUST, Vietnam

To evaluate the relationship between the entrance grade and the CPA for each student, our research consider the results of 407 students in HUST (included the different schools in HUST such as ICT, Mechanics, Automation,...)

Table 1: The quantity of surveyed students in each school belonged to HUST.

		Frequency	%	Valid %	Cumulative %
Valid	Automation	74	18.2	18.2	18.2
	Mechanics	160	39.3	39.3	57.5
	ICT	118	29.0	29.0	86.5
	Chemistry	39	9.6	9.6	96.1
	Electronics	1	.2	.2	96.3
	Materials	3	.7	.7	97.1
	Economics	2	.5	.5	97.5
	Applied Mathametics	1	.2	.2	97.8
	Taylors	2	.5	.5	98.3
	Nuclear Engineers	6	1.5	1.5	99.8
	Engineering Pedagogy	1	.2	.2	100.0
	Total	407	100.0	100.0	

1. Statistics of the average grades in entracne exams at HUST

Table 2: The average grades in the entrance exams (max. of 10.0).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	From 5.3 to 7.0	84	20.6	20.6	20.6
	> 7.0 to 8.0	148	36.4	36.4	57.0
	Above 8.0	175	43.0	43.0	100.0
	Total	407	100.0	100.0	

2. Statictics of the CPA values of the second-year students at HUST

Table 3: CPA values (Max. of 4.0).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<1.0	93	22.9	22.9	22.9
	2-2.49	131	32.2	32.2	55.0
	2.5-3.19	139	34.2	34.2	89.2
	3.2-4.0	44	10.8	10.8	100.0
	Total	407	100.0	100.0	

The relationship between the entrance point and the CPA is analysised through Chi-square test (Hoang Trong Chu, Chu Nguyen Mong Ngoc, 2008). The result of Chi-square test is described in the following table:

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.19.

Thus, the Chi-square value is 33.423. Looking at the Table for the limited values of Chi-square, at the value of df = 6 and the meaning value of 0.995, the limited value of Chi-square is 18.5<33.423. Then, there is a relationship between the enrollment grades and CPA of each student.

Table 4: Chi-Square Tests.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	33.423[a]	6	.000
Likelihood Ratio	32.741	6	.000
Linear-by-Linear Association	25.806	1	.000
N of Valid Cases	407		

To determine the relationship in specific (relational dimension), we consider the value of tau-b, gamma, Spearman correlation.

Table 5: Directional Measures.

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.226	.043	5.100	.000
		Diemtt_new Dependent	.253	.047	5.100	.000
		CPA_new Dependent	.205	.040	5.100	.000

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Table 5: Directional Measures.

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.226	.043	5.100	.000
		Diemtt_new Dependent	.253	.047	5.100	.000
		CPA_new Dependent	.205	.040	5.100	.000

Table 6: Symmetric Measures.

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.228	.043	5.100	.000
	Gamma	.389	.071	5.100	.000
	Spearman Correlation	.250	.047	5.206	.000[c]
Interval by Interval	Pearson's R	.252	.048	5.243	.000[c]
N of Valid Cases		407			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

As a result of tau-b value, gamma, Spearman correlation, we found a positive correlation exists between the two quantities, Enrollment Grades and CPA values.

In summary, there is an exist of the relationship between Enrollment Grades and CPA values of the second-year students in HUST. Then, the quality of the training process in universities is influenced by the enrollment grades. So that, the next

reseach will introduce the meet of the entrance exams and the requirements of the training process in HUST.

1.2. The Gap Between the Entrance Exams and the Requirements of the Training Process in HUST

In the surveys about the requirement of training at HUST (Tran Khanh Duc and Colleagues, 2016), only 5.2% of the surveyed students said that the contents of the entrance exam meet the requirements of the learning process at a very high level. Up to 49.9% of the surveyed students said that the contents of the college entrance exam to meet the requirements of the learning process at a high level.

However, the percentage of students supposed the low level is up to 37.6%. And also 7.4% of the students said that this response is at very low level. This ratio also reflects the need to adjust the contents of the current entrance exam, to suit the requirements in training process at HUST.

Table 7: Evaluate the content of entrance exams can meet the requirements of the current school subjects that you are studying at HUST?

Very low / Low / High / Very High.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very low	30	7.4	7.4	7.4
	Low	153	37.6	37.6	45.0
	High	203	49.9	49.9	94.8
	Very High	21	5.2	5.2	100.0
	Total	407	100.0	100.0	

The spectrum of the average grade in the Entrance Exams of the year 2015 is illustrated in the figure 1.

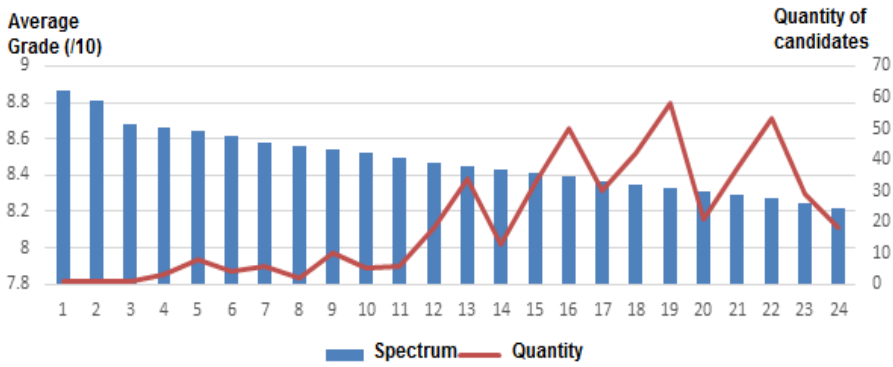


Figure 1: The spectrum of the average grade in the Entrance Examination at the school of ICT, HUST in 2015.

The school of ICT always attracts the excellent candidates to enroll. As seen in the figure 1, all candidates in the school of ICT (HUST) have high average grades in enrollment exams, above 7.8(/10). However, this results is not synchronous with the CPA values for second-year students as considering the distribution of the CPA in the graph below:

Although there are some changes in the national exams in recent time, the exams mostly are not suit to the requirement of the training process in HUST, especially in evaluation the creation, the ability of solving problems,...

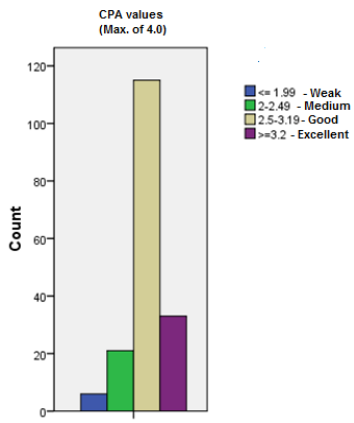


Figure 2: Distribution of CPA values of the second-year students in HUST.

2. COMPETENCY BASED ASSESSMENT MODEL

Competency Based Assessment is considered as one of the main approach of learning outcomes assessment at present. Accordingly, these assessments are integrated and closely linked to both the learning processes and the jobs. Competency Based Assessments confirm, adjust and develop the competence of the students by organizing the learning activities in case- studies. In each case study, there is a merge of the knowledge and skills into a completely scientific and practical structure of learner capability that relates to the job.

There are many types of learning task such as: Task of accumulating scientific knowledge; Task of practicing the cognitive thinking; Task of training hands-out skills and Task of training the learner's personality. Depending on the types of leaning tasks, learner can do the learning activities such as: study on class; self-study; team work; seminar/presentation/project/role play/simulation; store the learning profile; self- assessment in each learning task.

Approaching to action methods, learning competences is tha abilities of doing a various of learning activities. The structures of the learning competence in the model of competency based assessment:

- Perceptual Competences: the ability to observe and identify the traits, characteristics, relationships, the process of things, phenomena in nature, society and the production/ services

- Thinking competences: the ability to analyze, synthesize, logically think, calculate, generalize, systematize the issues, opinions, events, phenomena ...- Language competences: the ability to use language as a second signal system in communication activities, expressions, argument; presentations, making essay, persuasive, listening, empathy, express feelings ..)

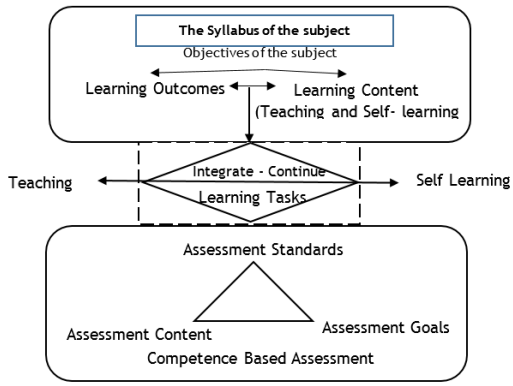


Figure 3: The structure of Competency Based Assessment Model (Duc, Learning Competence and Competency Based Assessment, 2016).

- Adaptive competence: the ability of handling sensitive, flexible situations, moving skills to implement new activities, share, evolution; coordination, teamwork ...

- Action competence: the ability to perform actions, gestures, proficient use of tools, vehicles, action process, the tectonic.

- Communication competence: the ability to work toghether, team work..

Types of assessment exercises:

- Identify, classify and analyze, review, evaluate, explain, comment, events, phenomena, natural relationships, social and career.

For example: classifying materials, equipment, techniques and instruments; structural analysis, technical process; explain the phenomenon, causes, technical problems

- Process information / situation / problem solving.

For example, processing situations and explosives; solve the problem of material deformation in machining processes, save energy.

- Calculate and logical thinking; apply the rules / principles / theories

Example: Calculating the technical parameters of capacity, power consumption, materials consumption; the dimensions of the parts.

Figure 3: Core learning competences (Duc, 2015).

- Drawing and design, use of standards / symbols / convention / diagram / picture / color / shape / size...

Example: Applying technical standards, read and draw technical drawings; determine the shape, the size of the tool or product; Select and use the possibilities for color schemes...

- Expressing and argue orally-writing (essay / presentation / exchange...)

For example, the displacement process engineering projects; Write describes the structure and technical process.

- Analyze, classify, compare and apply the methods, tools and rules.

For example: compares the metalworking method, electric welding process analysis, operational procedures of pumps.

- Implementation of actions, action movement (operation, repair / maintain tools, equipment)
- Synthetic Exercises (Assignments / Projects subject / Research-thematic experience ...)

3. INNOVATION IN THE ENROLLMENT EXAMINATION

- Procedure of competency based assessment in the enrollment examination:

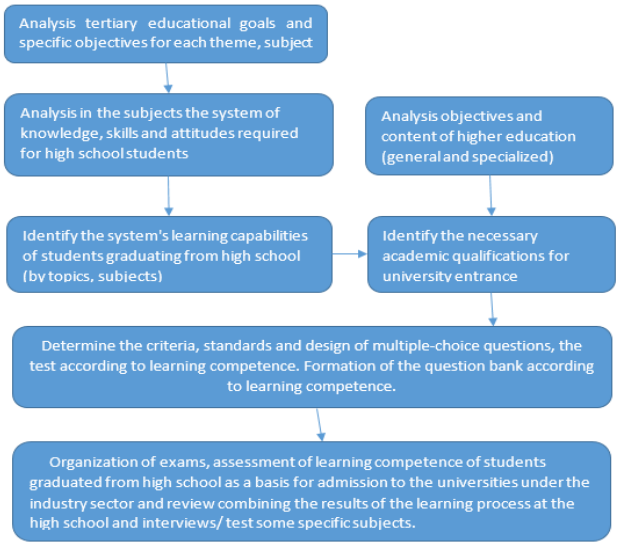
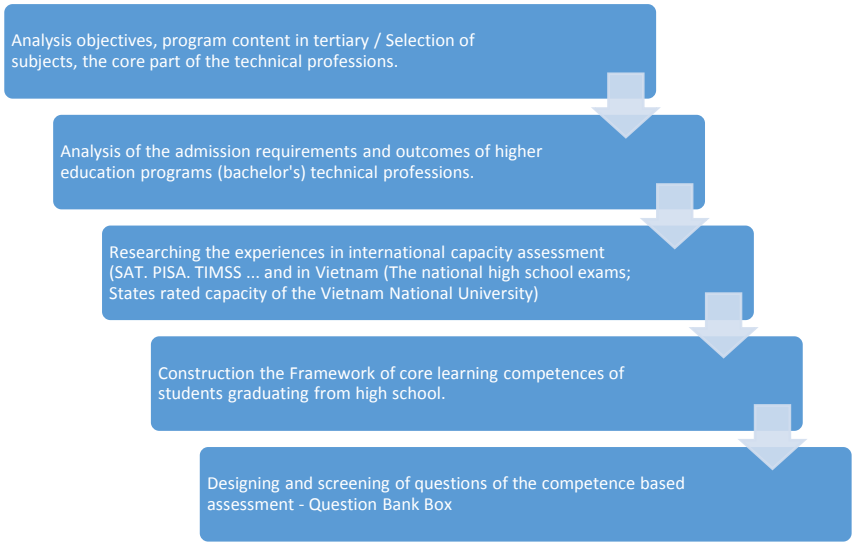
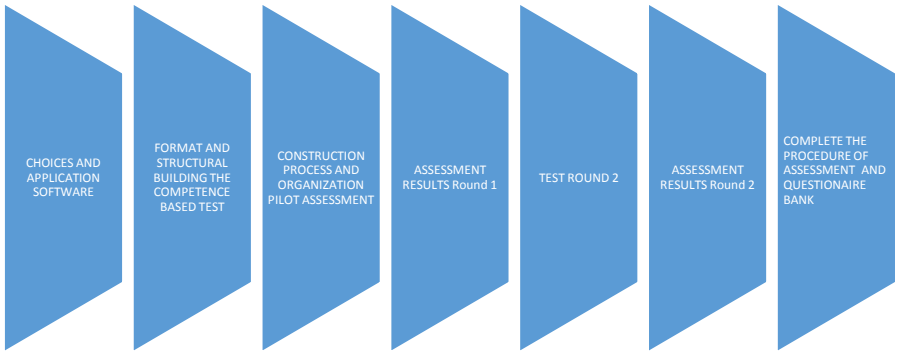


Figure 5: Procedure of competency based assessment in the enrollment examination.

Building the question bank for enrollment examination according to competency based assessment model

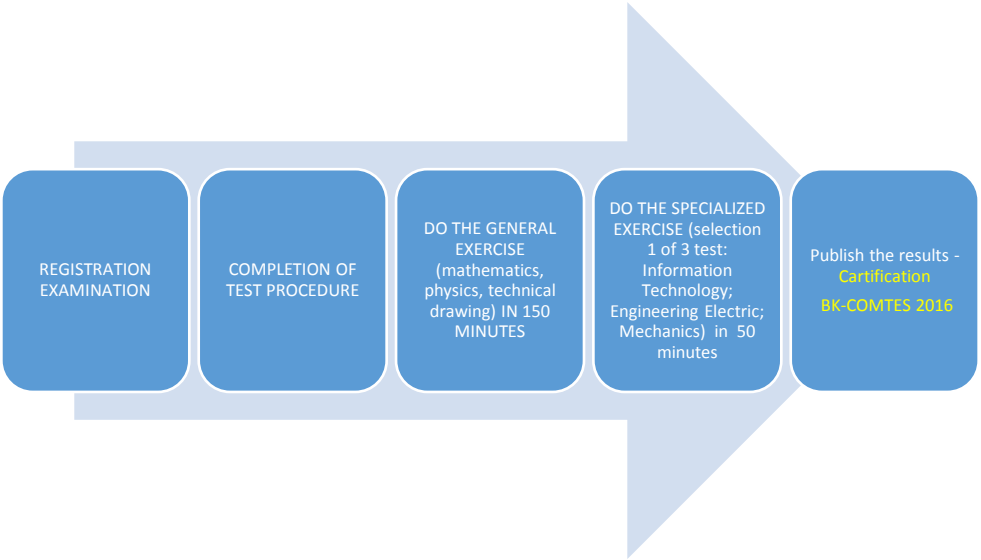


- Implementation the enrollment examination according to competency based assessment in trial phase



- Steps for organizing the enrollment examination according to competency based assessment

In conclusion, learning is a basic activity of human beings and learning is forming the suffcient competency of each person to meet the needs of their lives and society. Learning competency based assessment is an evaluation process based on objectives and learning content in order to determine the level of competence is formed at certain learning process.



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Assessment the Results of High School Technology Learning in the Capacity Approach by Means of Graphic Tests

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ABSTRACT

The world is entering the industrial revolution 4.0, the amount of knowledge increases exponentially. Content-based education is no longer appropriate. Educational innovation towards the development of learner capacity is a trend of education today. General education in Vietnam is also gradually moving towards the development of learner capacity. However, success in the field of capacity development requires specific research. This paper reviews the study of evaluating the results of high school technology learning in the capacity approach by means of graphic tests. The goal is to propose a new and more effective way of assessing competencies in high school teaching technology.

Key word: *Assessment, capacity, competence, graphic test, technology.*

INTRODUCTION

The general trend of education reform today is the shift from content to access to competence. However, when applied to each country or territory, specific research is required. Because each country and territory has its own specificities in the culture of education, the level of science and technology and the living conditions of the people. In Vietnam, education reform is taking place in the direction of a strong capacity-based approach from the high school to the university level. There are many projects, research works on this issue. The article examines the performance of high school education in a qualitative approach using a graphic-based approach developed by the author with the objectives of clarifying the concept of competence and competency assessment, identification of competencies required for students to study Technology; The role of graphics in technology teaching and capacity development; Finally, how to design a graphic assessment test. With this content the author hopes that this will be a new assessment tool that

will contribute to the development of effective capacity in teaching technology in high school.

COMPETENCE AND COMPETENCE-BASED ASSESSMENT

Competence: There are many different definitions of competence, depending on the purpose of research have corresponding ways.

- According to the Dictionary of Education: Competence is the ability to be formed or developed, enabling people to achieve success in a physical, mental or occupational activity. Competence is reflected in the ability to perform an activity, perform a task (5, pp 278)

- FE Weinert: The competence of students is a rational combination of knowledge, skills and willingness to engage in responsible, responsible and positive individual action towards solutions to problems (13).

- According to Bernd Meier, competence is understood as the ability or skill learned or available to the individual to solve specific situations, as well as motivational, social,... and the ability to apply problem-solving methods responsibly and effectively in flexible situations (13).

- According to Tran Khanh Duc (2014): Competence is the ability to receive and utilize all potential human resources (knowledge, skills, attitudes, physical strength, belief ...) to perform quality and performance work or deal with a situation, a certain state of life and occupational work under specified conditions and in accordance with certain standards (4).

From the above understandings, it is possible to understand the general competence as follows: competence is the quality of psychology and human physiology to ensure the performance of a certain activity.

* ***Competence-based assessment:***

From a learner-centered viewpoint, evaluating educational outcomes is geared toward after school, students are able to apply the knowledge and skills they learn in school to life, rather than just evaluating each unit of knowledge, skills alone. Therefore, there is a need for a different assessment. It is assessed in terms of competency approach. Evaluation based on competency approach is to assess learners' knowledge, skills and attitudes in a meaningful context (Leen Pil, 2011).

Competence-based assessments assess the ability of students to apply knowledge, skills and attitudes learned in real-life situations. Competency assessment is another way of evaluating performance. In essence, there is no conflict between competency assessments and assessments of knowledge, skills, and attitudes (assessment based on content approach), where competency assessments are considered to be higher than Assessment of knowledge and skills.

To demonstrate that the learner is capable to some degree, there must be an opportunity for them to solve the problem in a realistic context. By completing a task one can assess both cognitive abilities, performance skills, values and emotions of learners.

On the other hand, the competency assessment is not based entirely on the subject syllabus, such as the assessment of knowledge, because the competence is to sum up, to crystallize knowledge, skills, attitudes, emotions, values, ethical standards,... is shaped from many fields of study and the natural and social development of a human being.

The scale in a competency assessment is standardized according to the learners' capacity development levels, rather than whether or not they have met the content they have learned. Therefore, competence assessments focus on the goal of evaluating a learner's progress versus oneself rather than the purpose of rating grading among learners.

Building the learning task to assess competence must cover the lowest levels of competence. Therefore, the capacity-based assessment tool is usually a system of tasks ranging from easy to complex, from simple to complex in one area, to measure the development of the capacity of all objects.

The way to analyze the results of a competency assessment, the more complex and difficult the task is performed, the higher the competency will be, ie the outcome depends on the difficulty of the task. The case has been completed. In addition, the results of capacity assessment will depend on the speed at which tasks are performed over a period of time. Those who solve more tasks are considered to have better capabilities.

COMPETENCIES NEED TO FORM AND DEVELOP IN TEACHING HIGH SCHOOL TECHNOLOGY

Characteristics of high school technology

High school technology is a practice-related subject that brings together the characteristics of technology: Specificity - reflects objects that students can perceive directly on objects or tissues (product, model, manipulation); Abstraction - concepts, principles, technical processes - technology can not be directly perceived. In order to express these contents in textbooks, they must be simulated using symbols, figures and diagrams; Practicality - is an inherent attribute of technology for the purposes, objects and results of research in technology and technology are derived from reality, reflect reality and tested in the practice; Integrated - contains knowledgeable elements from many different subjects: mathematics, chemistry, physics, economics, sociology,... but related and consistent with each other in reflecting specific technical objects.

Competencies need to form and develop in teaching high school Technology

According to the draft reform of the general education program in Vietnam launched in April 2017, the formation and development of six students quality is love the country, love people, study hard, work hard, honest, responsibility and 10 core competencies. The overall capacity for all subjects and educational activities contributes to the formation of self-control and self-efficacy, communication and collaboration capacity, problem solving and creativity; Professional competence is formed mainly through the following subjects: language ability, computing power, natural and social exploration capacity, technological capability, computer competence, aesthetic capacity, physical ability.

Technological capacity is formed primarily through technology. In (Ngo Van Toi, 2017) the author has researched and proposed the technological capabilities to be formed as follows: Capacity for technical thinking, ability to use technical language, ability to form ideas and Technology design, technical innovation capacity, technology deployment capacity, technology selection and evaluation capabilities, specific technology usability, business and consumer capabilities. (*Under the doctoral title of Ngo Van Toi conducted at Hanoi University of Science and Technology, May 20, 2017*).

Graphic and role of graphics in general technology teaching

Technology is a discipline that is embedded in the real world, enabling them to have technical competences at a universal level. Engineering subjects in the fields of mechanics, construction, electricity and electronics are the objects that students must perceive during learning process (seeing, touching, hearing...). However, in the process of learning, we can not bring all of the objects to teach students that must be through the image, model simulation, ... The image model as close to reality (real object) the higher the teaching effectiveness. Through this, the development of technical competences of students more convenient and effective. This particular feature shows that the teaching of technology in general education is indispensable in the image and simulation model ... Therefore, in the assessment of technology learning in the approach of capacity needs to strengthen use images, models ... to increase the effectiveness of teaching.

EVALUATE THE RESULTS OF HIGH SCHOOL TECHNOLOGY LEARNING IN THE CAPACITY APPROACH BY MEANS OF GRAPHIC TESTS.

* Multiple choice questions

+ Matching question: Requires the candidate to correctly match pairs of pairs in two columns to match the meaning.

+ Missing question: If a clause is missing a part, candidates must devise the appropriate content to fill in the blank.

+ The question requires a short answer: This is a question that requires to answer by a short word or phrase.

+ True-False question: Given a judgment, the candidate must choose one of two alternatives to confirm that it is true or false.

+ Multiple choice questions: Give a judgment and some answers, candidates must choose to mark the best or the best. The multiple choice has two parts, the first part is called the lead, the information is necessary, or ask a question. The following are options to choose from, usually marked with the letters A, B, C, D ... or the digits 1,2,3,4,5 ... In the alternatives available only one option is right or one is the best option, alternatives are confounding factors for contestants. The noise options are usually reasonable and attractive.

+ Self-answering question: A digital answering question that the new SAT test improved in 2005 to reduce candidates' dependence on a given frame. The answer value of the number of candidates can be filled in the form answer form, so can be marked by machine. Example: Find the value of x that satisfies two equations: $|4x-7|=5$ and $|3x-8|=1$

So 4x - 7 = 5 inference x = 3 or x = $\frac{1}{2}$.

So 3x - 8 = 1 inference x = $\frac{1}{4}$ or x = $\frac{1}{2}$.

From these two results, the inference x is satisfied x = $\frac{1}{2}$. Contestants must paint the number plates $\frac{1}{2}$ on the answer sheet.

* The software uses

Graphical software used in the Assessment of Technology is relatively rich. Some of the following software may be included:

+ Software used in the field of mechanics, building: AutoCAD, Solidworks, ANSYS ...

+ Software used in the field of electrical engineering, electronics: Orcad, Psim, Multisim, ...

+ Some other software can use: Photoshop, ActivInspire.

In this paper, the author uses static drawing software only, 2D. Specifically, the ActivInspire software and some drawing tools in the word to design in 2D, static. Next time will design 3D, dynamic.

* Principles of evaluation

+ The purpose of the assessment should be clear and relevant to the situation: the type of competency to be assessed, the level of assessment, and the object to be assessed.

+ Assessment must be authentic and meaningful: The type of exercise chosen for the assessment must be close to the reality of the student's life, similar to the classroom learning activities that do not put pressure on such a traditional test.

+ Types of assessment should be diverse and assessment exercises must be complex: There are many solutions such as using different types of assessment tools

+ Evaluation must ensure validity: The validity of an evaluation tool is simply defined as "the appropriateness and accuracy of the statements derived from the test score"

+ Evaluation must be reliable: Reliability is the stability of the evaluation result, ie there are similar scores between the measurements when there are no significant effects.

+ Assessment for student progress: The scale in the assessment of standard competence is based on the level of student's ability to develop, rather than whether or not a person has achieved or is not learning the content they have learned. Evaluation must be for the progress of the student itself and not against the other student.

* The process of designing tests with graphic tests

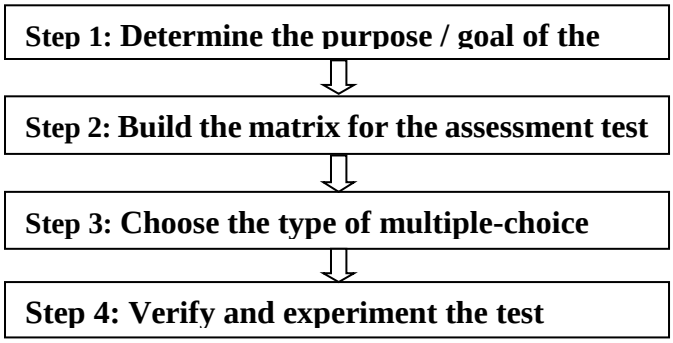


Figure1: Assessment process.

Step 1: Determine the purpose / goal of the test:

First, determine what type of capacity to evaluate. Has the capacity been fostered in the development of teaching? To assess that competence, the content of the study has the advantage. Determine when to evaluate (regular, periodic, summative), long or short evaluation time (15', 45', 60', 90' ...), what the evaluted object is.

Step 2: Build the matrix for the assessment test:

The matrix table for the test is a two-dimensional matrix consisting of two basic elements: *one is* the type of competency to evaluate and the content of the assessment; *Second is* the level of competence to assess.

Table 1: Matrix for the assessment test.

Capacity levels / Capacity types, Content /Question		Understanding	Similar application	Flexible application	Creative application	Optimal creative application
Capacity types	Content Total question: Total score: Percent %: The score /The test	Number of questions: Total score:	Number of questions: Total score:	Number of questions: Total score:	Number of questions: Total score:	Number of questions: Total score:
Capacity types	Content Number of questions: Total score: Percent % The score/ the test	Number of questions: Total score:	Number of questions: Total score:	Number of questions: Total score:	Number of questions: Total score:	Number of questions: Total score:
Total score	10 (100%)	Total score of level 1:	Total score of level 2:	Total score of level 3:	Total score of level 4:	Total score of level 5:

Level of understanding: Questions / exercises / problems require students to have good memory, quick replay, correct use of what they learned. Example: Two-stroke engine is internal combustion engine or burned out? Why?

Level of similar application: A question / assignment / problem that asks learners to apply their knowledge to solve similar problems. Example: Based on a three-speed gearbox, design a four-speed gearbox.

Level of flexible application: A question / assignment / problem that requires learners to use certain types of manipulations and form of thinking; It is possible to see the new in the old, the general in the individual, the outlines of the intrinsic attributes, the normative relationships, the predictions of the development and development of the object of study. To recognize and improve them. Types of questions / exercises of analysis, synthesis, identification, diagnosis, technical troubleshooting... are in this level.

Level of creative application: It is required that students have the ability to suggest themselves, to set up new issues, new ideas or new processes; It is possible to evaluate and criticize the object from which there are suggestions for improvement complete.

The optimal level of creative application: It is required that students have the ability to propose by themselves, to set up new issues, new ones, new processes, to be able to assess on each new problem, new solution, new process, compare them together to choose the optimal solution.

Step 3: Choose the type of multiple-choice questions:

From the newly constructed matrix, construct the questions / exercises / problems. Use multiple-choice methods to design questions / exercises / problems in the form of "graphic" images.

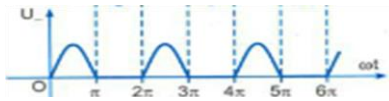
Step 4: Verify and experiment the Test

After the design is completed, the test can be given to experts, teachers for evaluation, evaluation for correction. Then have students take the test and try it out, revising it for the last time before using it massively.

Example: Design some graphic tests in the 12th grade technology test

- *Ability to use technical language:*

Question 1: What rectangular waveform of this rectifier circuit? (Understanding level)



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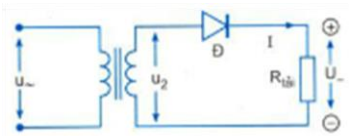

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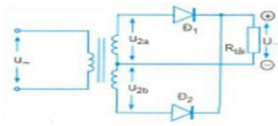

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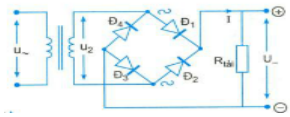


- *Ability to use specific technology*

Question 2: A radio repairman needs a 470 resistor, which has the following color resistors in the house. Please select the type of resistor required. (Understanding level)

Quesion 3: Please select the appropriate components and draw the missing parts for the following electrical circuit to work. (Level of application)

A.  there are color rings: Red, Dark Red, Brown, Yellow

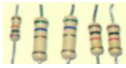
B.  there are color rings: Yellow, Purple, Brown, Gold

C.  , there are color rings: Yellow , Purple , Black, Silver

D.  there are color rings: Br

A  re are 2 types of resistors: $R_1 = 30\ \Omega$, $R_2 = 135\ \Omega$.

B..  There are 2 types of resistors: $R_1 = 135\ \Omega$, $R_2 = 35\ \Omega$.

C.   his kind of resistor has $R = 47\ \Omega$

D.   s capacitor has $C = 100\ \mu F$

Question 4: Design a one-way source circuit for the output voltage of the following form (*Just drawing the source circuit*) (Level of creative application).

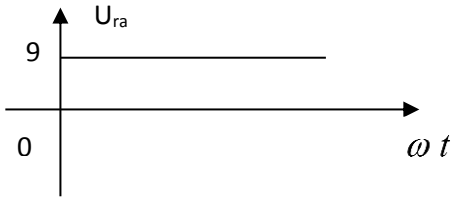


Figure 2: Source circuit design drawing

After designing the questionnaires in accordance with the matrix of the test, we proceed to consult experts and teachers who are teaching Technology in general. Finally, we put to test. Then edit and put into the question bank to check for mass use.

CONCLUSION

Examining and evaluating the results of high school learning in a qualitative approach by means of graphic tests is a new form of testing, with the aim of *increasing the picture channel, reducing the text channel*. The test approached the realities of real life. As far as practicing, the more quantitative the level of competence is. This article introduces the process of designing a proficiency test with graphic tests based on capacity theory, asymptotic assessment, multiple choice,

graphical software. At the same time, I designed some graphical competency assessment questions in high school technology. Initially the author designed and tested in high school for feasible results. However, in order to have a general overview, more detailed studies are needed.

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A Survey on Importance of Cost Parameters in Indian Software Industry with Special Reference to Educational Software Development

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ABSTRACT

Most of the software products are developed as per the client's requirements. The most important is that the underlying technology changes and advances so frequently and rapidly that experience of one product may not be applied to the other one.

All such business and environmental constraints bring risk in software development hence it is essential to manage software projects efficiently. It is an essential part of software organization to deliver quality product, keeping the cost within client's budget constrain and deliver the project as per scheduled.

There are several cost parameters like total time, total effort, size, total functions, technology, product reliability, security and product complexity, which may influence on Project Estimation. With correct estimation, project managers can manage and control the project more efficiently and effectively.

A questionnaire survey was conducted on 300 IT organizations, among those project managers and software developers of the system involved to investigate the importance of cost parameters in Indian software industry.

The study shows that few parameters like total effort, total time, size of the project, security and product complexity are extremely important (75.66%) during general software development and parameters like size of the project, total time and total functions are extremely important (72.33%) during educational software development.

Keywords: *Software project management, software cost estimation, software complexity, software reliability.*

1. INTRODUCTION

Software cost estimation is the prediction of the costs for proposed software. Exact Cost estimation is complicated task. There are number of variables involved in the calculation of software cost, such as the time, efforts required to develop the proposed software, size of proposed software, technology, expected security, reliability and many more. Following are some of the cost parameters found during the literature review

1. **Time:** Time estimation means to estimate the time required to develop the project. Software tasks related to proposed software are divided into smaller tasks, activities or events by Work Breakthrough Structure (WBS). The tasks are scheduled on day-to-day basis or in calendar months. The sum of time required to complete all tasks related to proposed software in hours or days is the total time required to complete the project. Overestimating time due to a lack of resources or some other reason can convince management not to approve projects that may otherwise contribute to the organization. On the other hand, underestimation may result in approval of projects that will fail to deliver the expected product within the time and budget available. Time estimation is a crucial activity in project management as most of the sponsors often judge whether a project has succeeded or failed depending on whether it has been delivered on time and on budget. (Shubhangi Potdar, 2014)

2. **Effort:** Effort estimation is the process of calculating the most realistic value of required effort in person-month to develop or maintain the proposed software on the basis of inputs like software requirements, function points, size, use case points etc. (Ashish

Sharma, 2012). Effort estimation accuracy depends on available information but in reality very less information is available at the starting of the project. Most of the time we have proper information about the project after requirement analysis but though effort estimation at the starting of the project is very important activity in project management, as it is the input for planning, controlling , decision making, iteration plan, budgets, investment analysis, pricing processes and bidding rounds. (Effort Estimation For Software Development)

3. **Size:** Software sizing is an activity in software engineering that is used to estimate the size of a software application or component in order to be able to implement other software project management activities (such as estimating or tracking). (Harish Chandra Maurya, January 2015)An accurate estimation of software size is an essential element in the cost estimation. Initial size estimates are typically based on the known system requirements. Currently two metrics are popularly being used widely to estimate size: lines of code (LOC) and function point (FP). An accurate estimate of the size of the software to be built is the first step to an effective estimate. (Peters)

4. **Total Functions:** The size of a software product is directly dependent on the number of different functions or features it supports. A software product supporting many features would certainly be of larger size than a product with less number of features. (Software Project Planning Version 2). The Function Point Analysis is the method of quantifying the size and complexity of a software system in terms of the functions that the system delivers to the user.

5. **Product Reliability:** Product reliability is the probability that the software will work without failure for a specified period of time. For many practical situations, reliability of a system is represented as the failure rate. Failure means the program in its functionality has no met user requirements in some way. For measuring the failure rate of a software product, we can have N installations of the software under observation. If the total number of failures in all the N installations in a time period T is F, then the best estimate for the failure rate of the software is [18] = F / (N * T). (Pankaj Jalote)

6. **Security:** IT industries are now keen to provide secure software as requested by customers' desire with respect to security and quality of their products especially related to the software costing estimation in the software development and implementation environment. Therefore, there is a need to consider the potential security risks while estimating the application cost. (Nur Atiqah Sia Abdullah, 2009)

7. **Complexity of the software:** Each software is considered at one of three complexity levels: simple, average or complex. While calculating complexity of the software following are the parameters IT industry has to consider

1. Required reliability
2. Size of data base
3. Required efficiency (memory and execution time)
4. Analyst and programmer capability
5. **Technology:** Technology being used for the proposed software is key issue in the development of any software. Technology risks are derived from the software or hardware technologies that are being used as part of the system being developed. Using new or emerging or complex technology increases the overall risk, it can increase the time, efforts etc. Under most circumstances regulatory cost estimates ignore the possibility of technological progress. Technical factors plays main role in cost estimation, but these factors are not stable they are changing. (Shubhangi Potdar, 2014)

The information Technology (IT) has changed rapidly over the past two decades. Internet and related technology changed the communication and learning habits of society and most developers build web applications without using any specific development method and don't know how to integrate the suitable measurements inside the process to improve and reduce defect, time and rework of the development lifecycle. (Shubhangi M. Potdar, 2017)

During the review of these different papers on software cost estimation, it is found that while estimating cost of software, there are various cost parameter which must be considered like time, size, effort, technology, total functions, security, product complexity, product reliability.

6. RESEARCH METHODOLOGY

As the cost parameters plays a vital role in software cost estimation. It is decided to investigate the importance of these cost parameters in general and educational software development. To achieve this, objective of the research is framed as 'To identify the extent of cost parameters that involved in general and educational software development'. On the basis of this objective two hypothesis are framed as follows:

1) The proportion of Level of importance for Cost Parameters in general software development is same.

2) The proportion of Level of importance for Cost Parameters in educational software development is same.

To test the hypothesis following research questions were asked to the respondents from IT Industries.

1) While estimating cost of general software development, which cost parameters are on your priority?

2) While estimating cost of educational software development, which cost parameters are on your priority?

First, the data is classified and then presented in tabulation format, the classification and tabulation in fact goes together. Therefore, classification is the basis for tabulation. Tabulation is a mechanical function of classification because in tabulation, classified data is placed in row and columns. For this survey total 300 respondents including project managers and software developers were involved. As the targeted respondents were from IT industries developing or developed educational software, purposive sampling method was used for collecting the samples.

7. RESULT AND ANALYSIS

There are eight cost parameters involved in estimation of software like total time, total effort, size, total functions, technology, product reliability, security and product complexity. Table 1.0 shows Cost parameters on priority of respondents .

Table. 1.0: Cost parameters on priority of respondents while developing general software.

Levels	Total time percent)	Total effort (percent)	Size (percent)	Total Function (percent)	Technology percent)	Product Reliability (percent)	Security (percent)	Product Complexity (percent)
Extremely Important	76	79	75	70	70	71	74	74

Others (Very important ,Not at all important, Slightly Important, Neutral)	24	21	25	30	30	29	26	26

Table 1.0 shows that according to the respondents, parameters like total effort, total time, size of the project, security and product complexity are extremely important (75.66%) during general software development. The data in table 1.0 is shown graphically using bar chart and presented in Figure1.0.

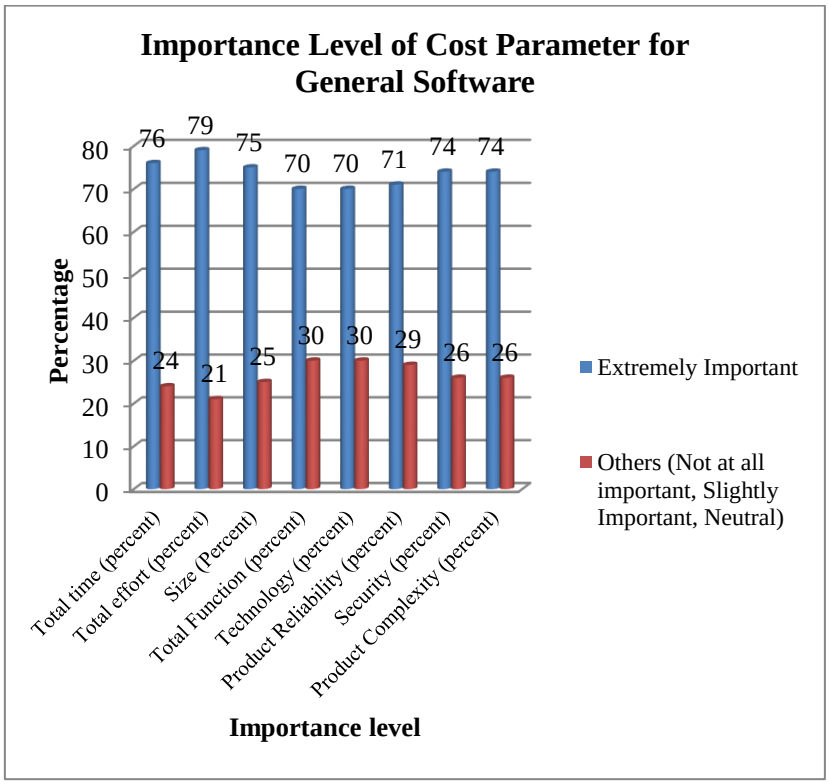

Figure1.0: Importance level of cost parameter for general softwares

Table. 2.0: Cost parameters on priority of respondents while developing educational software.

Levels	Total time (percent)	Total effort (percent)	Size (Percent)	Total Function (percent)	Technology (percent)	Product Reliability (percent)	Security (percent)	Product Complexity (percent)
Extremely Important	72	66	59	58	75	70	63	64
Others (Very important, Not at all important, Slightly Important, Neutral)	28	34	41	42	25	30	37	36

Table 2.0 shows that according to the respondents, parameters like size of the project, total time and total functions are extremely important (72.33%) during educational software development. The data in table 2.0 is shown graphically using bar chart and presented in Figure2.0.

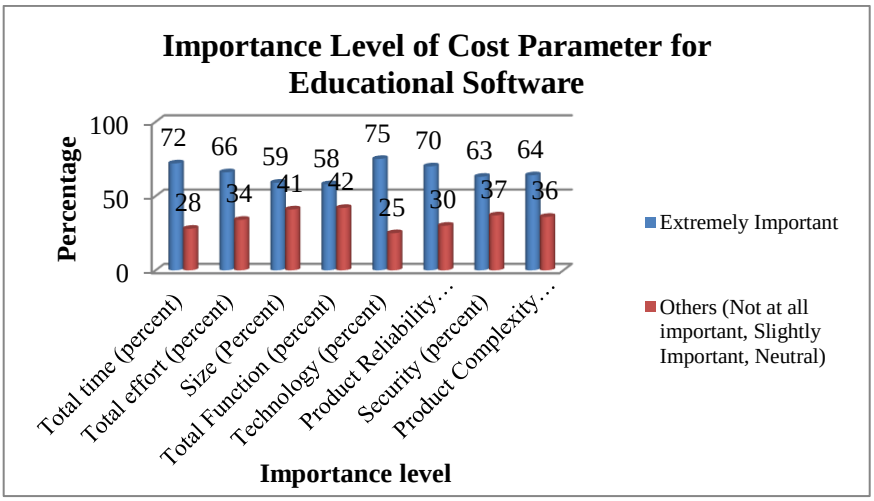

Figure 2.0. Importance level of cost parameter for educational software.

To test the hypothesis, statistical Z-test for proportion is used to compare the level of importance within various cost parameters. The result of Z-test for proportion for General Software Development is as given in table 3.0 and Z-test for proportion for Educational Software Development is as given in table 4.0

Table 3.0: Z-test for proportion for General Software Development.

General Software								
Levels	Total time (percent)	Total effort (percent)	Size (Percent)	Total Function (percent)	Technology (percent)	Product Reliability (percent)	Security (percent)	Product Complexity (percent)
Extremely Important	76	79	75	70	70	71	74	74
Others (Very important, Not at all important, Slightly Important, Neutral)	24	21	25	30	30	29	26	26
No. of respondents	300	300	300	300	300	300	300	300
Z Calculated value	12.73**	14.37**	12.24**	9.79**	9.79**	10.29**	11.75**	11.75**
Z table value	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58

According to the opinion of respondents for development of software, as per the Z calculated value the parameters like total effort, total time, size, security and product complexity are extremely important cost parameters for general software development.

Table 4.0: Z-test for proportion for Educational Software Development

Educational Software								
Levels	Total time (percent)	Total effort (percent)	Technology (percent)	Product Reliability (percent)	Size (Percent)	Security (percent)	Total Function (percent)	Product Complexity (percent)
Extremely Important	72	66	75	70	59	63	58	64
Others (Very important Not at all important, Slightly Important, Neutral)	28	34	25	30	41	37	42	36
No. of respondents	300	300	300	300	300	300	300	300
Zcal	10.78**	7.838**	12.24**	9.79**	4.40**	6.67**	4.082**	6.85**
Z table value	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58

According to the opinion of respondents, for development of software as per the Z calculated value the parameters like Technology, total time, and Product Reliability are extremely important cost parameters for educational software development.

8. CONCLUSION

Our observations and related analysis to get accuracy in any type of general software cost estimation, total effort, total time, size, security and product complexity these are the extremely important cost parameters. While in development of educational software, Technology, total time, and Product Reliability are the extremely important parameters to be considered.

If software industries concentrate on these core cost parameters then it would be possible for these industries to increase the accuracy of estimated cost as well as to increase the chances of success in software projects. At the same time, there are various technologies using which we can reduce development time, efforts, size of the software and indirectly the estimated cost, due to which it would be possible for the educational industries to negotiate the estimated cost of the proposed software.

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Utility of Software-As-Service for Analysis of Data in Academic Research – A Case Study of Indian Research Institutes

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ABSTRACT

The purpose of this paper is to study the utility of cloud computing service model – 'Software as Service' to facilitate academic researcher's for analysis of data. This paper is conceptual in nature wherein quantitative method has been used to substantiate the significant difficulties faced by academic researchers in avaialbility of data analysis tools. A structured questionnaire has been utilized to collect data from researchers doing academic research in various institutes and universities in Maharashtra, India. SPSS tool have been used for performing statistical analysis of data. From primary and secondary data it was possible to identify the requirement of data analysis software applications in various areas of research. Further the opinion of searchers on access to licensed data analysis software applications was analysed. It has been concluded from the research finding that researcher's availability of software data analysis tools on common cloud computing platform will facilitate researchers to perform quality research and accelerate research activities. This paper contribute to literature on utilization of cloud computing service model – 'Software as Service' on common academic cloud which can facilitate research activities and adds value and is key aspect of the novelty of this research paper.

Keywords: *Cloud Computing, Academic research, Data Analysis, Software as Service.*

INTRODUCTION

In the research work carried out in different areas of research, researcher collects primary or secondary data. Analysis of data is one of the important steps for arriving

at the outcome of research. The data that is collected is just raw to make that information meaningful, it needs to be organized, filtered, and analyzed. Researchers mostly face lot of difficulties in getting access to licensed data analysis software's for analysis of data in their area of research.

In order to facilitate the data analysis, intuitions need to procure and maintain different data analysis software's. The area of research could be in physics, chemistry Biology or Management but finally the research organization need to maintain Information Technology infrastructure and maintain the same. Maintaining Information technology infrastructure required separate skilled Information technology resources, hardware and software Annual maintenance contracts , up gradation of software versions and replacement of hardware platforms periodically. Retaining skilled resources in current days is expensive and difficult. Further every research organization needs to maintain separate IT resources, multiplying the expenditure on IT infrastructure. Also in many cases due to shortage of funds may research organizations find it difficult to purchase and maintain data analysis software tools.

CLOUD COMPUTING TECHNOLOGY

Cloud computing is basically delivery of computing services—compute, storage space, databases, networking, software, analytics and more over the Internet or Intranet. Cloud providers normally charge for cloud computing services based on usage, similar to how you are billed for utility services like water or electricity at home.

In a cloud computing system, there's a significant workload shift. Local computers no longer have to do all the heavy lifting when it comes to running applications. The network of computers that make up the cloud handles them instead. Hardware and software demands on the user's side decrease. The only thing the user's computer needs to be able to run is the cloud computing systems **interface software**, which can be as simple as a Web browser, and the cloud's network takes care of the rest.

Cloud computing is broken down into three segments: "application" "storage" and "connectivity." Each segment serves a different purpose and offers different services. Cloud Computing Deployment Models can be classified as below:

Community cloud shares infrastructure between several organizations from a specific community with common concerns, whether managed internally or by a third-party and hosted internally or externally. The costs are spread over fewer users than a public cloud (but more than that of a private) to realize its cost saving potential.

A public cloud is established where several organizations have similar requirements and seek to share infrastructure. This is the cloud computing model where service

providers make their computing resources available online for the public. It allows the users to access various important resources on cloud, such as: Software Applications or Stored data. One of the major benefits of using public cloud is that the researcher are emancipated from performing certain important tasks on their computing machines that they cannot get away with otherwise, these include: Installation of resources, their configuration; and Storage apart from their research domain.

A private cloud refers to cloud computing resources used exclusively by a single business or organisation. A private cloud can be physically located on the company's on-site data enter. Some companies also pay third-party service providers to host their private cloud. A private cloud is one in which the services and infrastructure are maintained on a private network.

Hybrid clouds combine public and private clouds, bound together by technology that allows data and applications to be shared between them. By allowing data and applications to move between private and public clouds, hybrid cloud gives greater flexibility and more deployment options.

Most cloud computing services fall into three broad categories: infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (Saas). These are sometimes called the cloud computing stack, because they build on top of one another.

Infrastructure-as-a-service (IaaS) is the most basic category of cloud computing services. With IaaS, you rent IT infrastructure—servers and virtual machines (VMs), storage, networks, operating systems—from a cloud provider on a pay-as-you-go basis.

Platform-as-a-service (PaaS) refers to cloud computing services that supply an on-demand environment for developing, testing, delivering and managing software applications. PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development.

Software-as-a-service (SaaS) is a method for delivering software applications over the Internet, on demand and typically on a subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle any maintenance, like software upgrades and security patching. Users connect to the application over the Internet, usually with a web browser on their phone, tablet or PC.

SOFTWARE AS SERVICE

As discussed above Software as a service (**SaaS**) is a **software** distribution model in which a third-party provider hosts applications and makes them available to end

user over the Internet. **SaaS** is one of three main categories of cloud computing, alongside infrastructure as a **service** (IaaS) and platform as a**service** (PaaS).

SaaS is a natural fit for organizations which intent on reducing IT costs and responsibilities. Instead of investing in additional in-house server capacity and software licenses, organizations can simply adjust their Software as a Service subscription on a monthly / quarterly / yearly basis, scaling consumption requirements up and down based on research demands and other variables. Software as a service is an alternative to the standard software installation in the research environment (traditional model) where a user has to build the server, install the application and configure it.

In SaaS, the user does not pay for the software itself. Instead, it works like a rental. They have the authorization to use it for a period of time and pay for the software that they are using. Usage of SaaS has many benefits like:

1. It reduces the time spent in installation and configuration, and can reduce the issues that can get in the way of the software deployment.

2. SaaS has a differential regarding costs since it usually resides in a shared or multitenant environment where the hardware and software license costs are low compared with the traditional model. Maintenance costs are reduced as well, since the SaaS provider owns the environment and it is split among all customers that use that solution.

3. Usually, SaaS solutions reside in cloud environments that are scalable and have integration with other SaaS offerings. Comparing with the traditional model, users do not have to buy another server or software. They only need to enable a new SaaS offering and, in terms of server capacity planning, the SaaS provider will own that.

4. SaaS providers upgrade the solution and it becomes available for their customers. Costs and effort associated with upgrades and new releases are lower than the traditional model that usually forces the user to buy an upgrade package and install it, or pay for specialized services to get the environment upgraded.

5. SaaS offerings are easy to use since they already come with best practices and samples inside it. Users can do proof of concepts and test the software functionality or a new release feature in advance. Also, they can have more than one instance with different versions and do a smooth migration. Even for large environments, users can use SaaS offerings to test the software before buy it.

DATA ANALYSIS REQUIREMENTS IN ACADEMIC RESEARCH

Almost all the academic research involves collection of data using various instruments. The data collected needs to be organized and further analyzed to obtain meaningful information to arrive at conclusions of research. Depending on the area of research the requirement of data analytic software's vary. Based on secondary data obtained from various books, research papers and online resources a review

has been done on requirement of various data analysis software's being used in academic research.

Some of the common data analysis tools used include -

Microsoft Excel: If the statistical analysis needs are basic, Excel can be used. Microsoft Excel provides a set of data analysis tools called the Analysis Tool Pak that can be used to save steps when you develop complex statistical, agricultural analysis, scientific or engineering analyses. Some tools generate charts in addition to output tables. Related to worksheet functions, Excel provides many other statistical, financial, and engineering worksheet functions. Some of the statistical functions are built in and others become available when you install the Analysis Tool Pak.

R : The most popular open-source statistical software, ***R*** requires some programming knowledge to navigate its command-line interface. Users enter lines of code to execute R's functions, but even those lacking a sophisticated computer science background can learn it quickly. R runs on a variety of operating systems, and its thriving user community will help if you get stuck.

SPSS Statistics : It is a software package used for statistical analysis. The software name originally stood for Statistical Package for the Social Sciences (SPSS), reflecting the original market, although the software is now popular in other fields as well, including the health sciences and marketing.

SPBD: Statistical Package for Balanced Incomplete Block Designs enables a user to select and generate a randomized layout of Balanced Incomplete Block (BIB) Design. The package also provides the analysis of variance with both treatments adjusted and blocks adjusted sum of squares, adjusted treatment means, variance of the estimated treatment contrasts and the contrast sum of squares, etc. The package is useful for the experimenters, classroom teaching as well as for the researchers in Statistics with special interest in Design of Experiments. or computing genetic parameters for one-way and two-way classified data.

SPFE : Statistical Package for Factorial Experiments generates the designs for symmetrical and asymmetrical factorial experiments with and without confounding. It also generates the randomized layout of the designs for factorial experiments. A null hypothesis on any other contrast of interest can also be tested.

SPAB: Statistical Package for Animal Breeding has been developed keeping in view, the computing requirements of scientists/students, mainly working in Animal Breeding and Animal Genetics research.

SSDA: Software for Survey Data Analysis (SSDA) is useful for the analysis of survey data. SSDA analyzes the data collected using systematic, simple random sampling (SRS), probability proportional to size (PPS), stratified, cluster, two stage and stratified two stage sampling schemes.

PSPP : It is alternative for IBM SPSS. It has a graphical user interface and command-line interface. It can generate high quality plots to help with visualization of distribution of data.

ADaMsoft : It is an open source statistical software developed in Java which supports Neutral Network MLP, Graphs, Data Mining, Regression, Decision Trees etc.

BV : This tool is used for decomposing time series using Berlin Procedure. This decomposes and seasonally adjusts monthly or quarterly economic time series using Berlin procedure.

Apart from few data analysis tools mentioned above, specific data analysis tools are required which are specific to the area of research. Few areas of research have been explored in this paper.

Data Analysis tools in the area of Astronomy and Astrophysics

Table 1.1: Data Analysis tools in the area of Astronomy and Astrophysics.

fitsplode	fitsplode is a simple tool for extracting spectral line data that is stored in binary FITS tables. It works for Effelsberg raw data in MBFITS format and Arecibo raw data in CIMAFITS format.
MeqTrees	MeqTrees is a software package for implementing Measurement Equations. This makes it uniquely suited for simulation and calibration of radio astronomical data, especially that involving new radio telescopes and observational regimes.
Obit	Obit is a group of software packages for handling radio astronomy data, especially interferometric and single dish OTF imaging.
AIPS	Classic AIPS
AIPS++	Astronomical Image Processing System ++
	(frozen in October 2006, replaced by...)
CASA	Common Astronomy Software Applications, developed in collaboration by NRAO, ATNF, and ASTRON.
xs	developed by Per Bergman at the Onsala Space Observatory for the 20m, 25m, and the Odin satellite

GIPSY	Groningen Image Processing SYstem, orginally developed for the Westerbork Synthesis Telescope, now capable of handling a number of instruments
GILDAS	Grenoble Image and Line Data Analysis System
CLASS	Continuum and Line Analysis Single-Dish Software, developed at IRAM
SPC	Spectral Line Reduction Package for Parkes & Mopra
ASAP	ATNF Spectral Analysis Package, developped at ATNF for single-dish, single-pointing telescopes, especially ATNF instruments. This package is intended as a replacement for SPC.
MIRIAD	Multichannel Image Reconstruction, Image Analysis and Display, developed for the Berkeley Illinois Maryland Association (BIMA) Array
SpecX	Millimetre wave spectral line reduction package developed for the James Clerk Maxwell Telescope.
SPLAT	Spectral Analysis Tool: SPLAT is a graphical tool for displaying, comparing, modifying and analysing astronomical spectra stored in NDF, FITS and TEXT files as well as the new NDX format. SPLAT is part of the STARJAVA collection of starlink, and is integrated in the Virtual Observatory AstroGrid.
GBTIDL	Greenbank Telescope package based on IDL
pleinpot	an environment designed for astronomical data reduction and analysis developed at Université de Lyon
Karma	toolkit, applications, and data visualisation tools developed by Richard Gooch
IRAF	Image Reduction and Analysis Facility, used by many infrared astronomers
SAOImage DS9	Astronomical Data Visualization Application developed by Smithsonian Astrophysical Observatory
PulsarAstronomy	all the stuff for pulsar astronomy

Data Analysis tools in the area of Biology and Chemistry

Table 1.2: Data Analysis tools in the area of Biology and Chemistry.

Gegenees	Gegenees is a software project for comparative analysis of whole genome sequence data and other Next Generation Sequence (NGS) data.
Gene Designer	A brilliant software tools that allows one to combine building blocks such as regulatory DNA elements
Seqool	Sequence analysis software designed primarily for searching biological signals in nucleic acid sequences.
BioEditor	This application that can be used to prepare and present structure annotations containing formatted text, graphics, sequence data, and interactive molecular views.
RasMol	RasMol is software for looking at molecular structures. It is very fast: rotating a protein or DNA molecule shows its 3D structure.
TinyQuant	TinyQuant is a graphical display program designed for analysis and limited manipulation of images obtained by scanning of gels or autoradiographs.
SMART	Statistical Metabolomics Analysis - An R Tool

Research Methodology

Primary data for the study was collected through structured questionnaires administered to respondents. Questionnaires were administered through Google forms and personal meetings. Participation in study was purely voluntary. The respondents were researchers from various research organizations in Pune. A purposive sample of 170 research scholars was considered for final analysis. For data collection more than 200 research scholars were contacted and a usable size of 170 was collected. The purposive sample size of this study (N=170) is reasonable for this kind of study.

Data Analysis

The information collected in study has good reliability and good internal consistency which is indicated with the Cronbach alpha coefficient and Guttman Split-half Coefficient as reported in table 1.3 below:

Table 1.3: Reliability analysis of information collected.

Cronbach's Alpha	0.716
Guttman Split-Half Coefficeint	0.604

The frequency distribution of information collected is presented in the table 1.4 below.

Table 1.4: Frequency distribution of information collected.

Questions	**Do not Agree**	**Neutral**	**Agree**
Data analysis software's for any time use can enhance quality research	4.1	25.9	70
Ease of Data Analysis for research work can enhance quality research	3.5	21.2	75.3
1. Computing Elasticity for research work can enhance quality research	5.9	39.4	54.7
Data Elasticity (Increase storage space as you grow) for research work can enhance quality research	2.4	30.6	67
Availability of tools for rapid Prototyping for research work can enhance quality research	2	45.1	52.9
Open source Software applications are used to carry out research activities	1.2	3.5	95.3
Easy access to home grown Software applications can enhance quality research	1.8	1.8	96.4
Easy access to Community Developed Software applications can enhance quality research	1.8	3.5	94.7
Easy access to Commercial Software applications can enhance quality research activities	3	18.2	78.8
The research work need Bursty resources	2.4	9.4	88.2
2. The research work need computing and data analysis support for scientific workflows	0.6	18.2	81.2
The research work need data sharing	5.9	16.5	77.6
3. The research work need domain-specific computing environments	5.3	36.9	57.8
The research work need data management and analysis	5.3	25.3	69.4

Availability of data analytic software - Uptime is important for timely completion of planned activities	7.1	38.8	54.1
Data analytic software Performance - Response time, throughput, timelines are important.	7.1	29.4	63.5
Data analytic Software Application Reliability - Uptime history – is important.	5.3	14.1	80.6
Data analytic Software scalability - Granularity, elasticity varies	2.9	14.7	82.4
Data analytic Software security - Compliance Certifications, Authentication, Authorization, Attack Prevention, Backup Coverage, Backup Periodicity, Recovery Velocity, Infrastructure Architecture?	5.9	27.6	66.5
Data analytic Software support - Resolution Rate, Resolution Time is important.	1.8	11.7	86.5
Data analytic Software Application Interoperability - API Coverage is important	2.4	40	57.6
Data analytic Software Modifiability (Customization) - Data Layer Modifiability, Logic Layer Modifiability, Presentation Layer Modifiability s important.	2.4	34.1	63.5

CONCLUSION

The descriptive statistical data analysis results reveal that data analysis is extremely vital for academic research. Ease of avaialbility of data analysis software's can enhance quality of research. As observed from secondary data, there are numerous data analytic tools relevant to different areas of research and academic research organizations cannot procure and maintain all data analysis tools. However as seen from the basic descriptive analysis the data analysis tools are extremely vital. Hence in order to facilitate researcher with these data analysis tools software as services cloud service model can prove as to be an ultimate solution for researchers to solve the research problems.

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An Extension of UTAUT Model in Education Sector Through Smartphone: A Theoretical Framework

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ABSTRACT

Smartphone is a cell phone having an advanced operating system which can be performed like a normal computer. The purpose of this study is to find out the factors that influence students to accept smartphones for learning in Pune. In this study, we examine the impact of Perceived - Playfulness as a determinant for smartphone learning as independent variable. This determinant proposed to find the influence on behavioral intention for using smartphones for learning along with performance expectancy, effort expectancy, social influence, and facilitating condition. The research will be carried out using questionnaires distributed to 159 students. A model of smartphone-learning based on (UTAUT) has been developed and tested empirically in this study.

Key words: *smartphone, UTAUT, education sector, Pune*

INTRODUCTION

The first smartphone was developed by IBM and BellSouth, which came out to the public in 1993. A smartphone is a type of gadget, which merges cell phone and computer functionality. All activities which can be performed on normal

computers, such as sharing information, sending and receiving emails, chatting, opening and editing documents, paying for products, browsing and shopping can be done using a smartphone; a small device which can be kept inside a pocket of a trouser or a shirt. (J.L. Kim and J. Altmann, 2013). With time, smartphones have replaced computers and have become a dynamic and sophisticated trend in communication.

LETERACTURE REVIEW

According to The Economic Times latest study, in India, the number of smartphone users grew 54 per cent during 2014, reaching 140 million in number and the number of smartphones will grow 4.7-fold between 2014 and 2019, reaching 651 million in number. In 2015, out of the world's 4.5 billion mobile phones, 1.75 billion are smartphones. The progress of any nation depends on the system of education adopted by it to groom the next generation. With the proliferation of mobile technologies in all walks of life, there is a need of the hour for India to remodel and upgrade the current education system. Despite the development in ICT, M-learning is still in the first stage, and its theoretical underpinnings have not yet matured (Muyinda, Paul B., Kathy Lynch, and Jude T. Lubega, 2008). In particular, the issues regarding how to promote learners' acceptance of M-learning are largely unsolved. Research in this regard is very scare (Liu, Yong, Hongxiu Li, and Christer Carlsson, 2010; Alrasheedi, Muasaad, and Luiz Fernando Capretz, 2013). There are a number of issues surrounding the acceptance of mobile learning among university students. Studies of trends in smartphone usage among students have been conducted in colleges affiliated with SPPU. The models suggest that whenever a new technology is presented, a number of factors influence the decision about how and when to use it. Various models have been developed related to this. Rogers'(Ismail SAHIN 2006) depicted Innovation Diffusion Theory (IDT) as the most appropriate for investigating the adoption of technology in higher education and educational environments (Medlin, 2001; Parisot, 1995). Fishbein and Ajein analyzed Theory of Reasoned Action (TRA), which focuses on volitional behavior and excludes other behaviors, which are spontaneous, impulsive, habitual, the result of cravings or simply scripted or mindless, which are non-volitional. Fishbein & Ajzen (Ajzen, 1991) focused on the theory of Planned Behavior (TPB), which is an extension of the theory of reasoned action, and made it necessary by the original model's limitations in dealing with behaviors over which people have incomplete volitional control. Davis (Mohammad Chuttur) projected another model - Technology Acceptance Model (TAM) and suggested that user's motivation can be explained by three factors: Perceived Usefulness, Perceived Ease of Use (PEOU) and Attitude towards using the system. Miller and Dollard (Bandura, 1977) proposed Social Cognitive Theory (SCT) as theory of social learning and later expanded by Bandura (1977). SCT integrates concepts from behaviorist, cognitive and

emotional models of behavior change. Thompson et al. (Li, 1991) refine Triandis' model to predict PC utilization behavior. Davis et al. (Li, 1992) apply the motivational theory to study information technology adoption and use. The Motivation Model suggests that individual behavior is based on extrinsic and intrinsic motivations. Taylor and Todd (1995) illustrated another model the Decomposed TPB (DTPB) in their study titled "Understanding information technology usage: a test of competing models". Venkatesh and Davis (2000) investigated TAM2 on the basis of TAM. A TAM2 based study of website user behavior — using Web 2.0 websites as examples – described an integrated model of technology TAM3 in association with the model of the determinants of perceived ease of use. Vekantesh et al., (2003), Biljon and Kotze (2007), Wu et al., (2007), Samuel Attuquayefio (2014) proposed UTAUT, which has been tested against eight preceding technology acceptance models and it was found to outperform them. The determinants that influence the technology acceptance model for M-Learning are still in early stage in Pune. Therefore, this study tries to investigate the determinants that affect the acceptance of M-learning in the higher education context, by identifying the critical factors that ensure the successful deployment of M-learning in the SPPU.

CONCEPTUAL RESEARCH MODEL

Based on the literature review, UTAUT has been tested against eight preceding technology acceptance models and it was found to outperform them. The UTAUT model is extended in various fields by researches such as M-banking, online social support on network information technology usage. social networks in organizations, mobile Internet acceptance, acceptance of smart wearable devices, adoption of e-book, webinar system etc. In addition to UTAUT, the literature revealed that there are many other factors that could explain the variation in the acceptance of M-learning. One of the factors would perceived - playfulness for learning. Thus, the independent variables of this study includes: 1) Performance Expectancy, 2) Effort Expectancy, 3) Social Influence 4) Perceived - Playfulness for Learning, 5) Facilitating Conditions as an independent variable. In accordance with the UTUAT model, this study employs behavioral intention as a dependent variable and independent variable that predicted to influence the use behavior. Use behavior is the ultimate dependent variable of this study. Figure 1.1 shows the proposed model of this study.

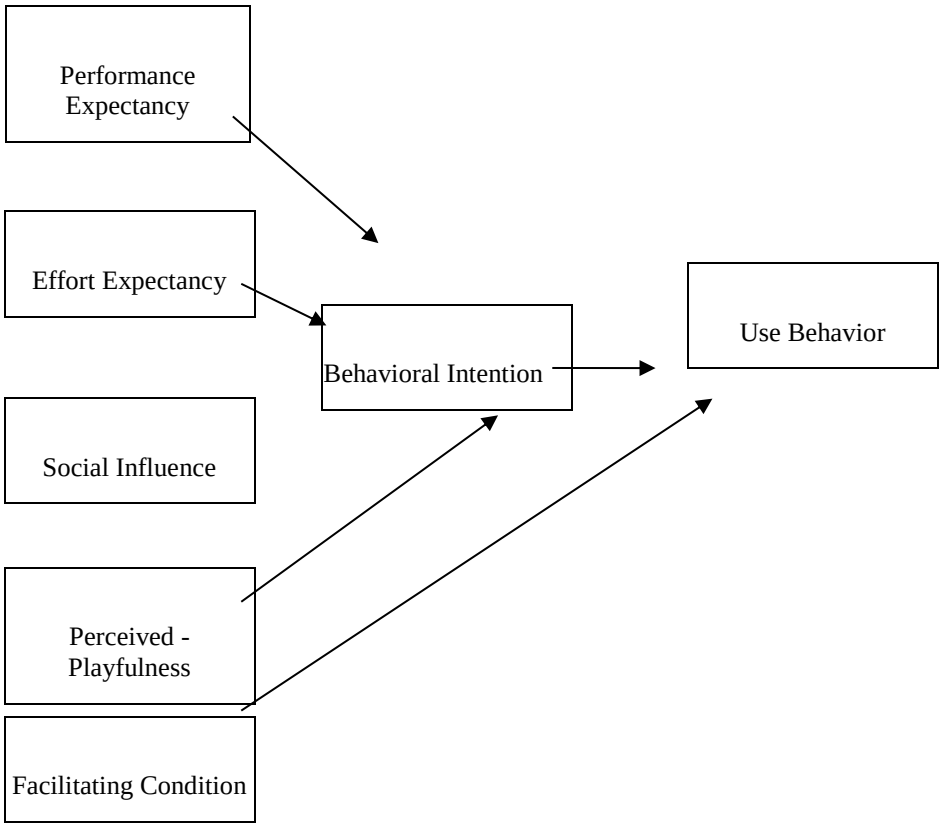

Figure 1: Conceptual Research Model.

Based on the literature review and the proposed research model, the following hypotheses are framed:

Hypothesis 1: Performance Expectancy has a positive effect on Behavioral Intention to use smartphone-learning.

Hypothesis 2: Effort Expectancy has a positive effect on Behavioral Intention to use smartphone-learning

Hypothesis 3: Social Influence has a positive effect on behavioral intention to use smartphone-learning.

Hypothesis 4: Perceived - Playfulness has a positive effect on Behavioral Intention to use smartphone learning.

Hypothesis 5: Facilitating Conditions have a positive effect on Use Behavior.

Hypothesis 6: Behavioral Intention influences positively the Use Behavior.

METHODOLOGY

The study follows a quantitative approach to find the factors that influence the adoption of smarphone-learning. The sample of this study is 170 respondents. Out of which a total of 159 gave complete answers. Therefore data of 159 is considered and the respondents are mix of engineering and management students of affiliated colleges of Savitribhai Phule Pune University.

FINDINGS AND DISCUSSION

Respondent Profile Demographic information of the respondents such as their age, gender, and level of study are given in Table1.

Table 1: Demographic Information of Respondents

	Label	Frequency	Percent
Age	less than 19 years	88	55.3
	20-24 years	53	33.3
	25-29 years	18	11.4
	Total	159	100.0
Gender	Male	96	60.4
	Female	63	39.6
	Total	159	100
Education Level	Undergraduate	114	71.7
	Postgraduate	45	28.3
	Total	159	100.0

HYPOTHESES TESTING

The hypotheses are tested by using regression analysis. Table 2 presents the coefficient. Strongest indicators of the behavioral intention is performance expectancy (B= 0.515, p-value =0.000) followed by Perceived - Playfulness (B= 0.47, p-value = 0.002), effort expectancy (B= 0.38, P-value= 0.001), and social influence (B= 0.25, P-value= 0.005). In term of the use behavior, the strongest indicators is behavioral intention (B= 0.622, P-value= 0.000) followed by facilitating conditions (B= 0.213, P-value= 0.001).

Table 2: Coefficient.

Model			Unstandardised Coefficients		t	Sig.
			B	S.E		
Behavior Intention	BI	Constant	2.17	1.03	2.09	.036
		Performance Expectancy	.515	.10	.16	.000
		Effort Expectancy	.38	.18	.47	.001
		Social Influence	.25	.23	1.13	.005
		Perceived - Playfulness	.47	.26	.21	.002
Use Behavior	UB	Constant	1.200	.824	1.586	.112
		Behavioral Intention	.622	.061	10.060	.000
		Facilitating Condition	.213	.190	.594	.001

CONCLUSION

Based on the findings it is observed that Perceived - Playfulness is the one of the strongest indicator that influences the behavioral intention of students to accept Smartphone-learning in Pune. This study has employed the model of UTAUT along with Perceived-Playfulness of learning. It is recommended for future work to include more variables. Finally, the study aimed at identifying the determinant that influences the acceptance of smartphones-learning in Pune.

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A Comparison and Evaluation of Open Source Learning Management Systems

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ABSTRACT

Online Learning is becoming an important tool to allow the flexibility and quality requested by learning process. In the recent past, a great number of open source learning management system (OSLMS) have been introduced in the market showing different characteristics and services. All these OSLMS reduces cost acquired by proprietary learning management system. Market is occupied with large number of OSLMS. The main purpose of this study is to analyze and explore the right decision when choosing a suitable OSLMS platform to meet the requirements of education system. This study focuses on evaluation of Moodle, Atutor, Sakai, Ilias, Claroline, Olat and Dokeos related to learner tool and support tool.

Keywords: *Learning management systems (LMS), Open-source learning management systems (OSLMS), learner tool, support tool, communication tool, administration tool, curriculum design and instructional design tool.*

1. INTRODUCTION

LMS have significant role in distance learning. Halls defines LMS as, "Software that automates administration of training events" [1]. In distance learning process OSLMS are widely used. Open source software(OSS) are freely available software with no licensing cost. These OSS extends education beyond the traditional classroom where learners build knowledge and understanding through collaborative exchanges. This paper evaluates seven OSLMS. Each OSLMS program is based on the ability to accommodate different active learning experiences in online courses. The selected OSLMS are Moodle, Atutor, Olat, Sakai, Ilias, Claroline, and Dokeos. This paper is organized as follows. Section 1 represents brief introduction of paper. In Section 2, background of the study is discussed. In section 3, literature review has been carried out. Section 4 shows research methodology used. A comparative study of selected OSLMS is presented in Sections 5, section 6 and section 7. In Section 8, findings and discussions are mentioned. Section 9 represents conclusion of the study.

2. BACKGROUND

Study has been carried out related to evaluation of OSLMS. Past study shows that, evaluation is carried out related to presence or absence of feature. For e.g. – Presence of chat or blog feature is checked. In depth checking is not performed related to chat or blog feature. Further, no recent study is available related to best OSLMS for educational activities.

This study shows sub features of categories like chat, email, video service etc. This study also shows best OSLMS for performing basic and advance educational tasks. For evaluation purpose, selected OSLMS are installed and studied in depth. Each feature is executed.

3. LITERATURE REVIEW

Jamil Ahmad Itmazi and Miguel Gea (2005) [2] have carried out paper surveys of 58 studies of comparison and evaluation of OSLMS and proprietary system by comparing functionality. Result of the study shows that WebCT is the mostly used proprietary LMS and Moodle is the mostly used OSLMS.

Matjaz Kljun, Jernej Vicic, and Branko Kavsek (2007) [3] have reviewed 31 LMS comparison and evaluation papers. Comparison methods includes Feature comparison, Learning paths support, Sharable content object reference model (SCORM) specifications, OSS compliance, the study reveals that present LMS development tries to catch up with standards, although the SCORM standard is unfortunately not as widely supported.

PeterLengyel MiklosHerdon and Robert Szilagyil (2006) [4] have done the comparison amongst Atutor, Moodle and OLAT by considering various parameters like support and compatibility to standards, content development The study shows that Moodle is at higher position supporting 13 features out of 14. Atutor and OLAT support 9 features.

Guzin Tirkes (2010) has [5] done the comparison amongst Atutor, Moodle and OLAT and Dokeos by considering support and compatibility, content development and editing tool,. Result of their study is shows that Moodle possesses all 17 features, Atutor and OLAT supports 12 features, whereas Dokeos support 15 features.

Barbar A.Lewis and Virginia M. MacEntee (2005) [6] have evaluated WebCT, v.4.1; BlackBoard, v. 6.1; Jones E-education; Educator; Angel; .LRN; McGraw Hill Pageout; Moodle; and e-College A. Study shows that amongst the proprietary LMS WebcCT is at topmost position. Amongst OLSMS, DotLRN is at topmost position and Moodle is at second position.

4. RESEARCH METHODOLOGY

Evaluation method is used to know the best learning software. Evaluation means measuring useful information. It also includes comparing usability features, design features, implementation issues etc.

In case of open source software, there is no third party support. Due to this organizations are hesitating to use it. This evolution will help education sector to know the best OSLMS in terms of usability, effectiveness and efficiency for carrying out daily educational tasks.

With the help of result of literature review it is found that most of the study was related Moodle, Atutor, Olat, Sakai, Ilias, Claroline, and Dokeos. The evaluation was past dated. Updated evaluation related to these OSLMS is not available. So researcher has selected the same OSLMS for evaluation purpose.

These OSLMS are evaluated on the basis of parameters like communication tool, course delivery tool, security tool, curriculum design tool and student involvement tool.

5. COMPARATIVE STUDY OF OSLMS FEATURES

OSLMS features are divided into category as learner tool, support tool and technical specification. This study compares and evaluates all these features. Following figure shows architectural design view of curriculum design tool.

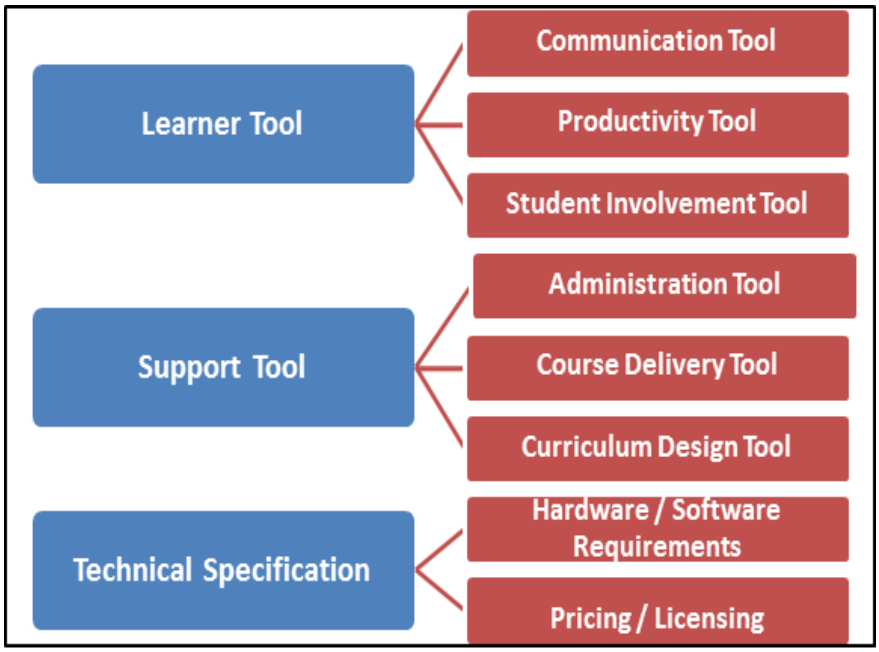

Figure 1: Architectural design view of OSLMS.

6. LEARNER TOOL

Learner tool includes work done by student or learner. Learner tool is classified into communication tool, productivity tool, and student involvement tool.

6.1 Communication tool

Communication means interaction among users. In online setting these users are student and faculty. They can interact with each other with the help of group, chat, email, blog, discussion forum, file exchange and video services. The figure below shows Architectural design view of communication tool.

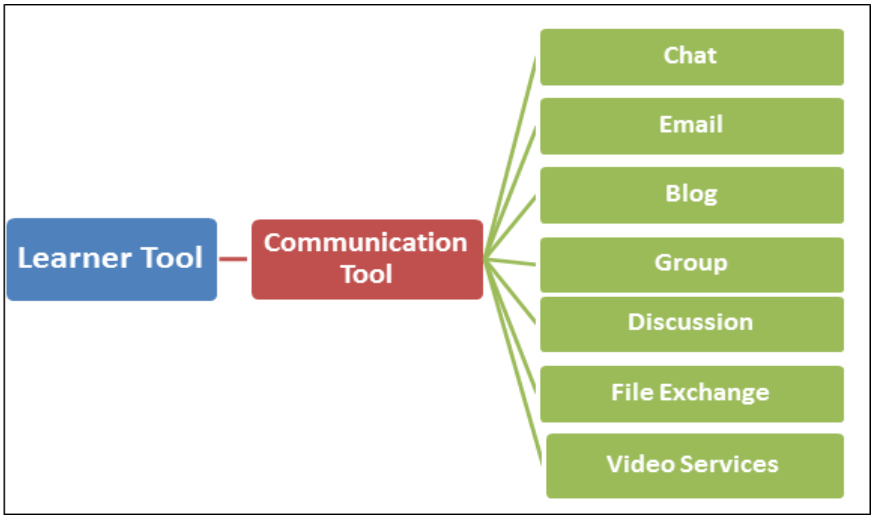

Figure 2: Architectural design view of communication tool.

6.1.1 Communication Tool Result

From the figure it can be observed that features related to chat, email, blog, group, discussion forum, file exchange and video services are compared and evaluated. Result of the communication tool is shown in the table below. [19]

Table 1: OSLMS Communication tool ranking table

Sr.No	Features compared and evaluated	Total compared features	First ranked OSLMS	Second ranked OSLMS	Third ranked OSLMS
1	**Chat**	21	Moodle (21)	Ilias(14)	Sakai(9)
2	**Email**	13	Moodle(13)	Ilias(8)	Sakai & Dokeos(6)
3	**Blog**	15	Olat(15)	Ilias & Moodle(12)	Sakai(11)
4	**Group**	16	Moodle(16)	Ilias(14)	A tutor & Olat(13)
5	**Discussion Forum**	30	Moodle(30)	Sakai(17)	Ilias(16)
6	**File Exchange**	5	All OSLMS supported all compared 5 features.		
7	**Video Services**	5	All 4 OSLMS supported all compared features except Claroline does not support any video service features.		

From the table it can be observed that, total numbers of features compared and evaluated related to chat, email, blog, group, discussion forum, file exchange and video services are 105. Out of 105 features, Moodle is at first rank supporting 102 features. Ilias at second rank supporting 74 features and Sakai is at third rank supporting 74 features.

6.2 Productivity Tool

It is related with bookmarks, searching of content etc. The figure below shows Architectural design view of Productivity Tool

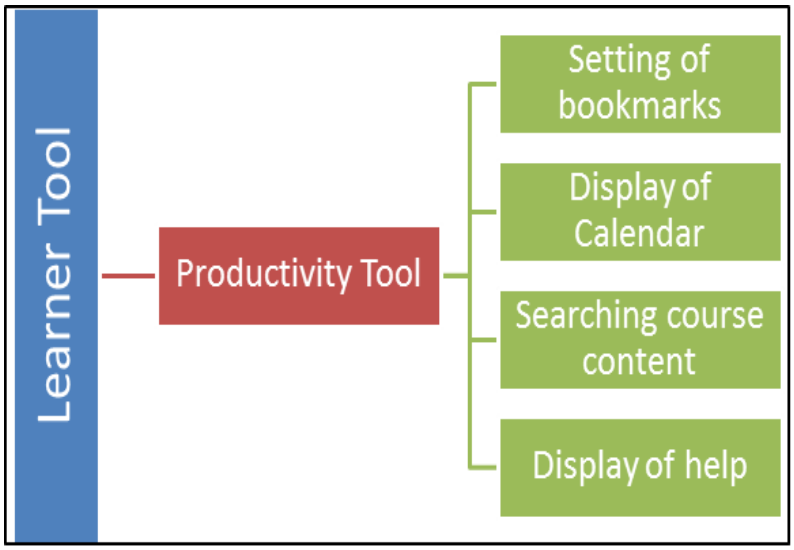

Figure 3: Architectural design view of productivity tool.

6.2.1 Productivity Tool Result

From the figure it can be observed that Features related to bookmarks, calendar, searching course content, and help are compared and evaluated. [8,9,10,11,12,13,14,15,16,17,18]. Result of the productivity tool is shown in the table below.

OSLMS Rank	First ranked OSLMS	Second ranked OSLMS	Third ranked OSLMS
OSLMS name	Moodle Olat Ilias	Dokeos Sakai Claroline	Atutor
Total No.of Features supported by OSLMS Out of(5)	4	3	2

Table 2: OSLMS productivity tool ranking table.

From the table it can be observed that, total numbers of features compared and evaluated related to bookmarks, calendar, searching course content, and help are 5. Moodle, Olat, and Ilias are supporting all 5 features and they secured first rank. Dokeos, Sakai and Claroline are supporting 3 features and they are at second rank whereas Atutor is supporting only two features and is at third rank.

6.3 STUDENT INVOLVEMENT TOOL

It includes features related to student community, portfolio building, self-assessment etc. The figure below shows Architectural design view of Student Involvement Tool.

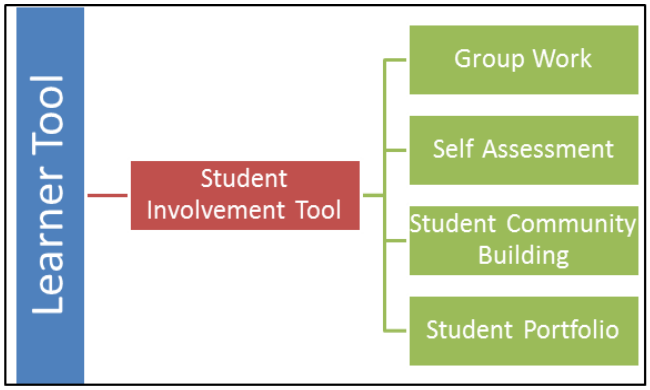

Figure 4: Architectural design view of Student Involvement Tool.

6.3.1 Student Involvement Tool result

From the figure it can be observed that features related to group work like creation or deletion of group work, sharing of resources are compared and evaluated. [8,9,10,11,12,13,14,15,16,17,18]. Result of the Student Involvement Tool is shown in the table below.

Table 3: OSLMS student involvement tool ranking table.

OSLMS Rank	First ranked OSLMS	Second ranked OSLMS	Third ranked OSLMS
OSLMS name	Moodle Olat Dokeos	Atutor Sakai Ilias	Claroline
Total No.of Features supported by OSLMS Out of(11)	11	10	9

From the table it can be observed that, total numbers of features compared and evaluated related to group work. Self-assessment, student community building and student portfolio are 11. Moodle, Olat, and Dokeos are supporting all 11 features and they secured first rank. Atutor, Sakai and Ilias are supporting 10 features and they are at second rank whereas Claroline supporting nine features and is at third rank.

UPPORT TOOL

This tool is required for overall management of courses. The figure below shows Architectural design view of Support Tool.

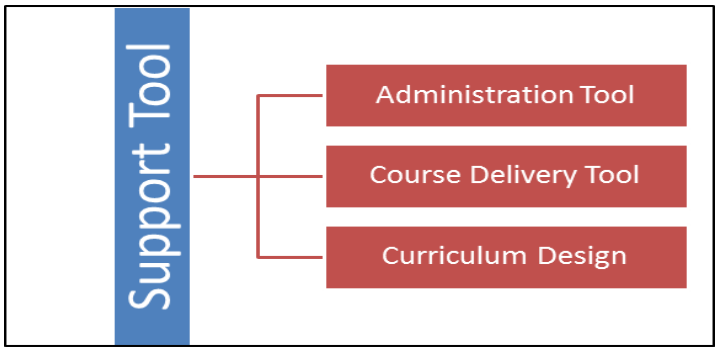

Figure 5: Architectural design view of Support tool.

7.1 Administration tool

It includes feature related to overall site management and its security. The figure below shows Architectural design view of Administration tool

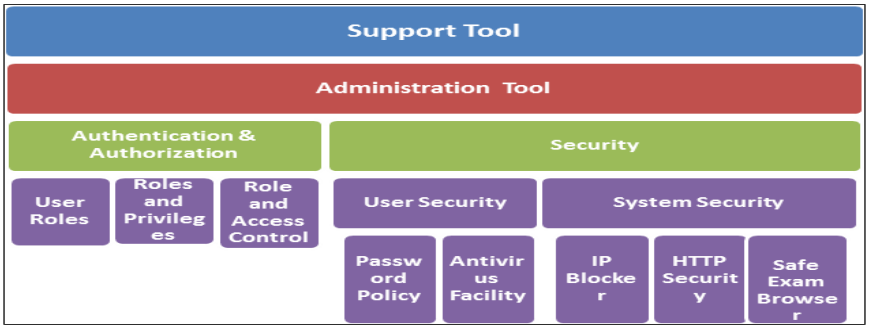

Figure 6: Architectural design view of Administration tool.

7.1.1 Administration tool Result

From the figure it can be observed that, in administration tool features related to authentication, authorization and security are compared. They are further classified into user roles, privileges and access control. User security performs checks related to password policy and antivirus whereas system security includes features related to IP Blocker, HTTP Security and inclusion of safe exam browser. [20]. Result of the administration tool is shown in the table below.

Table 4: OSLMS Support tool ranking table

Sr. No	Features compared and evaluated	Total compared features	First ranked OSLMS	Second ranked OSLMS	Third ranked OSLMS
1	Role creation and access control	4	Moodle, Sakai (4)	Atutor, Claroline, (3)	Olat, Dokeos, Ilias(2)
2	Password policy	8	Moodle, Dokeos(8)	Atutor, Olat(6)	Sakai(2)
3	Antivirus	1	Moodle, Sakai(1)	Others have not supported built in antivirus facility	
4	System security	3	Moodle(3)	Olat, Ilias(1)	Others have not supported these features
5	User security	2	Moodle(2)	Others have not supported these features	

From the table, it can be observed that, total numbers of features compared and evaluated related to authentication, authorization and security are 18. Moodle is supporting all 18 features and secured first rank. Dokeos is supporting 10 features and it is at second rank whereas Atutor and Olat are supporting 9 features and they are at third rank.

7.2 Curriculum Design Tool

It include features related designing of curriculum i.e. course content and its instructional design. The figure below shows Architectural design view of curriculum design tool.

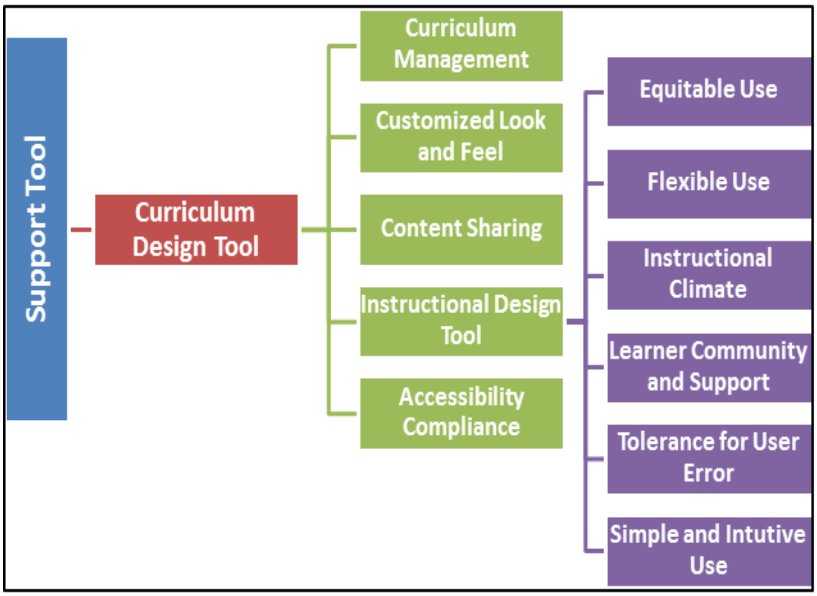

Figure7: Architectural design view of curriculum design tool.

7.2.1 Curriculum Design Tool Result

From the figure it can be observed that, in curriculum features related to curriculum management, customized look and feel and instructional design, content sharing, and accessibility compliance are compared and evaluated. Result of the curriculum design tool is shown in the table below, [21].

From the table it can be observed that, total numbers of features compared related to curriculum management, customized look and feel and instructional design, content sharing, and accessibility compliance are 65. Out of 65 features, Moodle is supporting 64 features and secured first rank. Sakai is supporting 54 features and it is at second rank whereas Olat is supporting 51features and is at third rank.

Table 5: OSLMS curriculum design tool ranking table.

Table 5 : OSLMS Curriculum design tool Ranking table

Sr.No	Features compared and evaluated	Total no.of features compared	First ranked OSLMS	Second ranked OSLMS	Third ranked OSLMS
1	Curriculum Management	14	Moodle (14)	Atutor, Sakai(11)	Dokeos, Ilias(9)
2	Customized look and feel	13	Moodle , (13)	Olat, Claroline, Dokeos(10)	Atutor(9)
3	Content sharing	5	Moodle, Ilias, Sakai(5)	Olat(3)	Dokeos, Claroline (1)
4	Equitable use	3	Moodle, Atutor, Olat, Sakai, Dokeos, Ilias, Claroline (3)		
5	Flexible use	6	Moodle (6)	Atutor, Dokeos(5)	Ilias, Olat, sakai(4)
6	Simple and intuitive use	4	Moodle, Atutor, Olat, Sakai, Dokeos, Ilias, Claroline (3)		
7	Perceptible Information	5	Sakai, Moodle, Olat(5)	Atutor(4)	Ilias(3)
8	Tolerance for user error	4	Moodle, Atutor, Olat, Sakai, Dokeos, Ilias, Claroline (3)		
9	Technical & Physical effort	3	Moodle, Atutor, Olat, Sakai, Dokeos, Ilias, Claroline (3)		
10	Learner community and support	2	Moodle, Atutor, Olat, Sakai, Dokeos, Ilias, Claroline (3)		
11	Instructional climate	3	Moodle, Atutor, Olat, Sakai, Dokeos, Ilias, Claroline (3)		
12	Accessibility compliance	3	Moodle, Atutor, Olat, Sakai (3)	Ilias(2)	Dokeos(1)

1. Course Delivery Tool

It include features related to course management, content management etc. The figure below shows Architectural design view of course delivery tool.

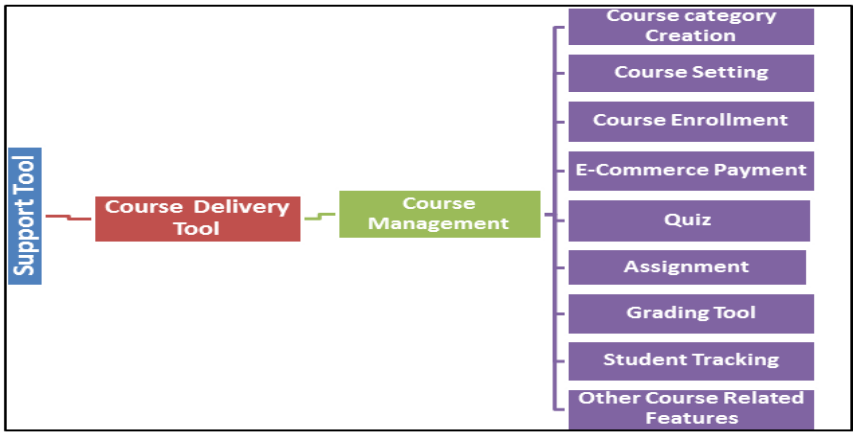

Figure 8: Architectural design view of course delivery tool.

7.3.1 Course delivery tool result

From the figure it can be observed that, course management features like course category creation, grading tool, quiz etc. are compared and evaluated. Result of the course delivery tool is shown in the table below, [22] From the table it can be observed that, total numbers of features compared related to course category creation, grading tool, quiz are 131. Out of 131 Moodle is supporting 129 features and secured first rank. Atutor is supporting 73 features and is at second rank whereas Ilias is supporting 72 features and is at third rank.

Table 6: OSLMS Course Delivery Tool Ranking table

Sr.No	Features compared & evaluated	Total compared features	First ranked OSLMS	Second ranked OSLMS	Third ranked OSLMS
1	**Course creation**	4	Moodle (4)	All other OSLMS are supported 2 features	
2	**Course category creation**	10	Moodle(9)	Claroline(7)	Atutor(6)
3	**Course setting**	18	Moodle(18)	Ilias(15)	Sakai(14)
4	**Other course related features**	28	Moodle(27)	Dokeos(16)	Ilias(15)
5	**Course enrollment**	12	Moodle(12)	Atutor, Olat, Claroline(8)	Dokeos, Illias, Sakai(6)
6	**E-Commerce Payment**	4	Moodle, Dokeos(4)	Atutor, Olat(2)	Other OSLMS have not supported these features.
7	**Student Tracking**	3	Moodle(3)	Atutor(2)	Dokeos, Illias, Sakai(1)
8	**Grading setting and grade items**	22	Moodle(22)	Atutor(9)	Dokeos, Illias(5)
9	**Quiz**	15	Moodle(14), Ilias(14)	Atutor(12)	Sakai(11)
10	**Assignment**	15	Moodle(15)	Ilias(10)	Atutor(9)

7. FINDINGS AND DISCUSSION

The table below shows overall evaluation result for learner tool and support tool.

Table 7: Evaluation result of all tools of OSLMS.

Table 7: Evaluation result of all tools of OSLMS

Evaluation Category	Subcategory of evaluation category	Moodle	Atutor	Olat	Dokeos	Ilias	Sakai	Claroline
Learner Tool	Communication Tool Out of(105)	102	49	56	53	74	59	39
	Productivity Tool Out of(4)	4	2	4	3	4	3	3
	Student Involvement Tool Out of(11)	11	10	11	11	10	10	9
Support Tool	Administration Tool Out of(18)	18	9	9	10	4	7	3
	Curriculum Design Tool Out of(65)	64	50	51	46	49	54	36
	Course Delivery Tool Out of(131)	129	73	45	60	72	59	54
Total features(334)		**328**	**193**	**176**	**183**	**213**	**192**	**144**

This study shows that overall 334 features are compared and evaluated related to Moodle, Atutor, Olat, Sakai, Ilias, Dokeos and Claroline. Out of 334 features, Moodle is supporting 328 features and is at first rank. Ilias is supporting 213 features and is at second rank. Atutor is supporting 193 features and is at third rank. So Moodle is the best OLMS that can be implemented in any educational sector to perform basic as well as advance educational tasks.

8. CONCLUSION

Many educational institutes are not financially strong. They are not in a position to buy commercial software. For them OSLMS is a best option, as they are freely available without any licensing cost. So if the awareness is created definitely many educational institutes will adopt OSLMS.

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Experiential Learning Projects in Engineering Education

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ABSTRACT

In this paper, we approach Ropohl's theory of technology systems (Ropohl, 2009) to determine the values in engineering education that should be provided to students. Using experiential learning projects as a pedagogical method to create value in engineering education, in which Kolb's model of learning (Kolb, 1984) is used as a strategy for developing values. It is a combination of projects, classroom activities and real-world experiences to create an exciting and engaging engineering course for students. Instructs teachers to design classroom activities and external experiential activities. We conducted a case study on the implementation of experiential learning projects in program "Profession-Oriented Higher Education – POHE" at Hung Yen University of Technology and Education, Vietnam.

Keywords: *Experience, Experiential Learning Projects, Engineering Education, Internship.*

INTRODUCTION

An effective engineering education program at engineering schools requires that students be exposed to real occupations, especially practical experiences that are important to the learning and success of students, it is no less than classroom activities (Kuh, 1995). In Vietnam today, the relationship between engineering schools and enterprises has been established and improved continuously to address the compatibility of education programs and the demands of the labor market. This relationship is realized by internship contracts that benefit both students and

enterprises. Accordingly, students will be engaged in the practice at the enterprise according to the schedule already prepared, complete the tasks / tasks assigned at the request of the enterprise, the practice time is usually from 1 - 2 months, and the student may be paid part of the salary for the degree of completion of his work.

However, internships usually only allow students to perform a single occupational event or challenge, a temporary job at a work location, compliance with workplace rules, and labor productivity for enterprise. Engineering schools and enterprises often have little or no interest in students' aspirations and expectations, lack of cohesion between engineering schools and enterprises during their internship, the reflection of learning is primarily a journal or internship report, lack of continuous and daily reflection. Therefore, internships are almost exclusively developed academic values for students, with little regard for professional values, moral values of engineering occupations.

In this paper, we use experiential learning projects as the central pedagogical strategy of engineering education to develop value sources, overcome the limitations of internships by incorporating a model of experiential learning into an internship. Present experience using experiential learning projects at Hung Yen University of Technology and Education in recent years.

THEORETICAL FRAMEWORK

Value in Engineering Education

Ropohl (2009) has provided the general structure of technology in Figure 1. He argues that technology has three aspects: 1) Technical objects (or technical objects systems) and its origin; 2) Socio-technical systems reflect the relationship between the use of technical objects in the natural, human and social contexts; 3) The consequences of technology to nature, human and society. Ropohl concluded that: 1) Technology does not fall from the sky, it develops in natural conditions through human actions and social relations; 2) Technology does not have an isolated life, it always causes certain consequences to the natural ecosystem and human life forms, each invention is an intervention in nature and society [Ropohl, 2009, p. 44].

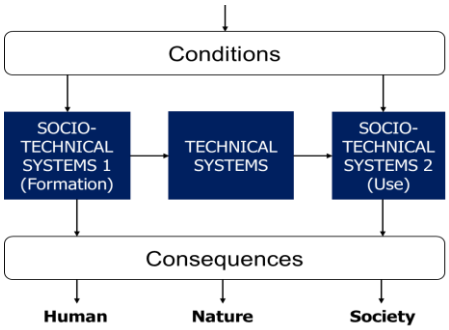

Figure 1: System structure of technology [Ropohl, 2009].

From the approach to systematic theory of technology (Ropohl, 2009), we propose that an effective engineering education program should provide students with three sources of value: 1) Academic value of technical system; 2) Professional value in Socio-technical system; 3) Moral value of technical action.

1) Academic value of technical system: Emphasis on technical objects or technical objects system as a product of human culture, including machines and tools to bring value to human use in nature and society. Along with that is the system of technical languages that humans can work with itself. Traditional engineering education programs often provide students with these values in the form of lectures intended to provide pure knowledge.

2) Professional value in Socio-technical system: A collection of human engineering actions in nature and society, in which interactions between workers, the technical object system and the labor object. The Socio-technical system is a reflection of human engineering actions for the purpose of producing or using a system of technical objects such as design, manufacture, calculation, interpretation, Optimization, production, quality control, advertising, transportation, use, maintenance, repair, disposal ..., and other skills such as communication skills, time management, teamwork, information processing, leadership skills, etc. Traditional pedagogical methods with lectures, example illustrations, video views, or case studies often provide little opportunity for students to fully develop these technical actions.

3) Moral value of technical action: Assess the impact of technology on humans, nature and society upon the introduction or use of technical object systems. The engineering education program should provide students with practical opportunities to develop their technical assessment capacity to deal with moral dilemmas, responsibility for nature and society in the world of technology today.

The engineering education program needs to develop students with these three sources of value. Traditional engineering education tends to take on a career context in which students have to do assignments, while ethical values is primarily related to the cultural and political context. The traditional approach reduces the students' responsibility to make decisions related to technology, and the impact of technology on nature, society and people. Today, engineering education emphasizes the responsibility of students with technical solutions and assesses its impact on society. It emphasizes the responsibility of students in relation to their actions and decisions in order to provide the society with useful products and services associated with the rules of morality. The National Society of Professional Engineers (NSPE) (2007) has issued rules of ethics, which states that “engineers shall hold the paramount importance of the safety, health and welfare of the public”. Davis (1991) states that “engineers clearly are responsible for acting as their profession's code of ethics”. Just as Jonas (1985) argues that technology requires ethical values in engineering, where engineer responsibility is the central element, because modern technologies can destroy the earth and mankind.

Today, engineering education requires allowing students to experience real-world projects to perform technical tasks set by society. Engineering projects must integrate three sources of value: 1) Moral value reflects the student's acceptance of social responsibility for the technologies they develop; 2) Academic value of the technical system reflected through the choice and use of reasonable, sustainable technology; 3) Professional value reflect the student's consideration of technology ideas during the design phase and negative social consequences. Kolb's Experimental Learning Model (Kolb, 1984) may be a solution to this problem.

Experiential Learning Projects as a Pedagogical Method to Create Value in Engineering Education

There are many educators who focus on experiential learning, but the most prominent is Experiential Learning Theory of Kolb (Kolb, 1984). Kolb defines experiential learning as "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p. 41). The center of Kolb's experiential learning theory is a model that describes four stages of effective learning: Stage 1 - Concrete Experience (Take out the meaning of experience); Stage 2 - Reflective Observation (Try to describe and draw conclusions from experience); Stage 3 – Abstract Conceptualization (Generalizing the findings from observations to create a model or theory); Stage 4 – Active Experimentation (Test, and bring a new experience and create new learning cycles) (xem Hình 2). Throughout the learning cycle, students will gain more experience, improve frequently, and improve the performance of difficult tasks. Kolb's learning model as a theoretical framework is very useful for updating pedagogical methods to create three value sources in engineering education (see Figure 2).

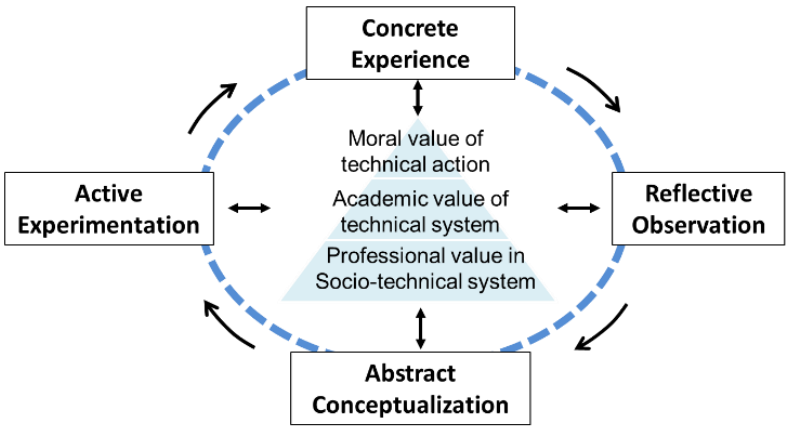

Figure 2: Create Value in Engineering Education using Kolb's Experiential Learning Model.

According to Scott & Sarkees-Wircenski (2008) argues that engineering education programs are inclusive of factual occupational events, which must allow students to perceive and apply it in the workplace. According to Clark, Threeton, & Ewing (2010), students learn concepts / theories in the classroom and apply them in the lab is not enough, but they need to be supplemented by working experience in a practical workplace. Knobloch (2003) argues that internships in the real context is an effective teaching and learning model in the areas of engineering education as automotive technology and construction technology... As Kosnik, R. D., Tingle, J. K., & Blanton (2013) argue that practice allows students to be immersed in professional activities that require students to take the initiative and make decisions, thereby promoting the development of moral values and professional values for students, however, "it is more challenging to create consistent academic value through internships" (p.617). Many educators say that many internships are merely the application of knowledge in the development of professional events or challenging problem-solving activities in practice, without reflection in learning, not tied to the expectations of students. Internships are virtually lacking cohesion with a theoretical model of education based on experience, such as Kolb's learning model (Kolb, 1984). Like Roberts (2006), there is a "theory of experiential learning" behind these internships that is less noticeable in engineering education programs.

Experiential learning projects can be an effective pedagogical strategy to link an experiential educational model/theory (especially Kolb's experience learning model) to student internships. Experimental learning projects allow groups of students to practice in professional organizations to complete a specific task while closely linked to formal courses such as classroom or laboratory. As Efstratia (2014) states, the core idea of experiential learning projects is to connect students' real-world experiences with formal classroom spaces to stimulate critical thinking as students learn new knowledge. Kosnik, R. D., Tingle, J. K., & Blanton (2013) emphasized, experiential learning projects "embeds the practical experience directly into the course content and structure" (p.617), "in-class activities, lectures, and reading assignments can provide students with the theories, tools, and frameworks to apply in the project..., the reflection and conceptualization stages can be incorporated in class meetings and written assignments" (p.618). On the other hand, experiential learning projects create group learning environments, develop social skills, and personal skills for students. In short, experiential learning projects are a combination of projects, classroom activities and real experiences to create an exciting and engaging course, while adding value to the whole process of engineering education.

Designing Classroom Activities

In experiential classrooms, the creation of project structures can be done by Dewey's "Pattern of Inquiry" (Dewey, 1938). Dewey's Pattern of Inquiry emphasized, thinking occurs not only after an experience but also throughout the entire experience. Learning activities usually begin with learner curiosity, taking place in a five-step spiral cycle of inquiry: 1) Asking questions; 2) Investigating solutions; 3) Creating new knowledge as we gather information, 4) Discussing our discoveries

and experiences; 5) Reflecting on our new-found knowledge. Going through each step in the process will naturally create new questions to begin the next inquiry cycle.

Classroom activities can be started by asking students to solve a problem related to their life, and get their attention. Instructing students to design their own learning activities is essential to starting a learning project, so that students do not feel it is a job assigned to them. Just as Wurdinger (2005) emphasizes, learning projects must encourage thinking, planning and implementing ideas to create something meaningful to oneself.

Designing External Experiential Activities

The principle of the external experiential activities is the use of reflective observations of experiences synthesized in different real-world situations (Moon, 2004, p. 167). This principle can be realized by combining Dewey's Pattern of Inquiry into an experience that helps students understand their experience. Moon also directed some external experiential activities for teachers to plan student activities including: working in the enterprises, communicating and working with people, evaluating their own performance, discussing and feedback from others, project implementation plan, organization of individual activities... On the other hand, the issue of negotiating contracts between engineering schools and enterprises is essential to both benefits, listing benefits (wages, working hours, working conditions...), activities that students will experience in the business.

RESULTS OF HUNG YEN UNIVERSITY OF TECHNOLOGY AND EDUCATION

Hung Yen University of Technology and Education is one of eight universities in Vietnam that has inherited the Vietnam-Netherlands POHE project since 2005. The philosophy of the POHE project is to establish a cooperative relationship between universities and enterprises, enhance the role of enterprises in program development, teaching, practical support, internships, coordinated assessment of student learning outcomes... From 2007 up to now, Hung Yen University of Technology and Education has designed and rebuilt its engineering education program to use experiential learning projects from the beginning and throughout the learning process of student. Experiential learning projects are considered as a major component of the curriculum, with about eight projects in one program, ranging from simple to complex, short to long term, distributed evenly from the first year to the last year (see Figure 3).

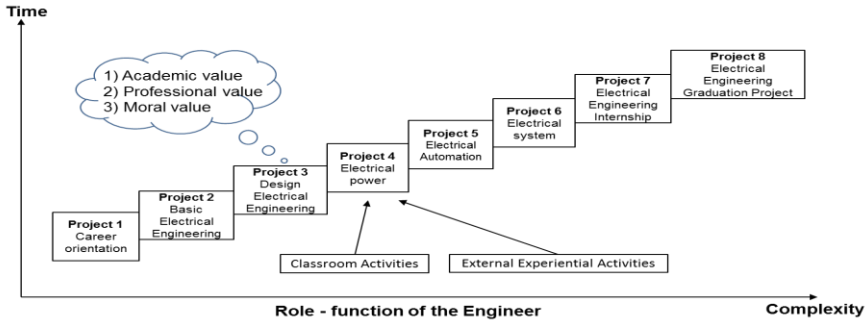

Figure 3: Structure of Experiential Learning Projects in Electrical Engineering Education.

In each of these projects, students are confronted and dealt with intelligently with real life professional situations, creating experiences to quickly adapt to new career contexts. The working environment in life or enterprises becomes an effective learning environment, providing practical experiences for the full development of values for students. When implementing an experiential learning project, students are exposed to two types of learning activities: classroom activities and internship in life or enterprises. Students will have to put themselves in the position of an engineer / employee to define their tasks / tasks. From there, students develop comprehensive sources of academic value, professional value and moral values in engineering education.

After years of implementing experiential learning projects in electrical engineering education, in 2017 we conducted an inquiry asking students to self-assess their experience and the effectiveness of the process in project. A question about the effectiveness of experiential learning projects compared with traditional method by three levels: 1- Ineffective, 2- Somewhat effective, 3- Effective. A question for students to assess the success of projects by 4 levels: 1- Unsuccessful, 2- Somewhat successful, 3- Successful; 4- Very successful. There are a total of 50 responses received by students representing the courses, and the summary results are shown in Table 1 and Table 2.

Table 1: Realizing the Effectiveness of Experiential Learning Projects.

Question	Level	Frequency	%
How do you feel about the effectiveness of experiential learning projects compared to traditional methods?	1- Ineffective	0	0
	2- Somewhat effective	4	8
	3- Effective	46	92
Mean	**2.92**		

Table 2: Realizing Success in Experiential Learning Projects.

Question	Level	Frequency	%
Your success in experiential learning projects?	1- Unsuccessful	0	0
	2- Somewhat successful	2	4
	3- Successful	25	50
	4- Very successful	23	46
Mean	**3.42**		

Open questions are used to collect students' feedback about the experiences they have learned in their projects, through three questions that reflect the three values in engineering education: *1) What are your strengths and weaknesses in the project? 2) How do you feel about teamwork skills, communication skills, time management, leadership skills? 3) Would you do otherwise the next time?* Most of the students' responses show that experiential learning projects help them work harder, plan and work smarter, persist, look for new things, share and collaborate together...

CONCLUSION

Experiential learning projects emphasize learning by doing, creating opportunities to cultivate professional skills, expand academic knowledge, and develop moral values. In order to fully develop the values in engineering education for students, engineering schools should provide opportunities for students to engage in real experiences, thereby extending the chances of success in the labor market. The use of experiential learning projects in the engineering education program will enable students to develop a full range of values, gaining experience in each learning phase. The case study on the use of experiential learning project at Hung Yen University of Technology and Education shows that when the working environment is used as a learning environment, it will provide a full range of real experiences for students.

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Does the Transformation of Pedagogical Approaches in Engineering Education Further Student Interest in Engineering and Enhance Engineering Epistemology?

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ABSTRACT

Victoria University (VU), decided to tackle both issues of poor attractiveness and relatively high attrition rates in engineering undergraduate courses with a pedagogical paradigm shift. In 2006 Problem Based Learning (PBL) was introduced into engineering undergraduate courses at VU. It was accompanied by advertising campaign and substantial financial investment in developing of new learning spaces. The purpose of this work is to examine whether, from a student perspective, such process produced positive outcomes. Second year undergraduate mechanical, building/architectural engineering students were surveyed, over a seven year period, via a comprehensive questionnaire to determine whether the marketing of PBL was effective, to determine students perceptions of PBL and its effect on their plans on continuing with the current engineering courses at VU. The introduction of PBL as a pedagogical showpiece in engineering education has not shown itself a panacea for attracting higher caliber of students and enhancing their educational experience, nor was a predictor for increasing student retention rates. The lack of positive outcomes as a result of the introduction of PBL could be attributed to poor marketing, ability to introduce new and more relevant curricula and greater investment in human resources required by education based on PBL.

Keywords: *Engineering pedagogy, engineering attractiveness, problem-based learning.*

INTRODUCTION

The decision by the university in 2005 to introduce a new pedagogical paradigm was driven by the desire to reduce the relatively high attrition rates and improve the attractiveness of VU as a study destination. It was also hoped that these changes would also address external perceptions of poor academic standards, and allow the university to reposition itself in the student market. It was hoped that such educational shift would lead to:

1. Educational differentiation from other universities translating into greater interest among senior secondary students to consider engineering as a course of study at VU;
2. Generating greater interest in engineering among senior secondary students. This may lead to a greater participation in engineering education at all universities and address concerns by expressed Taylor (2008) and King (2008) about the future shortages of professional engineers in Australia [1],[2];

3. Enhancement of professional graduate attributes such as the ability to work in teams and autonomously, communication skills and social awareness, ability to contextualize engineering work in terms of economic, sustainable, social, ethical and political frameworks and instil good habits of life-long learning-curiosity; and

4. The reduction of attrition rates and the improvement of progression rates in engineering at VU. Approximately 10-12% of undergraduate engineering students at VU complete their course in the minimum time [3]. Godfrey et al (2010) and King (2008) made this issue a focus of their studies.

In 2006 problem-based learning (PBL) pedagogy was introduced in 50% of curricula at both engineering schools at VU. This was immediately followed by an extensive publicity as a part of marketing campaign in the press and at secondary schools throughout Melbourne. The objective of this project is to ascertain the effectiveness of the marketing campaign and evaluate whether any positive outcomes could be attributed to either pedagogical differentiation or just increased marketing of engineering courses at VU.

METHOD

The enquiry used a simple questionnaire shown below to ascertain:

1. Reasons why student pick engineering as their choice of course of study among their two top initial preferences prior to the change of preference period. Latter student preference selections are likely be influenced by students' academic outcomes.

2. Students' preferences of choosing VU engineering in their first cycle of selections.

3. Students' awareness of PBL delivery prior to their selection of primary preferences and its influence on choosing VU engineering.

4. Students' attitudes to PBL delivery and how such attitudes affected their likelihood on continuing with their course.

The investigation was restricted to domestic students in the School of Architectural, Civil and Mechanical Engineering and is based on, with one exception, 30 to 90 responses. The survey was restricted to first semester second year students because they were already well exposed to PBL teaching and were still in position to make a decision concerning their future academic path. Surveys were conducted in weeks 8-9 of the semester during their common classes.

Table 1: Simple student questionnaire.

(Tick the appropriate answer)
Did you place engineering as a preferred course prior enrolling at VU? (Was engineering amongst your top two preferences?): ☐ Yes ☐ No
Was VU amongst your first two preferences (before change of preferences) on your selection of university 6 months before enrolling at VU? ☐ Yes ☐ No
Were you aware of PBL pedagogical course delivery in engineering course delivery prior to enrolling at VU? ☐ Yes ☐ No
Would the knowledge of PBL as a teaching method make a choice of engineering at VU? ☐ A more attractive option 6 months before you selected your preferences ☐ A less attractive option 6 months before you selected your preferences ☐ No difference in selecting preference
Do you prefer PBL subjects to delivered:

☐ In the current form of discovery and working in teams ☐ The PBL subjects delivery be supplemented with lectures and tutorials
Given another chance would you enrol into a different engineering discipline course? ☐ Yes ☐ No
Are you considering transferring into another (other than engineering) course? ☐ Yes ☐ No
Are you considering transferring to another university? ☐ Yes ☐ No

RESULTS

Results outlined in this paper cover the period 2008-2013 inclusive. The first second year cohort was not included in the survey because it was not till 2008 PBL pedagogy was shaped to resemble current the form. Earlier data has been published elsewhere [4]. The first two questions were designed to ascertain whether choosing engineering as a course of study was given a high priority by students in their first preference selection cycle. The data is presented in table2. The results of the survey showed that a relatively high proportion of second year VU engineering students placed high preference for engineering as their choice of course (Table2). These figures varied between 82 to100 percent.

The choice of placing high preference for studying engineering VU did not match the proportion of students selecting engineering as their preferred course of study. Nevertheless, with the exception for 2011, a respectable 50-60% percent of second year students placed VU engineering in their final year at school amongst their top two preferences.

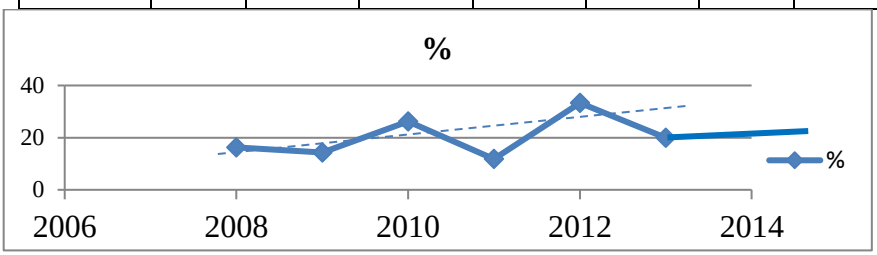
Year	2008	2009	2010	2011	2012	2013	2015
Overall	88.1	100.0	95.4	94.1	90	82.4	79.6
For VU	48.8	57.1	60.5	25.0	55.2	56.3	46.7

Table 2: Proportion (%) of students who initially selected engineering in top 2 preferences.

The third question tried to evaluate the effectiveness of the publicity campaign informing secondary students of the new pedagogical pathway in the delivery of engineering education at VU. Unfortunately the publicity penetration managed by VU was fairly disappointing. Only a third of second year students in 2013 had any awareness of PBL suggesting that the 2010 publicity campaign intensity declined (see table 3 and its graphical representation).

Table 3: Student awareness (%) of PBL at VU engineering prior choosing their initial preferences.

Year	2008	2009	2010	2011	2012	2013	2015
%	16.3	14.3	26.2	11.8	33.3	20.0	20.0



By the end of the first semester, second year students have been exposed to at least 3 semesters of PBL pedagogy allowing them to form concrete views on PBL delivery. Table 4 indicates that substantial (but decreasing) proportion would have been influenced in preference selection in their final year at school had they have known more about the practical aspects of PBL pedagogy.

Students were more likely to preference VU engineering on the basis of what they know about PBL educational experience. These students had generally positive orientation towards PBL. Figure 1 derived from table 4 suggests that the net positive empathy Δ for PBL varies between 70 to -20%. It needs to be noted that 30 to 65% of students have neutral attitude towards PBL.

Table 4: The effect of PBL awareness on student preference selection.

YEAR	2008	2009	2010	2011	2012	2013	2015
Overall	69.8	66.7	52.6	46.7	57.1	35.3	38.9

Students with positive PBL perception	69.8	33.3	48.8	13.3	50.0	17.6	22.7
Students with negative PBL perception	0.0	33.3	3.8	33.3	7.1	17.6	17.6
Δ (Positive-negative)	69.8	0.0	45.0	20.0	42.9	0.0	5.1
R= Δ/ Students with neutral PBL perception	2.31	0.0	0.86	0.38	0.85	0.0	0.09

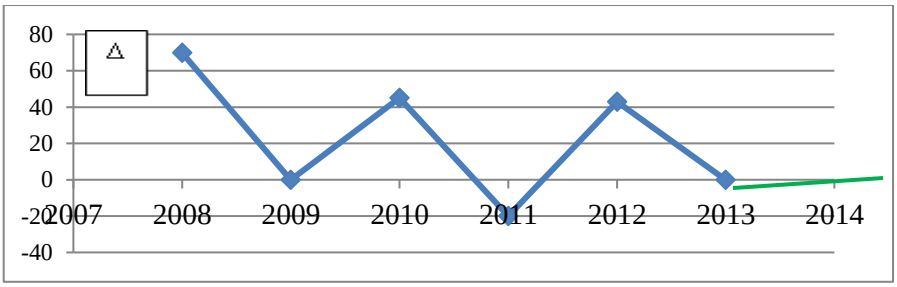


Figure 1: Difference between students having positive and negative perspectives on PBL.

Ratio R was introduced in table 4 to quantify the impact of PBL on students. High positive value of the R would indicate large positive impact of PBL. With the exception for 2008 the impact of PBL on placing VU engineering high on selection preference was minimal or even negative. Figure 2 seems to indicate that overall the introduction of PBL pedagogy would have a marginal effect on attracting and retaining students in engineering at VU.

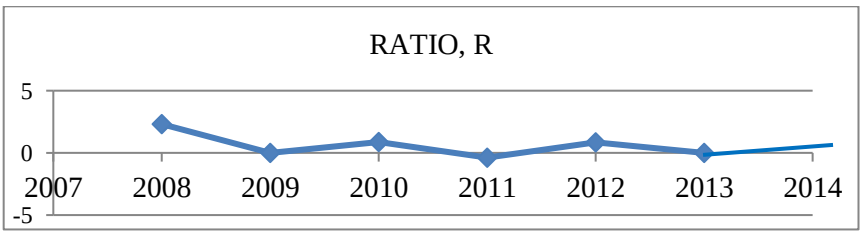
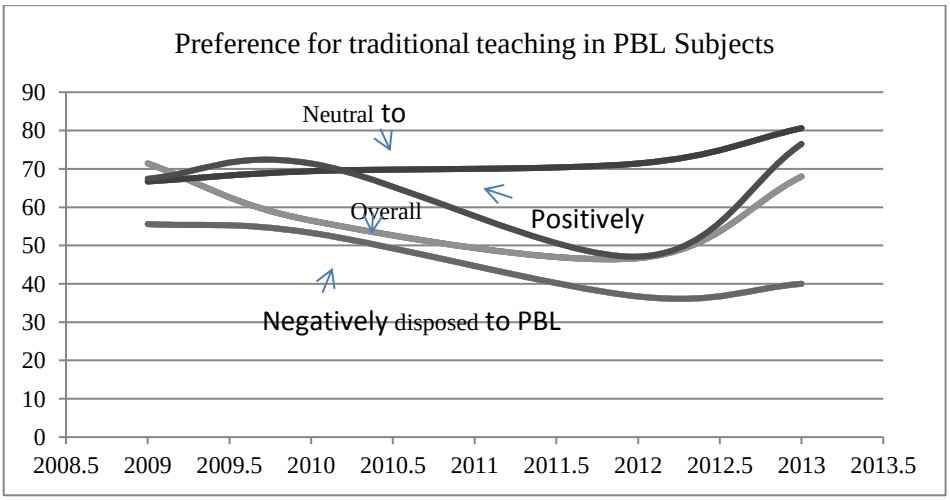


Figure 2: Ratio R measuring overall attractiveness of PBL pedagogy.

Students were also asked to suggest whether an augmentation of PBL pedagogy can be achieved by using traditional instructive teaching of lectures, tutorials, seminars.

Table 5: Proportion (%) of students who prefer the inclusion of traditional instruction in PBL subjects.

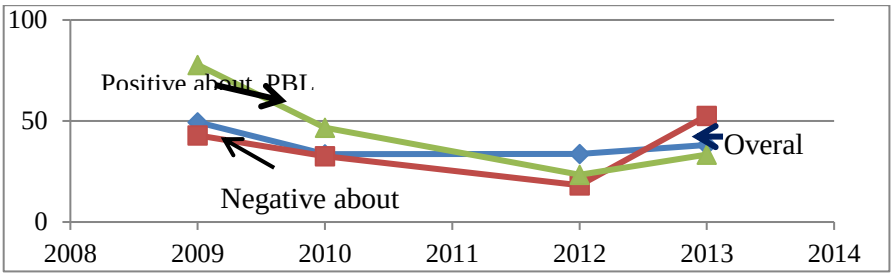
YEAR	2008	2009	2010	2011	2012	2013	2015
Overall	67.4	71.4	62.8	47.1	59.3	76.5	75.2
Students who are positively disposed to PBL		71.4	56.5	0.0	46.7	68.0	68.1
Students who are negatively disposed to PBL		55.6	53.3	47.1	36.7	40.0	4.6
Students who are neutrally disposed to PBL		66.7	69.4	0.0	71.4	80.6	77.6



An area of concern is the relative high attrition rates of at VU. One of the objectives was to evaluate the impact of PBL pedagogy on students' retention. The results are shown in table 6 and its graphical representation.

Table 6: Proportion (%) of students considering transfer to another university.

Year	2009	2010	2012	2013	2015
Overall	49.4	33.6	33.7	38.2	41.1
Students who have a positive view of PBL	42.9	32.6	18.2	52.6	36.7
Students who have a negative view of PBL	77.8	46.7	23.4	33.3	46.8
Students who have a neutral view of PBL	48.9	31.6	32.5	46.4	49.1



DISCUSSION

The good news (table 2) is that more than 80% of second year engineering

students chose engineering as their preferred course of study. More than 50% of the same cohort chose VU engineering amongst their top two destinations of study. However choosing engineering does not necessarily translate into passion for studying engineering. Owore et al (2006) showed that students often choosing undergraduate engineering studies had wrongful impressions of engineers' work [5].

Using 2004 as a base-line the commencing domestic student as a measure for enrolment growth in engineering, VU exhibited relatively good growth rate (figure 3). DEEWR (2011,2015) data shows that VU exceeded the national rate of domestic student engineering enrolment growth [6],[7].This can be attributed to the fact that some universities were weaning themselves on the dependence on domestic enrolment. The same statistical data also shows that both RMIT and SUT, with similar historical profile to VU, had a relatively high proportion (40-55%) of

commencing engineering enrolment as full-fee paying overseas students. This compares with 8-20 % overseas engineering commencing o enrolment at VU. The downturn in the commencing growth rate at VU from 2010 onwards could be attributed to the uncapping of university places at Australian universities.

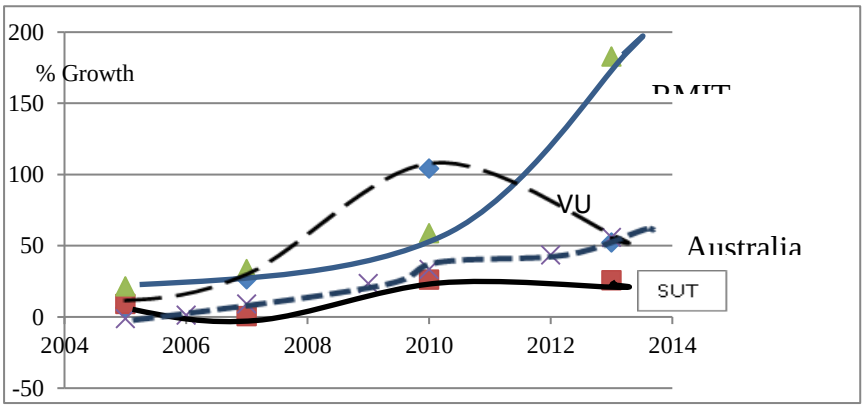


Figure3: Comparison of the growth rate in domestic commencing engineering students with the national figures and with RMIT and SUT, both institutions with comparable history and traditions to VU.

Publicity extolling virtues and the differentiation of PBL pedagogy in engineering education as an attractive option showed to be partially effective (table 3). The marketing penetration was relatively modest with the majority of students who chose engineering at VU being unaware of PBL pedagogy prior to their enrolment. It was hoped that with time the quality and quantity enrolment in engineering at VU would be expected. However consolidation of PBL teaching at VU over the years did not lead to better enrolment outcomes. Table 4 also suggests that the impact of PBL on students had not lived up to expectations. Perhaps PBL constructivist pedagogy may itself be problematic. PBL education requires students' high participation in team meetings to meet their project objectives. It is not an ideal educational situation for students who are balancing paid work with academic demands. PBL is also a natural learning process for self-starters and good learners but is problematic for students who are not well prepared for university education. Cook and Lackey (1999) found that new ways of learning can be alienating for students who at their early years of a university course expect their learning experience to mirror one of secondary school [8]. It is the expectation of teaching rather than learning. Table 5 clearly demonstrates that students, irrespective of their attitudes to PBL, would prefer their PBL subjects to be augmented by traditional instructional methods. Cronin and Byrne (2011) found in their student surveys that the majority of students felt that lectures were beneficial to their learning [9]. Disengagement from the education process translates in student leaving for other

academic pastures. An unusually high proportion of students, at the end of their first semester of second year course, are considering transfer their studies to other universities (table 6).

One measure of educational outcomes can be based by comparing published data of the proportion of commencing domestic students who complete their course in four years (figure 4). This aggregate data includes attrition rates (indicating whether a course is unpopular), latter year entries from other institutions (course is popular), as well as remaining students who are at various stages in their course. Such figures can therefore exceed 100% [5]. It is a "rough" measure but provides a relative snapshot of progression rates and course popularity of courses at other universities.

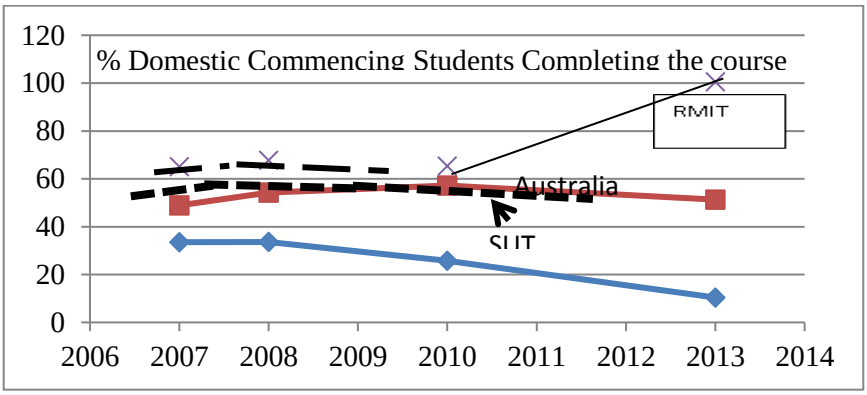


Figure 4: Ratio (%) of domestic graduates to commencing domestic students 4 years earlier.

The educational output at VU engineering clearly demonstrates undesirable attrition rates. It does not necessarily reflect management of PBL delivery. Attrition rates have also been shown to be a consequence of the socio-economic profile of the student body, attractiveness of other institutions and student to staff ratio, which is significant. The student to staff ratio at VU engineering is more than 20 %higher than at SUT and 10 % greater than at RMIT. This is a problem because PBL pedagogy requires greater pastoral involvement than the traditional instructional delivery.

CONCLUSION

Attracting more students and better academically qualified students to engineering courses by introducing new pedagogies could be effective if students in secondary colleges were informed about the nature of the new pedagogy, and how it would enhance students' educational experience and outcomes. The publicity and marketing programs of VU engineering has had a modest impact at best. Successful

publicity of a product works best if the product itself is attractive. Students in general were not inspired by the programs run at VU with majority preferring supplementary traditional instructive teaching methods such as problem solving learning (PSL). Obviously either the current PBL curricula need to be re-designed or introduced in the third and fourth year of the engineering course. That itself would present a dilemma in trying to differentiate engineering at VU from engineering at other universities. Though large amount of capital and financial resources were invested in teaching and learning spaces, it was not accompanied by investment in human resources which are needed to support PBL programs because of their pastoral demands. The university needs to shift its balance from research to teaching to ensure the viability of Engineering at VU.

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10. The Australian March 12, 2012

Some Techniques for Updating Programs to Meet Outcomes

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ABSTRACT

Purpose:

We have applied CDIO to Information Technology Program in our university for about 7 years. We would like to share some techniques for updating currently program to meet the CDIO learning outcomes.

Design/Methodology:

To update the program, in addition to constructing and making surveys on the learning outcomes, we need to consider how the courses align with program outcomes. Some techniques such as ITU exercises have been applied to identify the gap between our current courses and CDIO-based program outcomes. Not only top-down but also bottom-up approach is used.

Findings:

Up to now, based on the techniques, we have basically completed the update courses to meet the CDIO outcomes. Although improvement work needs to be done through each phase of the development cycle, we know what we need to do and how we do it. We also integrated tools which related with the techniques into our program manager system.

Conclusions:

In the paper, we have presented some techniques for adjusting current courses. The techniques help us identify the gap between course outcome and program outcome, and achieve a good balance between desired attributes.

Value:

Without appropriate techniques, it will take a lot of time, effort and cost to update the courses. Over 7 years of implementation, we have adapted and modified techniques to make our courses more and more responsive to the learning outcomes not only on paper, but also in the practical implementation of the courses.

Keywords: *techniques, update, program, syllabus.*

INTRODUCTION

Since 2010, Faculty of Information Technology (FIT), *University of Science Ho Chi Minh City* is one of the two Faculties of Vietnam *National University* HCM *City* has been selected to experiment the applying of the CDIO approach to improve the quality of teaching and learning in the curriculum at the university level. Up to now, FIT has applied this model into the program for 7 years, including the students of the courses from 2011 to date.

According to the 12 Standards CDIO (Crawley et al., 2011), standard 3, 7 refer to the design of an integrated syllabus and integrated learning experiences. The content revolves around the need for goals to be fully covered and throughout the learning process. It is accompanied by skills that need to be integrated and progressively advanced in the course curriculum each semester. In particular, standard 3 should be considered in the course of updating current courses to meet the outcomes. Standard 3 represents the integrated curriculum, ie a curriculum is designed with

mutual support of specialized discipline, with a clear plan for integrating knowledge and skills together.

Most current university training programs are available prior to CDIO deployment. A common problem is how to update the current training program in line with the continuously updated outcomes that are updated to suit the reality. Commonly available items are: list of courses, teaching methodology system, assessment methods, facilities, etc. While the CDIO has proposed very clearly the required learning outcomes for a graduate student, integrated skills into the course, active teaching methods, and methods for assessing the achievement of the learning outcomes. Thus, how to make changes to the current status for respond to CDIO requirements is a question that needs to be given and resolved.

In the content of this paper, we will delve into one aspect of the whole process of changing training program. That's accumulator are currently in the CDIO. Specifically, the analysis of the course response to the program, parsing link of multi courses to complete the given target, the support tools for this integration. Experiences of these methods are implemented in programs at Faculty of Information Technology, University of Natural Sciences based on the context and specific conditions.

The paper is presented in the following: first of all, black-box exercises will be presented to examine how existing courses meet the learning outcomes; next, the ITU matrix is implemented to determine the level of knowledge and skills covered each semester and course. A benchmark was created to test the validity of the ITU labeling process in the previous step. The next step is to assess how well the coverage of the benchmarks is going throughout the program. From there, the gap is identified in the placement of courses against the outcomes. The final section is tools for data collection and evaluation to see the level of achievement of each outcome at the course level.

BLACK-BOX EXERCISE

The first, the FIT's outcome is set to Level 4 (x.x.x.x) based on Syllabus CDIO 2.0 (Crawley et al., 2011) with changes to suit the Faculty's specificity. These outcomes are surveyed by stakeholders to ensure that outcomes are aligned with future career requirements of students. Figure 1 is the outcome developed for the Information Technology bachelor program.

CDIO SYLLABUS (X.X.X.X)
FACULTY OF INFORMATION TECHNOLOGY

1			**Fundamental Knowledge**
1	**1**		**Science Knowledge**
1	1	1	Mathemetics
			Analytics
			Algebra
			Discrete Math
			Probability Statistics
1	1	2	Physics
			General Physics
			Applied Physics
1	1	3	Electricity and Electronics
			Digital Circuit
			Basic Electricity and Electronics
1	**2**		**Fundamental of Information Technology**
1	2	1	Programming
			Basic knowledge of programming

Figure 1: Information Technology Syllabus.

The next, we must know how the existing disciplines meet this outcome. Lecturers in the Faculty are invited to attend a study session related to the courses they have been involved in compiling or teaching. The tool that CDIO experts have suggested is doing Black Box exercises (Figure 2) (Crawley et al, 2007). This exercise helps to raise awareness of the overall curriculum. Thereby, the link between the courses that support each other in the program can be identified and clarified.

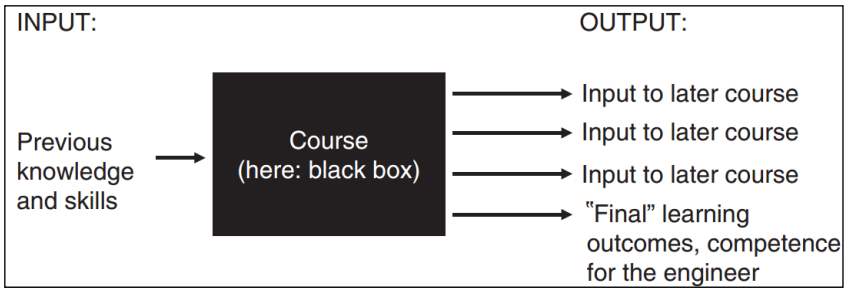

Figure 2: Black-box Survey – (Crawley et al, 2007).

In this exercise, each course is considered only in terms of Input and Output knowledge and skills without regard to the detailed content of the course. The objective of this exercise is to coordinate the clarification of the role of each discipline in the program. All disciplines are performed as a black box. Each individual course, lecturer presented the specific knowledge and skills that students had had before participating the course (INPUT) and students must achieve after the end of the course (OUTPUT). Skills and knowledge are expressed in the expected outcome (what student can solve/explain/identify ...).

Some of the questions that we asked the lecturer to answer during the session were:

1. What *knowledge* do students have to *have before* entering this course? (Input)
2. What *skills* and *attitudes* should students *have before* entering this course? (Input)
3. Which *courses* do students have to *study first without* having to *pass*?
4. Which *courses* do students have to *study first and pass*?
5. Which *courses* should take place *simultaneously* with the current course?
6. What *knowledge* do students have to gain *after taking* this course? (Output)
7. What *skills* and *attitudes* do students have to achieve *after taking* this course? (Output)
8. Which *courses* will *inherit* the knowledge, skills and attitudes that students have accumulated through the current course?

Each course can be discussed by a group of lecturers who have been in charge of this discipline. They must to answer the full questions based on rigorous and logical reasoning. In parallel, they can prioritize each of the knowledge, skills and attitudes that they have proposed. This make the re-selection process easier, as some lecturers may offer too much or too little based on the local point of view in their course.

Based on this exercise, each lecture can better shape what is needed for the course to take place, as well as the responsibilities that the course must be undertake so that the training process continues in the next phase. In addition to the knowledge that the subject equips students, lecturers also see more clearly the skills and attitudes that the course needs to integrate. If we only offer courses that teach purely occupational knowledge, some course focus on skills, others focus only on attitude,… then we do not bring anything significant change compared to before. CDIO philosophy is not about this discrete but instead emphasizes the integration of skills and knowledge into one another. Use skills to gain knowledge, apply skills

to improve understanding. Therefore, skills need to be integrated into each course. CDIO also requires that the experience be gradual, not just about one course, but to stretch through the course of a student's life. Design goes from simple to complex, with repetition in some parts of the system to improve the maturity of students (spiral model). Therefore, through this Black box exercise, lecturer will understand the intentions that the CDIO-based program leadership want to achieve.

After the lecturers have done the Black Box exercises, they will make adjustments such as updating the content of the course, integrating skills and finally assigning ITU matrix between the course and the curriculum outcome. The skill integration methods we mentioned in the paper at IETEC'13 conference (Bac et al, 2013). So we just mention ITU matrix assignments and related work in the next sections.

ITU MATRIX

CDIO (Crawley et al, 2010) suggests the three levels of acquired knowledge: I(Introduced), T(Taught), U(Used). Level I is about the knowledge that should be introduced to students without going deeply in explaining why and how. Usually at this level, lecturers do not need to evaluate students. Level T requires lecturers to teach in a way that focuses on helping students understand thoroughly the content so that they can use it later in practice. The third one, level U, assumes students already understand the knowledge; as a result, the lecturers expect students to be able to apply or to enhance the ability to apply in other areas. In the same course, different levels can be applied to each element. For example, marking I/T means that the lecturers will both introduce and teach that element to students. It might be the case that students are at initial stages of knowing and understanding new concepts.

		LO 1										
		LO 1.1			LO 1.2		LO 1.3					
Sem	Courses	1.1.1	1.1.2	1.1.3	1.2.1	1.2.2	1.3.1	1.3.2	1.3.3	1.3.4	1.3.5	1.3.6
4	Introduction to AI	U2	-	-	U2	I	U2	-	U2	-	U2	-
4	Automata and formal language	TU2	-	-	U2	I	U2	-	-	-	-	U2
5	Data mining and applications	-	-	-	U2	U2	U2	-	-	-	-	T2
5	Introduction to algorithm analysis	TU2	-	-	U2	U2	U2	-	-	-	-	TU2
5	Data hiding	U2	U2	-	U2	U2	U2	-	-	-	-	TU2
5	Embedded System	-	-	I	TU2	U2	TU2	T2	T2	T2	-	T2
5	Research Methodology	U2	U2	U2	U2	U2	-	-	-	-	-	-
5	Foundations of Computing Systems	U2	U2	U2	U2	U2	U2	U2	U2	U2	U2	U2
6	Knowledege - based systems	U3	-	-	U3	U3	U3	-	-	-	-	U3
6	Machine Learning	U3	-	-	TU3	U3	U3	-	-	-	-	TU3
6	Fuzzy Logic	U3	-	-	U3	I	U3	-	-	-	-	U3
6	Web science	U3	-	-	U3	U3	U3	U3	U3	U3	U3	U3
6	Compiler	U3	-	-	U3	U3	U3	-	-	-	-	T3

Figure 3: Marking ITU for courses and program outcomes.

We used the ITU on two objectives. The first objective is to assess how well each course responds to the program outcome. The second objective is to assess the level of instruction in the syllabus of each course. In this paper, we focus on the first objective. Lecturers in each course will assess what course is covered by the outcomes and to what level. They will use ITU labels with the same meaning as with a verb tense determinant used in the Bloom Taxonomy (Overbaugh, 2013). For example, when they mark TU3, that outcome will be taught and applied in Bloom's third level course. Level 3 in the Bloom of Knowledge is an application. When describing the course outcome, they must use verbs corresponding to this level to express. Thanks to this process of assigning the ITU, we see the development of each of the outcome through the courses.

Figure 3 shows the ITU marking process in our training program. We represent standard from L1 level (Fundamental Knowledge) to level 3 (X.X.X). Courses will be delivered in semesters and assigned with the course outcome. Which course outcome is not covered, we use the symbol "-" to express. As each lecture did a Black Box exercise, they were able to determine what outcomes were taught ahead and what should be done in the course.

Besides lectures marked ITU, the program leadership also performed this task. This approach we call the top-down approach, in contrast to the bottom-up process from the lectures. The reason that we perform these two processes is because of their objectivity and rigidity. Lecturers are the ones who know the most about their course so they will appreciate exactly what the course needs and can do. But they see only part of the whole curriculum that leads to a number of outcomes that may be repeated at the same level as taught in the previous course, or they go beyond the role of the course in the semester that the course take place. Conversely, management can see the whole of a training program so they can be more rigidly assigned to ensure that the learning outcomes are fully covered and progressively increased to the next level. Figure 4 is a diagram of the ITU matrix matrices.

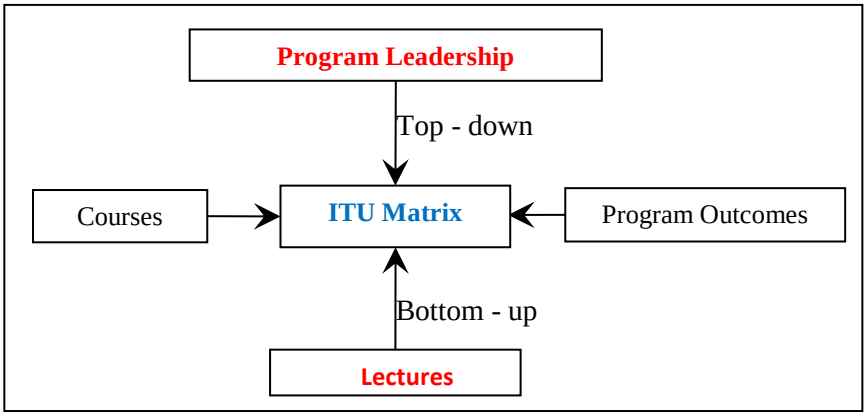

Figure 4: A diagram of the ITU matrix matrices.

The results of the implementation process may lead to a mismatch between the instructor's style and the management's style. Fixing this issue, we will elaborate in the following sections.

In the process of labeling, there is a problem that the ratio of I, T, U on an learning outcome or in a course may be unbalanced. We need to apply a tool to check this balance. The next part we'll cover in detail is a tool called benchmark.

BENCHMARK

When assigning ITU, many training programs also raise the question of whether the ratio between I, T, and U is how to ensure quality. If too much I, we can see a lot of knowledge is only introduced that will not be taught or applied. Or if too much T, the students only know theoretical knowledge, manipulation will not be good or master. On the contrary, if too much U is the student will struggle in the process of implementing knowledge into reality and may be in danger of not having enough knowledge. So how much will the ITU rate fit?

Many studies have been studied such as (Bankel et al., 2005), (Oosthuizen et al., 2007), (Kleemola et al., 2010), in which we've been found the research of the author Bankel (Bankel et al., 2005) matching for practical implementation. There, the author was based on surveys of different programs of universities such as the Engineering Program at Chalmers University of Technology, Engineering program at the Royal Institute of Technology (KTH). Based on this data, the author suggested the ITU as in Formula 1.

$$\text{ITU Index} = \frac{0.1\sum_{i=1}^{N} I + \sum_{i=1}^{N} T + 0.3\sum_{i=1}^{N} U}{(N/10)} \qquad \text{(Formular 1)}$$

where N is the number of standard courses.

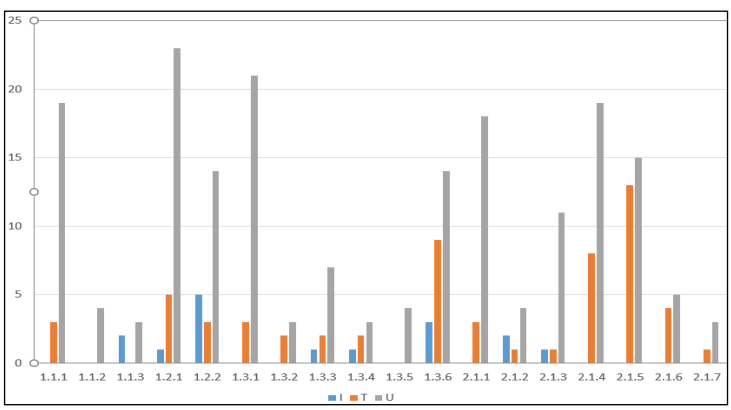

Figure 5: Distribute I, T, U on each learning outcome.

In Formula 1, "I" would account for 10% and "U" would make up 30% of "T". We apply this formula to compare the differences between the outcomes when assigned ITU. Figure 5 shows the number of each I, T, U on each outcome. Figure 6 is the corresponding ITU.

These are indicators that we have just finished implementing the ITU. It is possible to use the benchmark tool we can see quite a lot the proportion of U performance of courses on each of the outcomes. At the same time, there is also quite a difference between each of the outcome taught. This forces us to consider and make appropriate adjustments to avoid potential problems.

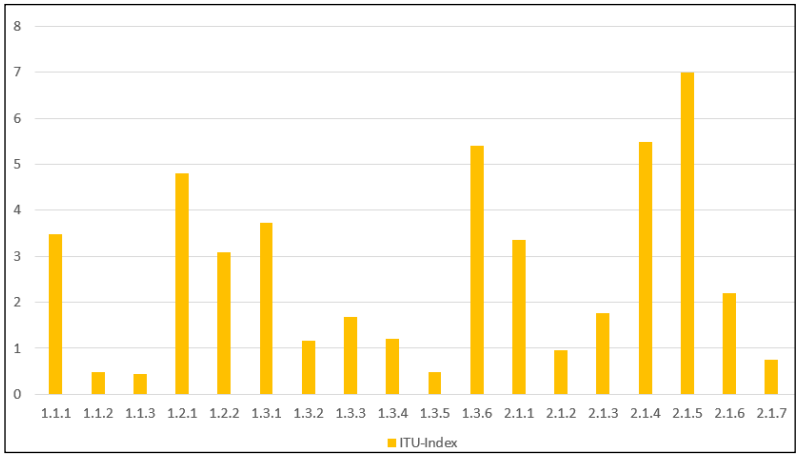

Figure 6: ITU indicator per outcome.

GAP ANALYSIS

As we mentioned in the previous sections, some problems may occur during implementation. Specifically, course outcomes are not on the list of program outcome. On the other hand, there are outcomes that are not covered by the course or are covered by fewer courses. Assigning ITU in a top-down and bottom-up manner results in no match. The level of ITU does not increase by the level of each semester or increasing and then falling down in the next semester. Moreover, the ITUs have abnormalities. For each problem, the first thing to look at is that they exist. The tools we presented above help us to identify these anomalies.

For example, by assigning ITU matrices, we have seen that a number of outcomes are covered very little or not covered by any course. In Figure 7, criterion 2.3.2 is covered by too many courses while criterion 2.3.3 is not covered by any course. Criterion 2.3.4 is only covered by a few courses. Enhanced level is not suitable for

criterion 2.4.2. These problems will need to be considered between lecturers in charge of the course and program leaders to find a way to overcome. Leaderships can also add new courses to meet their goals.

The proportion of ITU is also considered when there is a huge gap between each ITU level in an outcome or between the outcomes together. Figures 5 and 6 show these problems.

		2								
		2.3				2.4				
Sem	Courses	2.3.1	2.3.2	2.3.3	2.3.4	2.4.1	2.4.2	2.4.3	2.4.4	2.4.5
4	Introduction to AI	U2	T2	-		-	U2	U2	-	-
4	Automata and formal language	-	U2		-	TU2	-	-	-	TU2
5	Data mining and applications	U2	U2	-	-	-	-	U2	-	U2
5	Introduction to algorithm analysis	U2	U2		-	-	U3	U2	-	-
5	Data hiding	-	U2	-	-	TU2	-	-	-	TU2
5	Embedded System	U2	U2	-	U2	-	-	U2	U2	TU2
5	Research Methodology	T2	T2	-	-	T2	T2	U2	TU2	TU2
5	Foundations of Computing Systems	U2	TU2	-	-	-	-	U2	-	-
6	Knowledege - based systems	-	U3	-	-	-	-	-	-	TU3
6	Machine Learning	U3	U3	-	-	U3	-	U3	-	-
6	Fuzzy Logic	-	TU3		-	U3	U3	U3	-	TU3
6	Web science	U3	TU3	-	-	-	U3	U3	-	TU3
6	Compiler	U3	U3		-	-	-	U3	-	U3

too tight empty too narrow cluttered order

Figure 7: Some issues appear on the ITU matrix.

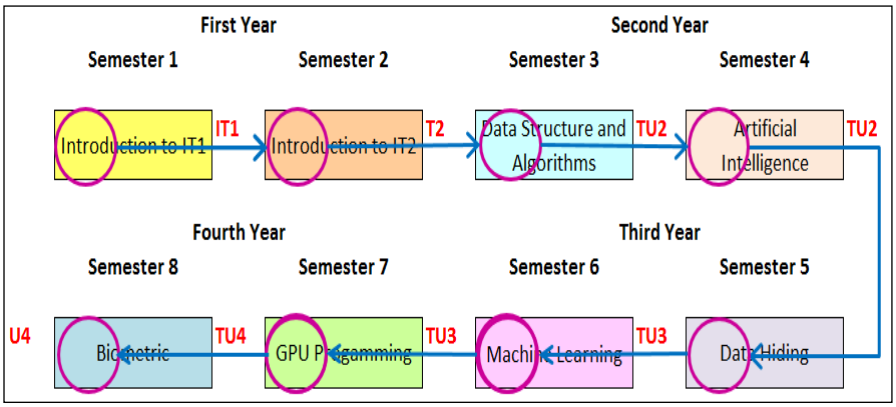

Figure 8: Courses sequence to access teamwork skill outcomes.

Another problem can also happen and be of interest. Due to credit system, students can have the option of registering courses they think they like and that they are useful. This leads to some outcomes not in the courses chosen by the students. It is not easy to overcome this problem regardless of how well designed and balanced the program are, there can still be "paths" (selection of courses) to avoid a certain outcome. The measure we limit the impact of this problem is based on student enrollment surveys, based on core courses in each major discipline to deliver key outcomes of program. From there we created a sequence of courses. With this sequence, we will focus on tracking the process of the outcome on it. Figure 8 is courses sequence that we choose to evaluate teamwork skill outcomes.

COLLECT DATA AND EVALUATION

In addition to the tools to integrate courses into CDIO training programs, we also develop tools to test the performance of the courses for the expected learning outcomes. Figure 9 illustrates this tool.

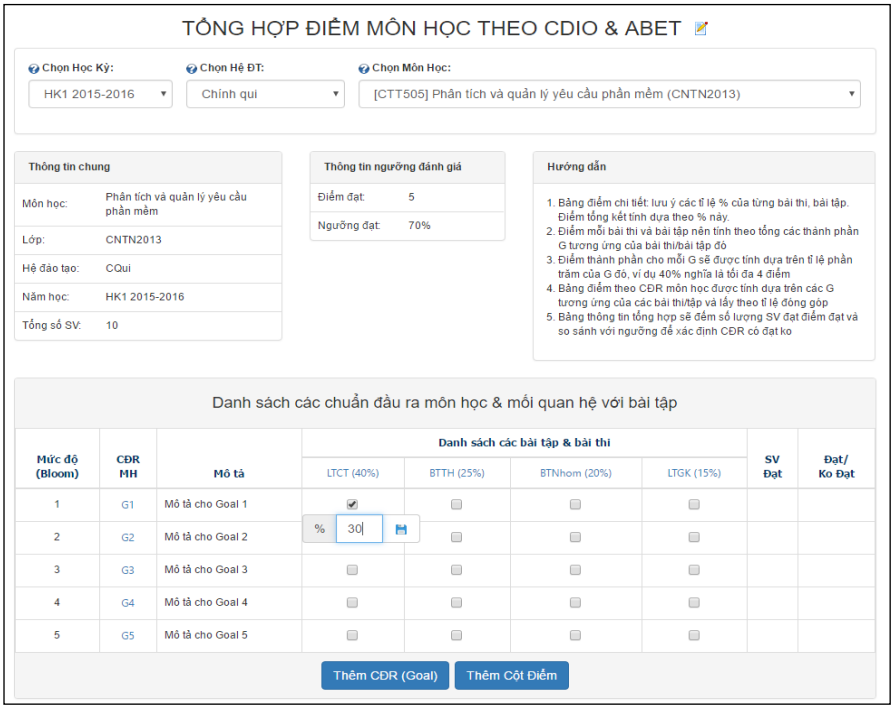

Figure 9: A collection tool to test the achievement of the outcome.

During the teaching process and after the end of a semester, lecturers will be required to enter transcripts with multiple components and assessments on each course outcome to the Faculty management system. The tool will automatically compile and output whether or not the outcome is successful. From there, leadership can evaluate and make adjustments or measures to help students meet program outcomes.

CONCLUSION

We have spent 7 years implementing and adjusting our curriculum to meet CDIO requirements and helping our students meet the requirements of the companies. The techniques we presented in this paper are what we have applied to change discrete courses and integrate them into the CDIO training curriculum. We recognize that they are very helpful in expressing the tightness, cohesion, coverage, and especially for us to find weaknesses that we need to adjust. The courses are updated almost completely and the work is still ongoing every year, so that there is always an appropriate program that meets the requirements of the society. We are continuing to research and develop techniques to ensure that the learning outcomes are fully understood and mastered by our students.

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The scientific way to develop the inductance concept in physics education

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ABSTRACT

The way to develop the inductance concept presented in school textbooks has not yet been fully implemented in a scientific way, where the existence of the phenomenon is solely based on logical reasoning as it considers this phenomenon as a logical consequence drawn from the phenomenon of electromagnetic induction, but an experimental verification of the logical consequence is ignored or not properly considered. How can this problem be solved and whether there is any difficulty? The paper deals with a full scientific way to develop this concept and how to solve the related difficulties. Students' learning should be considered like researching through which predictions drawn from logical reasoning, need to be verified experimentally. If so, the perception of this concept must go through the following steps: Prediction, Verifying the prediction experimentally. The paper deals with ***p****roposing a full scientific way to develop the concept of inductance and solving the related difficulties when teaching the concept for two different levels of education: high school and college, universities. To develop the physics knowledge, it is necessary to organize learning as researching.*

Keywords*: learning as researching, inductance, prediction, verifying experimentally*

INTRODUCTION

Physics is the basis of engineering and technology. Being aware of the physics knowledge is a condition for the perception of technical and technological knowledge. So it is very necessary to teach and learn physics in a scientific way, in other words, learning as researching.

One of the physics phenomena much applied in engineering is the phenomenon of inductance. The development of the concept presented in many textbooks has not yet been fully implemented in a scientific way, where its development only includes a prediction of the appearance of an inductance electromotive force and hence an inductance current based on the Faraday's law, Lenz's law, Kirchhoff's laws and other already known knowledge, and the prediction has not been verified empirically or there is no convincing experimentation. It is demonstrated in detail as follows.

1. Prediction on the appearance of the inductance electromotive force in the coil

The prediction states: If the current through a coil is altered then the flux through that coil also changes, and this will induce an emf in the coil itself. This phenomenon is called inductance or self-induction.[1,2,3,4,5,6] Faraday's law for this case

$$\varepsilon = -\frac{d(N\Phi_B)}{dt}$$

shows that the number of flux linkages $N\Phi_B$ (N being the number of turns) is the important characteristic quantity for induction. For a given coil, provided no magnetic materials such as iron are nearby, this quantity is proportional to the current i, or

$$N\Phi_B = Li$$

in which L, the proportionality constant, is called the inductance (or more precisely, the self inductance) of the coil. From Faraday's law above the induced emf can be written as

$$\varepsilon = -L\frac{di}{dt}.$$

This prediction is demonstrated by a simple experiment using the apparatus shown in the diagram (Figure 1a, b).[7]

An air cored inductor is connected in series with a d.c. supply and a 12 V bulb. The resistance of the solenoid will be low so that it barely affects the light emitted by the bulb, and placing an iron core inside the inductor will make no difference to the bulb's brightness

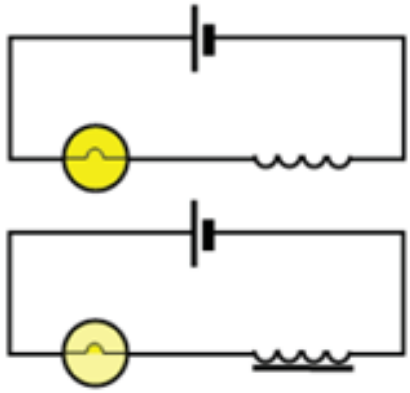

Figure 1a.

If the experiment is repeated using an a.c. with an air core, the inductance will probably prevent the lamp from reaching its full brightness. If an iron core is placed inside the solenoid, however, its inductance is increased considerably and the lamp goes out due to the increased self-inductance and resulting back emf in the coil.

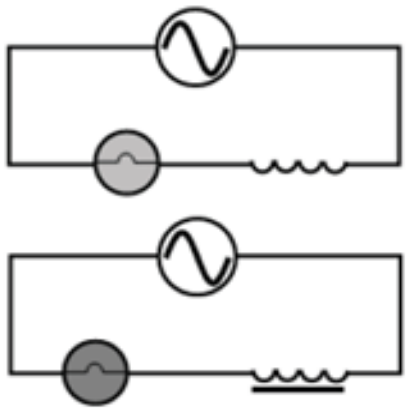

Figure 1b

Figure 1: A simple experiment demonstrates that no inductance occurs, when the current in the coil is unchanged (1a) and an inductance occurs, when the current in the coil is changed (1b).

A different experiment as an introductory experiment uses the apparatus shown in the below diagram (Figure 2a and 2b) to pose problem.[1,8,9] This experiment is described as below:

Note: The bulbs in the diagram are the same. The resistance of the rheostat R is equal to the coil's pure resistance.

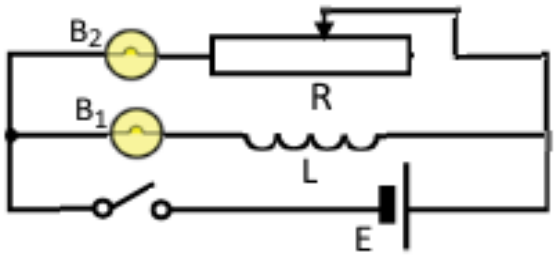

Figure 2a.

When the switch is closed, it is observed that the bulb 2 lights up right and the bulb 1 light up slowly.

While the switch is opened, it is observed that light of the bulb does not turn off immediately but flashes and then goes off.

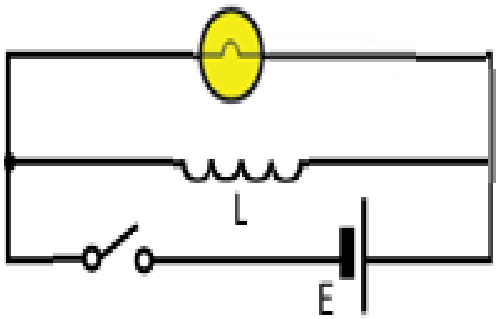

Figure 2b

Figure 2: Experiment on the inductance phenomenon when switch is closed (a) and switch is opened (b).

2. Prediction drawing on the appearance of the inductance current in the coil and the equation describing the variation of this current

Below is a prediction drawing on the equation describing the variation of the inductance current corresponding to circuit used the apparatus shown in the diagram (Figure 3).[5,6,7]

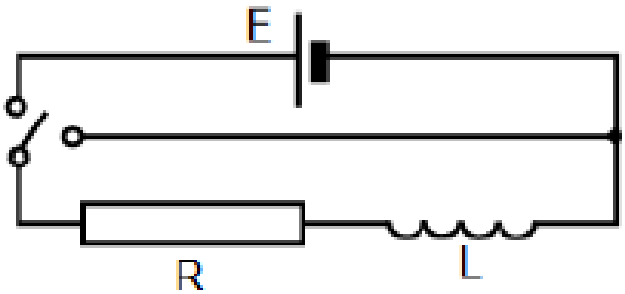

Figure 3: The circuit is used to investigate the variation of the inductance current.

When a battery of emf E is connected, the equation describing the variation of the inductance current is:

$$I = \frac{E}{R}(1 - e^{-\frac{R}{L}t})$$

and this shows that the growth of current is exponential towards a final value E/R (Figure 4).

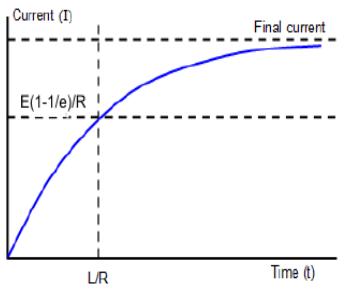

Figure 4: Graph on the variation of the inductance current when switch is closed.

When the cell is disconnected, the equation describing the variation of the inductance current is:

$$I = \frac{E}{R} e^{-\frac{R}{L}t}$$

and this shows that the decrease of current is exponential towards a final value of zero (Figure 5).

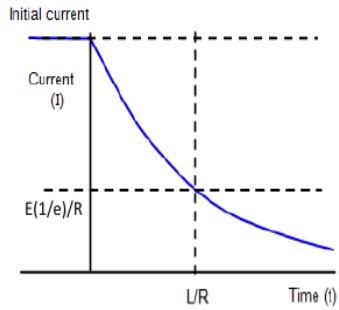

Figure 5: Graph on the variation of the inductance current when switch is opened.

The above ways of the development of inductance phenomenon are only based on logical reasoning to draw prediction of the appearance of the inductance electromotive force, demonstrated via simple experiments instead of experiments for proper verification. The above analysis show that the above ways, although are according to the scientific method but an experimental verification of logical consequences is ignored or not properly considered.

There are following problems: How should be the concept of inductance completely developed? Are there any difficulties while developing this concept?

The solution to those problems is presented below.

1. METHODOLOGY/SOLUTION

Our research methodology is based on the scientific method for investigating the phenomena, acquiring new knowledge to develop the inductance concept.

The scientific method

The scientific method is considered as "a method of research in which a problem is identified, relevant data are gathered, a hypothesis is formulated from these data, and the hypothesis is empirically tested". [10]

The scientific method is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. [11]

Steps of the scientific method are**:** [12]

Observation/Research; Hypothesis; Prediction; Experimentation; Conclusion.

"Prediction is a key concept in scientific method, where it is a precondition for testing hypotheses. It is by applying deductive reasoning to our hypotheses that we generate predictions" [13] and "the most important part of the scientific method is the experiment"[14] because "by analyzing the results of observations/experiments we evaluate whether our predictions are confirmed or contradicted, and thus whether our hypotheses are supported or not by our observations/experiments".[13]

The same content of these steps is also presented by W.G. Rasumowski in the below flowchart/ diagram of the scientific creation cycle (Figure 6) .[15]

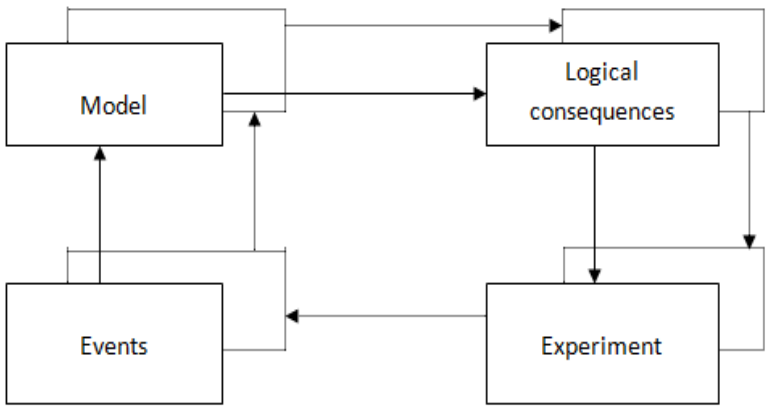

Figure 6: Diagram of the scientific creation cycle by W.G. Rasumowski.

1. The developing the inductance concept according scientific method

The answer to the research question: "How should the concept of inductance completely be developed", is that the concept need to be fully developed via a scientific method, where the step "Experimantation" needs to be properly considered. Furthermore, experiments used to verify prediction is often related to the operational principle of the technical applications of physical models.

In this case, the Faraday's and Lenz's laws play the role of hypothesis, models and the inductance phenomenon, inductance electromotive force, inductance current including their equations play the role of logical consequences - predictions. These predictions are not always true, so they must be tested experimentally.

This is just to focus only on two important steps in the development of the inductance concept according to the scientific method. The steps are as follows: Prediction and Experimentation.

What qualitative and quantitative content of the predictions should be induced? It depends on the level of the student, first of all their obtained knowledge.

Below we give different predictions that suit different levels of students. At level 1, student in most high schools in many countries (including Vietnam) obtained knowledge as Faraday's law, Lenz's law and laws of voltage and current in the parallel and serial circuit of d.c power. At level 2, student in most colleges, universities in many countries, in addition to the above knowledge, they also obtained knowledge of the Kirchhoff's laws, knowledge of differential equations.

1. Prediction

2.2.1.1. Prediction at level 1

The drawn prediction should be based on specific situations also experimental scenarios.

We choose an experiment scenario using the circuit shown in figure 2a, because in fact, the experimental diagrams 2a and 2b are one. Further when the switch is closed, predictions drawn can be only verified experimentally within the conditions of using the circuit shown in figure 2a.

When the switch is closed

Prediction 1

An inducted electromotive force, that is indicated by $\mathcal{E}_{ind}$, appears in the circuit with coil. Its equation is $\varepsilon_{ind} = -L\frac{di_1}{dt}$, (where L is inductance of the coil and i_1 is the initial current flowing through the coil). Its poles are shown in figure 7. Hence in this circuit, an inducted current appears, that is indicated by i_{ind}. Its direction is opposite to that of the current generated by the power source. That means i_{ind} flows from left to right. Therefore, the current indicated by i_1, being generated by power source E and $\mathcal{E}_{ind}$, running in this circuit will increase more slowly than normal, from 0 to the maximum value, that is the value of the current when the inductance loss.

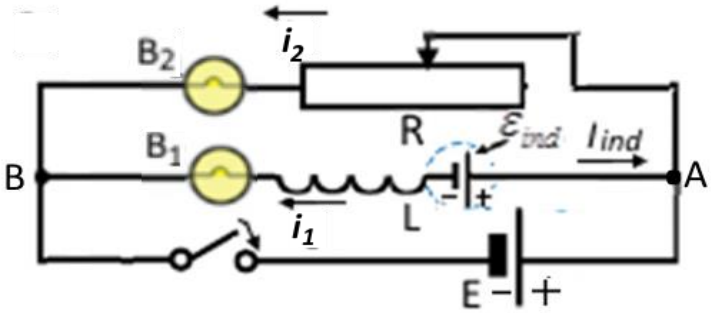

Figure 7: The circuit is used to investigate the variation of the inductance current i_1 when the switch is closed.

Prediction 2

At branch point A, a part indicated by $i_{ind.1}$ of i_{ind} flows into the circuit with rheostat in the right to left direction and an its remain part indicated by $i_{ind.2}$ flows into the main circuit in the right to left direction (Figure 8). In this case, the current indicated by i_2 running through rheostat consists of a part of the main current generated by power source E through rheostat, and $i_{ind.1}$. This leads to i_2 reaches the maximum value immediately.

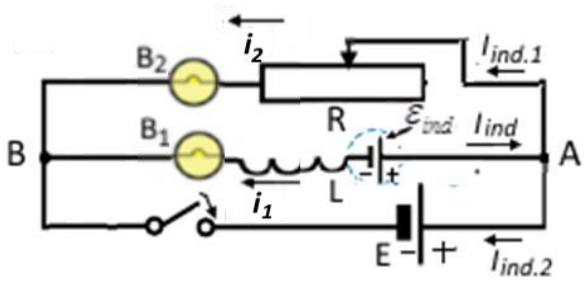

Figure 8: The circuit is used to investigate the variation of the inductance current i_2 when the switch is closed.

When the switch is opened

Note that: When the switch is not opened, the currents in the circuit with rheostat and coil flow from right to left.

Prediction 3:

An inducted electromotive force, that is indicated by ε_{ind} appears in the circuit with coil. Its poles are shown in figure 10. Hence in this circuit, an inducted current

appears, it is indicated by i_{ind} in diagram. Its direction is the same direction to the direction of the before appeared current generated by the power source.

The inductance current in the circuit with coil i_{ind} flows from right to left. At branch point B, it flows into the circuit with rheostat from left to right. The current running in the circuit with coil indicated by i_1 and the current running in the circuit with rheostat indicated by i_2 are just i_{ind} (Figure 9). So the magnitude of i_2 also i_1 does not decrease immediately to zero but decreases from maximum value to zero.

Below is a sketch on the change of current through the circuits with rheostat i_2 and coil i_1 when the switch is closed (Figure 10) and the switch is opened (Figure 11).

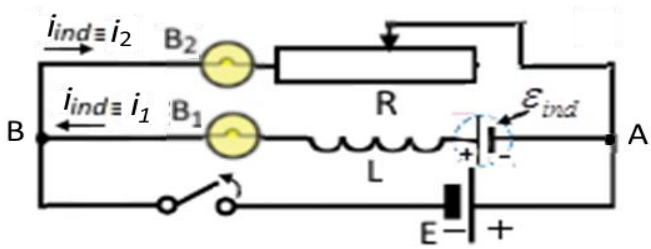

Figure 9: The circuit is used to investigate the variation of the inductance current i_1 and i_2 when the switch is opened

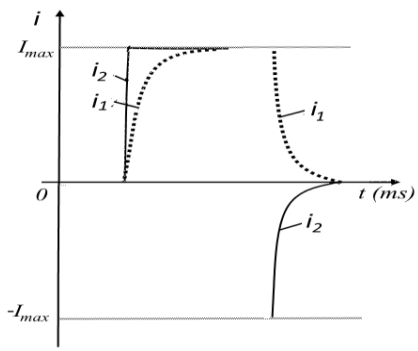

Figure 10 (left): The sketch on the change of currents i_1 and i_2 when the switch is closed.

Figure 11 (right): The sketch on the change of currents i_1 and i_2 when the switch is opened.

Note: Since these predictions are not derived based on quantitative expressions of electromotive force as well as not based on Kirchhoff's laws, the knowledge of differential equations should be limited to qualitative. The sketch on the change of currents i_1 and i_2 are qualitative. Therefore different students may sketch different forms of the increase or decrease of i_1 and i_2.

2.2.1.2. Prediction at level 2

We still choose the experiment scenario using the circuit shown in figure 2a, where bulbs are removed and the pure resistance of coil is indicated by R_1, the resistance of rheostat is indicated by R_2 shown in figure 12.

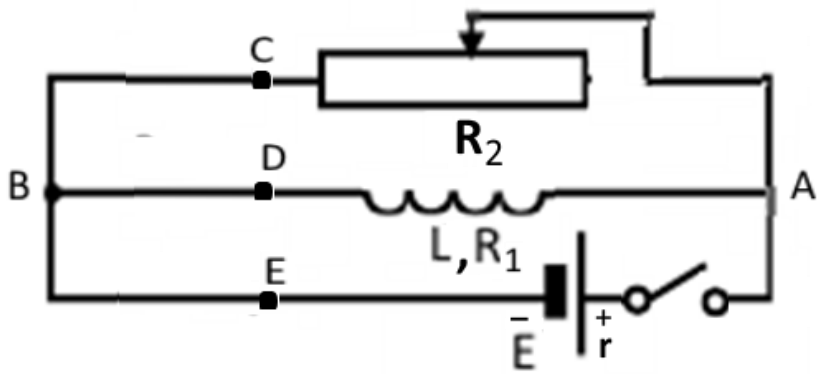

Figure 12: The circuit is used to investigate the variation of the inductance current i_1 and i_2 when the switch is opened.

When the switch is closed:

1. At the branch point A, we label currents going to and from the point and choose their directions as shown in figure 13.
2. We traverse loops DACB and EACBE in a counterclockwise direction.

When applying Faraday's law, Lenz's law and Kirchhoff's laws, we obtain the following equations

$$i_r - i_1 - i_2 = 0 \quad (1)$$

$$L\frac{di_1}{dt} + i_1R_1 - i_2R_2 = 0 \quad (2)$$

$$E - i_r r - i_2 R_2 = 0 \qquad (3)$$

The solution of the 3 equations gives us the following solutions:

$$i_1 = \frac{R_2 E}{R_1 R_2 + R_1 r + R_2 r}\left(1 - e^{-\frac{R_1 R_2 + R_1 r + R_2 r}{L(r+R_2)}t}\right)$$

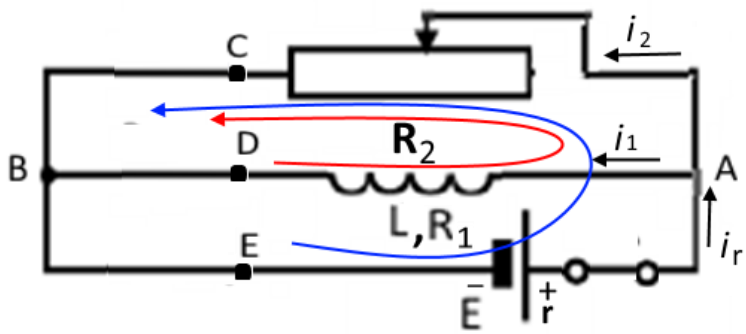

Figure 13: Direction of currents flow in circuit and direction of loops chosen.

If $R_1=R_2=R$, i_1 becomes

$$i_1 = \frac{E}{R+2r}\left(1 - e^{-\frac{R(R+2r)}{L(r+R)}t}\right)$$

Then

$$i_2 = \frac{E}{r+R} - \frac{r}{r+R}\left[\frac{E}{R+2r}\left(1 - e^{-\frac{R(R+2r)}{L(r+R)}t}\right)\right]$$

and

$$i_3 = \frac{E}{R+r} + \frac{R}{(R+r)}\frac{ER}{(R+2r)}\left(1 - e^{-\frac{R(R+2r)}{L(r+R)}t}\right)$$

If we use a stable power source of the computer as the source E, then *r* is very small, considered to be zero. So

$$i_1 = \frac{E}{R}(1 - e^{-\frac{R}{L}t}) \quad (4)$$

$$i_2 = \frac{E}{R} \quad (5)$$

$$i_3 = \frac{E}{R} + E(1 - e^{-\frac{R}{L)}t}) = E(\frac{1}{R} + (1 - e^{-\frac{R}{L)}t}) \quad (6)$$

when $t = \infty$, i_1 reachs to a stable value of *E/R* labeled as I_{10} . Then i_1 and i_2 have the same value of $I_{10} = \frac{E}{R}$.

When the switch is opened

3. Now the circuit includes only one loop ADBC. In this loop the inductance emf causes the current i_1 through the coil and i_2 through rheostat. The currents have an equal magnitude and in the direction shown in figure 14.

4. We traverse the loop ADBC in a counterclockwise direction.

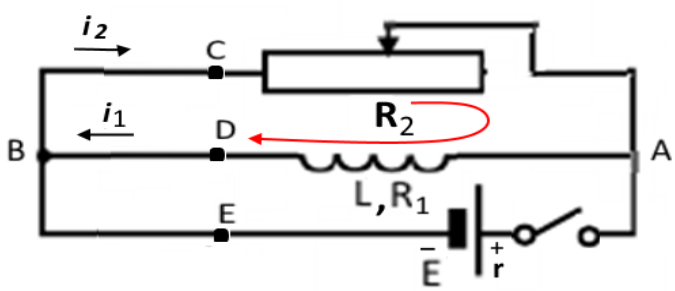

Figure 14: Direction of currents flow in the circuit and direction of the loop chosen when the switch is opened.

In the case of $R_1=R_2 = R$, the loop theorem gives

$$-L\frac{di}{dt} - Ri_1 - Ri_2 = 0 \qquad (7)$$

Since $i_1=i_2$ the equation (7) becomes

$$L\frac{di}{dt} + 2Ri = 0$$

and its solution is

$$i = I_{10}e^{-\frac{2R}{L}t}, \qquad (8)$$

where $I_{10} = \frac{E}{R}$.

Note: i runs through the coil, indicated by i_1 , from right to left and through the rheostat, indicated by i_2 , from left to right direction. If they are represented on a graph, they will be symmetric across the horizontal axis. If the graph of current flowing from right to left is drawn above the horizontal axis, then the graph of current flowing from left to right is drawn below the horizontal axis. Thus, the equation describing i_1 and i_2 have the same form of the equation (8) but they differ by the minus sign in front of the equation. If we use the equation (8) to describe i_1 then the equation describing i_2 have the form as below

$$i_2 = -I_{10}e^{-\frac{2R}{L}t} = -\frac{E}{R}e^{-\frac{2R}{L}t} \qquad (9)$$

If you choose E = 12V, R = 106, L = 1.45 H, then the graph on the initial currents i_1, i_2 when the switch is closed (Figure 15a) and the graph on the initial currents i_1 , i_2 when the switch is opened (Figure 15b) are as below:

Note:

Qualitative predictions about the variation of the currents at 2.2.1.1 are similar to quantitative predictions about the variation of the currents at 2.2.1.2.

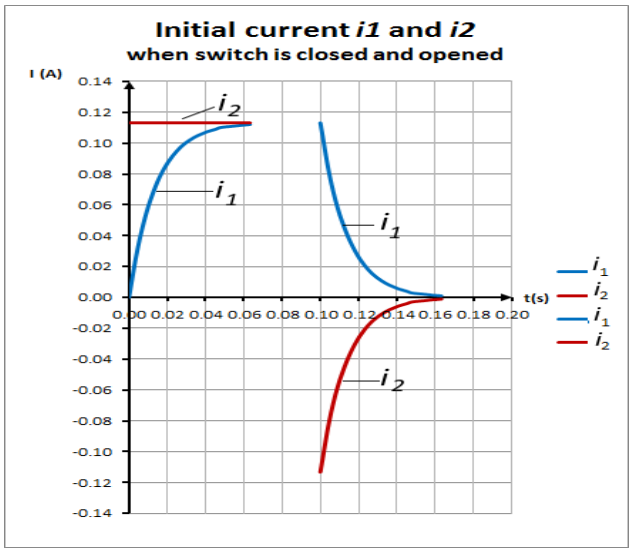

Figure 15a: The graph on the initial currents i_1 , i_2 when the switch is closed

Figure 15b: The graph on the initial currents i_1 , i_2 when the switch is opened

2.2. 2. Experimental Verification

2.2.2.1. Conducting experiments

We use the circuit shown in the Figure 12a to verify predictions and a computer-assisted experiment in order to measure and display very fast, instantaneous variation of potential differences across components of the circuits. It is not possible to do with traditional experiments.[16] Experimental devices are chosen as follows:

1. The power supply E with stable voltage 12v d.c. retrieved from the computer
2. The bulbs B_1 and B_2 are replaced by resistors $r_1 = r_2 = 100\,\Omega$, L=1,45H, the resistance of rheostat and coil have a same value of $R = 6\,\Omega$.

Measuring the current i_2 and i_1 (in direction and magnitude) can be conducted through measuring emf across resistors r_1 and r_2.

Below is the installation diagram of the experiment (Figure 16).

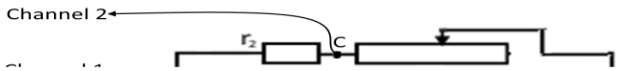

Figure 16: The installation diagram of the experiment.

1. Data collection

The instantaneous variation of the emf across resistors r_1 and r_2 is shown in figure 17.

The white line indicates the potential difference U_2 across r_2 and the green line indicates the potential difference U_1 across r_1.

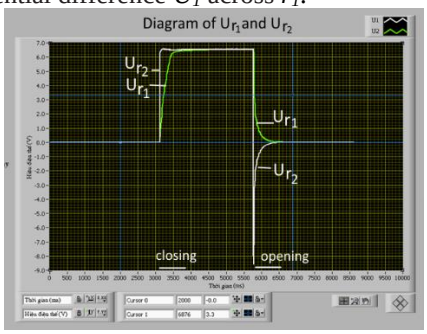

Figure 17: The instantaneous variation of the emf U_1 and U_2 across resistors r_1 and r_2

When the switch is closed, an emf is inducted in time interval from about the 3100th millisecond to the 3800th millisecond.

When the switch is opened, an emf is also inducted in time interval from about the 5800th millisecond to the 6500th millisecond.

2. Analyzing data and drawing conclusions to verify predictions

Since $U = ir$, so the change of U gives us the change of i. Experimental graphs U_1, U_2 in any case (when the switch is closed or opened) are similar figures with graphs of i_1 and i_2 drawn from the above equations (4), (5), (8) and (9) .

However, there is a difference between the experimental graph and the theoretical graph related to the current i_2 when the switch is closed as follows: From the moment $t = 0$ the current i_2 drawn theoretically reaches I_{10}=E/R immediately but this current drawn experimentally reaches this value later. The reason for this is that r (of the power source E) is considered to be zero but in reality it is not so.

Based on the analysis of the experimental data, it is concluded that the predictions are confirmed, that means if the current through a coil is altered then the flux through that coil also changes, and this will induce an emf in the coil itself. This phenomenon is called inductance or self-induction. And thus the Faraday's law, the Lenz's and etc. as hypotheses are once again verified experimentally.

3. FINDINGS/DISCUSSION

Our research results include

- proposing the addition of content "Experimentation" into the process of developing the inductance concept according to the scientific method.

- choosing a physical phenomenon, based on which predictions can be drawn and proposing a test plan to verify the predictions (in qualitative form or in quantitative form suited with different levels of students), conducting the computer assisted experiment (used LabVIEW software) in order to verify the predictions.

However, when choosing the physical phenomenon, experiment used apparatus shown in figure 2a, there are advantages and disadvantages as following:

1. Advantages:

This chosen physical phenomenon is an introduction experiment, which posed problems and therefore impresses students. Predictions drawn from this phenomenon are about basic issues of the inductance phenomenon when the switch is closed or opened. Further, by choosing this phenomenon, it allows the comparison of differences regarding the change of voltage applied to the circuit with the coil and to the circuit with the resistor when the switch is closed.

2. Limitations:

When the switch is closed, the inductance phenomenon appears in the circuit with resistors and a coil connected in parallel, is more complex as they are connected in series. The quantitative predictions are drawn only by students at level 2. In addition, a graphing software with tools for curve fitting is used to verify predictions, that are represented by mathematical functions.

3. CONCLUSIONS

It is necessary to base on the approach “learning as researching” and particularly on the scientific method to organize a learning of physics knowledge including knowledge related to technical applications.

Below are brief recommendations on how to organize a student’ learning the inductance concept based on the approach "learning as researching" according the scientific method.

Table 1: Steps of the scientific method.

Steps of the scientific method	Applying the scientific method to develop the inductance concept
1. **Observation/ Research**	Introduction experiment, posing problems (using experiments presented in figure 2a and/or 3 ... etc.).
2. **Hypothesis**	Recalling the laws of Faraday, Lenz, etc ... (if need)
3. **Prediction**	Make predictions based on the laws of Faraday, Lenz, Kirchhoff’s laws etc.
4. **Experimentation**	Verify predictions by traditional experiments (if possible) and / or computer assisted experiments (in a variety of ways, such as teacher’s experiments, student‘s experimental practice, or at least the experiments is described in words…)
5. **Conclusion**	Conclusion

This educational approach could be applied particularly in physics education and science education in general. Based on this approach an active and creative learning can be organized with the application of Piaget’s theory of cognitive development and Vygotsky’s sociocultural theory of cognitive development.

However, the applying of this approach in teaching and learning requires a lot of time, equipment as well as teacher qualifications.

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Developing Module-Based Integrated Teaching Competency for Technical Education Students in Order to Renovate the Technical and Vocational Education in Vietnam

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ABSTRACT

Vietnam is undergoing a radically and comprehensively renovation of education and training in the direction of shifting from content-based training to competency-based training to form professional competencies for learners. In training institutions of the Technical and Vocational Education (TVE) system, there have also been a transformation into module-based training which the integration of theoretical and practical contents. Whereas, in Universities of Technology Education (UTEs) theory and practice are still taught separately, that is not directed towards the development of integrated teaching competency (ITC) for students. Hence, there should be an innovation. This paper mentions concepts related to integrated teaching with module-based approach, proposes the integrated teaching competency structure for TVE trainers and ways to develop ITC for students at the Universities of Technology Education.

***Keywords**: Compentency/ integrated teaching competency/ module-based approach.*

INTRODUCTION

It is clearly stated in the Resolution No.29/2013/NQ-TW on radically and comprehensively renovation in TVE: "The content of TVE is built in the direction of integrating knowledge, skills and professional working style to shape occupational competencies for learners"[3]. The Ministry of Labor, Invalids and Social Affairs (MOLISA) has organized the development and promulgation of training curricular by modules integrated theory and practice. The General

Directorate of TVE has also issued training materials for TVE teachers on methods of compiling, teaching and evaluating integrated lessons [2].

In Vietnam, the training of teachers for general education and preschool education is the task of pedagogical universities and colleges; The training of teachers for vocational education is the task of Technology Education universities. However, competence-based approach has been applied in vocational training in Vietnam, meanwhile 100% of universities of Technology Education in Vietnam have not organized competence-based training yet and has not directed to the development of integrated teaching competency with module-based approach for students. The objectives as well as the method of training TVE teachers in Universities of Technology Education are still separated knowledge and skills, not aiming at developing students' necessary ITCs. As a result, the output of these institutions has not met the requirement of ITCs for teaching staff in TVE institutions. Therefore, developing module-based ITC for technical education students is currently an important and urgent task to improve the quality of TVE teachers training and to make contribution to the implementation of the Resolution No.29/2013/NQ-TW on radically and comprehensively renovation in education and training.

1. Some Concepts

- *Competency:* There have currently been many different related concepts such as ability, possibility, competency. The term "Competency" is used in this article includes knowledge, skills and attitudes necessary to enable employees to perform the duties of an occupation meeting certain standard requirements under the conditions provided in advance.

- *Skill:* The concept of “Skill” is also considered from different aspects (technical aspects of manipulation, action, activity, aspect of action efficiency). However, this paper uses the following “skill” concept: Skill is the effective execution of an action, a task on a specific requirement, aiming to achieve definite purpose in particular conditions, circumstances and means.

- *Integration:* There are many concepts of integration with different extents and levels, such as the integration of teaching methods, integration of subjects (combination), integration between theory and practice (integration) ... This article uses the concept Integration which is the closely link between theory and practice in teaching and learning.

- *Integrated teaching*: Integrated teaching is a method in which theory and practice are always closely connected to form professional competency for learners and to follow the educational principle “Study links with practice, Internship combined with production” during training process.

- *Integrated teaching competency*: Integrated teaching competency is a set of knowledge, skills and attitudes needed to effectively fulfil the task of teaching theory integrated with practice to form professional competencies for learners.

- *Module:* Module is defined to be a learning unit in which professional theory, practical skills and occupational attitudes are integrated, to be an entirely complete

one to provide learners with competencies of completely fulfilling a specific task up to the professional standard.

- ***Modular Approach:*** Within the scope of this paper, modular approach is understood as the application of modular teaching methodology to form and develop ITCs for future TVE teaching staff.

2. Structure of Integrated Teaching Competency by Modular Approach

There are various structures of teaching competency, depending on the choice of criteria to form the structure. In this article, basing on the steps of the teaching process, the ITC for TVE teachers proposed by the author consists of the following four components.

2.1. Competency to analyze current training curriculum to identify integrated modules and lessons

In order to achieve ITC with modular approach, the prerequisite is that the content of the curriculum must be structured into integrated modules. However, it is impossible for every content in the current curriculum to be integrated teaching. Therefore, to implement integrated teaching, the first thing is to select appropriate contents to be designed into integrated modules. It is the process of studying the objectives, contents of the current curriculum and carrying out occupational analysis for TVE teacher to identify tasks and works that TVE teachers have to do in the process of integrated teaching, on that basis, determining the content for integrated teaching in each task and restructuring these contents into modules. Thus, the competency of analyzing current curriculum to identify integrated modules is composed of two core competencies, i.e. competency of curriculum analysis to select contents possible for integrated teaching and competency of integrated modules design. Integrated modules design includes module objectives and content design, module teaching method selection and tools design for evaluating end-of-module learning outcome.

In order to do this, students at Universities of Technology Education should be equipped with knowledge and skills in developing curriculum following integrated modular-based structure and work analysis with DACUM (Development A CurriculuM) method.

The teaching content of each module is usually to form the competency to fulfill one task of the occupation with a fairly long teaching time. Each task normally involves some works, so each integrated module is often subdivided into lessons to create convenience to teaching. According to the guidelines for the implementation of Official Direction No.1610 by the General Department of VTE [2]: If in any teaching content, there is a correlation between theory and practice by the ratio of 30% theory and 70% practice, that lesson can be determined to be a integrated lesson of the module. In addition, the integrated lesson must be structured in such a

complete way that helps one or some occupational competencies of the learner to be formed and developed after completing the course.

In order to have this, students at Universities of Technology Education should be equipped with knowledge and skills in job analysis and teaching with modular approach.

2.2. Competency to prepare integrated lessons

Once lesson have been selected to teach in integrated method, the following things of an integrated lesson will need to be prepared: setting goals, selecting content, composing multiple-choice questions, and assignment evaluating the learning outcome; preparing integrated lesson plan and conditions for integrated teaching.

Lesson plan is a script for the teaching process so it must be designed in detail. In the field of VTE, the prescribed lesson plan includes the objectives of topics of teaching content, teaching and learning activities of teachers and students, teaching and learning methods and technical facilities needed for teaching and learning, time required to teach each topic of the lesson, tests, questions and exercises to assess learning outcomes.

Hence, the competencies of preparing integrated lesson includes components such as competency of composing integrated lesson, developing integrated lesson plan, designing learning materials and preparing the technical equipment for theory and practical teaching needed for the lesson.

In order to achieve this, students at Universities of Technology Education should be equipped with knowledge and skills on TVE training methods, technical facilities for training and training process management.

2.3. Competency to teach integrated lesson

Teaching is the main and most important part of the teaching process. Competency of conducting integrated lesson includes the following competencies: competency to organize integrated teaching-learning process, competency to utilize active teaching methods, competency of theoretical and practical teaching, competency to use teaching aids and equipment for training, competency to apply information technology to perform interactives in teaching with knowledge and skills in the lesson connected to real work, competency of assessing the integrated lessons' learning outcome.

In order to do this, students at Universities of Technology Education should be provided with knowledge and skills about VTE training process management, active teaching methods and techniques, VTE practical teaching methods, use of ICT in teaching, use of technical equipment in VTE training, design and use of methods and tools for assessing learning outcome.

2.4. Competency to assess learning outcome at the end of the module

End-of-module learning outcomes are assessed at the end of each module may be done individually if the institution implements individualized learning or in group. The competency to assess the learning outcome of a module includes the competencies of designing modular assessment tools, collecting and analyzing evidence, collating evidence with goals and evaluation criteria to validate modular learning outcome.

In order to do this, students at Universities of Technology Education should be equipped with the knowledge and skills in modular teaching methods, design and use of tools for assessment the end-of-module learning outcome.

In summary, module-based ITC consists of four components shown in Diagram 1.

In order to do this, students at Universities of Technology Education should be equipped with knowledge and skills in curriculum development following integrated modular-based structure and job analysis with DACUM (Development A CurriculuM) method.

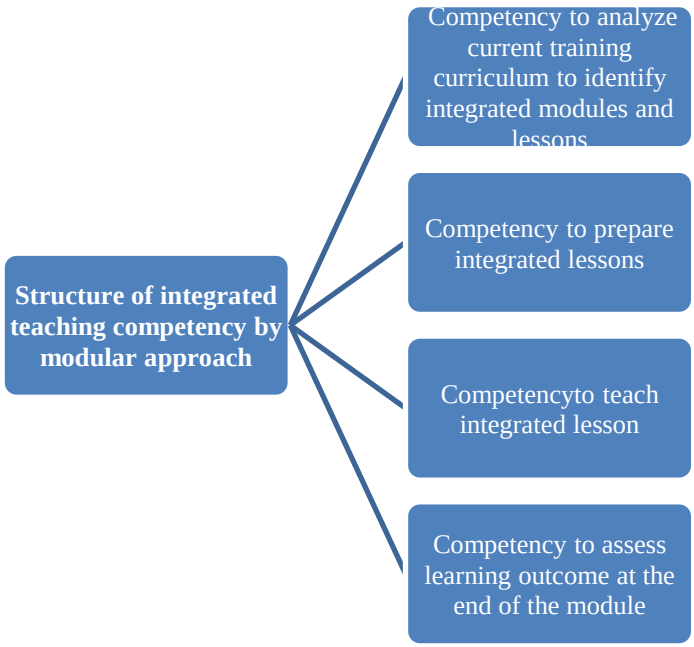

Figure 1: Structure of integrated teaching competence following module-based approach.

The above competencies will be developed in sequence for students during learning process. For each component competency, teachers organize students to study theoretical knowledge related to that competency; then, teachers give instructions so that students are able to practice the skills of that competency. Theoretical and practice instructions must be seamless conducted as in modular training and must ensure that corresponding competencies are formed and developed for students. For example, with the lesson preparation competency, teachers organize students to learn theories related to this such as concepts, roles, tasks of lesson preparation; after that, teachers guide students to practice lesson preparation skills. When students have prepared their lessons, i.e they have the capacity to prepare the lessons, then teachers organize and instructs students to develop following competencies such as ability to perform lessons, capacity to evaluate.

3. Ways to Develop ITC for Technical Education Students

Basing on the curricula at Universities of Technology Education, there are some ways to develop ITC with modular approach for technical education students as follows:

3.1. Through teaching pedagogical modules of the curriculum

In the curricula at Universities of Technology Education, there are following pedagogical subjects: Professional Psychology, TVE Education, Teaching Facilities, Communication and Pedagogical Behavior, Vocational Training Curriculum Development, Information Technology Applicationin teaching, Vocational Training Skills and Methods, Pedagogical Internship. Through these subjects, students' ITC can be formed and developed. However, theoretical subjects are currently being separated from pedagogy internship (4 weeks). Therefore, only by restructuring the theoretical subjects together with the pedagogic internship into integrated modules could be formed the ITC for students.

3.2. Through regular pedagogical training activities

Through regular pedagogical training activities, students have the opportunity to apply professional knowledge to solve real-life tasks, thereby pedagogical knowledge and skills are developed.

The rational organization of regular pedagogical training practice will bring optimal results for students because it will create favorable psychological premise, creating excitement and career ideal, right morality and motivation in professional personalities of technical education students.

3.3. Through attending model lectures, exchanging and learning experiences from teachers

Attending lectures, drawing experience lessons and exchanging, learning from teaching experiences of teachers, especially pedagogical internship instructors, give students a general understanding of contents relating to teaching preparation activities, teaching activities, monitoring and evaluating teaching-learning results. Through direct class observation, the students themselves perceive and determine the process of teaching organization, the competency to use technical equipment and teaching aids. Moreover, students can get a clear view on the process of teaching and learning actions as well as the combination of teaching actions which aims at solving teaching tasks when there are corresponding facilities and teaching conditions.

3.4. Through teaching competitions

The teaching competition is one of the important activities to equip students with the necessary knowledge about the profession. Through these activities, students are strengthened, deeply engraved and able to master pedagogical knowledge; at the same time, they are opportunities for students to experience understanding, perform and experience competency of teaching and solving pedagogical situations as well as evaluation competency of future teachers. This is a useful, practical playground, creating an environment and opportunities for teacher students to train professional aspects and develop their pedagogical talents.

3.5. Through self-practice

Self-study and self-practice are decisive factors in learning and training quality as it is the ability of self-exploring, self-direction and self-application of knowledge in new situations or similar ones with high quality. Through self-study, self- practice, students can study themselves for the whole life and that is the key in the 21st century - a century of lifelong learning, learning society. And study at universities, the most important is learning how to learn, is self-learning, self- practice [1]; [4].

In fact, it can be seen that no matter how good the teachers are, how deep their knowledge and professional skills are, if students do not study hard and deeply, do not expand their knowledge by independent learning, learning quality cannot be high. Under the same school conditions, the students' academic performance are significantly different, which is largely due to the self-study ability. Therefore, in order to develop integrated teaching competency, the students themselves must always try to learn, to self-study, to experience the knowledge as well as skills needed and it must be a long and persistent process of each student.

CONCLUSION

The VTE system in Vietnam is undergoing a radically and comprehensively renovation, in which an important task is to move from content-based training to competency-based training to develop professional competencies for learners. In order to achieve this, it is necessary to unify a number of related concepts which are now under different concepts in order to develop ITC following modular approach for students at Universities of Technology Education first.

On that base, the paper proposes the structure of ITC for VTE teachers, including: Competency to analyze current training curriculum to identify integrated modules and lessons; Competency to prepare integrated lessons; Competency to teach integrated lesson; Competency to assess learning outcome at the end of the module. These competencies may be formed for students at Universities of Technology Education through teaching pedagogical modules of the curriculum, attending model lectures, exchanging and learning experiences from teachers, teaching competitions and self-training.

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The Online Learning Environment According to Learning Styles

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ABSTRACT

Online learning is the modern trend of teaching and learning in the 21st century. In Vietnam, however, it is necessary for schools to prepare the fundamental conditions to deploy online courses effectively, such as: fostering the awareness of the role of online learning; developing the teachers' skills in designing learning objects; assuring the quality of online learning; creating online learning environments. Therefore, learning styles and its relation to online learning activities are the basics for designing the adaptive online environments.

In this paper, we propose the online instructional technology, then develop the online learning environment according to the technological approach; and support solutions to organize the learning activities adapting to learning styles.

Keywords: *Online Learning Environment, E-learning, Learning Styles, Online Instructional Technology*

I. INTRODUCTION

Online learning is changing the way that people deliver and obtain their knowledge. Based on the advances of information and communications technology (ICT), online learning offers an uniform learning environment so that online courses can be accessed by anyone, any time and anywhere.[1] It is considerable to implement online learning in Vietnam because IT infrastructure is developing effectively, IT skills of Vietnamese people is high. Therefore, it is a big advantage for schools to implement online courses in Vietnam nowadays. [2] In fact, it is unsuccessful for Vietnamese schools to apply e-learning now: online courses as the portal of learning materials; same learning contents to all students; unattractive SCORM lectures; lack of the government's policies in deploying e-learning... Therefore, the aims of our research are:

1. pointing out the feasible and effective conditions to implement online courses in Vietnam;

2. the way to personalize the learning contents in online courses, a fundamental for designing adaptive online courses, partly improving the quality of online learning.

II. THEORETICAL FRAMEWORK OF DESIGNING THE ONLINE LEARNING ENVIRONMENTS

2.1. Online Instructional Technology

Deploying the online learning feasibly and effectively requires our researches focus on how to integrate the technological approach into learning and teaching process, especially in online learning.

According to the technological approach, learning and teaching process will be considered in two aspects: feasibility and effectiveness. Then, technological approach guides us how to design, implement, evaluate and improve the quality of learning and teaching process. The feasibility of learning and teaching process is made by the instructional means and methods that ensure the quality of teaching and learning possible. The effectiveness is the fact of the successful instructional result that is determined mainly by instructional skills. As a result, there are three main elements of the instructional technology, such as: means, methods and skills.

Online learning (or online learning and teaching) is the instructional form that integrates ICT applications into delivering lessons via the Internet.

Online instructional technology is a system of online instructional means, methods and skills using psychological, sociological and objective laws to educate and train online so that learners can achieve the necessary qualifications (including working knowledge, skills and behavior) in order to meet the employment needs of the society.

*Online instructional means c*onsist of means for orientating actions, *visual means and symbol means. They are:*

- Multimedia;

- Virtual and parametric interactivity;

- Real-time online interactivity;

- Reusable simulations: accessible, capacity and quality.

Online instructional methods are rules for application of online teaching's theory into designing multimedia; using multimedia and internet services; building pedagogical strategies to organize an online course for delivering learning contents.

*Online instructional skills are s*kills to apply effectively the theory, means and methods into online learning.

- *basic ICT skills*

- *skills for using and designing the modern teaching means, Internet services.*

- *behavior skills of "self-guided learning".*

2.2. Models of Learning Styles

Learning styles are the preferred and stable characteristics of learners that specify how to receive, process, store and respond information to gain knowledge in learning environment.

There are many different models of learning styles, so it is very necessary to assess the contribution of each model for individualize learning in online courses. This helps to find out the most suitable model applied into an adaptive online learning environment.

There are many approaches on how to control the learning differences among online learners, then some models of learning styles are introduced. In our research, the learning orientation model (LOM) of Margaret Martinez is applied into classifying online learners, then each suitable learning environment is proposed to correspond to each leaner group.

LOM describes four learning orientations based three important aspects of online learners: (1) emotional/intentional motivational aspects, (2) self-directed strategic planning and committed learning effort, (3) learning autonomy.

This model classifies learners into 4 groups: Innovator, Implementer, Reproducer and Resister.

Learner Group	*Learning styles*
Innovators	Strong passions and intentions on learning Set long-term challenging goals Commits great effort to study Responsibility and self-management

Implementers	Focuses emotions/intentions on learning selectively or situationally Set short-term, task-oriented goals Commits measured effort Prefers coaching and interaction for achieving goals.
Reproducers	Focuses intentions and emotions cautiously and routinely as directed. Follows and tries to achieve simple task-oriented goals assigned and guided by others. Wants continual guidance, and expects reinforcement
Resistors	Focuses on not cooperating. Efforts to resist assigned or expected goals Avoids learning (apathetic, frustrated, unable, discouraged, or disobedient)

III. DESIGN OF ONLINE LEARNING ENVIRONMENT ORIENTED TO LEARNING STYLES

Online learning environment oriented to learning styles is defined as the learning environment that its learning contents are presented according to online learners' styles.[3]

There are three types of learning environments that is suitable for learners' styles in LOM:

- Research-based Learning Environment
- Collaborative Learning Environment
- Guided-structured Learning Environment.

3.1. Research-Based Learning Environment

Research-based Learning Environment is organized as a small individual project. The research – based learning environment is suitable for two learner groups: Innovators and Resistors.

Online Instructional Technology

- Online Learning Means: Webquest. [5]
- Online Learning Methods*:* Project based Training.
- Online Learning Skills: Self-learn Guidance

Learning Organization of the Research-based Learning Environment

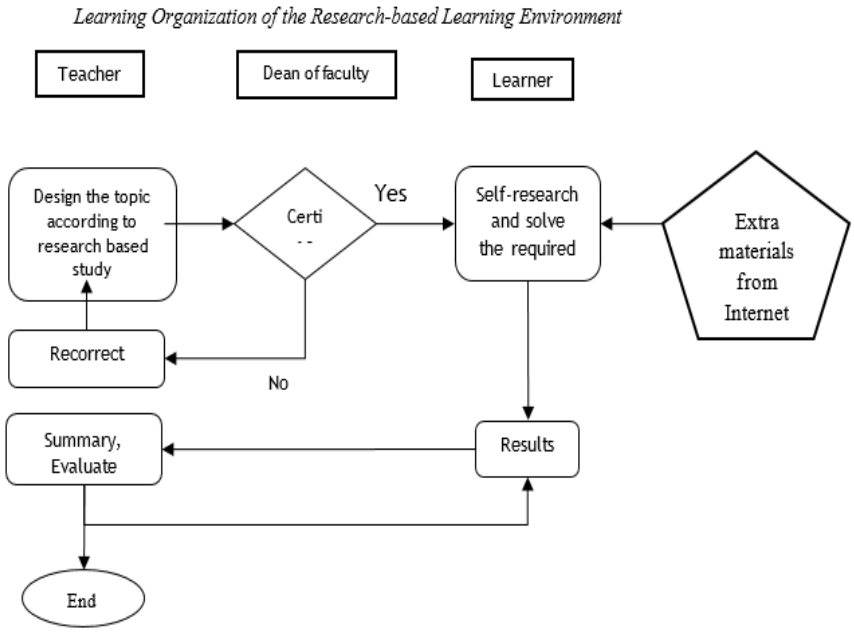


Figure 1: Learning organization in the self-research online learning environment.

3.2. Collaborative Learning Environment

Collaborative Learning Environment is organized as an internet based seminar. This environment is suitable for the Implementers.

Online Instructional Technology

- Online Learning Means*: Social networks such as:* Facebook, Forum or Wiki

- Online Learning Methods*: Case-study*

- Online Learning Skills*:* Collaborative

Learning Organization of the Collaborative Learning Environment

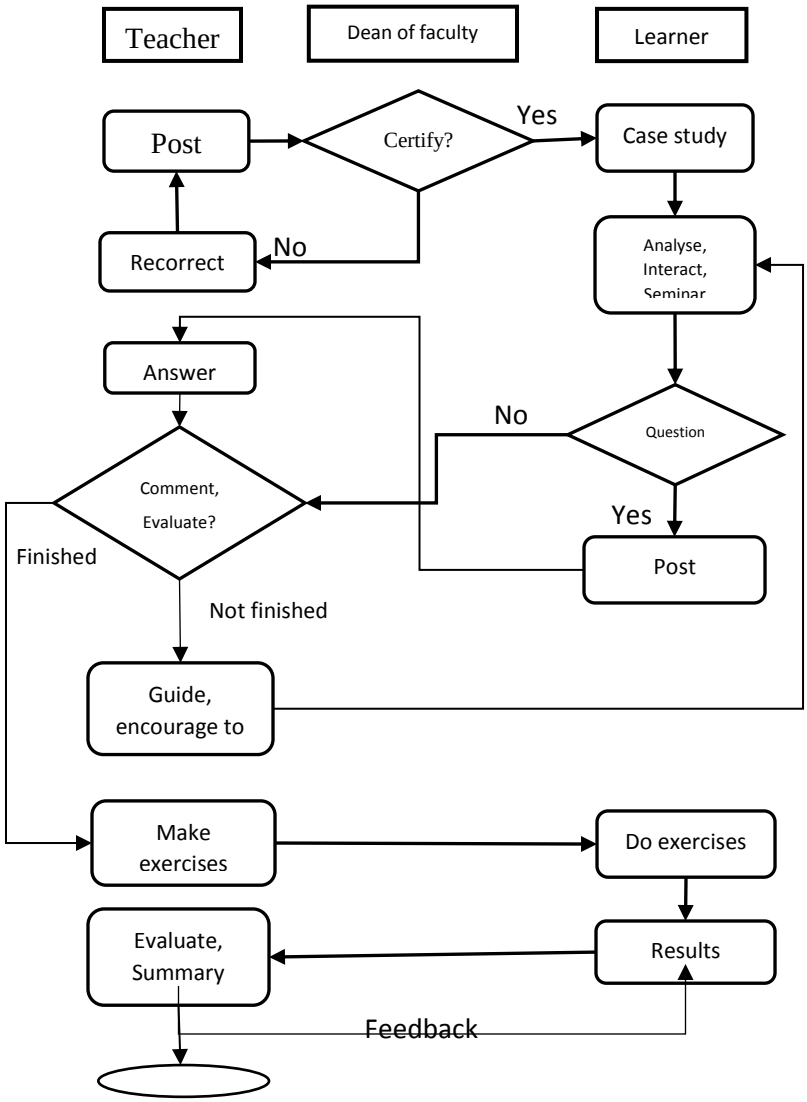


Figure 2: Learning organization in the collaborative online learning environment.

3.3. Guided-Structured Learning Environment

Guided-structured Learning Environment is organized as linear structure with fully-guided tasks. The guided-structures learning environment is suitable for Reproducers.

Online Instructional Technology

- *Online Learning* Means*: Multimedia lectures (in SCORM format)*

- *Online Learning* Methods*:* method of deductive-expository that presents general information and then presents some examples.

- Online Learning Skills*: skills of designing multimedia*

Learning Organization of the Guided-structured Learning Environment

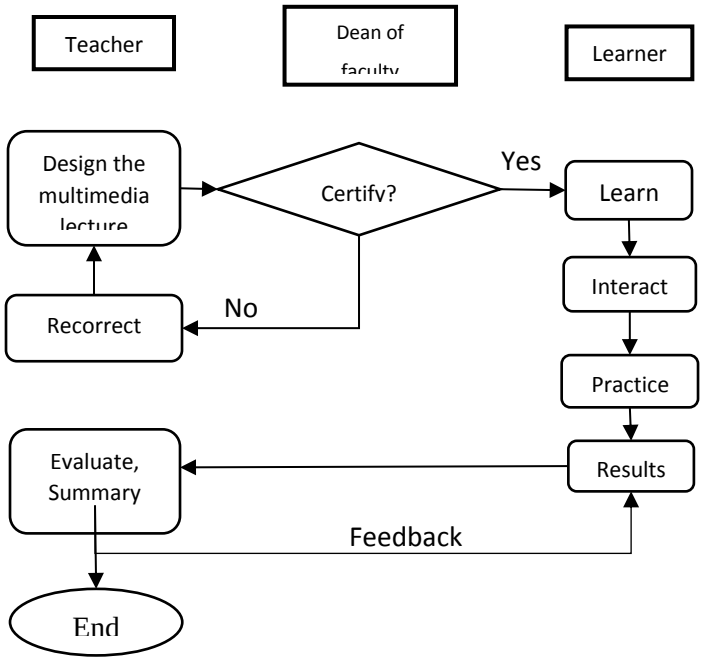


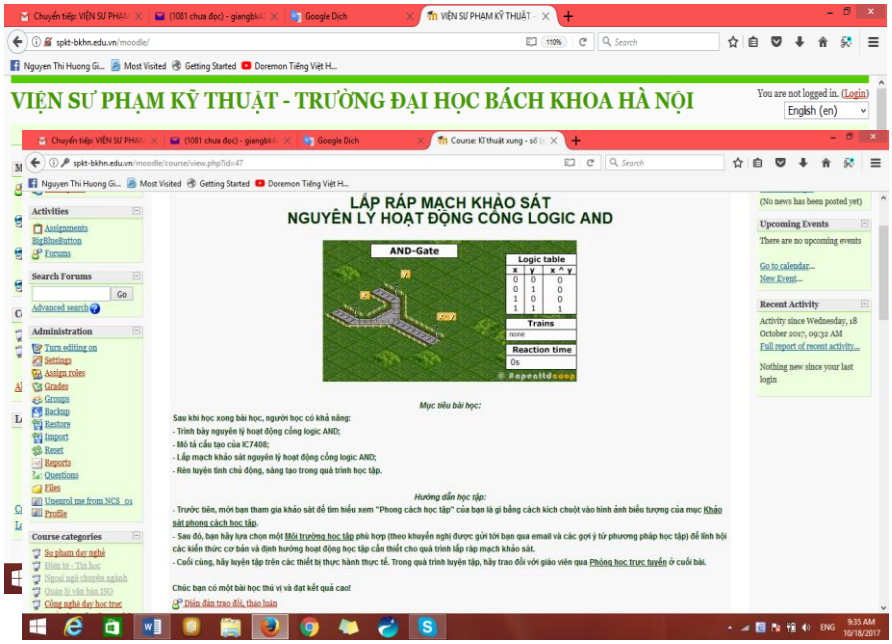
Fig 3. Learning organization in the guided-structured online learning environment.

IV. IMPLEMENTATION OF ADAPTIVE ONLINE COURSES DESIGNED ACCORDING TO LEARNING STYLES

Implementing the solutions of building an online learning orientation environment according to technology approach in teaching the Subject of Digital Electronics, a topic **"Assembling the circuit for experiment on operating principle of AND logic gates"**.

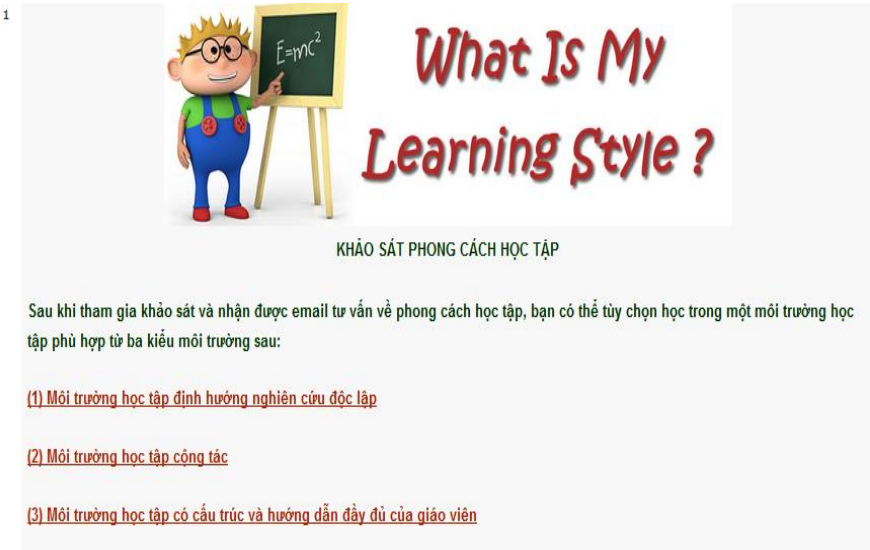
Organization the learning activities in the adaptive online environment includes the following steps [7]:

- *Access the website to study*, the website address is http://spkt-bkhn.edu.vn/moodle



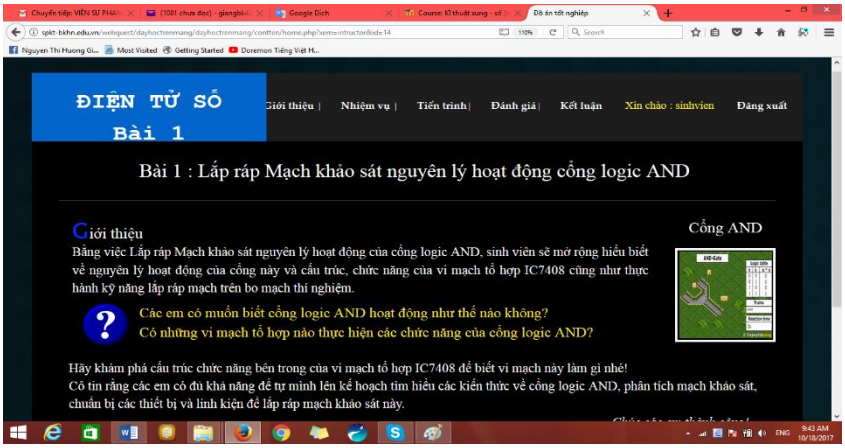
- *Choose the experimented course* **"Assembling the circuit for experiment on operating principle of AND logic gates"**.

- Identify the learner' style

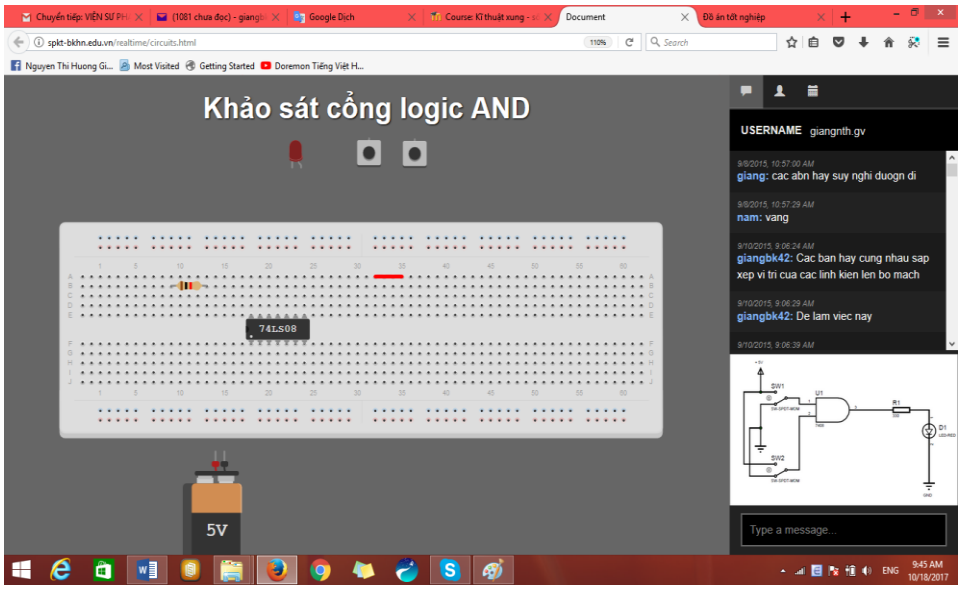


- *Choose the suitable environment according to teacher's recommendation from the lists of environments:* Research-based Learning Environment; Collaborative Learning Environment or Guided-structured Learning Environment.

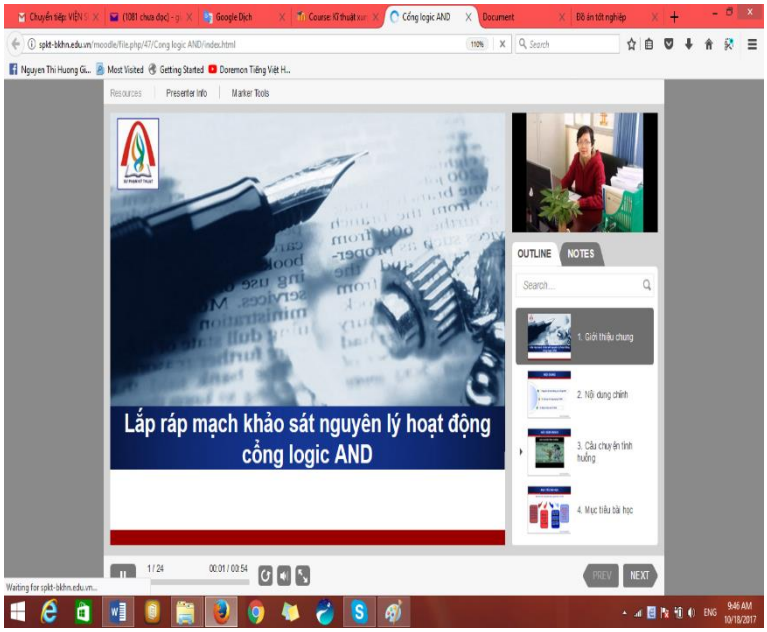
1. Research-based Learning Environment



(2) Collaborative Learning Environment



(3) Guided-structured Learning Environment



- *Evaluate the learning results*

The process of learning and teaching in the adaptive online environment can be described as an below figure 4:

V. EVALUATION THE LEARNERS' SATISFACTION IN THE ADAPTIVE COURSE

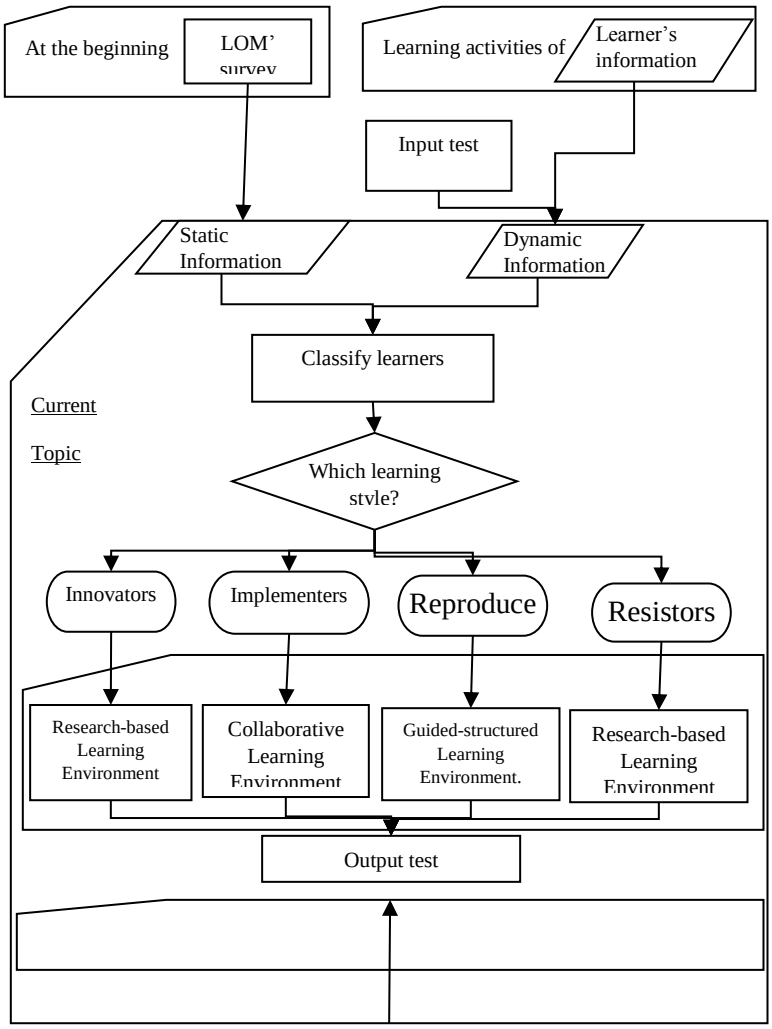


Figure 4: Organization the learning activities in the adaptive online environment.

There are 47 students attended the experimentation of the adaptive course, divided into two groups: Innovators and Implementers.

Experiments on the Group of Innovators

Table 3. 1. The results of ANOVA analyzing on learning motivation of Innovators.

ANOVA

Do you like the course

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.119	2	3.060	21.401	**.000**
Within Groups	2.431	17	.143		
Total	8.550	19			

The result of ANOVA, analyzing learning satisfaction of Innovators in three different learning environments, has the level of observed sig. = .000<0.05. This means that there is a statistical significant learning satisfaction variance of Innovators in three different learning environments. The learners have the highest satisfaction (2.6667) when they study in the Research-based Learning Environment, have the lower satisfaction (1.1250) in the Collaborative Learning Environment and have the lowest satisfaction (1.1111) in the Guided-structured Learning Environment.

Experiments on the Group of Implementers

Table 3. 2. The results of ANOVA analyzing on learning motivation of Implementers.

ANOVA

Do you like the course

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.521	2	3.260	9.597	**.003**
Within Groups	4.417	13	.340		
Total	10.938	15			

The result of ANOVA, analyzing learning satisfaction of Implementers in three different learning environments, has the level of observed sig. = .003<0.05. This means that there is a statistical significant learning satisfaction variance of Implementers in three different learning environments. The learners have the highest satisfaction (2.8333) when they study in the Collaborative Learning Environment, have the lower satisfaction (1.8333) in the Research-based Learning Environment and have the lowest satisfaction (1.2500) in the Guided-structured Learning Environment.

V. CONCLUSION

Online course is an ICT enriched learning environment, supporting a flexibility of geography, time and personalized ability in learning process. Through researches in the world and Vietnam, the initial contribution of online learning is assessed positively as possible to help participants reach the social learning, enhance lifelong learning opportunities; help students quickly access and update with society through the tools and modern media; create a positive learning environment, promoting an active role of the learner. However, online learning implementation still faces many difficulties as in perception because the habit of both teachers and learners become accustomed to the face to face learning environment; some teaching content can not teach pure by online learning; and especially the barriers of authentication in online courses, evaluation of online learning, pedagogy of online courses has not been sufficient attention and lack of governments' policies in e-learning...

The paper proposed the theoretical and practical perspectives of online instructional technology such as the concepts of online instructional technology, online teaching

means, online teaching methods, online teaching skills and how to design an online lecture according to technology approach.

Building successful the adaptive online environment, the learner will be routed corresponding to each topic, and experience in various learning environments during the learning process. Therefore, depending on the learner's ability in each subject, he will be recommended to study in a suitable environment. Such as, the Collaborative Learning Environment is designed for the Implementers, the Research-based Learning Environment is designed for Innovators and the Guided-structured Learning Environment is designed for Reproducers. The more adaptive learning environment, the more learners' satisfaction.

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The research is funded by the Hanoi University of Science and Technology (HUST) under Project number T2017-PC-161.

Occupational Skill Training for Students of Technology Education to Meet the Demand of Innovating Vocational Education and Training in Vietnam

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ABSTRACT

Occupational skill is a competence element of a teacher teaching at vocational education and training institutions. Occupational skill is formulated while studying at universities of technology education and during the process of teaching. However, occupational skills of students are limited in terms of skilfullness and short of the quantity. To meet the demand of innovating vocational education and training, it is necessary to develop the outcome standards and curricula according to CDIO approach, to develop the curricula and study materials on the basis of the outcome standards, and to organize the occupational skill practice at the laboratories and enterprises.

Keywords: *Occupational skill, the practice of occupational skills, teacher training vocational education.*

1. THE NECESSITY TO TRAIN OCCUPATIONAL SKILLS FOR STUDENTS OF VOCATIONAL EDUCATION

The demand to innovate the vocational education and training in Vietnam: Vocational education and training aims at better satisfying the demand of direct human resources for socio-economic development; contributing to the employment; improving the labor productivity, developing quality and the competitiveness of the economy in the international integration to ensure that the vocational education and training in Vietnam reach advanced level in the region by 2025.

According to the professional standard, teachers working in vocational education and training institutions have to be skilful at assigned occupational skills and skilfully organize the assigned manufacture and service.

However, there is a gap between the quality of human resources in Vietnam and other developed countries in the region. There are some certain limitations on the quality of training occupational skills in vocational education and training institutions. One of the reasons is the level of occupational skills of teacher and the lack of skills of vocational teachers who graduate from universities of technology education. The level of occupational skills of teachers directly affect the quality of occupational skill training of students.

Therefore, it is essential to train and improve the quality of occupational skill training for students of technology education.

2. SOME RELATED CONCEPTS

2.1 Competency and Skill

Professional competency is reflected in the ability to effectively perform an occupation, a specialized function, or specific tasks with the requisite expertise. Competency is generally considered in relation to certain types of activities or relationships. No capacity exists outside activities and communication.

Competency is composed of basic components such as: 1) knowledge in the field of activity or relationship; 2) Skills to conduct activities or to promote and interact with each other in a relationship; 3) The psychological conditions for organizing and implementing knowledge. [57- 58, 7]

One of the three mentioned psychological structures when separated is considered specialized types of competency: 1) Competency in the form of knowledge (competency to know); 2) Competency in the form of skills (competency to do); 3) Competency in the form of emotion (expressive competency).

When combined, they are still considered competency but are more complete and general. The confusion between skill and competency is the indistinguishable form of competency. At the specialized level, the skill includes knowledge of actions at a more specific level.

In English, there are two words for capacity: **Ability** and **Competency**

The diagnosis of personality refers to Ability, while the evaluation of activities refers to the performance of the subject - Competency.

The Ability: refers to capacity in the psychological sense which can allow individuals to perform the task of operation.

The Competency: refers to capacity to perform activity in the sense of performing a real job. For that reason, it is easy to find that competency has the psychological nature ensuring that the subject knows the right way while doing in order to find a

reasonable and optimal solution for the whole task of action as well as communication. The material form of physical skills is behavior or activity. [59,7]

2.2 Occupational Skill

Occupational skills are the ability to carry out an action, an activity or a task of an occupation, on the basis of selecting and applying existing knowledge, experience and skills to act in accordance with the objectives and practical conditions of the occupation.

Occupational skills have the following characteristics: 1) Accuracy: full attendance of required actions and correctness in each action when performing the task, eliminating redundant and incorrect actions; 2) Proficiency: the action is done smoothly, reasonably and fast; actions are coordinated skilfully to achieve common goals; 3) Flexibility: the ability to perform well not only in familiar conditions but also to apply in different conditions and circumstances; 4) Effectiveness: the actual result of the action is the details, components of the product or the results of the steps that meet the requirements; 5) Occupational skills are associated with certain occupational activities and formed only during the occupational practice of the individual.

The quality of occupational skill training is the level of attainment of occupational skills that learners achieve after learning compared to training objectives. The quality of occupational skill training is measured in terms of the number of occupational skills and skill levels. Each specific skill, measured in 5 levels of achievement on a Bloom scale: transformed, mastered, accurate, accomplished, accomplished but flawless.

3. THE SITUATION OF OCCUPATIONAL SKILLS OF TECHNOLOGY EDUCATION STUDENTS

In order to evaluate the results of occupational skill training of technology education, we conduct a survey on occupational skills in majors trained at Nam Dinh University of Technology Education: Electrical-Electronic Engineering, Electrical Engineering, Controlling and Automation Technology, Mechanical Engineering, Manufacture Engineering, Automotive Technology, , , , and Information Technology. [31, 4]

Participants in the survey: Lecturers teaching technology education students at Nam Dinh University of Technology Education and Technology Education students of the fifth year (senior students)

Method: Questionnaire

The survey outcomes are presented in the following table (on the basis of Bloom scale):

Table 1: The evaluation of occupational skills of technology education students in 7 majors at Nam Dinh University of Technology Education.

No.	Majors	Skill level (the percentage of students)				
		5	4	3	2	1
1	Electrical-Electronic Engineering	3,1	15,5	35,3	43,7	2,4
2	Electrical Engineering	3,5	14,9	35,7	43,7	2,2
3	Controlling and Automation Technology	2,9	13,3	36,3	45,7	1,8
4	Mechanical Engineering	1,9	11,1	40,3	46,0	0,6
5	Manufacture Engineering	2,4	17,0	37,6	41,8	1,2
6	Automotive Technology	2,6	12,4	39,6	44,0	1,4
7	Information Technology	2,2	15,6	45,6	32,9	0,6
General percentage		2,7	14,5	38,8	42,0	1,5

The outcomes of the survey show that the skills are mainly at level 2 and 3 on the Bloom scale (level 5 is the highest, level 1 is the lowest). Some skills are at low level because they are related to new controlling technology. Besides that, there are some students who do not pass the test.

The results of the survey on occupational skills of technology education students in electrical in the major of Electrical and Electronic Engineering can be shown in the following table:

Table 2: Evaluation on the occupational skills of technology education students in the major of Electrical and Electronic Engineering [33,4].

Skills	Achieved level (%)				
	5	4	3	2	1
1. Use basic measurement equipment, multimeter, oscilloscope to measure electrical quantities such as: current, voltage, power, R-L-C, frequency, phase angle by many methods.	6,4	20,8	34,4	32,0	6,4

Skills	Achieved level (%)				
	5	4	3	2	1
2. Identify, look up parameters, test and determine the polarity, status and application of common electronic components.	1,6	19,2	38,4	36,0	4,8
3. Design and manufacture the printed circuit boards of electronic circuits; manufacture the circuit boards; Solder the components on the circuit board; measure and test the parameters.	0,0	12,0	25,6	61,6	0,8
4. Install, operate, and repair electrical circuits, simple electrical equipment: household lighting system, production lighting system and urban lighting system...	4,0	16,8	21,6	56,0	1,6
5. Assemble and repair electronic circuits using diode, BJT, FET, amplifier IC ... applied in basic and specialized electronic circuits.	2,4	12,0	27,2	55,2	3,2
6. Install, operate, and repair transformers of small capacity, single-phase and three-phase electric motors.	4,0	20,0	36,0	40,0	0,0
7. Identify the basic transmission stages of the electric drive, adjust the motor speed by changing the circuit, changing the voltage, changing the frequency; use soft starters…	3,2	12,8	38,4	44,0	1,6
8. Assemble, test, operate and repair the electric motor and electrical circuit in accordance with the principles of time, current, speed, and route.	2,4	13,6	41,6	40,0	2,4
9. Survey, draw diagrams for development of typical circuit diagrams of some industrial machines.	4,8	17,6	44,0	32,0	1,6
10. Design, install, operate, maintain and repair electrical and electronic control systems on machine tools and integrated production systems in industry.	0,0	11,2	28,0	56,8	4,0
11. Assemble, adjust and repair controllers, power modules of single phase and three phase power rectifier circuits.	0,0	14,4	32,0	52,0	1,6

Skills	Achieved level (%)				
	5	4	3	2	1
12. Identify, select, calibrate to parameters, signal wave form of the DC - DC power converter; calibrate, conduct experiments to take the parameters, signal waveform of the frequency converter in the type of voltage converter and width pulse type.	4,8	17,6	43,2	34,4	0,0
13. Operate and adjust AM and FM radio receivers; digital audio-broadcasting system; color transceiver; VCR (video cassette recorder); digital television; digital camera.	7,2	25,6	39,2	28,0	0,0
14. Use specialized software to draw electrical and electronic circuits, and specialized electrical and electronic software to design and simulate electronic circuits on computers: AUTOCAD, PROTUES, LABVIEW, MATLAB, PLC, WINCC, ...	11,2	20,0	36,0	31,2	1,6
15. Use software to program and simulate microcontrollers; load program for microcontroller; assemble, modify, and repair microcontroller interfaces with peripherals.	1,6	10,4	34,4	50,4	3,2
16. Use software to program and simulate PLC; extract scripts and write programs that control systems such as: traffic, conveyor belts, mixers, elevators and other industrial machine systems.	0,0	11,2	41,6	44,8	2,4
17. Use software to program, select equipment, connect equipment, write controlling program, monitor, collect data in the industrial communication network system, SCADA system; surveillance systems for data collection and processing in industry.	1,6	9,6	36,8	48,0	4,0
General percentage	3,1	15,5	35,3	43,7	2,4

In order to meet the requirements of integrated teaching in vocational education institutions, students' occupational skills must be achieved mainly at Level 3 and Level 4.

The cause of the situation is: 1) The curricula focus on theory; 2) Equipment does not meet the requirements of occupational skill training; 3) Insufficient and out-of-date teaching materials on occupational skills of new technology; 4) The process of teaching is not linked to business.

4. MEASURES TO TRAIN OCCUPATIONAL SKILLS FOR TECHNOLOGY EDUCATION STUDENTS

To formulate occupational skills, students must acquire the necessary knowledge about technology through theoretical learning. Simultaneously, it is essential to practice in a planned and positive manner in the right conditions at workshops and in the industry. When dealing with different situations in the real world of manufacture, students have the opportunity to apply the knowledge and experience they have in practice to formulate occupational skills, as well as to reinforce, expand and deepen the knowledge and improve existing skills. In order to train occupational skills, the following solutions should be implemented:

4.1. Develop the Outcome Standards in Occupational Skills for Technology Education Majors According to CDIO Approach

It is necessary to develop the outcome standards and curricula according to CDIO approach including: one) general knowledge, basic professional and specialized knowledge; two) professional skills, occupational skills and personal qualities; three) teamwork and communication skills; four) formulating ideas, designing, implementing and operating in a social and business context.

For example: Developing the outcome standards for occupational skills in the manufacture engineering will specify the skills that students will need after graduation. This is the basis for the revision of the practical curriculum[1]. The occupational skills in the manufacture engineering include: [80-81,3]

1) Design mechanical product models and technical drawings using CAD software tools.

2) Design the technology process of mechanical processing details

3) Calculate, select the cutting mode and cutting tools for machining mechanical products on traditional lathing machine, milling machine, grinding machine, planing machine and drilling machine.

4) Operate safely traditional lathing machine, milling machine, grinding machine and planing machine for machining mechanical products.

1 The research findings of the project "CDIO approach in training vocational teachers of university level at universities of technology education"

5) Write manual advanced program for machining on CNC lathing and milling machine with common control systems such as FANUC, SIEMENS... for machining simple mechanical products.

6) Write advanced program using CAD/ CAM technology for machining on CNC lathing for machining simple and complex mechanical products.

7) Operate safely CNC lathing and milling machines with FANUC, SIEMENS control systems; CNC pulsing machines; CNC wire cutters for machining mechanical products.

8) Use measuring tools for mechanical quantities; maintain and calibrate measuring instruments.

9) Maintain the mechanical equipment: chuck, specialized equipment on lathing, milling and drilling machine; Maintain lathing, milling and drilling machine.

The identification of the needed skills will help to develop the curicula, study materials and the practice of occupational skills.

4.2. Develop the Curricula and Material for Practice Training

Developing the curriculum for practice training is one of the most important solutions in improving the quality of vocational training. Through research, business, technology education students and vocational teachers suppose that:

1) Increase the duration of the practice program. The duration for practice training accounts for 15 - 20% of the total credit in the course.

Table 3: Attitudes towards practice duration [56, 4].

No.	Duration	Percentage		
		Students	Lecturers	General percentage
1	Remain the practice duration	17.4	6.3	8.7
2	Increase the practice duration	82.6	93.8	91.3
3	Reduce the practice duration	0	0.0	0.0

91,3% lecturers and students take part in the survey suppose that it woud be advisable to increase the practice duration. Currently, the number of practice credits is 18 credits for all majors. Most of the participants of the survey suggest increasing 4 – 6 more credits. Therefore, it is necessary to increase the practice duration besides other measures.

2) Compose the practice curricula on the basis of CDIO approach.

3) Compose materials to teach practical modules. Currently, there are many materials for teaching theory, but materials for teaching practice are inadequate and do not meet the requirements.

4.3. Organize Occupational Skill Training at Workshops and in the Industry

When universities and businesses are separated and there is a lack of efforts from both sides, the knowledge and skills trained at universities are separate from the human resource demand at the enterprises. In order for students to meet the requirements of the businesses, the process of practicing occupational skills should be conducted at workshops as well as in the businesses:

1) Basic occupational skills are learned and practiced at workshops.

2) Occupational skills associated with the equipment and machines are practiced in the businesses. Students practice with the equipment and machines that the universities have not yet had or been invested.

However, it is also important to be aware that: The knowledge and skills that students achieve in the on-campus training are the basic knowledge and skills which help students be able to train themselves to adapt to the job requirements in the businesses and vocational education training institutes. [58,4]

CONCLUSIONS

Occupational skills of the teacher directly affect the quality of occupational skill training at vocational education and training institutions. Occupational skills are developed during the learning process at universities of technology education and in the teaching process of the teacher. In order to improve the quality of occupational skill training for technology education students, a number of measures should be taken: 1) Developing outcome standards for occupational skills according to CDIO approach; 2) Developing curricula and teaching materials for occupational skills on the basis of CDIO approach; 3) Organize occupational skill practice at the workshops and in the enterprises.

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Study of Sea Wave Power Potential of Mindanao: Examining the Collaborative Research Efforts

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ABSTRACT

This paper is aimed to determine the collaborative research efforts of the different disciplines comprising the study of sea wave power potential of Mindanao. The paper utilized quantitative and qualitative approaches. Primary and secondary data were used. Data analysis and interview were taken. The study of the sea wave power potential of Mindanao comprises different disciplines. Each stakeholder contributed its information, expertise and competence to the very broad study. The output was developed through collaboration of civil, electrical, electronics, computer, mechanical, energy and geospatial engineering fields. Several engineering disciplines collaborated to the research output of the study of sea wave power potential of Mindanao.

Keywords: *collaborative research efforts, examining, sea wave power*

I. INTRODUCTION

Research is a systematic investigation or inquiry and study of materials and sources in order to establish facts and reach new conclusions. There should be an organized and creative work to develop new applications (OECD, 2002).

Collaborative research, also known as participatory research, can be defined as combined efforts of researchers from different fields working together to achieve the common goal of producing new scientific knowledge or developing new technologies.

The project study was aimed to develop a device converting sea wave potential into electricity using analog-to-digital technology. The identified potential areas are the eastern seaboard areas of the Mindanao Island. Mindanao is the second largest island of the Republic of the Philippines and located in the south. Figure 1 shows the Mindanao Island.

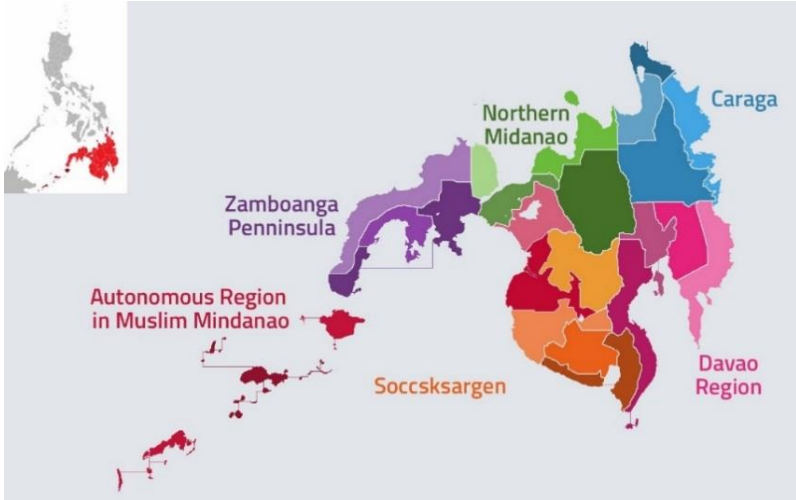

Figure 1: Mindanao Island.

Figure 2 shows the prototype device developed by the engineering students of St. Mary's College of Tagum, Inc. located in Tagum City, Philippines:

Figure 2. The Prototype Device

Figure 3 shows the Input-Output-Process (IPO) Model of the prototype device:

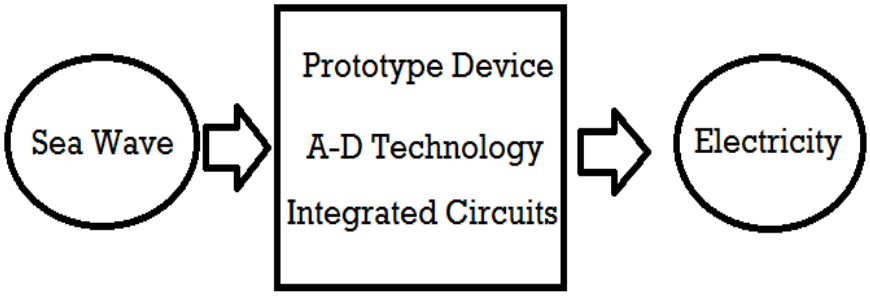

Figure 3: IPO Model of the Prototype Device

Hence, this study attempted to examine the different engineering disciplines comprising the study of the sea wave power potential of Mindanao.

Objectives of the Study:

The main objective of the study is to determine collaborative research efforts of the different disciplines comprising the study of sea wave power potential of Mindanao. The following are the specific objectives:

1. To find out the tasks involved in the study of sea wave power potential.
2. To identify the engineering discipline/s that is/are involved in each task.

(3) To develop a concept map examining the tasks and corresponding engineering discipline/s.

II. METHODOLGY

Research Design:

This study utilized quantitative and qualitative approaches. It employed descriptive research design. This determines the tasks involved and the engineering discipline/s in each task. Data analysis and interview were taken.

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Respondents:

Engineering professionals were asked and commented. The study was conducted from June 2016 to May 2017.

Research Procedure:

The following is the procedure used by the proponents:

1. Gathering of Information
2. Interview
3. Tasks Examination
4. Concept Mapping
5. Tabulation, Analysis and Interpretation of Data

III. RESULTS AND DISCUSSION

Tasks Involved in the Study of Sea Wave Potential:

The following are the phases and tasks involved per phase in order to complete the sea wave power potential study:

Phase 1. Idea Generation

1. Study Conceptualization
2. Survey of the Potential Areas
3. Sea Wave Data Collection
4. Conversion of Data from Analog to Digital
5. Truth Table Development
6. Determination of the Potential Waves for Energy Conversion
7. Formulation of Equation per level of Truth Table
8. Boolean Equation Simplification

Phase 2. Electronic Works

9. Creation of Electronic Gates from Boolean Equations
10. Development of Integrated Circuits
11. Creation of the Prototype Device
12. Validation of the Study to the Potential Areas
13. Testing of the Prototype Device
14. Calibration and Adjustment of the Device

Phase 3. Structural Works

15. Finalization of the Prototype Device
16. Large Scaling of the Project

Engineering Discipline/s Involved:

Table 1 shows the engineering discipline involved in the tasks under idea generation phase:

Table 1: Engineering Discipline/s Involved per Task under Idea Generation Phase.

Tasks	Engineering Discipline/s Involved	Contribution/s to the Project
1. Study Conceptualization	Electronics Engineering Mechanical Engineering Civil Engineering Electrical Engineering	Each discipline contributed ideas for the realization of the project.
2. Survey of the Potential Areas	Civil Engineering Geospatial Engineering	There was an assessment of the areas for potential generation of electricity from the sea waves. Geospatial engineering involved in the work to geo-codify and map out the potential areas.

3. Sea Wave Data Collection	Civil Engineering	The data were colleted like the depth, height, frequency, and other characteristics of the sea wave in the potential areas.
4. Conversion of Data from Analog to Digital	Computer Engineering Electronics Engineering	There was an initial conversion the analog data to digital data. They tried to figure out the feasible truth table and logic gates involved in the designing of integrated circuits.
5. Truth Table Development	Computer Engineering Electronics Engineering	The truth tables were created in relation to the digital data. The logical analysis of the analog signal converted to digital signal was considered.
6. Determination of the Potential Sea Waves for Energy Conversion	Electrical Engineering Energy Engineering	The electrical and energy engineering investigated and analyzed how the potential sea waves converted to electrical energy.
7. Formulation of Equation per Level of Truth Table	Computer Engineering Electronics Engineering	The analysis paved the way to the formulation of the Boolean equation per level of truth table.
8. Boolean Equation Simplification	Computer Engineering Electronics Engineering	The Boolean equations were simplified.

Table 2 shows the engineering discipline involved in the tasks under electronic work phase:

Table 2: Engineering Discipline/s Involved per Task under Electronic Work Phase.

Tasks	Engineering Discipline/s Involved	Contribution/s to the Project

9. Creation of Electronic Gates fro Boolean Equations	Computer Engineering Electronics Engineering	The electronic (logic) gates were identified such as "And" gate, "Or" gate, etc.
10. Development of Integrated Circuits.	Computer Engineering Electronics Engineering	The identified gates were integrated into the circuit system.
11. Creation of the Prototype Device	Mechanical Engineering Computer Engineering Electronics Engineering	The prototype device was develop incorporating the integrated circuits.
12. Validation of the Study to the Potential Areas	Electrical Engineering Computer Engineering Electronics Engineering Energy Engineering Mechanical Engineering Civil Engineering	The project study was validated by engineering professionals in relation to the potential areas.
13. Testing of the Prototype Device	Electrical Engineering Electronics Engineering Mechanical Engineering	The device was tested in the identified areas.
14. Calibration and Adjustment of the Prototype Device	Electrical Engineering Electronics Engineering Mechanical Engineering	The device was calibrated and adjusted accordingly.

Table 3 shows the engineering discipline/s involved in the tasks under structural work phase:

Table 3: Engineering Discipline/s Involved in the Tasks under Structural Works Phase.

Tasks	Engineering Discipline/s Involved	Contribution/s to the Project
15. Finalization of the Prototype Device	Electrical Engineering Civil Engineering	The prototype device was finalized and presented.
16. Large Scaling of the Project	Electrical Engineering Electronics Engineering Mechanical Engineering Civil Engineering Geospatial Engineering	The project will be scaled up and mo unted to the areas after proper study, financing and approval.

Concept Map:

Included in Figure 4, the concept map showing phases, tasks and engineering discipline/s involved in the project study.

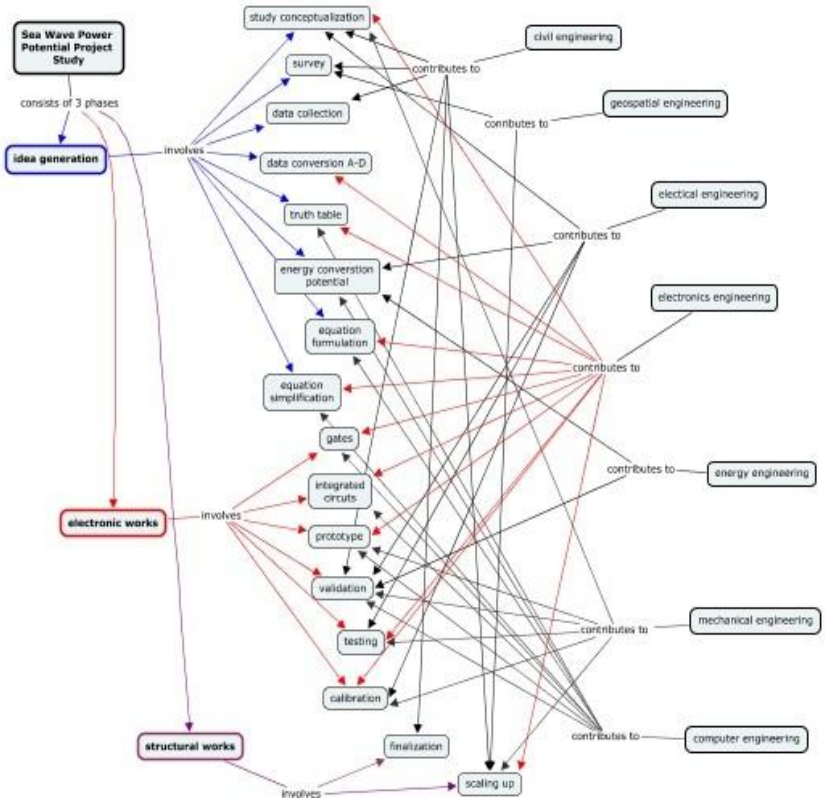

Figure 4: Concept Map showing Phases, Tasks and Engineering Discipline/s Involved in the Project Study.

IV. CONCLUSION AND RECOMMENDATION

It is concluded that several engineering disciplines such as civil, electrical, electronics, computer, mechanical, energy, and geospatial engineering collaborated to the research output of the study of sea wave power potential of Mindanao.

It is respectfully recommended that further study be made in order to determine the detailed description of the tasks involved in the project study.

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An Approach for Assessing Student Learning Outcomes at Course Level

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ABSTRACT

Purpose of paper is to show our approach for assessing course level outcomes. Our approach is built and applied to the education program of Information Technology Faculty of Ho Chi Minh University of Science. We describe how learning outcomes are carefully designed in courses, leading to achievement of the intended program level outcomes. Additional, we also present a learning outcomes assessment approach at course level. Finally, we introduce to our software built for collecting grading data and analyzing the result of learning outcomes achievements. The result is to build the outcomes-based approach for assessing course level learning outcomes. Our approach focus on what students must be able to demonstrate they know, values, and can do at the end of a course. Grading data is collected by our software to analysis and demonstrate achievements. Our approach focuses on learning outcomes, activities, assessments and resources. They should be designed and organized to help students archive learning outcomes. We have built a completely approach for assessing student learning outcomes at course level. Our work is supported by our software. In the future, we will build and demonstrate a fully approach for assessing program-level outcomes

Keywords: *Learning Outcomes Assessment, Outcomes Assessment Approach, Outcomes Assessment Process, Outcomes Assessment Software.*

INTRODUCTION

An outcomes-based approach to education clearly specifies what students are expected to learn and arranges the curriculum such that these intended outcomes are achieved (Harden, 2007a). Learning outcomes provide the base for an effectively aligned and integrated curriculum, where instructional actives and assessment strategies are explicitly linked to course-specific and degree-level learning outcomes, which are ted to institutional and provincially-defined graduate degree level expectations (DLEs) (Figure 1) [Natasha et at, 2012]

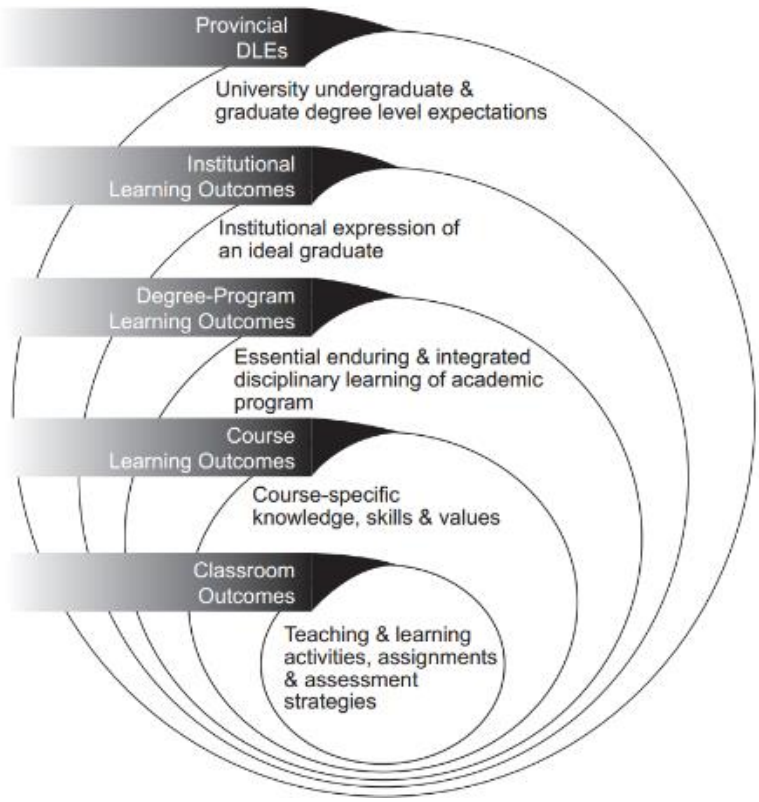

Figure 10: Graphic representation of outcomes-based curriculum alignment, from degree level expectations to course-specific actives

Learning outcomes provide a powerful framework upon which to structure curricula. According to Harden et al. (1999; 2007b) learning outcomes [6]:

1. help to provide clarity, integration and alignment within and between a sequence of courses;
2. promote a learner-centered approach to curriculum planning;
3. encourage a self-directed and autonomous approach to learning, as students can take responsibility for their studies, and are able to actively gauge their progress;
4. promote a collegial approach to curriculum planning, as instructors collaborate to identify gaps and redundancies;
5. ensure that decisions related to the curriculum and learning environment are streamlined;
6. foster a philosophy of continual monitoring, evaluation and improvement; and,
7. help to ensure accountability and assure quality of our education programs.

An aligned curriculum organizes structures and sequences courses around the intended learning outcomes. It is therefore essential that all courses within the curriculum have clearly defined learning outcomes. In order for this approach to succeed, learning outcomes must be: 1) clearly articulated in a way that is contextualized within the discipline; 2) communicated broadly; 3) used to inform and influence decisions about the curriculum; and, 3) monitored regularly to ensure that they remain current and accurately reflect the intent of the degree program (Manogue and Brown, 2007; Harden, 2007a) [6].

One of the great advantages of Outcomes Assessment is that when done in a systematic way, it has benefits for people throughout the institution, from our students to the faculty to the administration [8]

For students, Outcomes Assessment will:

1. communicate clear expectations about what's important in a course or program
2. inform them that they will be evaluated in a consistent and transparent way
3. reassure them that there is common core content across all sections of a course

4. allow them to make better decisions about programs based on outcomes results

For faculty, participating in Outcomes Assessment will:

5. help them determine what's working and what's not working in their courses or programs
6. facilitate valuable interdisciplinary and intercampus discussions
7. provide powerful evidence to justify needed resources to maintain or improve programs
8. allow them to tell their story to individuals outside their area (e.g. administrators, employers, prospective students, transfer institutions, politicians)
9. provide reassurance that all faculty teaching a particular high demand course agree to address certain core content

For administrators, implementing college wide Outcomes Assessment will:

10. demonstrate an institutional commitment to continually improving the academic programs and services offered by the College
11. provide valuable data to support requests for funds from state and local government and private donors
12. demonstrate accountability to funding sources
13. provide valuable data for academic planning and decision-making
14. enable them to inform elected officials, local businesses, and potential donors about the College's impact on our students and our community in a very compelling and convincing way

Internationally assessing your own program-level learning outcomes can be of great benefit, as can effective, well-planed assessing to [9]:

1. ensure that students learn the most important skills, ideas, attitudes and values of the discipline or professional.

2. Document evidence of student's learning, based on the actual outcomes they have archived, for accreditation and accountability purposes.
3. Ensure that expectations are communicated clearly to and understood by students (including those interested in applying to a program)
4. Allow you to improve the effectiveness of your program based on actual student archives.
5. Showcase the quality of your program; make your graduates appealing to employers and your program attractive to prospective student and donors.
6. Emphasize current institution priorities for teaching and learning.

Systematic outcomes assessment is now a requirement for accreditation by all higher education accrediting organizations. One of the great advantages of outcomes assessment is that when done in a systematic way, it has benefits for people throughout the institution, from our students to the faculty to the administration. In this paper, we describe how the courses are carefully coordinated to ensure steady development or scaffolding from introduction to mastery of learning outcomes, leading to achievement of the intended program-level outcomes. Additional, we present assessment approaches used for assessing student learning outcomes at the course-level. Finally, we also introduce to our software tool was built for collecting data to assess student learning outcomes.

BACKGROUND

The school has run through the CDIO adoption process to revise the school learning outcomes, the curriculum, the syllabi and the teaching methodology. The project is considered as the key project with the participation of all the lecturers, nearly 2000 students in 6 different departments of the school, the alumni, and the industrial partners. With the advice and review by invited CDIO experts every year, our school staff members have done their best to achieve the most out of the project.

The project is implemented using both top-down and bottom-up approaches. At first, the learning outcomes and the curriculum of the school have been revised and verified by all the stakeholders, such as the school scientific committee, the lecturers, the alumni, and the industrial partners. A revised learning outcomes and an updated and integrated curriculum have been introduced to all participants. New syllabi for courses have been prepared to include personal, inter-personal and CDIO skills. A few courses have been carried out based on the CDIO framework as pilot programs and then more courses will come in the next years. So far, the 12 CDIO standards have been carefully considered by the school in order to cover the adoption process fully. At the end of each year, the school runs the self-evaluation

process to assess the current status of the school and finds out what to do next in the coming years.

The Adoption Process in Last Years

In the last 2 years, we have learned the CDIO framework and tried to apply it into the school of Information Technology. In the first stage, the learning outcomes of the school, the integrated curriculum, and the new syllabi for the courses. All lecturers have also participated in different training workshops and programs to build up their technical, professional knowledge and the teaching skills [7].

The school learning outcomes

In the first year of the CDIO adoption, the main objective of the school is to revise the current learning outcomes and re-build a new, detailed and CDIO-based learning outcome. The new learning outcomes must be verified by all of the stakeholders, such as lecturers, alumni, and industrial partners. It is, then, approved by the school scientific committee and by the university.

The process of revising and building up the new learning outcomes for the school is described in **Figure** . The process consists of 5 main steps:

1. Step 1: based on the existing learning outcomes and CDIO syllabus, we build the 1st version of the learning outcomes for the school up to the details of X.X.X.
2. Step 2: The learning outcomes were presented in front of the school scientific committee for feedback and comments. The revised version is then prepared.
3. Step 3: The new learning outcomes were then verified by different stakeholders, such as the lecturers, the alumni, and the industrial partners.
4. Step 4: The CDIO team collects all the survey data to make adjustments in the current version of learning outcomes. This version was then presented in front of the scientific committee again for feedback and discussions.
5. Step 5: The final version of school learning outcomes was approved by the school scientific committee and then the university committee.

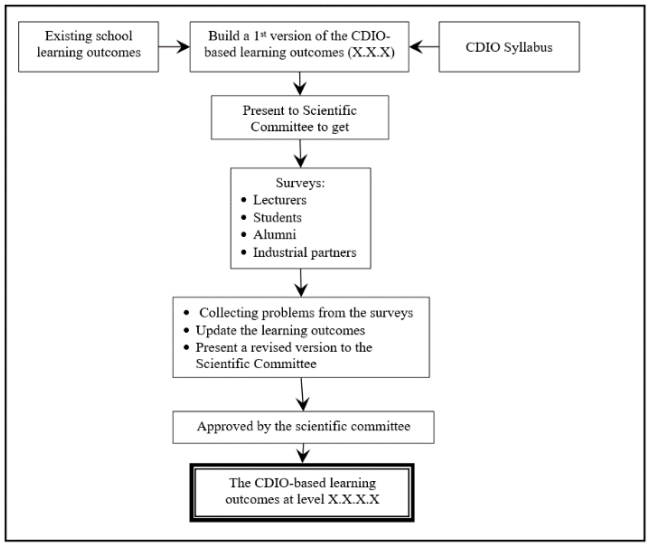

Figure 2: The process of building new CDIO-based learning outcomes.

Throughout these steps, the new CDIO-based learning outcomes have been created based on the characteristics of the school, the CDIO syllabus and the verification of all the stakeholders. In the process of revising and re-building the school learning outcomes, we noticed from the surveys that there was a strong agreement among stakeholders in most of the entries in the learning outcomes.

An updated and integrated curriculum

Besides the process of building up the school learning outcomes, the curriculum has been also revised and updated. The process is shown as in Figure 3.

In the process of revising and updating the school curriculum, we have done the following main steps:

1. Step 1: based on the existing curriculum and the new CDIO-based learning outcomes, we asked all lecturers to do the black box exercises for all the courses that they have taught and then do the ITU mapping for those courses.

2. Step 2: With the results from the black box exercises and the ITU mapping, the school realizes the gap between courses, the missing learning outcomes and the learning outcomes that are not covered by any course.

3. Step 3: The head of the departments and the school scientific committee were sitting together and discussed to propose new courses, modify the courses to make sure that they have covered all the learning outcomes of the school. In addition, the continuation of courses in different levels is also considered to avoid gaps and overlaps. In particular, the personal, inter-personal and CDIO skills have been carefully considered in each course.

4. Step 4: Finally, the new list of courses with their learning outcomes are presented in front of the school's and university's scientific committee for approval.

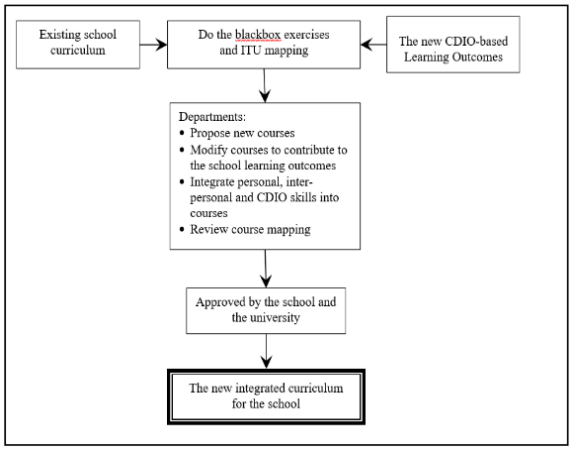

Figure 3. The process to update the school curriculum

In the new curriculum, each course has clearer pictures of what it will contribute into the overall learning outcomes of the school. Most of the gaps and the overlaps between courses have been addressed. Lecturers who teach the same course or the previous or the next courses in the course map were sitting together to share their courses' syllabi and teaching information. They tried to arrange the level of contributions in overlapped learning outcomes.

OUTCOME ACCESSMENT PROCESS TO EVALUATE BASED ON SYSTEMATIC VIEW AT FACULTY OF INFORMAITON TECHNOLOGY

Develop the Process to Access Outcomes

In [6], outcome assessment is a process of gathering information to indicate an organization whether services, activities, or experiences it provides actually impact on those who participate in it. In other words, this process checks if the organization makes a difference to the lives of individuals with what it provides.

In a higher education system, simply, there are 3 phases to access outcomes:

1. Identify the most important goals for students to achieve as a result of participating in the results (LO)
2. Evaluate how students achieve the results (assessment).
3. Use evaluation results to improve, enhance learning experience

In our Faculty of Information Technology, the process to access outcomes is developed with the following steps (

Figure):

1. Step 1: Identify the program-level outcomes
2. Step 2: Identify the major-level outcomes based on program-level outcomes
3. Step 3: Identify the course-level outcomes based on the major-level outcomes.
4. Step 4: design the teaching and evaluation activities for course-level outcomes. In this step, the assessment data will be collected, then the level of achievement of each outcome will be evaluated, and necessary decisions will be made to update the outcomes of the program accordingly.

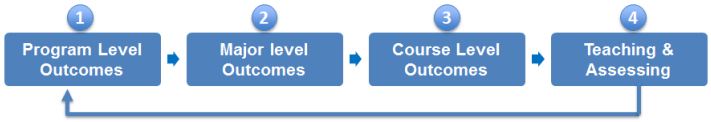

Figure 4: The process to develop curriculum with outcomes.

At present, our Faculty of Information Technology developed outcomes (level 3) at program level. In the curriculum of Faculty of Information Technology, there are six disciplines: Computer Science, Software Engineering, Information Systems, Knowledge Technology, Computer Networks, and Computer Vision and Robotics.

For each discipline, a set of core courses is developed and each course is described in detail in its syllabus. In each course syllabus, we identified key outcomes to meet the requirement of the discipline as well as the program-level outcomes. For each course-level outcome, we also determined the level of achievement with the notation of I (Introduce), T (Teach), U (Use) and the level of achievement based Bloom taxonomy.

For example, if we decide the outcome 1.1.1 of Course A with TU3, it means that this outcome is taught and used in Course A so that students can achieve level 3 in Bloom taxonomy.

In addition, when identifying course-level outcomes, we need to determine and specify the details of the teaching and assessment activities for each outcome through each topic and its related exercises. By evaluating and collecting such data,

we can assess student achievement on level outcomes at course-level, major-level, and program-level. Figure illustrates the relationships and compatibility of course-level outcomes and program-level outcomes.

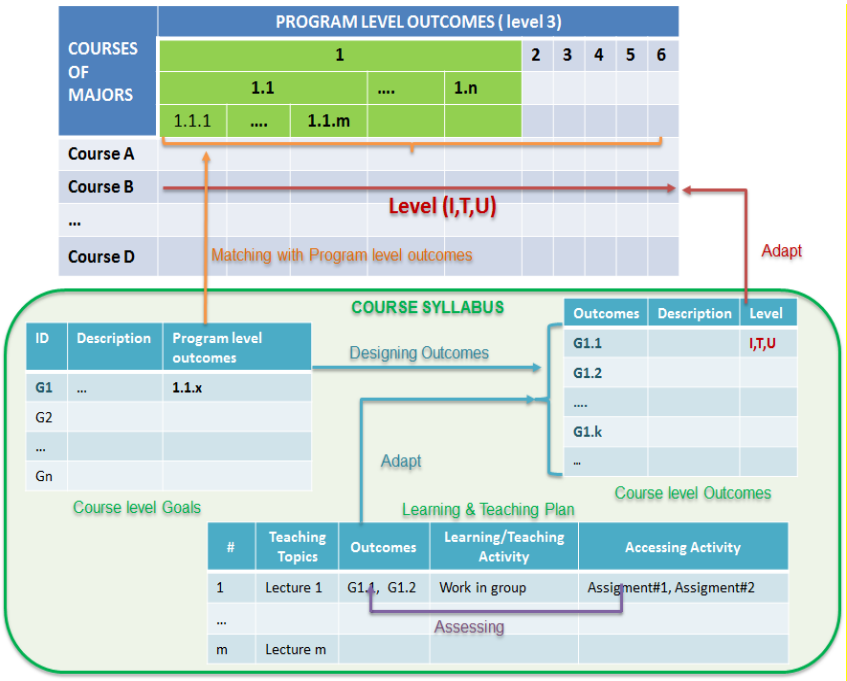

Figure 5: Design the relationships and compatibility of course-level outcomes and program-level outcomes.

Illustration: Outcome assessment in Information System major

In this section, we present an illustration of the development of courses in Information System major in each year and semester.

We only present the period when students begin to select major courses in Information Systems and ignore the period when students study general education (year 1). Figure shows the arrangement of courses in Information Systems in each semester of each year. The sequence of courses is designed so that outcomes of courses are in ascending order (in Bloom taxonomy).

In each course, students are trained not only in knowledge but also in skills, namely teamwork, foreign language, reasoning, and problem solving skills.

The knowledge and skills of each course are specified, and gradually increased to ensure that after the completion of the course, students are able to attain expected outcomes.

Figure illustrates an example sequence of the design of the outcome of teamwork via a sequence of courses in Information Systems. Figure illustrates for the outcome of teamwork skill through a particular sequence of courses.

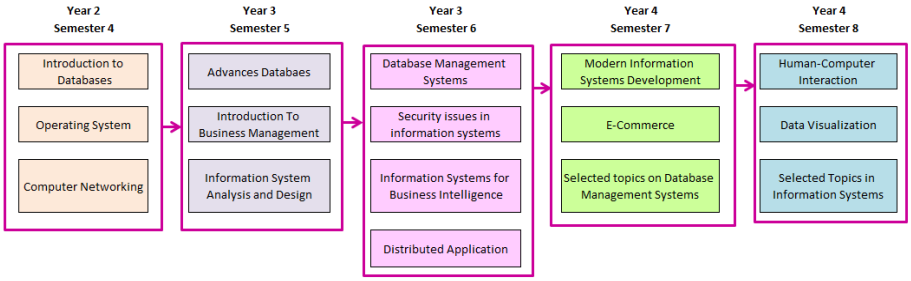

Figure 6: Sequence of courses in Information Systems in each semester/year.

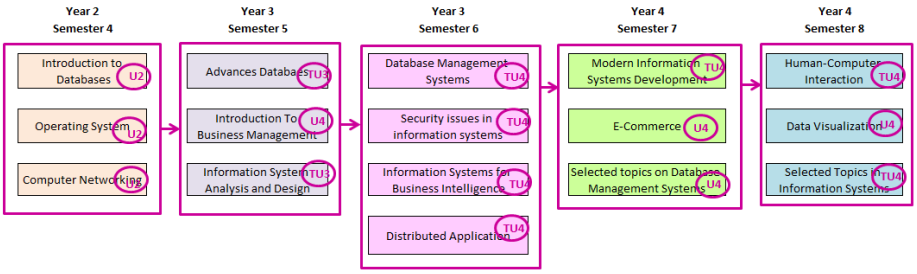

Figure 7: An example sequence of the design of the outcome of teamwork via a sequence of courses in Information Systems.

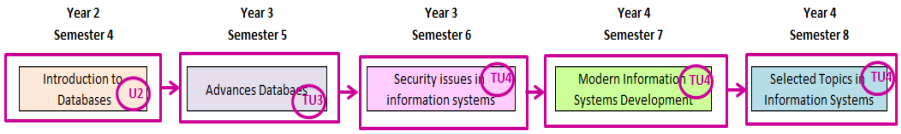

Figure 8. An example sequence of teamwork skill.

DATA COLLECTION TOOL FOR EVALUATING DATA

In order to serve the evidence management of the degree of completion of students in each outcome of each course, Faculty of Information Technology developed an online system that supports course result input and analyzes the results for each outcome. Currently, this system has been developed and integrated directly into the Faculty's management website, allowing lecturers to input their course results [5].

The system allows only the course leader of a course to configure the outcomes of that course, the number of score columns, the relationship of each score compared to course outcomes and the percentage (weight) of each score column.

With the support tool, lecturers can log in and enter details for their course results. Through this, the system will synthesize, analyze and evaluate the level of completion of each course, and at the same time show outcomes that students have unexpected results.

In the near future, this support system will be upgraded with features such as analysis, statistics, complete results of students, and analyses of each course, etc.

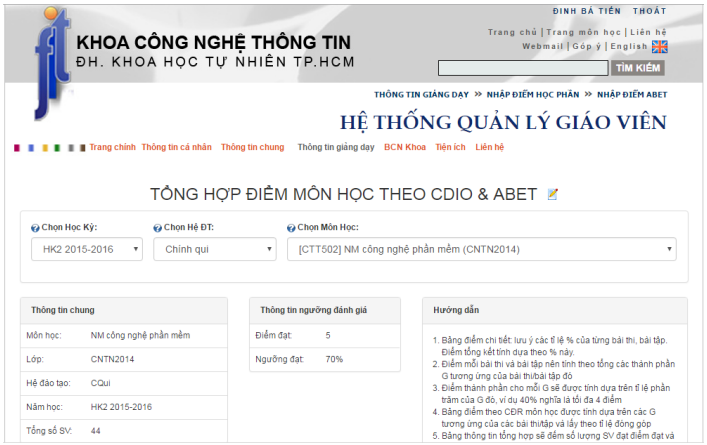

Figure 9: System to collect course results for each outcome in a course.

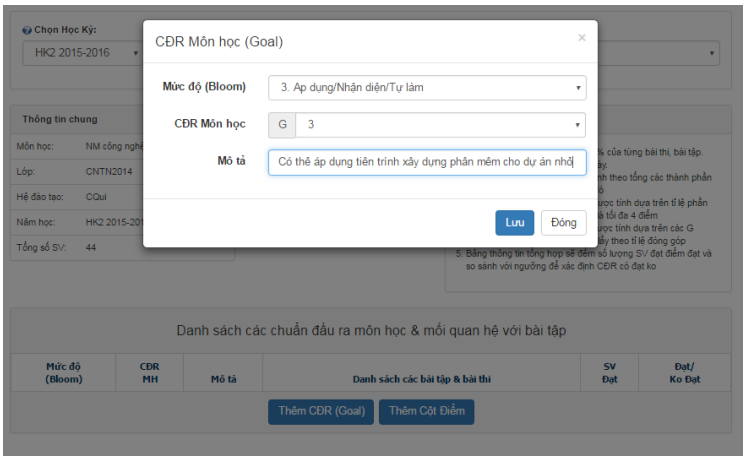

Figure 10: Course leader can configure the details of outcomes and score columns.

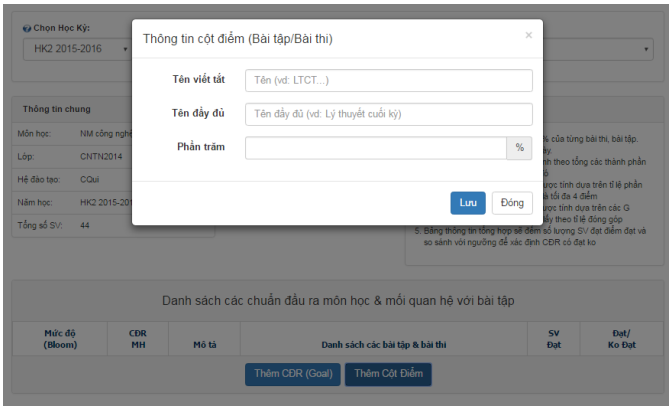

Figure 11: Create a score column and its weight:

CONCLUSION

Program level learning outcomes identify what students should know, value and or able to accomplish after successfully completing their program. These outcomes are often achieved through specific learning objectives, which are integrated at the course-level and build toward overall program-level learning.

The value of our paper is to show the learning outcomes assessment approach at course level. Our approach focusses on designing syllabus of a course, learning outcomes determining, assessment tasks. Once the learning outcomes and

assessment tasks are found out, the learning activities, teaching methods, and resources required to achieve those outcomes and assessments may be planned –in turn, every element of a course supports the intended learning. The scoring data will be collected by our software tool.

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Develop creative thinking competency for technical college students in teaching the industrial electricity modules by problem-solving teaching method

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ABSTRACT

In the context of international integration and the development of science and technology, technical education has gradually changed and moved from content-based training to competency-based training. It requires students to be positive, proactive and innovative in acquiring knowledge, practicing skills. Therefore, creative thinking competency developing for technical college students is an important and inevitable requirement in teaching process. By this article, we would like to give some criterion for assessing creative thinking competency and apply such findings in teaching Industrial electricity modules by problem-solving method through 4 stages of creative thinking development for technical college students.

Keywords: *problem-solving teaching method/ develop creative thinking capacity/ technical college students/ modules of industrial electricity.*

INTRODUCTION

Industrial electricity is one of the key subjects commonly taught at technical colleges in Vietnam. Teaching professional modules has a substantial impact on the ability to do occupational duties of students. In fact, today's technical matters are very diversified and redundant, so employees should take advantage of knowledge, skills in a creative way to do the work quickly and effectively to achieve success. Therefore, research and application of active teaching methods including problem-

solving teaching method as a basis to develop creative thinking competency at technical colleges is very necessary.

1- CONCEPT OF PROBLEM-SOLVE TEACHING METHOD

In the 1960s, the author H. Hermanowicz provided description and analysis of types of problem solving in certain teaching activities, thereby generalizing them into a teaching method or teaching way. He also answered characteristics-related questions and pointed out contributions of problem solving teaching [1].

Vietnam pedagogics dictionary [2] indicates that the problem-solving method is an interactive teaching method for teachers and learners through discussions and solving problem.

According to Assoc. Prof. PhD. Nguyen Van Khoi, the problem-solving teaching is based on practical issues relating to the learner and learning contents specified in "standard knowledge and skills". On such basis, the learner will obtain knowledge and develop capacities such as planning, self-orientation for learning, coordination, high-level thinking skills, living skills, etc.

In [3] Tran Khanh Duc stated that the problem-solving teaching is a methodological system which introduces learners problematic situations and conditions to be solved along with guides to help learners to self-solve the problems. Technical situation with problems (technical problems to be solved) shows students theoretical or practical difficulties that they should be able to overcome, not immediately with an algorithm, but through an active thinking and action process to change the active subject or revise existing knowledge.

Hence, problem-solving teaching is an active teaching method in which teachers have to create problematic situations to help students find out problems, stimulate their self-consciousness, positiveness, activeness, and creativity so that they can solve problems and thereby obtain knowledge, strengthen skills to achieve objectives during the teaching process.

2- CREATIVE THINKING COMPETENCY AND TYPICAL FEATURES OF CREATIVE THINGKING COMPETENCY

2.1- Creative thinking competency

According to [4]: Creative thinking competency is referred to skilled action and innovation, which shown unique but also practical traits. It is not something innate but formed and grown in the course of performance by subject-matter.

For students, creative thinking competency in learning is shown in the ability to self-solve learning problems to find out new solutions that indicates trends, capacity and experience of the individual to some extent. To develop creative thinking, the individual should be in the problematic situation, find out how to solve perceptional and action conflicts, resulting in new solutions for students.

In this article, the definition of creative thinking competency may be understood as the ability to think in creative ways, independent of pre-existing patterns or the ability to gather and apply existing knowledge to solve problems in a quick and effective way.

2.2- Characteristics of creative thinking competency of technical college students

- Flexibility: means the ability to easily change from one mental activity or skill activity to another one.

- Fluency: means the ability to find out many solutions to complete a work, solve a technical situation at different angles.

- Uniqueness: proposing and implementing new ways which are not pre-existing patterns or rules, but still ensure high efficiency.

- Completeness: indicates independence in planning, combination of thinking to develop ideas, testing and implementation of such ideas.

- Sensitivity: shown in the prompt detection of problems, conflicts, mistakes, non-logicness, insufficient optimum, resulting in the desire to create new reasonable things.

3- PSYCHOLOGICAL AND PHILOSOPHICAL BASES OF PROBLEM-SOLVING TEACHING METHOD IN FORMING THINKING COMPETENCY FOR STUDENTS

3.1- Psychological Bases

According to psychologists, people have active creative thinking only when there is a need for thinking, i.e. when they encounter perceptional difficulties, or problematic situations. Psychological research also shows that the rule of thinking is identical to the rule of new knowledge achievement and affects the knowledge achievement. Particularly, knowledge arises when there is a perceptional problem, conflict and develops only when solving problems. The problem-solving thinking is a basis to develop creative competency and intelligence of learners.

On the other hand, with the same learning problem or content, each student has his own way to solve it effectively. Except for the merely congenital factors, this also depends on the demands, motivations and inspirations of learners. A passive teaching method cannot stimulate demands, motivations and inspirations, leading to the result that the learners will lack creativity and vice versa. In terms of problem solving teaching, the teachers have to control the leaners' mind so that they can think and choose the way to solve problems voluntarily with high efficiency based on existing conditions.

In summary, in the problem-solving teaching, the knowledge obtaining process of learners is not merely a mental activity in the narrow meaning in the psychological aspect, but also a process of practicing and developing creative thinking competency and intelligence for learners.

3.2- Philosophical Bases

The nature of problem-solving teaching is to solve conflicts between knowledge, skills, tactics, pre-existing experience of learners and practical problems and professional practice situations (created or mentioned intentionally by teachers). Hence, the learners have to think and apply knowledge, skills, tactics, and pre-existing experience in a creative way to solve such conflicts. When the conflicts are solved, the learners' knowledge, skills, tactics, pre-existing experience are developed to a new level.

From psychological and philosophical bases, the above-mentioned concept of creative thinking competency and problem-solving teaching shows that: Problem-solving teaching is one of the best and most effective methods to form and develop creative thinking competency for learners.

4- DEVELOP THE STUDENTS' CREATIVE THINKING COMPETENCY THROUGH THE TEACHING OF INDUSTRIAL ELECTRICITY MODULES TEACHING BY PROBLEM-SOLVING METHOD

Based on learning activities, we can divide the process of teaching Industrial electricity module by problem-solving method into different stages. We shall divide the process of problem-solving teaching into 4 stages corresponding to each specific period and learning task.

4.1- Stage 1: Specify Technical Problems, Situations to be Solved

At this stage, the teachers should create a beginning situation by assigning learning tasks though solving a technical problem suitable with learning contents and

occupational practices, also stimulating, creating learning inspirations. The students specify tasks and know that they must be active in solving tasks themselves.

For the Industrial electricity modules, based on the detailed vocational training program as promulgated in the Circular No. 21/TT-BLDTBXH on July 29, 2011 by the Ministry of Labor, Invalids and Social Affairs, the tasks/duties to be performed by students can be divided into several groups of issues as below [5]

- Problem class 1: Researching structure, surveying characteristics, explaining the working principles of electrical equipment, motors, instruments, etc.;

- Problem class 2: Designing, installing current circuits, electrical systems, etc. to meet technical requirements in reality;

- Problem class 3: Recovering, repairing industrial equipment, machines, etc.

4.2- Stage 2: Propose Solutions and Choose Ones to be Done

When facing a learning problem, students and groups of students should focus on searching data and using their knowledge, methods, perceptional, guessing and deducing techniques such as target orientation, specialization, similarization, generalization, considering interdependent links and forming solutions based on the teachers' directions.

- For problem class 1: the students should search and read documents, videos, images, application of motors, equipment or instruments, etc. in practice, or software, tools, which are possible to be used in a characteristics and working principles study, thereby select and propose suitable research-approaching solutions.

- For problem class 2: the students' task is to study, design, and assemble current circuit meeting a specific technical requirement. At this time, students should make analysis, thereby discuss to offer the most optimal design and installation plans, and then specify work to do, timeline, tools, materials, equipment, installation plans, etc.

- For problem class 3: the students should select, collect information relating to industrial machines and equipment such as technical characteristics, how to operate, current circuit diagram and principles, etc., and then survey practical situation to determine causes of defects, select method to repair in a quick and accurate manner.

At this stage, after analyzing the practical situation in order to propose solutions, the students should assess and defend proposed plans and, by the end of stage 2, the students must select the most optimal plan.

4.3- Stage 3: Implement Proposed Solutions

When the most feasible plan has been selected, it is required to implement solution to check the feasibility and effects of the selected plan.

In this stage, students/group of students will directly implement intelligent or practical activities which are interleaved and have mutual interaction. For smooth implementation of the solution, the students/group of students may discuss and exchange ideas with each other, and adjust the intelligent activities and skills to ensure the technical problems are solved as expected in stage 2.

After a certain period of time, depending on the difficult level of the technical problems, if the implementation is infeasible, consider and select other plans. At this stage, the teachers will be advisors who help answer questions, but do not participate directly. Intermediary results during the implementation are checked by group members or teachers to give useful feedbacks.

4.4- Stage 4: Analyze Implementation Results and Get Experience Lessons

After the student/group of student implement(s) the proposed solution, the teachers should analyze implementation results and compare them with standards, criteria, or objectives set out in stage 1 to assess the learners' creative thinking in solving technical problems. At this stage, teachers also need to affirm and acknowledge new knowledge, skills formed through the process of thinking, creativity and application of known knowledge and skills to solve problems. Also, they should get useful experience lessons to help solve technical problems and situations better in the next learning contents.

5- ASSESSMENT OF CREATIVE THINKING COMPETENCY OF THE TECHNICAL COLLEGE STUDENTS IN LEARNING THE INDUSTRIAL ELECTRICITY MODULES

5.1- Grading System for Assessment

To assess the creative thinking competency level of students at technical college in problem-solving teaching of Industrial electricity modules, the writer has given 5 levels of creative thinking competency in ascending order 1, 2, 3, 4 and 5 corresponding to grade level of 1, 2, 3, 4 and 5. Creative thinking competency is assessed on basis of arithmetic average grade of criterion specified.

The difference of arithmetic average between levels of grading system can be calculated as below: the highest grade of scale (5 grade) less the lowest grade of scale (1 grade). Differential grade of each level is (5-1):5= 0.8. After calculating the

arithmetic average, the creative thinking competency is ranked into 5 levels as identified in table 1.

Table 1: Grading system of creative thinking competency level.

No.	Level of creative thinking competency	Average grade (AV)
1	Poor creative thinking	1 < Average ≤ 1.8
2	Weak creative thinking	1.8 < Average ≤ 2.6
3	Fair creative thinking	2.6 < Average ≤ 3.4
4	Good creative thinking	3.4 < Average ≤ 4.2
5	Advanced creative thinking	4.2 < Average ≤ 5.0

On basis of finding and analyzing creative thinking competency characteristics, the writer has given some criterion for assessment applicable to creative thinking competency assessment in Industrial electricity modules teaching by problem-solving method as specified in table 2.

Table 2: List of criteria for creative thinking competency level assessment.

No.	Criteria for assessment	Specific characteristics	Assessment level				
			1	2	3	4	5
1	Sensitivity	1.1. Learning inspiration, cheerful, interested, focusing, listening to teachers' comments					
		1.2. Flexible in course of implementation: promptly and effectively remedy all incidents and problem arising during the course of implementation					
		1.3. Being capable to estimate probable situations or result of work piece					
2	Fluency	2.1. Proposing many different solutions: with each technical problem, it is required to propose at least 02 solutions					

No.	Criteria for assessment	Specific characteristics	Assessment level				
			1	2	3	4	5
		2.2. Promptly and effectively remedy all incidents and problem arising during the course of implementation (if any)					
3	Uniqueness	3.1. Unique proposed solutions, ideas: Proposed ideas, ways are not the same with or similar to pre-existing ones					
		3.2. Proposed solutions have many outstanding advantages: Feasible proposal which takes advantage of existing resources to solve problems and bring about practical value					
4	Completeness	4.1. Specifying clearly researching tasks: Actively raising questions relating to researched problems (if any)					
		4.2. Technical problems are solved effectively, ensuring to meet requirements based on proposed plans and objectives					
		4.3. Assess, defend against proposed solutions; giving opinions on proposed solutions; defend, explain one's own opinion					
5	Flexibility	5.1. Quickly adapting to working conditions					
		5.2. Applying knowledge, skills or necessary resources in smart way for resolving issues					

- Criterion: 2.1; 3.1; 3.2; assessed with coefficient of 3;

- Criterion: 1.2; 1.3; 2.2; 4.2 assessed with coefficient of 2;

- Others assessed with coefficient of 1

6- SOME NOTES FOR APPLYING PROBLEM-SOLVING TEACHING METHOD TO DEVELOP CREATIVE THINKING FOR STUDENTS

- Technical problems/situations introduced should be suitable with teaching contents, objectives, perception of learners and accepted by learners;

- Technical problems/situations introduced should contain conflicts to be solved, offer learners many ways to think and solve problems;

- This method should be combined with group learning and teaching techniques such as brainstorming, thinking diagram, etc. to uphold effects.

7- EXPERIMENTAL RESULTS AND ASSESSMENT

We conducted experiment of problem-solving teaching with Lesson 05 "*Installation of PLC aided construction elevator control model*" in PLC Programmable Logical Control modules at 01 class of Industrial electricity college and 01 class of Industrial electricity college with the similar level applied in the traditional teaching method for comparison.

No.	Name of class	Number of students	Categorizing
1	Industrial electricity 1 - K46Đ3	25	Experimental class
2	Industrial electricity 2 - K46Đ3	24	Control class

Test duration of Lesson 05 is 02 hours, overall assessment for process, final product and creative thinking competency of 02 said classes as follows:

7.1- Quantitative result

- The students of both class performed information retrieval positively but the students of the experimental class whose handling and selection of information from textbook, document, via internet for problem solving raised by teacher is better than the students of control class;

- The students of the experimental class shown their confidence in various implementation schemes proposal for technical problem, many of which highlighted creativity and feasibility more than the students of control class;

- The students of the experimental class solved technical situations arising quicker and more effectively than the students of control class;

- The students of the experimental class know how to assess and compare implementation schemes to select the most appropriate one;

7.2 Comprehensive Result of Creative Thinking Competency Level Assessment

Control class (CC)					
Grade (x_i)	**Number of students (n_{ic})**	**Probability ($d_{ic}=n_{ic}/24$)**	**Accumulated probability ($D_{ic}=[\sum d_{ic}]x24$)**	**% accumulated probability ($T_{ic}=D_{ic}/85$)**	**% accumulated by number of leaners obtained grade (x_i)or smaller ($T'_{ic}==\sum T_{ic}$)**
1 < AV ≤ 1.8	5	0.21	5.00	5.88	5.88
1.8 < AV ≤ 2.6	8	0.33	13.00	15.29	21.18
2.6 < AV ≤ 3.4	7	0.29	20.00	23.53	44.71
3.4 < AV ≤ 4.2	3	0.13	23.00	27.06	71.76
4.2 < AV ≤ 5.0	1	0.04	24.00	28.24	100.00
∑	24	1.00	85.00	100.00	

Experimental class (EC)					
Grade (x_i)	**Number of students (n_{ie})**	**Probability ($d_{ie}=n_{ie}/25$)**	**Accumulated probability ($D_{ie}=[\sum d_{ie}]x25$)**	**% accumulated probability ($T_{ie}=D_{ie}/76$)**	**% accumulated by number of leaners obtained grade (x_i) or smaller ($T'_{ie}=\sum T_{ie}$)**
1 < AV ≤ 1.8	1	0.04	1.00	1.32	1.32
1.8 < AV ≤ 2.6	8	0.32	9.00	11.84	13.16
2.6 < AV ≤ 3.4	9	0.36	18.00	23.68	36.84
3.4 < AV ≤ 4.2	5	0.20	23.00	30.26	67.11
4.2 < AV ≤ 5.0	2	0.08	25.00	32.89	100.00

Experimental class (EC)					
Grade (x_i)	**Number of students (n_{ie})**	**Probability ($d_{ie}=n_{ie}/25$)**	**Accumulated probability ($D_{ie}=[\sum d_{ie}]x25$)**	**% accumulated probability ($T_{ie}=D_{ie}/76$)**	**% accumulated by number of leaners obtained grade (x_i) or smaller ($T'_{ie}=\sum T_{ie}$)**
∑	25	1.00	76.00	100.00	

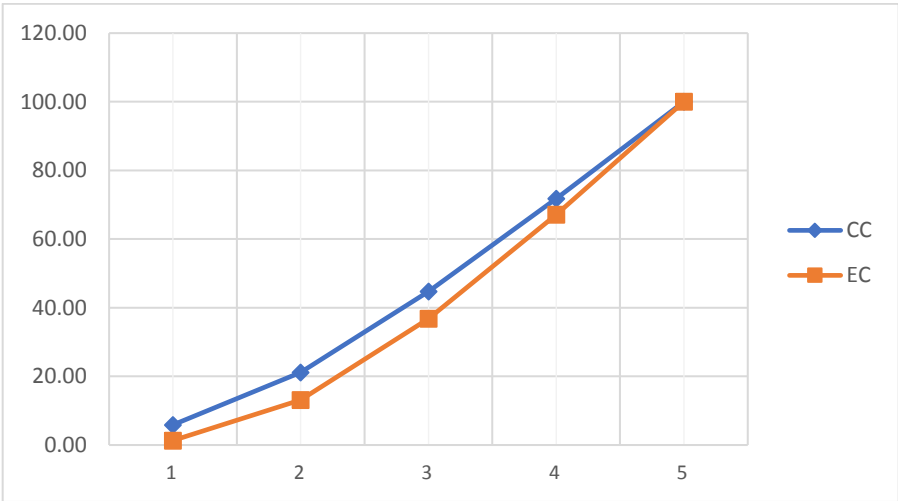

Figure 1: Graph on cumulative curve of control class and experimental class

7.3- Comprehensive Result of Knowledge And Skill Assessment

Grade	**0 to 4**		**5 to 6**		**7 to 8**		**9 to 10**		∑
Scheme	**CC**	**EC**	**CC**	**EC**	**CC**	**EC**	**CC**	**EC**	
Number of students	1	3	7	10	14	10	3	1	49
Scale %	2.04	6.12	14.3	20.4	28.6	20.4	6.12	2.04	100

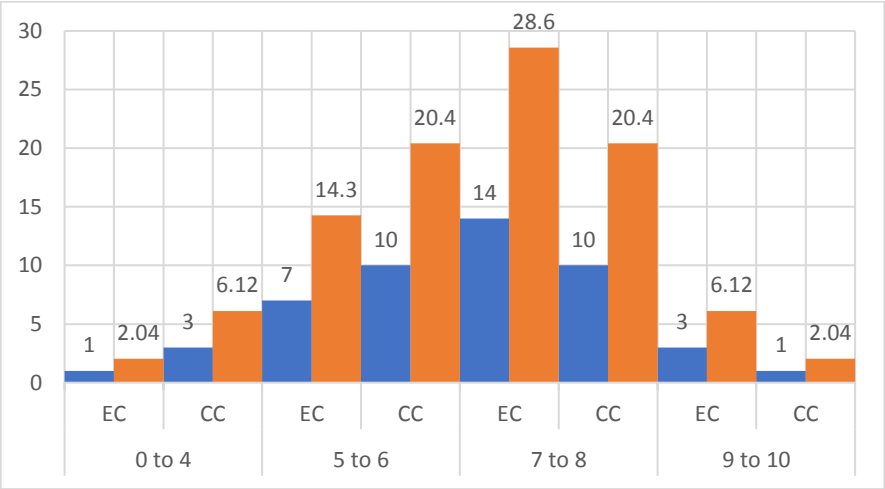

Figure 2: Scale % comprehensive result of knowledge and skill assessment.

Based on data processing result of pedagogical experiment in section 7.2, 7.3, academic result and creative thinking competency of the experimental class is higher than that of the control class, specified as following.

- % of weak, average students (0→6 grade) of the experimental class is always smaller than that of the control class;

- Arithmetic average grade and ratio of fair and good students (7→9 grade) from the experimental class is higher than the same from control class;

- Graph on cumulative curve which shown student's performance of the experimental class at ratio xi or smaller is always on the right side and underneath of the graph on cumulative curve of control class;

As foregoing quantitative and qualitative results, it is affirmed that application of problem-solving teaching method to teach programmable logical control is more effective than traditional teaching method in developing the creative thinking competency of students.

CONCLUSION

Creative thinking competency development for students during their formation of knowledge based on technical and technological problems is a solution suitable with

modern teaching theory and today's educational transformation orientation. Experiments shown that Industrial electricity modules teaching applying problem-solving teaching method and applying criterion for assessment, as viewpoint of the writer, the article has obtained some certain achievements in creative thinking development of technical college students. This helps students be active, confident and adaptive to professional practice situations, enhancing the quality of technical training and education in general in vocational education centers.

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The Training Measure for Career Counseling Skill for Teacher at High School in Vietnam

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ABSTRACT

In this paper, the author sets up the necessary career counseling skills of of teacher at High school. Basing on building tools, the author carried out to survey 115 teachers belonging 40 High schools in Vietnam by answering and interviewing sheet. As a result, it appreciated the reality of career counseling skills at High school that propose the training measure for career counseling skill for teachers. The result of experiment about fostering affirmed the reliability and scientific value about the studying content.

Keywords: *Skill, career counseling, career counseling skill, training*

INTRODUCTION

The career counseling at High shool plays an important role in providing and guiding students how to find the career information, training system and labour market effectively. It will help students choose their suitable career with their competence and social requirement. In Vietnam, the head-class teachers and the Technology teachers teach mostly the career counseling activity at High school. These groups are not trained formally about the vocational education field. Therefore, researching the reality and building the modul about training measure for career counseling skill for teachers at High school at present is very important to improve teaching career counseling effectively.

BACKGROUND TO THE TOPIC

1/In Vietnam, the career counseling is concerned and practiced at the target, content in the general education program. Especially, The ministry of Education and Training promulgated the project of whole general education programs on 11th April 2017 with particular target: “Helping students develop continuously and competence of the labourers; citizen’s awareness and personality; self-study ability

and self-study awareness forever, suitable career choice ability with competence and hobby; condition and circumstances of themselves to continue studying higher; studying career or taking part in labour life; correspondence ability with the changes of global background and new industrial revolution".

The career counseling is a important content in all periods of the general education program. However, some places, some schools carry out the career counseling ineffectively, the people who work in this field are mainly head-class teacher and technology teachers. Those teacher groups are not trained formally, less amount of teachers and not enough qualification. They are not equiped with knowledge and skill about career counseling. They help students mainly by their experience. Therefore, the career counseling at High school activity has difficult and ineffecient. The qualification doesn't respond with the requirement of students and society. The students don't prepare carefully to choose a suitable job for them and the demanding of society.

2/ The career counseling appeared in the end of 19th century in the world, as well as the creation of career theory, development career with the typical representators such as:

The authors Schmidt, J.J.(1996), Roger, D. H.(1998), Vernon, G.Z.(2002) pointed out the career counseling activity at High school to give the advice and help students in finding career world, their competence, personality, hobby to choose the suitable job.

In the book "Counseling in school: Essential services and comprehensive programs" of Schmidt, J.J.(1996) and "Handbook on career counseling" of UNESCO (2002) pointed out the content of career counseling including: Providing information about career world, connecting students with labour sources, helping students aware of their hobby, value, ability and personality, encouragement, promotion and giving advice for students to choose the as well as become a whole life learners.

In the career counseling procedure, there are some author: Jennifer, M.K.(2006) giving the career counseling procedure including four period and author group: Norman, C. G., Mary, J. H., Joseph, A. J.(2009) giving five period of the career counseling procedure. The authors pointed out the contend and the way to do each period and the counselors have role to help people aware and deal with their proplem.

In the career counseling skill, the presentators are Jennifer, M.K.(2006), Lynda, A., & Barbara, G. (1996), Norman, C. G., Mary, J. H., Joseph, A. J. (2009). They pointed out to get the career counseling work effectively that the counselors need their knowledge and skill such as: setting up relationship skill; understanding skill; hearing skill; sharing skill; observation skill; feedback skill; exploring information skill; analysis skill; finding psychological feature of student skill.

In Vietnam. The authors Thang, Nguyen Thi Viet (2008) Ai, Nguyen Thi Nhan (2011) consumed the theory of development job in career counseling from the foreign authors such as personality theory and factor of Parsons; Holland's theory; Ann Roes's theory; Ginzbegr's theory; Krumboltz's theory… and reasearching

about role, condition, requirement and using multiple choice in career counseling; the career counseling proceduce Qui, Nguyen Kim(2007), Ai, Nguyen Thi Nhan(2011) and Hoa, Truong Thi(2012).

In summary, there were many researches of many scientists in the world and Vietnam about the career counseling project from target, content to practice procedure in career counseling in and outside High school. The authors gave the needing skill system of counselors generally. However, there weren't research project mentioned to the career counseling skill and training career counseling skill at High school in Vietnam – The essential group in helping students orientating and choosing suitable career with their competences and social requirements.

Therefore, determining the necessary career counseling skills of teacher doing career counseling and proposing the content for fostering skill program for teacher is important and meaningful for Vietnamese education system.

METHODOGY

In this paper, author use analysic method and generalization reseach construction and professional method (05 professors) to build the need career counseling system of High school teacher.

Using the written and interview method to build "giving idea sheet for teachers doing the career counseling work by self-assessment" and "detail interview sheet". Survey 115 teachers of 40 High schools in Vietnam is to point out the reality of the career counseling at High school.

Beside, author use some different method such as: obvious method, researching activity product method, analyticak method about career counseling…

FINDINGS

Content career counseling skill of High school teacher

There are some conception about the career counseling skill, author think: "The career counseling skill of High school teachers is a action that teacher practice naturally base on science knowledge about the career counseling activity and biological, psychological, social condition relating to teacher to support students to improve their solving competence with difficulties in choosing job".

Basing on purpose, duty, content, procedure of the career counseling, it is inhervited the research on the career counseling from the authors: Jennifer, M. K. (2006), Lynda, A., & Barbara, G.(1996), Norman, C. G., Mary, J. H., Joseph, A. J. (2009), determine the career counseling skill of teacher including:

*** Basic career counseling skill group**, including:

1/ Establishment relationship skill with students.

2/ Making question skill in career counseling procedure

3/ Hearing students skill

4/ Observation students skill

5/ Feedback skill

6/ Understanding skill

*** Particular career counseling skill group**, including:

1/ Skill for finding physiological and psychological feature of students

2/ Skill for applying multiwork in career counseling procedure

3/ Skill for using multiple-choise and device calculation the physiological and psychological qualification

4/ Skill for working in personality and group in career counseling procedure

5/ Skill for exploring, analysing, appreciating information in career counseling procedure

6/ Skill for researching about world work, requirement about labour of job market in local, nation, area and internation

7/ Skill for designing and remaining data involving in career counseling procedure.

The reality of High school teacher's career counseling skill

The career counseling skill of High school teacher consists of 2 groups with 13 ingredient skills. Basing on analyzing, consuming scale about the development skill of author in country and foreign, author give the criterias to estimate each ingredient skill as following: 1/ Sufficient content and structure skill; 2/ Logical and proficient level of skill; 3/ Flexible level of skill; 4/ Effective skill

Each skill is estimated from one to four scores. To determine scale, author calculate the score of scale by the way:

Level = Maximum score – Minimum score

The distance between the scale level: (4 – 1) : 4 = 0,75 marks

The minimum score of level 1 is: 1 mark

The minimum score of level 2 is: 1 + 0,75 = 1,75 marks

The minimum score of level 3 is: 1,75 + 0,75 = 2,5 marks

The minimum score of level 4 is: 2,5 + 0,75 = 3,25 marks

Four levels of scale as following:

Skill	**Self-appreciation**	
	Average score	**Number**
Basic career counseling skill group		
1. Establishment relationship skill with students	2.51	3
2. Making question skill in career counseling procedure	2.51	3
3. Hearing students skill	3.05	2
4. Observation students skill	3.35	1
5. Feedback skill	2.17	9
6. Understanding skill	2.37	7
Particular career counseling skill group		
7. Skill for finding physiological and psychological feature of students	2.41	5
8. Skill for applying multiwork in career counseling procedure	1.97	11
9. Skill for using multiple-choise and device calculation the physiological and psychological qualification	2.17	9
10. Skill for working in personality and group in career counseling procedure	1.97	11
11. Skill for exploring, analysing, appreciating information in career counseling procedure	2.37	7
12. Skill for researching about world work, requirement about labour of job market in local, nation, area and internation	1.91	13
13. Skill for designing and remaining data involving in career counseling procedure.	2.41	5

Table 1: Estimating level.

Skill level	Average score
Poor level	From 1 to less than 1.75
Average level	From 1.75 to less than 2.5
Good	From 2.5 to less than 3.25
Very good	From 3.25 to 4

To estimate the level of career counseling skill of teacher, author survey 115 teachers of 40 High school in Vietnam. Result as following::

Table 2: Teachers estimate about doing the career counseling skill by themselves.

According to staticstic result in table 1, generally the career counseling of High school teacher is at the Average level. Only 4/13 skills are estimated at good level (Average score: From 2.5 to less than 3.2) and very good level (Average score: From 3.25 to 4) is "Establishment relationship skill with students","Making question skill in career counseling procedure"(Average score = 2.51); "Hearing students skill" (Average score = 3.05) and "Observation students skill" (Average score = 3.35). These skills of teachers are highly appreciated because these are basic and necessary skills for teaching and other educational activities of teachers and these skills are practiced regularly by teachers in their professional activities.

Other skills are appreciated at average level (Average score: From 1.75 to less than 2.5) especially "Skill for applying multi-work in career counseling procedure", "Skill for working in personality and group in career counseling procedure" and "Skill for researching about world work, requirement about labour of job market in local, nation, area and internation" that have the lowest average score. These particular career counseling skills are very important. They affect directly to the efficiency of career counseling. So, finding the improvement measure of this skill group for teacher is very essential.

To examine the research result about teacher's career counseling

skills, author research the effect of career counseling activity which teacher does, result as following:

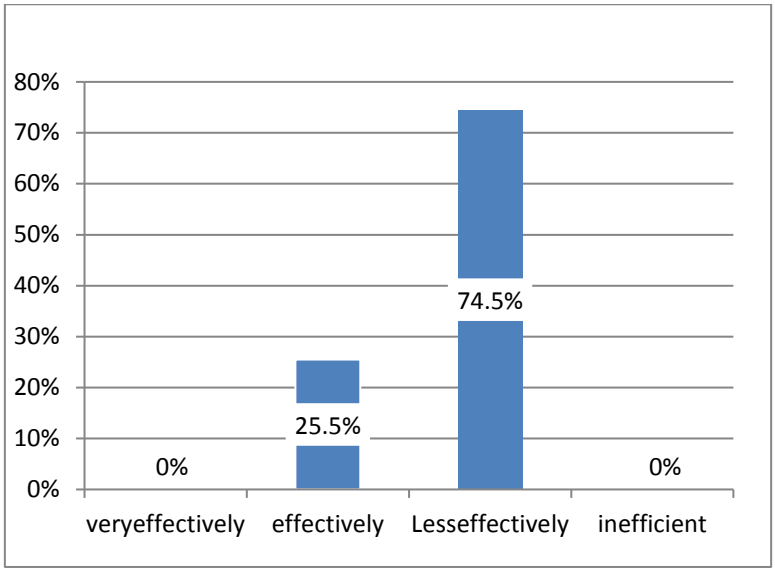

Figure 1: The effect of career counseling.

Most of teachers think that the career counseling nowadays is "Lesseffectively" (74,5%), few other ideas tell this activity is "effectively"(25,5%). The effect of career counseling is not high because there are many career counseling skills, especially the particular skills, teachers do them at average level as the analysis above. In reality, the teachers working is career counseling aren't trained through official program. They work on their experience and self-study. Therefore, the effect of career counseling activity is limited.

Moreover, author asked: "Did you study the training course about the career counseling skill?" 100% teachers said that they hadn't taken part in any training course about career counseling skill.

Mrs Luong has taught at Khoai Chau High school for eight years said that: " I'm a class head teacher, I often help students orient, choose career, choose subjects and the university they want. However, I teach career counseling by self-finding and support students by my experience. During eight years working at High school, I haven't taken part in any training coure about career counseling"

Mr Cuong, the head of the Ho Chi Minh Communist Youth Union of Pham Ngu Lao High School said that: "Every year, when the students enroll in the university, the Head school boad members organize the career counselling for school students, especially grade 12 . However, the effect of this activity is not really as good as we expected. Recently, the school has combined with inviting experts to organize consultations for students, but there are also difficulties in time, funds for expert payment. My school hope the teachers group, especially the class head teachers, technical teachers, teachers in charge of Communist Youth Union of school ... will

have opportunity to participate in career counseling skills training course for high school students to be able to improve the quality and efficiency at my school."

With the career counseling situation at present, establishing program and training High school teachers about the career counseling skill is very important, especially whole ministry of education and training is rushing to prepare all need and enough condition for carring out the new general education program in Vietnam.

The training career counseling skill program for High school teachers

Basing on the career counseling theory, the reality of career counseling skill of High school teachers and background in Vietnam now, author propose the career counseling program for High school teacher as following:

The training career counseling skill program for High school teachers

I. Scope of the study

The teachers of Technology, the Head of Communist Youth Union at School, the class-head teacher, teachers working the career counseling at the High school in country.

II. Aims and purposes of the study

After training course, learners will be able to:

* Knowledge:

Analyse some basic knowledge about career counseling

Demonstrate the content of skills in career counseling

Analyse aims and purposes, meanings, practicing period of career counseling for High school students

* Skill:

Use the multiple choise sheet about hobby, competence, career trend…to appreciate students' competence

Guide students to know about features, requirement of job, labour market in local, domestic and internation

Use the skills in career counseling

Design and organize the career counseling lesson for High school student

* Behaviour:

Have active awareness in doing career counseling

II. Content and time

Table 3: Content and time of training.

Training content	Time
1. The general issue about career counseling	10 periods
2. Career counseling theory and multiple choice	10 periods
3. Determining student's vocational competence	10 periods
4. The skills in career counseling	10 periods
5. Integration career counseling for High school student with other subjects	10 periods
6. Organize the career counseling for High school student	10 periods

With the training program above, the teacher at the University of Technology and Education (having both professional pedagogical skills and job skills) will take part is training the main teacher group – working in career counseling at High school.

Experiment

Basing on career counseling skill program for High school teacher, author carry out experiment training skill as following:

Experiment aims: to improve the career counseling for High chool teachers, author choose to train improvement for the particular career counseling skill group of teacher.

Author experiment on 30 staffs of 6 High school in Hung Yen

Place and time: From February to March 2017 at Methodology room, Department of Education, Hung Yen University of Technology and Education

* Content experiment

Table 4: Content experiment.

Time	Training	Skills
Day 1	The general issue about career counseling	-Skill for finding physiological and psychological feature of students -Skill for applying multi-work in career counseling procedure -Skill for using multiple-choise and device calculation the physiological and psychological qualification -Skill for working in personality and group in career counseling procedure -Skill for exploring, analysing, appreciating information in career counseling procedure -Skill for researching about world work, requirement about labour of job market in local, nation, area and internation - Skill for designing and remaining data involving in career counseling procedure.
Day 2	Career counseling theory and multiple choice	
Day 3	Determining student's vocational competence	
Day 4	The skills in career counseling	
Day 5	Integration career counseling for High school student with other subjects	
Day 6	Organize the career counseling for High school student	

* Organize experiment

The experiment of training career counseling skill for High school teacher is carried out as following steps: 1/ Prepare experiment; 2/ Design experiment program; 3/ Appreciate before experiment; 4/ Train skill; 5/ Appreciate after training and finishing experiment.

*** Experimental results are as following:**

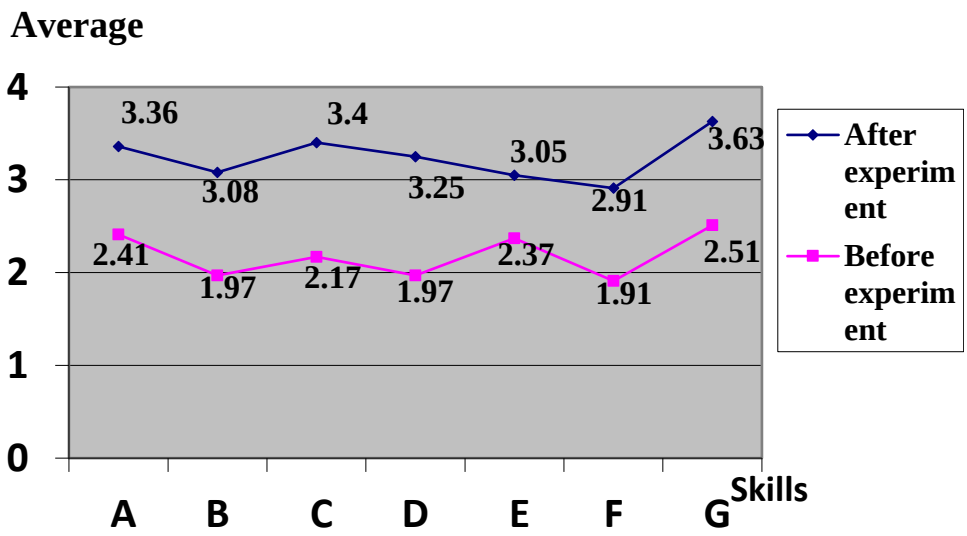

Figure 2: The level practice career counseling skill of teacher before and after experiment.

Note:

A:	Skill for finding physiological and psychological feature of students
B:	Skill for applying multiwork in career counseling procedure
C:	Skill for using multiple-choise and device calculation the physiological and psychological qualification
D:	Skill for working in personality and group in career counseling procedure
E:	Skill for exploring, analysing, appreciating information in career counseling procedure
F:	Skill for researching about world work, requirement about labour of job market in local, nation, area and internation
G:	Skill for designing and remaining data involving in career counseling procedure

Looking at Figure 2: In generally, the level of career counseling of High school teacher after experiment changed clearly before experiment. After experiment, most of teachers have better career counseling skill level. Particularly, some skills such as “Skill for applying multi-work in career counseling procedure”, “Skill for using multiple-choise and device calculation the physiological and psychological

qualification", "Skill for working in personality and group in career counseling procedure", "Skill for researching about world work, requirement about labour of job market in local, nation, area and internation" and "Skill for designing and remaining data involving in career counseling procedure" improve quickly after experiment (from average level to good and very good). Those skills are very important for teachers to do the career counseling effectively.

Mrs Thuy– a teacher of Tran Quang Khai High school said that: "Before, we appreciated students by ourselves, combined with contacting their parents. There were very few tools to appreciate and difficulty in organizing the career counseling for students. After taking this training course, we have not only knowledge but also special skills in career counseling. We are provided and known how to use the tools to appreciate students. Thanks to training knowledge, I believe that the career counseling activity at my school will have new advance".

The result of experiment proved that the establishment of training program and organizing the training courses is possible and effective in improvement career counseling skill for High school teachers.

CONCLUSIONS

The career counseling is important meanings in helping High school students to choose future career. The career counseling skill of High school teacher includes the basic career counseling skill and particular career counseling skill. The result of survery about career counseling is the proposing foundation to set up training career counseling program for teachers.

The experiment result proved that the content has value in training career counseling for High school teachers in Vietnam.

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What Students Value Most to Support Portfolio Assessment in Project-Based Learning Environments

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ABSTRACT

Purpose: *New assessment types can be distracting to students but sophisticated assessments are often necessary to learn professional skills in relevant contexts.* ***Methodology:*** *42 students were surveyed (27% response rate) from a first-year project-based learning unit to measure their opinions about the value of components of their portfolio assessment and the support tools provided.* ***Important findings****: These data suggest students appreciated having opportunities to discuss ideas and collaborate with others. Students also valued assessment tasks and resources which they felt were helpful in developing the skills and dispositions they would need in their future engineering career.* ***Conclusions:*** *It is highly worthwhile for lecturers to invest time in developing quality static resources such as exemplars as students do use and value these over more time-consuming personal communication.*

Keywords: *Portfolio, project-based learning, professional skills, student perceptions*

INTRODUCTION

People with self-regulated approaches to learning are very valued in the workforce, especially in highly regulated and performance-driven industries with continuing professional development expectations (Engineers Australia 2009; Medical Board of Australia 2010; Law Council of Australia 2014).

While both problem-based learning and project-based learning have many fundamental elements in common, there are important distinctions. Project-based learning (PBL) is described as:

> *"a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic (real-life) questions and carefully designed products and tasks."* (Markham et al. 2003)

There is a general understanding that new assessment types (including novel assessments such as portfolio assessment) can be distracting to students, requiring a greater investment in time for students to understand and complete such processes. Also, they may be concerned that strategies which brought them success in the past may not apply equally to the new task (Struyven & Devesa, 2016). In relation to portfolio assessment itself, studies from diverse disciplines (physiotherapy, teacher education, and English foreign language) that examined student perceptions of their assessment experiences found that students were very much concerned about the amount of time needed to create portfolios (Aydin, 2010; Bevitt, 2015, Kuisma, 2007; Struyven, Blieck, Roeck, 2014), identifying this as a negative aspect of this type of assessment.

The study described in this paper was a first step in examining student experiences of PBL within one university context, with a focus on understanding what supports within the unit helped students complete a final portfolio. It was hypothesised that students would have engaged with a diverse range of supports. Understanding what students find most helpful has clear implications for setting priorities in unit design, developing supports which students value and determining which current mechanisms could be eliminated to lessen instructor workload.

BACKGROUND AND STUDY CONTEXT

CQUniversity Australia first implemented PBL formally into undergraduate engineering programs in 1997 (Howard, Mark & Jorgensen 2008). Currently, 50% of units in CQUniversity engineering AQF8 program are PBL and are designed to provide a continuous rich and sustained inquiry-based learning experience from first term, first year through to the final year of the degree. The PBL units all follow typical distinctions from problem-based learning (Mills & Treagust 2003), in that there is emphasis on replicating professional projects and application of taught materials in current and prerequisite units, together with developing skills in self, team and project management.

A first-term, first-year 12 credit unit was studied to obtain student value perceptions from their first encounter with PBL. This unit has been designed following guidelines for implementing PBL established by synthesis of research on implementing project- and problem-based units (Chowdhury 2015; Gulbahar & Tinmaz 2006; Savery 2015; Tamim & Grant 2013):

1. students must have responsibility for their own learning;
2. project synopses must be open-ended and ill-defined to allow for free inquiry;
3. learning should be integrated from a wide range of disciplines or subjects;
4. collaboration is essential;
5. what students learn during their self-directed learning must be applied back to the project with reanalysis and resolution;
6. a closing analysis of what has been learned from work with the project and a discussion of what concepts and principles have been learned is essential;
7. self and peer assessment should be carried out at the completion of each project and at the end of the unit;
8. projects must represent real-world scenarios;
9. student examination must measure student progress toward the goals of PBL; and
10. PBL must be the pedagogical base in the curriculum and not part of a didactic curriculum approach.

Learning outcomes for the unit include:

1. Discuss the role of a professional engineer within a business environment, showing an appreciation of the interactions between the technical aspects of the role and the social, cultural, environmental, economic and political contexts
2. Investigate and select materials and processes for engineering applications and justify decisions made
3. Apply information literacy skills and information technology skills to engineering projects
4. Use drawing, modelling and simulation tools to analyse and present project outcomes
5. Describe, apply and justify risk assessment and workplace health and safety in engineering activities
6. Design, conduct and report on practical activities, including devising appropriate measurements and procedures, analysing and interpreting data and forming reliable conclusions

7. Articulate an appreciation of the complex nature of engineering activities including ill-defined situations and problems involving uncertainty, imprecise information, and conflicting technical and non-technical factors
8. Articulate and demonstrate personal application and development of the practice of professional engineering, including a professional attitude, problem solving skills, relevant technical knowledge, productive work practices and a commitment to lifelong learning
9. Provide evidence of a professional capacity to communicate, work and learn; individually and in peer learning teams

In this iteration of the unit, students completed one piece of summative assessment, an Individual Portfolio, designed to establish responsibility for learning. This is a widely adopted practice in engineering units across the sector (Howard & Eliot 2012; Jorgensen & Senini 2005). The unit studied provides a first experience to portfolio assessment for most students, which is widely reported to increase student stress (Davis, Ponnamperuma & Jer 2009; Vaughan, Florentine & Carter 2011).

The unit consisted of four team projects based on scaffolding student through the productive phases of group development (Tuckman & Jensen 1977) and providing continuous opportunities for inquiry-based learning (Savery 2015). In the 2015 offering, projects were designed to replicate engineering practice and included: model skyscraper design, prototype, construct and test challenge (forming); creation of a Team Charter (storming); mechatronics and sustainability research, design and demonstration challenge (norming) and; reservoir feasibility study including creating a numerical water-balance model and simulating township development scenarios (performing).

The unit projects provided scenarios to integrate learning on fundamental concepts for contemporary engineering practice including stakeholder engagement, problem solving, systems engineering, sustainability, ethics, risk assessment and many other topics which heighten student consciousness of their program graduate attributes (Engineers Australia 2016). Additionally, the complexity of latter projects in the unit forces students to collaborate rather than cooperate as can otherwise occur with less taxing group projects (Kirschner, Dickinson & Blosser 1996). This also enables students to continually reanalyse the outcomes of their self-directed learning to check for relevance to project objectives.

As part of the Individual Portfolio students are required to complete a Reflective Journal and Reflective Paper which establishes a closing analysis of their individual project-based experiences. These reflective instruments are referenced to extensively in the Portfolio Grade Nomination where students self-assess their compliance with the PBL unit Performance Standards by providing evidence of their learning achievements.

Self and Peer-Assessments (SPAs) are conducted through anonymous questionnaires on conclusion of each project. SPA results rate student performance on a three-point scale for metrics of communication, collaboration, commitment and reliability (Beer 2011). Students are encouraged to reflect on their SPA results and engage in mentoring to achieve greater results on the whole for their team.

To address the ten points of effective implementation of a PBL unit previously stated, there were many learning supports provided to the students including: portfolio preparation instructions including examples of acceptable approaches to complete reflective writing entries and to validate grade nominations from portfolio contents, in addition to frequent formative feedback at key milestones during the unit; a Performance Standards matrix to describe the PBL expectations; a Reflective Writing Guide that describes alternate reflective writing models (Atkins & Murphy 1994; Bain et al. 1999; Driscoll 1994; Gibbs 1988; Johns 1995) to scaffold reflective assessments; a Technical Report Template; assessment tips on Moodle including video demonstrations of modelling tasks for latter projects; Moodle forums to encourage communication within teams, with the wider cohort and with instructors; separated Wikispaces pages for each team and for each project; and a compulsory Viva Voce to discuss anomalies with grade nominations in their Portfolio.

METHODOLOGY

The study reported here was part of the larger Higher Education Participation Partnerships (HEPP) funded Supporting Student Assessment Success (SSAS) Project (Dargusch & Harris, 2015-2017), investigating students' perceptions of the assessment supports provided in first year Bachelor units. To gather data around student experiences of assessment supports within the unit, first ethical clearance was obtained (H15/02-024). All data were collected by the second and third authors who belonged to a different university school and were not involved in the unit. Data for this paper were primarily collected via surveys; students were provided details of the study and ethical safeguards, giving consent by choosing to complete the instrument. Additional demographic data about the students and their activities within the unit (e.g., access of resources, grades) were also collected. For this passive data collection, early in the term students were informed via email and forum, allowing them to choose to opt out, however none did.

Participants: Out of the 197 students originally signed up for the unit, 153 students were still enrolled when final portfolios were due. Of these, 42 returned valid surveys, leading to a 27% response rate. All but two respondents provided a name and student identification number, allowing further demographic data to be determined about this portion of the sample (n=40). 29 male and 11 female students participated, with 6 studying at regional campus 1, 4 at regional campus 2, 8 at regional campus 3, 14 at regional campus 4, and 8 via Distance mode. Using Australian Bureau of Statistics based geocoding of home addresses (Pink, 2013), 3

participants were classified as high socioeconomic status (SES), 24 as medium SES, and 13 as low SES. There was a range of achievement levels represented in the sample (High Distinction= 9, Distinction=10, Credit=9, Pass=9, Fail=1, and Supplemental Assessment=2). Mean participant age was 21.37 years old (SD=7.07), with ages ranging from 17 to 45. When comparing the sample to the unit population they were drawn from, while grades, age, campus location, and SES were generally representative, females were over-represented (27% of the sample versus 17% of the unit).

Instruments: The survey instrument was designed to gather data about the students' experiences of portfolio assessment in the unit. It contained 21 questions (i.e., 9 multiple choice, 5 free responses explored herein, and 7 matrix questions with rating scales) to measure student opinions about the difficulty and value of varying portfolio components, their effort and attribution of success, their perceptions of resources, and their suggestions for improvement. Results from analyses of multiple choice and matrix questions is available in Taylor, Harris, and Dargusch (2015) and adds to the conversation of how to best support students in their first encounter with Portfolio assessment. For free response questions, students were provided with a box in which they could type a short response.

Invitations to participate in the survey were distributed via email and forum posts during the final week of term. The survey remained open until the start of the next term – a period of approximately 4 weeks. A small number of gift vouchers distributed via random draw were offered as an incentive to encourage participation. Data were collected via the online survey system Survey Monkey and responses were not anonymous, allowing the research team to track responses to demographic information, Moodle activity, and student academic results.

Analysis: Free response questions were analysed by examining themes in the data (Boyatzis, 1998; Saldana, 2009); the second and third authors independently examined these data and identified themes, with the final analysis resulting from discussions undertaken to reach consensus about the major messages within these data. As similar responses were found for Questions 9 and 10 (relating to resources categorised as unhelpful and those they chose not to access) and Questions 19 and 20 (asking for ideas about potentially useful new resources and general suggestions for improvement), responses to each pair of questions was combined.

RESULTS AND DISCUSSION

Perceptions of helpful resources: Students had the option to respond to five open ended questions on the survey. While fewer students answered these questions, their answers can provide insight into the reasons why students responded in particular ways and help explain diverse participant experiences. The first open ended question (#8) asked students to explain why they nominated particular resources as

helpful. Within the 25 responses, some participants used the question to reiterate what aspects were helpful, but without any explanation (e.g., "the lectures were probably the most helpful thing in the unit"); teaching staff, peers, and resources from the Moodle website were all mentioned in this way. However, some students made clearer links between particular resources and why they were helpful (e.g., "The open student forums are very useful. The students can help each other out with problems that may have.")

Within this question, the major foci of responses were around a) organisation and clarity of unit resources, b) the provision of assessment tips and feedback, and c) ability of the assessment tasks to develop students as learners and future engineers. In relation to unit organisation and structure, students appreciated it when they were able to find the resources they needed easily within the online system and liked having 24-hour access to these materials. Additionally, they valued instructions which were clear, established the purpose of the task, and helped them work more efficiently (e.g., "These resources clearly outlined the purpose of the task, and if it was an area of uncertainty, gave helpful instructions and tips." "The unit performance standards increased clarity and removed ambiguity."). Students also appreciated having opportunities to discuss ideas and collaborate with others (e.g., "It was good to discuss the task at hand with other groups and your lecturer. I found that I was more open minded on a few things after I had these discussions."), reporting that both peers and instructors provided helpful feedback and tips.

Finally, students appreciated assessment tasks and resources which they felt were helpful in developing the skills and dispositions they would need in their future engineering career. For example, one student mentioned "The whole unit was about how to define and scope open ended and ill-defined situations. The unit did a good job of forcing students to learn how to locate and use the resources and communicate professionally" and another said, "I also found reflective tasks particularly helpful when attempting to prove learning claims as I could demonstrate my understanding through the discussion of my thoughts." Hence, if assessment tasks and support resources were seen as aligned with student professional goals, students were more likely to engage with them. Students also frequently referred to unit learning outcomes, and the value of assessment tasks and resources in allowing them to meet these. These learning outcomes are the unit-specific iteration of the skills and knowledge taught and which students must demonstrate through their assessment tasks. Students valued the way in which the learning outcomes were clearly described, including "tips on how to target a learning outcome" and the way in which the "task contributed to learning outcomes".

Perceptions of less-useful resources: Fewer students responded when asked if resources were less useful (Question 9, n= 18) or not accessed (Question 10, n=9) and these responses are analysed together. Those who did respond frequently stated that all unit resources had some level of value to them (e.g., "I found this whole unit to be very new to me so I chose to access as many resources as I could, and think

you are wasting an opportunity if you don't access these resources.”). Some students were critical of aspects of the unit, but these criticisms varied in nature. Criticism was leveled at the self-peer assessments students were undertook after each team project (“I saw the SPA's as of limited use. My thoughts were that they measured friendship more than performance. I'd rather not see them used as counting to unit performance standards.”). Students indicated that it was crucial for them to find and access the appropriate resources at times that were ‘right’ for them and that support needed to be clear and specific (“The feedback for the tasks took too long to get back to us and when we did get our feedback, it was rather vague and unhelpful”, “Supporting tutorial did not help my group when needed”). Students were clearly trying to work efficiently, with one commenting “There were easier ways of getting help,” suggesting resources perceived as time consuming or difficult to use will get less student uptake. It was also made clear that tasks and supports needed to align with student conceptions of what was relevant within the discipline (“The spotlight activities made for some interesting reading, however, I feel it did not really add to overall concept of engineering as well as other areas.”). Additionally, there was acknowledgement that at times, fault may lie with their usage rather than the resource itself (e.g., “This is mainly because I didn’t used the forums to there [sic] full potential and so I didn’t get any helpful information from them”). Students also noted potential difficulties associated with distance study (“Being a distance student some of the availability of being physically in a tutorial and asking questions in the same way an internal student would was difficult to do.”); hence some of these students would have liked more face to face interaction, which was not possible given their geographic location.

Perceptions of resource improvements: When asked what resources may have helped them better complete their portfolio and for their ideas for improvement (Question 19, n=16 and Question 20, n=17), the most frequent request was for an example of a completed portfolio to be provided early in the unit so they could visualise the task at hand (“maybe a better example of a whole portfolio and tips on how to achieve learning outcomes earlier on”, “When completing the portfolio, I had been told that it was going to be big. But until I saw it, I didn't believe it.”). There was also acknowledgement that while resources were there, students took a long time to understand what was expected (“It would be easier to have a better understanding from the start. It is not a matter of lack of information but the understanding of the importance.”). They also requested more support on technical competencies they needed to complete tasks (“A lecture on excel, as that was an aspect I struggled with as I had no prior knowledge with the program.” “More written programming instructions, and practical activities.”). Again, differences between face to face and distance mode were raised, with students concerned about issues related to access of information (“Some instruction was obviously given to internal students in tutorials that could of benefited flex students through being formalized or documented on Moodle for consistency. It was apparent in some facilitator feedback, particularly individual reflective paper, that not all the facilitators expectations had been communicated clearly to off campus students.”)

CONCLUSIONS

This study contributes to the literature by sharing student perspectives about what helped them to successfully engage in PBL portfolio-based assessment during their 1st year of study.

1. PBL provides opportunities for students to work in ways that will be characteristic of their future profession, which is an advantage of this type of assessment. It is positive that many students appeared to be able to see the links between their current learning and future goals. This study contributes to the professional conversation about PBL by providing insights into assessment approaches.

2. This study gives an insight into tensions that may exist between the design of a PBL unit and student perception and use of the supports provided for portfolio assessment. Thus, providing opportunity to consider further how students access supports for assessment resources in different ways and for different purposes. Eg. distance and on campus students

3. Opportunity to further consider the role of the unit designer in anticipating how best to support students, particularly first year students, in accessing new and challenging learning environments

There are limitations to this study which must be acknowledged. First, due to the timing of the survey, only students who were still enrolled at the end of the unit had the opportunity to participate. It is important to note that 22% of the initially enrolled students did not make it to this point. These students may have differing perspectives on what is needed to support students within PBL and future studies should try to elicit the perspectives of those students too. Additionally, while the qualitative survey data provide some ideas as to why student value assessment supports in PBL, more understanding is needed; qualitative interviews or focus groups would be valuable to help establish more about why particular support mechanisms resonate with students.

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Problem-Based Learning Pedagogy and Authentic Assessment in Computer Engineering Education: The Ateneo de Davao University Experience

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ABSTRACT

The 21st century education challenges educators to expose students to a wide variety of circumstances and problem situations where they are required to apply the skills they have learned. In engineering education, these are mostly limited to simulated scenarios which are devoid of real and actual interactions with the problems in the community. This paper aims to describe how problem-based learning pedagogy and authentic assessment are used in the Computer Engineering program of Ateneo de Davao University and its impact to the students, the teachers and the community. This is a descriptive & qualitative research that utilizes Focus Group Discussions & Key Informant Interview as methodologies for achieving its objective. This study uses the frame of experiential learning that is problem-driven, community-based, multi-disciplinary, integrative & collaborative.

Computer Engineering Program uses a multi-disciplinary and integrative approach to problem-based learning through the Service-Learning Program. This provides the students with an opportunity to interact with a community, identify its problem(s), analyze & create a concrete solution applying their acquired skills. Since the students are engaged with the community's actual and real problems, they will be assessed using authentic assessment mechanisms. Experiential learning, problem-based pedagogy with authentic assessment open doors of opportunities for a more meaningful and relevant computer engineering program.

Keywords: *problem-based learning, service-learning, authentic assessment, experiential learning*

I. INTRODUCTION

This paper is grounded on the general premise of experiential learning particularly the concepts of Problem-Based Learning (PBL) and Authentic Assessment (AA). These concepts are integrated through a Service-Learning Pedagogy as applied in the Computer Engineering Curriculum. With the onset of Outcomes-Based Education (OBE), and driven by the University's three-fold thrust of Academic Excellence, Robust Research and Social Formation, the Engineering department of Ateneo de Davao University has considered it of great significance to expose students to a wide variety of actual circumstances and problem situations in the community. where they are required to apply the skills they have learned in their specific programs, through a Service-Learning Pedagogy (SLP), a multidisciplinary, integrative and collaborative approach to PBL.

Figure 1 describes the concept adopted by Ateneo de Davao University in carrying out the challenges that OBE poses – the concept of SLP. SLP becomes the main methodology that is used by the teacher as it already integrates the concept of PBL and AA. SLP therefore is an integration of the academic formation, research and social formation of the students.

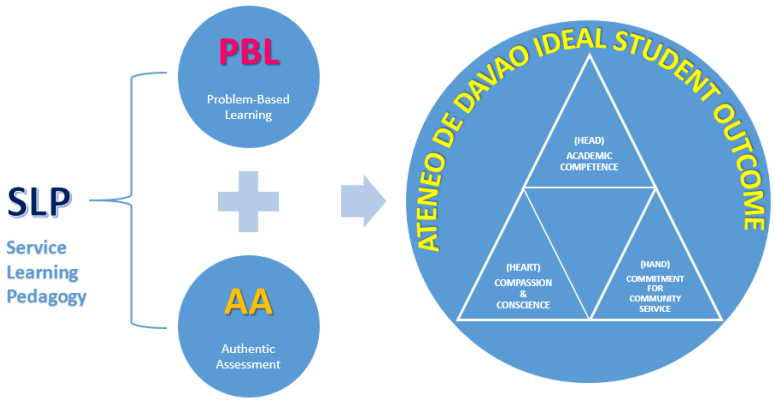

Figure 1: Service Learning Pedagogy – Ateneo de Davao University.

Service-Learning Pedagogy for Computer Engineering

In Computer Engineering program, 3 courses were identified to pilot test the idea of Service Learning namely, Computer Hardware Fundamentals, Software Engineering and Computer Engineering Seminars & Fieldtrips. In these subjects, students are required to immerse themselves in an identified indigent community within the city. They are expected to assess the situation of the said community paying particular attention to situations or problems which are relevant to their field

of studies. Then the students are required to offer a probable solution to the identified problem situation that has to be aligned with the defined course outcome using the competencies they have acquired from the subject.

In this particular case, the students were immersed in a small village within the city comprised of residents relocated from the different areas of the city. Most of the inhabitants are victims of calamities such as fire or flood. A Non-Government Organization (NGO) established a Day Care Center which offers Pre-school education and organizes periodic activities for the many out-of-school youths in the area.

The table below summarizes the problem situations that the Computer Engineering students were able to respond to with the use of the Service-Learning Pedagogy:

Table 1: SLP - Students' Output vis-à-vis Course Desired Outcome.

Course	Course Desired Outcome	Problem Situation	Students' Output
Computer Hardware Fundamentals	Assemble a microcomputer from various hardware components with proper handling techniques and safety and select and install the appropriate component needed for a hardware upgrade.	10 computer units were in the Day Care Center but they were not utilized by the pupils as they were either damaged or disfunctional.	Students were able to repair all the computer units and made them fully functional for the pupils.
Software Engineering	Develop a software application	Volunteer teachers were using outdated pre-school modules with very little innovative and 21st century learning methodologies	Students were able to come up with Computer-Aided Learning Modules based on the recommendations of the Volunteer Teachers of the community.
Computer Engineering	Organize and conduct relevant	There were many out-of-school youths in the area	Students organized a series of Training Sessions for the out-

Seminars & Fieldtrips	trainings on computer education	who were found to have been just standing-by and seemingly have nothing to do.	of-school youths on Basic Computer Office Applications and other Software Applications.

This SLP that the students of these 3 courses are involved in is a multidisciplinary, integrative and collaborative approach to problem-based learning. The students go through several processes before they are being fielded to the different communities. They go through a social formation orientation conducted by the office in-charge of Social Formation, and a separate academic orientation conducted by the Teacher. Then they will be fielded to the community which is facilitated by both the Academic Teacher and the social formation in charge. After their exposure/immersion to the community, a session will be conducted to process the social formative experience of the students. Then the academic teacher will take charge of all the academic concerns.

This Service-Learning Pedagogy (SLP) of Ateneo de Davao is geared towards allowing the students to make meaning of their academic learning in relation to the complex needs of the real world. It also challenges them to use their technical academic skills to be of service to the community. Authentic Assessments (AA) are then used to measure the performance of the student's vis-à-vis identified outcomes and the product that they are able to deliver to the community.

II. METHODS

Since this paper is a qualitative descriptive study, it uses Focus Group Discussions (FGD) with the students, teachers and staff who were directly involved in the process. Key Informant Interview (KII) was also used for the partner communities. This study uses Colaizzi's method of data analysis which involves, clustering of themes and making meaning of these themes as is applicable (Shosha, 2012).

All students who have been involved in the implementation of the SLP were part of the Focus Group Discussions (FGD). There were 3 focus groups, one for each of the 3 courses were SLP is employed. All students who were enrolled in those 3 courses where made part of the FGD. Major points of discussion revolves around the students experience of SLP, their important learnings, realizations and insights from the activities. On the other hand, all professors handling the 3 courses and all the staff of the faculty formation office were the key informants in an individual interview. The focus of the interview is on the professors' and staff's perspective as to the whole process – its strengths & challenges, the impact of the experience to the students, and the implications of the experience to the whole academic learning process.

As regards the partner communities, selected members of the community partners were chosen for the FGD. Discussion is more focused on the impact of the students' experience and output to their community.

III. FINDINGS

The use of Service-Learning Program (SLP) as the methodology in carrying out Problem-based Learning (PBL) and Authentic Assessment (AA) in Outcomes-Based Education (OBE) has brought about Strengths and Challenges for the students, teachers, the University and the community as a whole. The SLP is a collaborative program between the academic department and the social formation department of the university.

Strengths:

1. Students get to have actual interaction with an identified community and are able to find out their expressed need.

In this program, students are given a certain period for exposure/immersion to the identified community/institution where they need to interact with. They are given 3-5 days of exposure/immersion to the area in order to find out the situation/condition of the community and try to understand its context.

2. Students get to analyze critically the given reality in the community and design a concrete response to improve the situation in the area using their academic competencies.

Integrative sessions are conducted before and after every exposure/immersion of the students. These integrative sessions are conducted by the social formation office and assisted by the academic teacher of the course. It is geared towards assisting the students in making sense of their exposure experience and leading them towards coming up with a concrete response to the problem they see in the community.

With the PBL principle which uses cases and problems as departure points in order to accomplish the intended learning objectives (Birgili, 2015), students get to be critical with their experience in the community. More importantly, students get to develop these 6 skills as defined by the PBL Model (Baker, 2011):

1. Hypothetical-deductive reasoning
2. Development of cognitive flexibility

3. Self-directed learning
4. Development of collaboration skills
5. Student-centered learning
6. Development of self-reflection habits

With the use of the PBL concept in Ateneo's SLP – students experience self-directed learning, collaboration, and post-problem reflection which goes beyond focusing on knowledge, theories and concepts (Alrahlah, 2016).

7. Students are able to realize the relevance and the significance of their course of study in the real actual community.

Reflection sessions are then conducted towards the end of the entire experience of the students. These are facilitated by the social formation office and assisted by the academic teacher.

8. Students are given a chance to make a difference in the lives of the people in the community.

As a final requirement of the course, students are expected to present their output, based on the desired course outcomes to the academic teacher, the social formation and to the community. A turn-over of projects/product to the community is usually scheduled after the students have made their final defense of their project.

9. This approach concretely integrates the University's three-fold thrusts: academic excellence, research and social formation all gearing towards education for the common good.

For education to be meaningful and relevant, it has to be grounded on the context and has to be directed towards common good. This approach ensures that the students' academic preparation can better create an impact, no matter how small the contribution may be, to the greater community.

The processes of exposure/immersion, guided reflection and integrative sessions facilitate the development of metacognition in the students – a life skill that is of great importance especially in today's generation.

10. The University provided support mechanisms and structures that enables the whole process to proceed.

For this program to succeed, the University identified key offices particularly the social formation offices to take charge of the integrative and coordinative processes. More importantly, structures were created to ensure its implementation. A number of personnel were assigned to assist the academic departments in carrying out this program and an appropriate budget was allocated.

11. The Faculty handling the courses are open and willing to accept the challenges of designing the course based on the PBL concept and of preparing AA for the student's academic output.

The Faculty handling courses are ready to embrace new ways of proceeding in terms of pedagogy and assessments in their respective courses. They are also more accommodating and generous of their time since they are also required to be around during exposure/immersion of their students which in reality is already outside of the classroom and sometimes go beyond their required hours of service.

Since PBL is a different approach to the traditional teaching-learning methodology, the faculty needs to put in much effort in designing a PBL syllabus. For example, to facilitate their learning, scaffolding may need to be incorporated into the course's design. Approaches for scaffolding include providing explicit instructions or examples of how these problem situations can be approached and solved. It is also important to very clearly communicate the PBL process, the assessments and what is expected of the students (Stepien & Gallagher, 1993 and Barrows, 1985).

Authentic Assessment (AA) is also imperative in this process. It is a concept whereby students are engaged in applying skills and knowledge to solve "real world" problems, giving the tasks a sense of authenticity. These tasks are set in a meaningful context that provides connections between real-world experiences and school-based ideas (Lund, 1997).

The authentic assessment rubric was developed with reference to the Understanding by Design (UbD) framework and Task Design Guidelines (Chong et al., 2016). AA rubric focuses on four primary domains which are essential in the field of Engineering, namely cognitive, psychomotor, affective and critical thinking skills.

Challenges:

1. This program requires intensive coordination process between the academic department, the social formation department and the community.

Requisite to the program is proper planning and coordination between and among the different departments concerned and the community. One very specific challenge is scheduling particularly in times when students need to stay in the area. Careful considerations are placed on students' safety and ensuring that it wouldn't compromise the schedules of other courses that the students are taking.

2. This program requires the faculty to be more creative in designing PBL courses and Authentic Assessments in coordination with the social formation team.

There is a need to break away from the traditional teaching in the classroom, thus the need to design a more appropriate and problem-based course that would engage the students with the community. This requires more time and creativity from the faculty since the service-learning pedagogy is multidisciplinary and integrative in nature.

3. This program requires that an integration process be conducted so that the students will make more sense and meaning of their experience in the community immersion not only in the academic aspect but more importantly on the relevance of academic learning to social formation.

Facilitating the integration process in the students is a task that requires a deeper understanding of the situation in the community, a good grasp of the learning outcomes of the course and the skill to be able to weave together the two in order to be a guide of the students in making meaning of their experiences.

4. This approach may provide an avenue for students to be confronted with their own limitations which if not handled carefully may lead to frustration and disappointment in their part.

The immersion experience of the students provided them with a first-hand view of the different problem-situations in the community which in most instances can be very overwhelming. The guided reflection and integrative sessions are then very necessary to help them delimit their focus on something that can they can concretely respond to with careful consideration on their financial resource and academic and technical preparation.

IV. CONCLUSION & RECOMMENDATION

With all the challenges that the Service-Learning pedagogy of the Computer Engineering program of Ateneo de Davao University faces, it still has created a very positive impact in the lives of the students and the community. Yes, there are still many challenges that need addressing but so far, the good that it did to the students and the community far outweighs the concerns and challenges.

It is therefore recommended by the students and the faculty that this same pedagogy be made applicable, not only in the Computer Engineering program but to all programs in the University. To date, the Engineering Department particularly the Industrial Engineering, Mechanical Engineering, and Architecture programs have been incorporating the use of the Service-Learning pedagogy in some of their major courses.

ACKNOWLEDGEMENT

The proponents of this study are grateful to the following:

1. Ateneo de Davao University – Fr. Joel E. Tabora, SJ and Fr. Gabriel Jose T. Gonzales, SJ for their moral and financial support;
2. School of Engineering and Architecture – Dr. Randell U. Espina, Engr. Jenith L. Banluta, and Dr. Renyl Barroca for their technical support;
3. Arrupe Office of Social Formation – Ms. Lilibeth L. Arcena and Mr. Marcelino L. Severino III for their collaborative and logistical support and;

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Experiential Teaching Methods for Developing Core Competencies of Technical Students in Vietnam

(a case study at Ho Chi Minh City University of Technology and Education)

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ABSTRACT

This article discuses results of applying experiential teaching methods (project based learning; learning games) for developing core competencies (problem solving; team-work) of Technical students in Vietnam. This research generalizes brief literatures on core competencies and experiential teaching methods as well as design/organize experiential learning activities. Qualitative methods (observation, interview, practical learning products) were applied to identify the development of core competencies of Technical students. Results revealed that Technical students' problem solving and collaborative competencies have been developed, which proved the reliability and effectiveness of the proposed experiential teaching methods. Suggestions for applying experiential teaching methods by carefully considering a consistency of learning outcomes, teaching and learning methods and assessment has been given. The research proved that problem solving and collaboration competencies of technological - engineering students will be developed through designing and organizing experiential activities in the classroom. Experiential teaching methods are not new to the learning environment. However, they would be a new approach to some cultures, like Vietnam where most of students are not familiar with studying in a proactive way. This approach brings students opportunities and challenges to self - construct their competencies from experience.

Keywords: *Core competence, experiential teaching method, project based learning, learning games.*

1. INTRODUCTION

Core competencies can be defined as personal attributes or underlining characteristics, which, combined with technical or professional skills, enable an individual to fulfill a role/job. Core competencies such as problem solving or

teamwork are basic/fundamental for technical competencies (OECD). Becoming the member of the ASEAN Economic Community since 2015, besides opportunities, foreign languages, inadequate competencies like professional competences and particularly core competencies have been big barriers for Vietnamese workers. Employers in greater Hanoi and Ho Chi Minh City were not just looking for technical competencies to do the job, but also equally looking for what experts call cognitive competencies, social and behavioral competencies (team work, problem-solving, critical thinking, creative thinking ...) (Christian. B, Magnusson R.B, 2013). These social and behavioral competencies will be combined with technical or professional competencies, enable an individual to fulfill a job.

In Vietnam, Ho Chi Minh City University of Technology and Education (HCMUTE) is one of the leading universities in educating and training technical and vocational teachers, engineers and technicians for the whole country, especially for the Southern region. Awareness of employers' requirements, a training programme based on a CDIO approach (Conceive; Design; Implement; Operate) has been implemented since 2012 at HCMUTE to support technical students develop holistic competencies (knowledge, skills, attitude and core competencies). With this training programme, technical teachers are required to apply experiential teaching methods (project based learning, situated learning, capstone projects...) in the teaching process. However, it is not easy to teach subjects in an experiential way because of lack of knowledge, skills and literature on experiential teaching methods. This paper describes briefly little literature available on core competence and two experiential teaching methods (project based learning, learning games) as well as activities of teaching and assessment the development of students' core competencies at HCMUTE.

2. THEORETICAL TO CORE COMPETENCE AND EXPERIENTIAL TEACHING METHOD

2.1. Outline of Competence and Core Competence

"Competence" is a very popular concept to express an ability to do something successfully or efficiently. Competence (in the British context) or competency (in the Australian context) is derived from Latin - Competentia, means agreement or conjunction (Deißinger & Hellwig, 2011). Competence is not just knowledge and skills, but an ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular. According to Hoskins and Crick (2008), a competence is best described as a complex combination of knowledge, skills, understanding, values, attitudes and desire which lead to effective, embodied human action in the world, in a particular domain.

This paper based on the following working definition: "Competence is a flexible conjunction and application of knowledge, skills, attitudes, values, beliefs, motivations, interests, needs... to implement tasks or deal with complex real - world problems to achieve good results" (Oanh, 2016).

"Core competence" is constructed based on distinguishing the concept of "competence" in 2 groups: core competence and technical competence (OECD, 2014). Core competence can be defined as personal attributes or underlining characteristics, which combined with technical or professional skills, enable the delivery of a role/job. Core Competencies do not define individuals' technical roles and accountabilities, nor does it include the technical skills necessary to do the jobs. On the contrary, technical competencies cover the various fields of expertise relevant to the specific work (OECD, 2014). Core competencies and technical competencies link closely together and the development of technical competencies effect on core competencies (Kiem, Ry & Que, 2015). Ry, and Que (2015) classified core competencies in 3 groups:

1. Autonomous activity and personal development competencies contain self - study competence, problem solving competence, creative competence...
2. Social competencies contain communicative competence, teamwork competence...
3. Tool competencies contain language competence, computer competence, calculate competence...

Proposed main core competencies in this paper focuses on team work, problem solving, communication, creative thinking, and critical thinking.

2.2. Outline of Experiential Teaching Method

"Experience" is a familiar word with us to know things around through doing or practicing. In Oxford Learner's Dictionaries, "experience" means the knowledge and skill that you have gained through doing something for a period of time; the process of gaining this; the things that have happened to you that influence the way you think and behave. In the philosophy, it means a kind of internal action from heart connected with life and existence (Dongmei Sheng, 2016).

From the time of the first teachers, it has been recognized that an important relationship exists between experience and learning (Knutson.S, 2003). There is a common adage attached to experiential learning: "Tell me and I will forget, show me and I may remember, involve me and I will understand" (Confucius cirea 450 BC). Learning form experience is one of the most fundamental and natural means of learning available to everyone (Beard.C., Wilson.J.P., 2016). Kolb.D (1984) also believed that knowledge is gained through personal and environmental experiences.

In its simplest way, experiential learning means learning from experience or learning by doing (Linda.H.L., Williams.C.J, 1994).

Experiential learning links closely with experiential teaching. Experiential teaching method relies on experiential learning (Valerie.J.K, 2012) and is often referred to as the hands-on or problem-based teaching method (Brittany.L. Adams, 2010). Experiential teaching plays a very important role in creating an experience for the students to learn from. Experiential teaching method enhances a learning process to be student-centered and to allow space for individual student experience, interpretation, and learning. It is easy to find core values of the experiential teaching in developing competencies of learners, especially some core competencies like team-work, problem solving, creative thinking ... in some principles of experiential education pointed out in the Association for Experiential Education's website:

1. Experiences are structured to require the learner to take initiative, make decisions and be accountable for results.
2. Throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative and constructing meaning.
3. Learners are engaged intellectually, emotionally, socially, soulfully and/or physically.
4. This involvement produces a perception that the learning task is authentic.
5. Relationships are developed and nurtured: learner to self, learner to others and learner to the world at large.
6. The design of the learning experience includes the possibility to learn from natural consequences, mistakes and successes.

Experiential Teaching Method facilitates the experiential learning process, including action learning (Marquardt.M, 2007; Silberman.M, 2006); learning games (Silberman.M, 2006 and Ukens.L, 2007); field trip (Lei Li, Fan Cheung, Ning Wang, Lixing Lao, Yibin Feng, 2016), Project Based Learning (PBL) (Lee Hong Sharon Yam and Rossini.P, 2010; Efstratia.D, 2014) .... Experience for the students to learn from created by these methods would enhance the understanding of concepts as well as the gateway to develop skills.

PBL is a student-centered approach that engages students in exploring important and meaningful questions through a series of investigations and collaborations (Krajcik, J., Czerniak, C., Berger, C., 1999). Project Based Learning is to connect student's experiences with school life and to provoke serious thinking as students acquire new knowledge (Efstratia.D, 2014). The main objectives are to

expose students to experiential learning, and to provide them an overview of activities involved in valuation profession (Lee Hong Sharon Yam and Rossini.P, 2010). Seidel.S., Aryeh.L., Steinberg.A, 2002) believe that project-based learning is most-often characterized by:

1. A series of activities with a sustained focus over time and linked to an outcome of significance - a performance, product, or service that is highly valued by the students as well as a broader community.
2. A group effort that often moves beyond the walls of the classroom or after school, into the community for research, internships, presentations, etc.,
3. Clear learning goals that often embrace academic, social, and metacognitive dimensions simultaneously.
4. Assessment that is ongoing with frequent opportunities for students to receive and provide feedback as the work is developing as well as final evaluation from peers, instructors, and the public, including self-assessment.

In its simplest way, PBL has been organized with 5 steps as the following:

***Step 1*: Define the learning project topic, time allowed, team size and criteria**

Teachers state learning project topics, time allowed, team size and assessment criteria. Learning project topics are always combining between theories with practical problems. Criteria are designed clearly and precisely.

***Step 2*: Develop specific plans to implement the learning project**

Students make specific plans to implement learning projects. Plans often consist of the time, resources, contents, intended results...

***Step 3:* Implement the learning project**

Students implement learning projects according to their plan.

***Step 4:* Present results**

Students present their results in front of the class and answer questions concerning with learning projects and implementing them.

***Step 5*: Assess results**

Teachers, students and peer-students co-assess results based on checklists.

Besides PBL, learning games are also applied to enhance the experiential learning process of students. Play has been recognized an essential part of human being development as children start learning through play. We can practice behaviors and improve on our mistakes (Ukens.L, 2007). A learning game often requires such actions as solving problems and puzzles, analysing information, making self-disclosure and refers to the objective of improving the players' level of competency in particular areas (cited Ukens.L, 2007). So it provides learners an opportunity to overcome an obstacle with real feelings of success and real learning (Ukens.L, 2007) as well as to experience the total content before discussing the parts (Silberman.M., Biech.E, 2015).

3. DEVELOPING CORE COMPETENCES OF TECHNICAL STUDENTS THROUGH EXPERIENTIAL TEACHING METHODS AT HCMUTE

Cater for developing core competencies of students, experiential teaching and learning methods must be engaged deeply with both learning outcomes and assessment in the entire teaching process. With PBL and learning game, students are divided into small groups (typically of about five students) to implement learning projects or learning games. Students must define the problem, collect and analyze information, develop plans, implement proposed solutions and finally evaluate results in every project or game. Students are not only required to learn and work with others, but also relate well to others, co-operate, manage and resolve conflicts in their team. These activities are performance areas of core competencies like problem solving, team work... Different levels of the core competence development of students are completely quantified by using assessment tools (checklists).

In this paper, we introduce some findings of developing problem solving and teamwork competencies of students through experiential teaching methods in System Thinking subject. It is the common and optional subject belonging to the CDIO training programme at HCMUTE. System Thinking involves a holistic approach, taking into account as many different factors as possible to avoid interpreting problems from a single point of view (Kriz.W.K, 2008). After completing this subject, students will be able to apply the system thinking point of

view in building a specific system as well as develop some core competencies such as problem solving, teamwork, critical thinking, creative thinking...

Table 1: Organizing experiential teaching System Thinking subject.

Learning Outcomes	Contents	Teaching Methods	Activities	Intended findings
***Phase 1*: Overview of System**				
1. Describe a system; 2. Build a system; 3. Develop core competencies: problem solving and teamwork.	1. The definition of system 2. Describe a system 3. Analyze and design a system	1. Group work 2. Project based learning	<u>Learning Project topic</u> Build a system (a bridge, a house, a device, a gift ...) by recycling waste materials such as milk cartons, plastic bottles, cardboards, papers, textiles (clothes, woolen), aluminum (beverage cans)...	1. A system by recycling waste materials 2. A PPT report

***Phase 2:* Thinking and Technical Thinking**

1. Present the characteristics of thinking, technical thinking and thinking manipulations 2. Develop core competencies: problem solving, teamwork and creative	1. Overview of thinking 1. Definition of thinking 2. Characteristic of thinking 3. Thinking manipulations	1. Group work 2. Learning game	<u>TRI UAN game</u> Form a specific shape as a given outline by using seven wood shapes in the least time possible	A specific shape as a given outline
	3. Overview of technical thinking 1. Definition of technical thinking 2. Characteristic of technical thinking 3. Structure of technical thinking	1. Group work 2. Project based learning	<u>Learning Project topic</u> Build a tower by 200 straws and scotch tapes. <u>Criteria</u>: The highest tower and stand in the longest time will be the winner <u>Team size</u>: Suggested team size is 5 - 7 students	A tower by straws and scotch tapes

To help students engage closely knowledge of analysing and designing a system and building a specific system as well as develop the problem solving and teamwork competencies, students are required to implement the leaning project: "Build a system (a bridge, a house, a device, a gift ...) by recycling waste materials such as milk cartons, plastic bottles, cardboards, papers, textiles (clothes, woollen), aluminium (beverage cans)...". The time is allowed in one week. The team size is 5 - 7 students.

A group of students from the Faculty of Electrical and Electronics Engineering built a model of Han River Bridge by recycling bamboo sticks, bulbs and wires. Students applied electrical and electronics knowledge to make the bridge model which can be rotated. This product could be used as a visual learning model.

Figure 1: The model of Han River Bridge from bamboo sticks, bulbs and wires.

In this learning project, to build the system by recycling waste materials, students defined the problem through answering questions: How is the system built? Which waste materials are used in building the system? How do they build the system by recycling waste material? What is the system for? The bridge system was built by waste material such as carton, paper, and bamboo sticks.

Besides defining the problem, students collected information to make clear the defined problem: which is the model of the bridge? What are waste materials? What are waste materials for? How do students make the bridge system can be rotated? This information was analyzed and synthesized to serve for proposing solutions. Students analyzed advantages and disadvantages of each solution, the ability and condition of the implementation and selected the best appropriate solution: building the model of Han River Bridge rotated by recycling waste material such as bamboo sticks, bulbs and wires.

After collecting and analyzing information to propose the feasible solution, students made a specific plan to implement the learning project. Some points were done in the plan by students such as:

1. Pointing out activities concerning with building the bridge need to be done;

2. Listing waste material used to build the bridge;

3. Assigning tasks to each member of the group;
4. Determining concrete time for each member to complete the task;
5. Showing intended results.

Students implemented the proposed solution according to the plan. Each member in the group did not only do the assigned tasks, but also combine every member to revise and complete the model. The leader of the team shared: "Each member in our team gave their own ideas to build a system by recycling waste materials. We analyzed and evaluated these ideals together. In the process of implementing the learning project, the lecturer is always accompanied and helps us overcome differences ideas. We learned how to deal with the problem and work together". When the Han River bridge model done, students evaluated the result by reviewing as well as pointing out advantages and disadvantages of the model. The group revised the rotation system of the bridge when the switch is turned on.

In this learning project, students did not only apply knowledge of analyzing and designing a system to dealing with the real problem, but also define the problem, collect and analyze information, develop the plan, implement the proposed solution and evaluate the result. These performance areas of the problem solving competence of students were quantified based on the problem solving competence checklist. In this case, students' problem solving competence gained 95/100 points.

To experience a total content concerning with "thinking manipulations" before discussing about specific thinking manipulations, students were required to play a puzzle game: "*Form a specific shape as a given outline by using seven wood shapes in the least time possible*". Every 5 - 7 student group co-operated to analyze/synthesis/compare the given outline with the puzzled seven wood shapes. Each group presented activities experiencing to play the game. Then teacher combined experiential activities with every thinking manipulation. According to teacher's guidelines, students discussed about thinking manipulations' characteristics and how to apply them in constructing a specific system. Finally, thinking manipulation was summarized by the teacher and students. In this experiential learning game, performance areas of problem solving and teamwork competences were also quantified by checklist.

In our class, 5 groups were required to form a specific shape as 3 given outlines by using seven wood shapes in the least time possible. After ending the allowed time, only groups 1, 2 and 5 formed 3 shapes as the given outlines. These group used activities as thinking manipulations (analyze, synthesis, compare, generalize) to form shapes through identifying the puzzle problem, analyzing/comparing between the given outline and a concrete relationship of 7 wood shapes, forming shapes and evaluating results. Every member in these groups discussed the puzzle problem and ways of forming shape in harmony. The group 4 only formed 2 shapes as the given outlines. They were not successful in the third puzzle game because of not

identifying the puzzle problem. About the group 3, they were still finding the way to form the first shape as the given outline when the time ended. This group did not play successfully. A member of the group 3 said that: “Every member in our group played according to their way. We did not identify the puzzle problem before forming shapes”. So through the experiential learning game, most of students could self-construct knowledge on “thinking manipulations” and hands-on to develop performance areas of problem solving and team work competencies. A part of students still faced with challenges in identifying problems in a specific context and dealing with conflicts in small groups.

Figure 2: Technical students participated in the learning game.

4. CONCLUSION

Experiential teaching methods play a very important role to enhance students to study in the proactive and experiential way. These methods provide students with opportunities and challenges to self - construct knowledge, skills, attitude … from experience for their lifelong learning. The consistency of experiential teaching methods, learning outcomes and assessment will create a sustainable change in the quality of education in higher education institutions.

With experiential teaching methods, teachers and students need to change their teaching and learning way. Instead of focusing on presenting and requiring students to remember knowledge, teachers design learning situations associated with practical contexts and encourage students to co-operate in dealing with them to self - construct technical and core competencies. Through applying knowledge to tackle real world problems, students learn how to define and deal with tasks effectively. Thanks to experience together in leaning situations, students also learn how to relate well to others to solve specific problems.

Experiential teaching methods also provide students with good opportunities to develop core competencies gradually in the learning process. One of main psychological characteristics of most of Vietnamese students is not willing to share their opinions in working groups. Some of them prefer working according to their own way than collaborating with other students. In our class, they were encouraged to overcome the psychological barrier to implement learning projects or the learning game successfully. Their problem solving and team work competencies have been developed by quantifying based on checklists and concrete evidences associated with flexible application of knowledge, skills, attitudes, values and personal attributes in implementing tasks or dealing with complex real - world problems.

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Impact of Mobile Learning on Learning Behavior in Higher Education: A Review Study

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ABSTRACT

In today's era of higher education needs technological Innovision in the context of mobile learning. Mobile learning or ubiquitous learning is not new but in recent year a huge amount of handhelds devices and its application have developed and design to fulfill the needs in higher education through. Mobile learning technologies provide learners with flexibility and ubiquity to learn anytime and anywhere via mobile applications. However, very few researches have been conducted to investigate the impact of mobile learning on learning behavior in higher education. In this review study researchers, reviews research articles on technology acceptance factors which contributed towards how students' learning behavior changes using mobile technology and use of mobile learning in educational settings. Researchers reviews around 53 research articles from various reputed journals which are based on the mobile learning, usefulness of the technology, acceptance of the technology, students' behavioral patterns. Through this review study, essential characteristics of mobile learning were reviewed and discussed. With the essential characteristics, researchers emphasized on the impact of mobile learning and detailed mobile learning model in learning management courses.

Keyword: *M-Learning, Learning Behavior, Higher Education and Ubiquitous Learning.*

INTRODUCTION

With the rapid evolution of science and technology, the use of smartphones has been increasing in the India. Over the past few years, there has been a tremendous growth

and penetration of mobile technologies and mobile services in India. The number of mobile devices shipped to India has been increasing every year. At the same time, the number of mobile subscribers and Internet users has been increasing too. India to have over 480 million smart phones users by the end of 2017 and most of the user are in 18-34 ages' groups. Despite enormous used of mobile devices in higher education in India; their use to enhance education is limited. Most of the E-Learning technologies implemented in higher education are based on desktop computers. Desktop computers have limitations in terms of flexibility and mobility to learners [12].

M-learning will play an increasingly significant role in the development of teaching and learning methods for higher education. Though, the successful accomplishment of m-learning in higher education will be based on users' acceptance, perceived usefulness and past experience of this technology. Thus, the purpose of this paper is to review a research articles which discovers the impact of mobile learning on learning behavior. The recent emergence of mobile learning can provide a new platform for institutions in India to enhance Higher Education through mobile learning. M-learning offers learners with flexibility and ubiquity to learn anytime, anywhere via mobile devices connected to wireless Internet ([29], [32] and [33]). Moreover, it provides a new way to deliver education without installing complex communications infrastructure. Consequently, they give learners the opportunity to carry their institution in their own hands [29].

The behaviors of mobile learning applications' users can be defined as a set of actions in combination with the m-learning environment. The behavioral patterns may positively affect on mobile learners by content, ease of use, context, and design of mobile learning applications [23].

The findings of most of the researchers take into consideration in this review study show that perceived usefulness and perceived ease of use positively and significantly influence student's attitude towards M-Learning in management courses in higher education and in turn Attitude positively and significantly affects intentions to use M-Learning. Researchers also found out that individual differences have a huge impact on user acceptance and that the perceived enjoyment and perceived mobility can predict user intentions of using M-Learning.

ADVANTAGES OF M-LEARNING

Following advantages have been found out from different studies based on mobile learning in higher education.

1. M-Learning is more cost effective than traditional learning because less time and it is Ubiquitous.

2. M-Learning can be done in any geographical location and not bind with any particular location.

3. Flexibility is a major benefit of M-learning. M-Learning has the advantage of taking the class anytime anywhere.
4. M-Learning also has measurable assessments which can be created so the both the instructors and students will know what the students have learned, when they've completed courses, and how they have performed.

5. M-Learning allows students to select learning materials that meet their level of knowledge, interest and what they need to know to perform more effectively in an activity.

6. M-Learning encourages students to take personal responsibility for their own learning. When learners succeed, it builds self-knowledge and self-confidence in them.

RESTRICTION OF M-LEARNING ADOPTION

1. Technological – Screen size, Memory size, processing power, slow download time, bandwidth and connectivity,

2. Institutional – Institutional policies such as annual assessment, workload, accreditation procedures

3. Pedagogical – information overload

4. Personal Obstacles – technological skills, teachers' role and security

RESEARCH QUESTIONS

There are a huge number of published studies that research on mobile learning, user acceptance and behavioral positive changes in the context of mobile learning in higher education. However, since mobile learning is an emergent methodology for learners and teachers, it is important to get an overview of the advances and real impact of its use in educational settings. Within this context the research questions addressed by this study are:

1. What are the uses, purposes, advantages, limitations, and effectiveness of mobile learning in the context of Higher Education?

2. What are the characteristics which have the impact on learning behavior of through mobile technology?

3. What is the evaluation methods considered to monitor the impact on learning behavior learning through mobile technology?

METHODOLOGY

We reviewed 53 research articles from reputed journals and published during 2009 to 2016. We collected data from various reports published in reputed journals, websites, govt. published reports. Our focus was on mobile learning and its impact on learning behavior of student through mobile learning in higher education. The terms used in the search therefore included the following keywords: mobile learning, learning behavior, ubiquitous learning, higher education and mobile technology, pedagogy, context-aware, content-based, user acceptance model.

INCLUSION AND EXCLUSION CRITERIA

Considering the research questions, we have stated general criteria that define the time frame for the study and the type of studies that are relevant. Accordingly, we defined the following criteria:

General Criteria:

Studies published between 2009 and 2016.

1. Studies that describe innovations, applications or frameworks for mobile learning in higher education.

Specific Criteria:

1. Studies that report features, limitations, advantages and disadvantages of mobile learning.
2. Studies that describe how mobile learning have the impact on learning behavior in higher education.
3. Studies that describe UTAUT and Technology acceptance model (TAM), Teacher-Student perception about mobile learning in higher education.
4. Studies that describe opportunities and hurdles to implement mobile learning in higher education.

LITERATURE REVIEW

A number of models have been developed to examine individuals' acceptance and intention to adopt and use of new technologies in the world of information systems. Davis (1989) tried to determine what causes people to accept or reject information

technology. The most widely used model in the field of technology adoption is the technology acceptance model (TAM) (Davis, 1989). The idea of TAM is to give a theoretical basis to explain the impact of external variables (i.e., objective system design characteristics, training, computer self-efficacy) on internal beliefs, attitude toward use, behavioral intentions, and actual system use [10].

Another popular and recent model in information technology acceptance is the unified theory of acceptance and use of technology (UTAUT). This theory was proposed by [31] and attempts to integrate and empirically compare elements from different technology acceptance models in technology acceptance.

Ahmad, Abu-Al-Aish et al. (2013), This research study recommends a model to discover the factors that influence the acceptance of m-learning in higher education and to investigate if prior experience of mobile devices affects the acceptance of m-learning. Findings of the Study: The results indicate that performance expectancy, effort expectancy, influence of lecturers, quality of service, and personal innovativeness were all important factors that affect behavioral intention to use m-learning. The study extends UTAUT in the context of m-learning by adding following factors Quality of service and Personal innovativeness.

Minjuan Wang, Ruimin Shen et al. (2009), Qualitative and Quantitative Case Study approach. In this study based on experiment conducted at English class. With the mobile learning students were more interactive with teacher as well as peers. Experiment shows that without prompting by instructor, 95 students sent messages about the class and instructor. In another experiment instructor asked students about their winter vacation on replying to those 41 messages sent by the students.

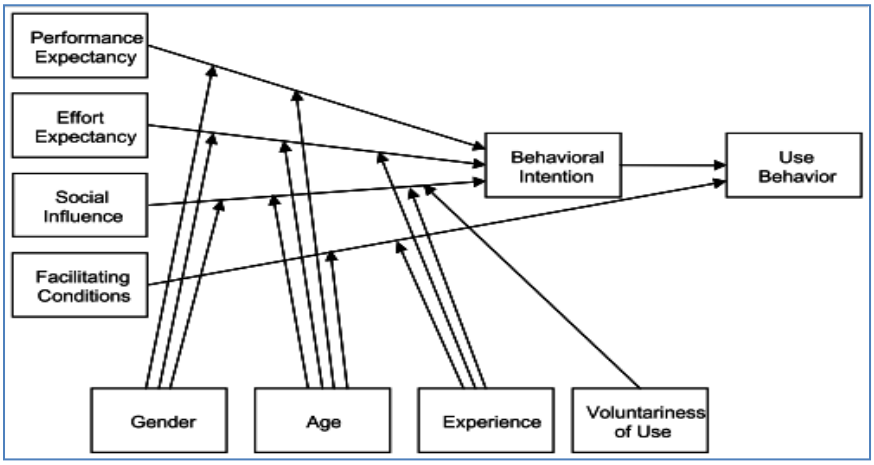

Figure 1: UTAUT Model [32].

Post Survey Method: 178 participants among them 143 were involved in m-learning activities.

Students reported using their mobile phones in the following class-related activities:

1. Discussing course content with classmates (85% of the participants);

2. Asking classmates questions (54%);

3. Asking the instructor or teaching assistant (TA) questions (90%);

Bacca, J et al. (2014) reviewed the, 32 studies published between 2003 and 2013 in 6 indexed journals were analyzed. The main findings from this review provide the current state of the art on research in Augmented Reality in education. Additionally, the research discusses trends and the vision towards the future and opportunities for further research in augmented reality for educational settings.

Wei-Han Tan et al. (2012) developed a conceptual model to examine factors that affect intentions to adopt m-learning in Malaysia. The findings indicated that perceived usefulness, perceived ease of use, and subjective norms can affect one's intention to use mobile learning; gender factors did not appear to show any effects on m-learning usage.

Further, Wang et al. (2009) extended the UTAUT model by including perceived playfulness that is behavioral tendency to interact with the computers. The findings of this review study shows that performance expectancy, effort expectancy, social influence, perceived playfulness and self management of learning all had positives effects on behavioral intention to use mobile learning. Moreover, researchers also found that age and gender are the important factors to moderate the effects of effort expectancy and social influence on using mobile learning.

Jairak et al. *(*2009) focused on evaluation of the acceptance of m-learning technology in higher education. The results show that only effort expectations and social influences affect students' intention to use m-learning. This study also found that performance expectations, effort expectation, and social influences affect the attitudes of students regarding mobile learning.

Kamaruzaman & Zainol (2012) considered behavioral responses among secondary school students. The researcher of this study developed an m-learning application to teach English language. Researcher also found that m-learning technology can improve the encouragement and performance of students when they learn English through the use of mobile devices. This study also found that the improved functionality of the m-learning application used, the attractive layout design, the relevant content, and personal motivation all influence behavior positively.

Shams (2013) investigate the factors that influence the behavior of learners towards the use of m-learning applications. The result of this study showed that important relationship between the utility of m-learning, easiness in m-learning, and self-

management of the learner, and positive changes in behavioral changes towards the actual use of m-learning applications.

Hamdan & Ben-Chabane (2012) investigated and discussed in this study that how to improve students' individual skills and performance by using m-learning applications. They executed the experiment with IT students at UAE University. Researchers found that using mobile learning technology may improve student performance in the educational process.

A study by Hassanein et al. (2010) considered only factors, facilitating student satisfaction with mobile learning. This study offered a model of student satisfaction with mobile learning, showing that both external and internal factors associated with the mobile learner can influence students' satisfaction with this technology.

Yordanova (2007) conducted a survey at Sofi a University about the student's attitude towards the M-learning and its integration in education environment found that among students involved in Bachelor of Science (B.Sc.) and Master of Science (M.Sc.) programs at age (19-26) years old. Researcher found that 62% accept the concept of mobile learning very much and only 10% of the respondents do not have an idea at all.

Hodgins and Duval have defined Learning Objects as any digital or non-digital thing that may be used for learning, adapting, education, and training. Learning Objects are building blocks that can be combined in a virtually infinite number of ways to construct collections that may be referred to as lessons, modules, and courses. The Learning Objects of mobile learning was divided into five types (see following Figure: 2)

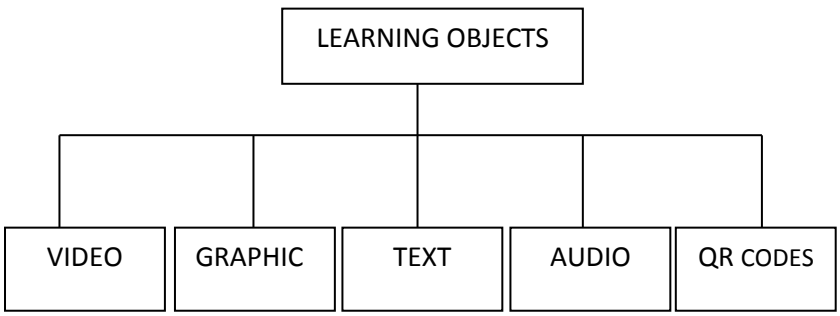

Figure 2: Learning Objects for Mobile devices.

Table 1 refers the number of research article from various reputed journals published during 2009-20016. In this review study, articles were searched on the keyword mobile learning, higher education, learning behavior and ubiquitous

learning. This review study also considered research articles which studied TAM and UTAUT models.

Table 1: Number of studies analyzed in this review by journal.

Sr.No.	Journals	No. of Article Referred	Published Year
1	(IEEE) Institute of Electrical and Electronics Engineers	27	2010 - 2016
2	Science Direct	3	2014 - 2015
3	Educational Technology and Society	3	2010 - 2015
4	MIPRO	2	2014 - 2015
5	ELSEVIER	1	2016
6	ResearchGate	1	2012
7	(BJET) British Journal of Educational Technology	1	2009
8	(CECIIS) Central European Conference Information and Intelligent Systems	1	2015
9	Electronic Journal of e-Learning	1	2012
10	IDC	1	2011
11	(IJAR) International Journal of Applied Research	1	2015
12	(IJARAI) International Journal of Advanced Research in Artificial Intelligence	1	2014
13	(IJCER) International Journal of Computational Engineering Research	1	2013
14	(IJEDICT)International Journal of Education and Development using Information and Communication Technology	1	2014

15	(IJETAE) International Journal of Emerging Technology and Advanced Engineering	1	2015
16	International Journal of Higher Education	1	2016
17	(IIMC) International Information Management Corporation	1	2015
18	(JITE) Journal of Information Technology Education	1	2014
19	(JJBA)Jordan Journal of Business Administration	1	2014
20	(MJET) Malaysian Journal of Educational Technology	1	2011
21	SAGE	1	2015
22	(TOJET) The Turkish Online Journal of Educational Technology	1	2015
Total		**53**	**2009-20016**

On the other hand, "Post-secondary non-tertiary education" (0%) and "upper secondary education" (0%) are target groups that need further research on the impact of mobile learning in educational settings. Informal learning is most important target group in the mobile learning in higher education. This review also states that mobile learning in higher education need more research.

Table 2: Target group in which ML studies were carried out.

Sr.No.	Sub-category	Number of Studies	Percentage (%)
1	Early childhood education	0	0%
2	Primary education	11	20.75%
3	Lower secondary education	0	0%
4	Upper secondary education	4	7.54 %
5	Post-secondary non-tertiary education	0	0%

6	Bachelor's or equivalent level	16	30.18%
7	Master's or equivalent level	2	3.77%
8	Doctoral	0	0%
9	Informal Learning	9	16.98%
10	Not mentioned in the study	11	20.75%

Table 3: Research samples in the studies reviewed.

Sr.No.	Sub-category	Number of Studies	Percentage (%)
1	6 to 30	5	9.4%
2	30 or less 230	17	32%
3	230 or less than 500	9	16.9%
4	Not specified in the article	22	41.5%

Regarding the "Research Methods," table 4 shows that most of the studies applied "mixed methods" (43.3%), "Qualitative-Exploratory- Experience Survey" (22.6%), "Quantitative-Descriptive research" (16.9%) and "Qualitative-Exploratory-Pilot Study" (7.5%) as research methods to conduct the study. Few studies have applied "Quantitative-Explanatory and Causal research" (5.6%) and "Qualitative-Exploratory-Case study" (3.7%).

Table 4: Research methods applied.

Sr.No.	Sub-category	Number of Studies	Percentage (%)
1	Qualitative-Exploratory-Case Study	2	3.7%
2	Qualitative-Exploratory-Pilot Study	4	7.5%
3	Qualitative-Exploratory-Experience Survey	12	22.6%

4	Quantitative-Descriptive Research	9	16.9%
5	Quantitative-Explanatory and Causal Research	3	5.6%
6	Mixed Methods	23	43.3%
7	Others	0	0%

Finally, for "Data Collection methods" as table 5 shows, most of the studies applied "Questionnaires" (54.7%), "interviews" (16.9%), "surveys" (24.5%) and "cases observation" (0%) as data collection methods. "Focus group" (3.7%). Since one study can apply more than one data collection method this study counts for more than one category.

Table 5: Data collection methods.

Sr.No.	Sub-category	Number of Studies	Percentage (%)
1	Questionnaires	29	54.7%
2	Interviews	9	16.9%
3	Surveys	13	24.5%
4	Cases observation	0	0%
5	Focus groups	2	3.7%

Table 6. Analysis Tools used.

Sr.No.	Sub-category	Number of Studies	Percentage (%)
1	SPSS 16	16	30.1%
2	SPSS 19	21	39.6%
3	AMOS 6	7	13.2%
4	NCSS 2007	2	3.7%
5	Not Specified	14	26.4

CONCLUSION AND FUTURE WORK

This review study stated that technology acceptance and its learning impact is mainly depends on various internal as well as external factors. More than 50% of the students from higher education give response effectively to their teacher. Most of the research in this review study investigated that students are actively participate class courses learning through mobile technology. This review study also investigated that there is significant improvement within higher education students in self-management, active response to the teacher, sharing ideas with peer. In the view of various studies more than 70% studies says mobile learning has great impact on learning behavior among higher education students.

Future work has scope of detailed study on factor of user acceptance and usability dimensions of m-learning application in management courses in higher education with an Indian perspective.

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Development of the CDIO Concept in Russia

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ABSTRACT

The paper is devoted to the CDIO Concept development for modernization of engineering education at graduate and postgraduate levels. Detailed analysis has shown that the CDIO Standards, initially developed for basic engineering education and training graduates for complex engineering activity, is not completely suitable for graduate and postgraduate studies, the aim of which is to prepare graduates for innovative and research engineering activities, respectively. In order to better adapt the CDIO Concept to graduate and postgraduate engineering education, the FCDI (Forecast, Conceive, Design, Implement) Standards and FFCD (Foresight, Forecast, Conceive, Design) Standards were developed for the design and implementation of MSc and PhD programs focused on graduate training for innovative engineering activity (including forecasting potential needs of society in new products) and research engineering activity (including technological foresight) respectively. The FCDI Standards and FFCD Standards are proposed in the paper.

Keywords: *engineering education, CDIO concept development, graduate and postgraduate programs, FCDI and FFCD Standards*

INTRODUCTION

The CDIO Standards are effective means for improving the quality of undergraduate engineering education. The standards are based on the CDIO (Conceive, Design, Implement, Operate) approach to training graduates prepared for complex engineering activities at all stages of the life cycle of technical products, processes and systems (E. Crawley et al 2014).

The CDIO concept is widely used, as it is consistent with the requirements of International Engineering Alliance (IEA) to the engineering Higher Education Institution (HEI)'s graduate learning outcomes (LOs) and to the competences of Professional Engineers. The CDIO Standards allow the design and implementation of BEng programs in accordance with the criteria for accreditation of engineering programs in the countries - signatories of the Washington Accord, including the accreditation criteria of the Association for Engineering Education of Russia (D. Brodeur 2012, A. Chuchalin 2012).

Since 2011 many Russian HEIs have implemented CDIO Standards to upgrade undergraduate engineering programs. In 2013 a group of 15 leading Russian universities became participants of so called "5-100 Russian Academic Excellence Project". The Project idea is to improve the prestige of Russian higher education and bring at least 5 universities from among the Project participants into the 100 best universities in the world according to the three most authoritative world rankings: QS, TIMES and ARWU (http://5top100.com/).

Nowadays the group of "elite" Russian universities – participants of the Project consist of 21 HEIs. Transition into the universities focusing on graduate and postgraduate engineering education became one of the main goals of the participants of the "5-100 Russian Academic Excellence Project". In this regard, the development of MSc and PhD engineering programs of high quality meeting international standards has gained special urgency for the "elite" group of Russian universities. To implement new strategy focusing on graduate and postgraduate engineering education, universities need a conceptual and methodological basis for modernizing and improving the quality of MSc and PhD engineering programs.

THE CDIO CONCEPT DEVELOPMENT

The CDIO concept could become such a basis. However, the concept, initially developed for basic engineering education and training graduates for complex engineering activity, is not completely suitable for graduate and postgraduate studies, the aim of which is to prepare graduates for innovative and research engineering activities, respectively (Chuchalin, Daneikina and Fortin 2016).

The graduates of MSc engineering programs should be prepared mainly for development and design of new products, systems and technologies (http://www.enaee.eu/wp-assets-enaee/uploads/2015/04/EUR-ACE-Framework-

Standards-and-Guidelines-Mar-2015.pdf). The graduates of PhD engineering programs should be prepared mainly to generate new knowledge and to transform fundamental knowledge into applied knowledge for its subsequent use in engineering, as well as scientific support of the development of new technical products, systems and technologies based on research results (Byrne, Jorgensen and Loukkola 2013).

The development of conceptual and methodological models, similar to CDIO Syllabus and CDIO Standards, but aimed at the improvement of MSc and PhD engineering programs is needed. The author of the paper led the development of the models for graduate and postgraduate engineering programs design by CDIO approach evolution. Faculty members of various departments of Tomsk Polytechnic University (TPU) when participating in the advanced training program "Global Trends and Experience in the Design, Implementation, and Quality Evaluation of MSc and PhD programs" (Prof. Arun Patil, Deakin University, Australia) as well as Skolkovo Institute of Science and Technology PhD students when studying the course "Pedagogy of Higher Education" (Prof. A. Chuchalin) actively participated in discussions of the models.

FCDI Model

In the formation of a list of intended LOs for graduate engineering program, it was proposed to use the abbreviation FCDI (Forecast, Conceive, Design, Implement) instead of the abbreviation CDIO (Conceive, Design, Implement, Operate). The absence of "O" (Operate) in a new acronym indicates that this kind of engineering activity (operation and maintenance of products, processes and systems) is not a great priority for MSc program graduates. The presence of "F" (Forecast) emphasizes the importance and great priority of forecasting potential needs of society in the new product, processes and systems.

A two-level list of intended LOs (FCDI Syllabus v1) for graduate engineering programs is given in Table 1. Section 5 (preparation of MSc program graduates for pedagogical activities) is introduced in the list of intended LOs to meet the requirements of the Russian Federal State Educational Standards for the 2nd cycle of Higher Education.

Table 1: The list of intended Los for graduate engineering programs.

FCDI Syllabus v1
1. INTERDISCIPLINARY SCIENTIFIC AND TECHNICAL KNOWLEDGE
1. In-depth knowledge of mathematics and natural sciences
1.2. In-depth knowledge of engineering and methods of innovative activity
2. PROFESSIONAL COMPETENCES AND PERSONAL QUALITIES
2.1. Analytical study and solution of innovative problems
2.2. Experimentation, research and acquisition of deep knowledge
2.3. Systematic innovation thinking
2.4. Attitude, critical analysis and creativity
2.5. Ethics, equity and other types of liability
3. PERSONAL COMPETENCES: TEAMWORK AND COMMUNICATIONS
3.1. Team leadership
3.2. Communication
3.3. Communication in foreign languages

4. FORECASTING, CONCEIVING, DESIGNING, AND IMPLEMENTING SYSTEMS IN THE ENTERPRISE, SOCIETAL AND ENVIRONMENTAL CONTEXT – THE INNOVATION PROCESS
4.1. Societal and environmental context
4.2. Enterprise and business context
4.3. Forecast and innovation management
4.4. Conceive
4.5. Design
4.6. Implementation
4.7. Leadership in innovative technical enterprise
4.8. Innovative technological entrepreneurship
5. PEDAGOGICAL ACTIVITY
5.1. Development and implementation of educational resources

Based on FCDI Syllabus v1 it is possible to generate detailed lists of intended LOs and to design the optimal structure, content, and technology of implementation and evaluation of the quality of MSc engineering programs.

In order to achieve the intended LOs (competencies of graduates), given in FCDI Syllabus v1, it was proposed to develop FCDI Standards that define the requirements to graduate engineering programs by analogy with the CDIO Standards.

Standard 1 FCDI – Context of Engineering Education.

Adoption of the principle that innovative product, process, and system lifecycle design and development – Forecasting, Conceiving, Designing and Implementing are the context for graduate engineering education.

Standard 2 FCDI – FCDI Learning Outcomes.

Specific, detailed learning outcomes for personal and interpersonal skills, and innovative product, process, and system designing and developing skills, as well as interdisciplinary knowledge and teaching skills, consistent with program goals and validated by program stakeholders.

Standard 3 FCDI – Integrated Curriculum.

A curriculum designed with mutually supporting interdisciplinary courses, as well as innovation and teaching activities with an explicit plan to integrate personal and interpersonal skills, and innovative product, process, and system design and development skills based on forecasting the needs of stakeholders.

Standard 4 FCDI – Introduction to Innovative Engineering.

An introductory workshop that provides the framework for engineering practice in innovative product, process and system design and development based on forecasting the needs of stakeholders, as well as introduces essential personal and interpersonal skills.

Standard 5 FCDI – Innovation - Design Experiences.

A curriculum that includes design projects entailing experience in engineering innovations based on forecasting the needs of stakeholders, as well as experience in teaching.

Standard 6 FCDI – Innovative Engineering Workspaces.

Engineering workspaces and laboratories that support and encourage innovative product, process, and system design and development, interdisciplinary knowledge, and social learning.

Standard 7 FCDI – Integrated Learning Experiences.

Integrated learning experiences that lead to the acquisition of interdisciplinary knowledge, as well as personal and interpersonal skills, and innovative product, process, and system design and development skills based on forecasting the needs of stakeholders.

Standard 8 FCDI – Active Learning.

Teaching and learning based on active learning and innovative methods.

Standard 9 FCDI – Enhancement of Faculty FCDI Competence.

Actions that enhance faculty competence in personal and interpersonal skills, and innovative product, process, and system design and development skills.

Standard 10 FCDI – Enhancement of Faculty Teaching Competence.

Actions that enhance faculty competence in providing integrated learning experiences, in using active and innovative learning methods, and in assessing student learning.

Standard 11 FCDI – Learning Assessment.

Assessment of student learning in personal and interpersonal skills, and innovative product, process, and system design and development skills, as well as in interdisciplinary knowledge.

Standard 12 FCDI – Program Evaluation.

A system that evaluates programs against twelve *FCDI* standards, and provides feedback to students, faculty, and other stakeholders for the purposes of continuous improvement.

FFCD Model

In the formation of a list of intended LOs for postgraduate engineering programs it was proposed to use the abbreviation FFCD (Foresight, Forecast, Conceive, Design). The absence of "I" (Implement) in the acronym indicates that participation in the production of products, processes and systems is not a great priority for PhD program graduates. The presence of "F" (Foresight) emphasizes the importance and great priority of technological foresight to anticipate potential needs of society and to create a scientific basis in the research activity for conceiving and designing new products, processes and systems.

A two-level list of the intended LOs (FFCD Syllabus v1) for postgraduate engineering programs is given in Table 2. Section 5 (preparation of PhD program graduates for teaching in HEI) is introduced in the list of intended LOs to meet the requirements of the Russian Federal State Educational Standards for the 3nd cycle of Higher Education.

Table 2: The list of the intended Los for postgraduate engineering programs.

FFCD Syllabus v1
1. NEW SCIENTIFIC AND TECHNICAL KNOWLEDGE
1.1. New knowledge in the field of basic and applied sciences
1.2. New knowledge in the field of engineering and research methods

2. PROFESSIONAL COMPETENCES AND PERSONAL QUALITIES
2.1. Analytical study and solution of scientific problems
2.2. Experimentation, research and generation of new knowledge
2.3. Systematic scientific thinking
2.4. Attitude, critical analysis of the scientific data and results of own research
2.5. Ethics, equity and other types of liability
3. PERSONAL COMPETENCES: TEAMWORK AND COMMUNICATIONS
3.1. Research team leadership
3.2. Communication
3.3. Communication in foreign languages
4. FORESIGHTING, FORECASTING, CONCEIVING, AND DESIGNING IN THE ENTERPRISE, SOCIETAL AND ENVIRONMENTAL CONTEXT - THE RESEARCH PROCESS
4.1. Societal and environmental context
4.2. Enterprise and business context
4.3. Foresight and innovation management
4.4. Forecast
4.5. Conceive
4.6. Design
4.7. Leadership in the research enterprise
4.8. Research entrepreneurship
5. PEDAGOGICAL ACTIVITY
5.1. Design and delivery of Higher Education programs

Based on FFCD Syllabus v1 it is possible to generate detailed lists of intended LOs and to design the optimal structure, content, and technology of implementation and evaluation of the quality of PhD engineering programs.

In order to achieve the intended LOs (competencies of graduates), given in FFCD Syllabus v1, it was proposed to develop FFCD Standards that define the requirements to postgraduate engineering programs by analogy with the CDIO Standards.

Standard 1 FFCD – Context of Engineering Education.

Adoption of the principle that creation of scientific basis for the development and design of innovative product, process, and system lifecycle – Foreseeing, Forecasting, Conceiving and Designing are the context for postgraduate engineering education.

Standard 2 FFCD – FFCD Learning Outcomes.

Specific, detailed learning outcomes for personal and interpersonal skills, and abilities to create scientific basis for innovative product, process, and system design and development, as well as transdisciplinary knowledge and pedagogical skills, consistent with program goals and validated by program stakeholders.

Standard 3 FFCD – Integrated Curriculum.

A curriculum designed with mutually supporting transdisciplinary courses, as well as research and pedagogic activities with an explicit plan to integrate personal and interpersonal skills, and abilities to create scientific basis for innovative product, process, and system design and development using the methods of technological foresight

Standard 4 FFCD – Introduction to Research Engineering.

An introductory workshop that provides the framework for engineering practice in creation of scientific basis for innovative product, process, and system design and development using the methods of technological foresight, as well as introduces essential personal and interpersonal skills.

Standard 5 FFCD – Research - Design Experiences.

A curriculum that includes research projects entailing experience in creation of scientific basis for engineering innovation design based on technological foresight, as well as pedagogic experience in higher education.

Standard 6 FFCD – Research Engineering Workspaces.

Engineering workspaces and laboratories that support and encourage creation of the scientific basis for innovative products, processes and systems design and development, transdisciplinary knowledge, and social learning.

Standard 7 FFCD – Integrated Learning Experiences.

Integrated learning experiences that lead to the acquisition of transdisciplinary knowledge, as well as personal and interpersonal skills, and abilities to create scientific basis for innovative product, process, and system design and development using the methods of technological foresight.

Standard 8 FFCD – Active Learning.

Teaching and learning based on active learning and research methods.

Standard 9 FFCD – Enhancement of Faculty FFCD Competence.

Actions that enhance faculty competence in personal and interpersonal skills, and abilities to create scientific basis for innovative product, process, and system design and development.

Standard 10 FFCDI – Enhancement of Faculty Teaching Competence.

Actions that enhance faculty competence in providing integrated learning experiences, in using active learning and research methods, and in assessing student learning.

Standard 11 FFCD – Learning Assessment.

Assessment of student learning in personal and interpersonal skills, and abilities to create scientific basis for innovative product, process, and system design and development, as well as in transdisciplinary knowledge.

Standard 12 FFCD – Program Evaluation.

A system that evaluates programs against twelve *FFCD* standards, and provides feedback to students, faculty, and other stakeholders for the purposes of continuous improvement.

Based on the FCDI Standards and FFCD Standards it is possible to develop, design, implement and evaluate graduate and postgraduate programs aimed at preparing graduates for innovative and research engineering activities, respectively.

CONCLUSION

The two-level lists of intended LOs for the graduate (FCDI Syllabus v1) and postgraduate (FFCD Syllabus v1) engineering programs, as well as the lists of recommendations for design and implementation of engineering programs (FCDI Standards and FFCD Standards) have been developed by analogy with the CDIO

Syllabus v2 and CDIO Standards for undergraduate (basic) engineering education. The Syllabi and the Standards are being "piloted" in TPU following new strategy as a participant of "5-100 Russian Academic Excellence Project". The FCDI and FFCD models are the results of the CDIO Concept development towards graduate and postgraduate engineering education.

ACKNOWLEDGEMENT

The author is grateful to TPU postgraduate student N. Deneikina and Skoltech PhD students, as well as to Prof. Arun Patil (Deakin University, Australia) and TPU faculty for participation in discussions concerning CDIO Concept development for graduate and postgraduate engineering programs.

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Kuban State University of Technology: Engineering Education Quality Assurance

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ABSTRACT

The paper presents Kuban State University of Technology (KubSTU), the first higher education institution in the Caucasian South of Russia. The University Quality Management System (QMS) providing high quality of engineering education is described. Strategic Development Plan of KubSTU for 2017 – 2022 and the main directions of the University QMS enhancement are discussed. The aim of the paper is to give brief information about Kuban State University of Technology, to demonstrate its vector of development and to arouse the interest of the international university community to cooperate with KubSTU in the field of engineering education quality assurance.

Keywords: *quality, management system, engineering education*

KUBSTU PORTRAIT

Kuban State University of Technology (www.kubstu.ru) was founded in 1918 as North Caucasian Polytechnic Institute in the City of Ekaterinodar (now Krasnodar). It was the first higher education institution (HEI) in the Caucasian South of Russia. The Institute began its activity in the dramatic period of revolutionary cataclysm

and Civil War in Russia. A remarkable historical fact is that the foundation of a HEI was independently supported by the two ideological opponents — Vladimir Lenin, leader of the Soviet Russia, and Anton Denikin, commander of the Voluntary White Army that fought against the Soviet Red Army.

During the Great Patriotic War (1941-1945) the Institution was evacuated to Uzbekistan because of its great state value. Many professors and students served at the front. The name of the Institution and its structure have been changed many times. From 1943 to 1963 the Institution was known as Krasnodar Institute of Food Industry. In 1963 the Institution got the name Krasnodar Polytechnic Institute. In 1993 the Institution was granted university status and was renamed for Kuban State University of Technology.

The University is one of the largest research, educational and cultural centers in the South of Russia that comprises the main campus in Krasnodar and branches in Armavir and Novorossiysk — the cities with a developed industrial complex on the Black Sea coast. The University trains engineers and specialists of other professions for high-tech industry: fuel and power industry, machine-building, industrial construction, material industry, car industry, highway engineering industry, food industry, techno-sphere safety and information security, economics and public relations.

For the time being about 20000 students study at KubSTU including 600 international students. Annual admission to the University is more than 5000 students ~~people~~. The University offers 31 Bachelor Programs, 5 Diploma Specialist Programs, 26 Master Programs and 56 Aspirantura (PhD) Programs. More than 1000 instructors two thirds of whom have Candidate or Doctor of Science degrees carried out educational and research activity.

The mission of KubSTU is "… to form intellectual potential of Russia through training of engineers with world-class competences and high civil liabilities". The University vision is: "… KubSTU is one of the leading Russian engineering schools, integrated into the world system of higher education, and focused on tiered engineering programs delivery and innovative technologies development". The basis for all types of the University activities are: "trust, honesty, leadership, academic freedom and plurality of opinions, social security of instructors and students, cultural compatibility in partner relations".

The main criterion of the efficient activity of any HEI is a successful professional and social career of its graduates. Nowadays specialists with the KubSTU diplomas and degrees are working in various industries. Their high professional competences, managerial talent and the ability to work in a team allow to make a substantial contribution to the development of the Krasnodar Region, the North-Caucasus and Russia as a whole. For almost 100 years KubSTU has trained more than 110000 highly qualified professionals for Russia and over 2200 specialists for 70 countries.

In 1948 the University was the first HEI in Kuban Region that opened its doors to international students. The main priority of the University international activity is

to consolidate its position in the world educational and research community through academic mobility of students and teaching staff; to enlarge the scope of language and professional training of international students. The basis for that are the principles of internationalism and tolerance.

For the time being KubSTU cooperates with more than 20 universities in France, Germany, China, Mongolia, Bulgaria, Ukraine, Kazakhstan, etc. The main form of cooperation is academic exchanges. Other forms include organization of international conferences and workshops, publication of the results of joint research projects, participation in international programs. Every year KubSTU students, teachers and researches are awarded with international grants and grants of the President of Russia to do research abroad. KubSTU is a member of the Black Sea Universities Network (BSUN). The cooperation with the diplomatic corps of foreign countries in Russia — embassies of France, Germany, Nigeria, Iraq, etc. is being developed.

LEADERSHIP AND QUALITY WITHIN KubSTU

Kuban State University of Technology was the first HEI of Krasnodar Region that has developed its own Quality Management System (QMS) (Zaika 2017). Today it is an essential part of the overall Quality Assurance System aimed at ensuring quality of education and research (Chuchalin and Kruglov 2011, Chuchalin and Zamyatin 2011). In 2009 KubSTU Quality Management System was first certified against ISO 9001:2008 Standard requirements. In 2012 it was successfully re-certified.

The University proved its devotion to quality through participation in the evaluation of its activity according to the EFQM Model. In 2008 KubSTU got the level «Acknowledged perfection» 4 stars. In 2011 the level was raised up to 5 stars. Within the framework of the program «Leaders of the XXI century» the University was awarded with the label of «European Quality» for its attempt to reach a high quality of products and services in accordance with European standards. Today KubSTU is registered in the Euroregister of the European Organization of Quality (Zaika et al 2017).

International accreditation of engineering programs is an important component of the KubSTU QMS. In 2014 Bachelor program “Technology of fermentation and wine making” and Bachelor program “Bakery technology” as well as Diploma Specialist program “Technology of perfumery and cosmetic products” were accredited with a quality mark “EUR-ACE Label” by the Association for Engineering Education of Russia (AEER), a member of the European Network for Accreditation of Engineering Education (Chuchalin and Shamritskaya 2015, Chuchalin and Shamritskaya 2016).

In 2015 by the decree of the Government of the Russian Federation the Kuban State University of Technology was awarded the “Government Prize of Quality” for

achieving significant results in the field of quality of products and services and the introduction of effective and efficient methods of quality management. This prestigious governmental award was a logical continuation of the road to perfection.

The transition of the University to a new level of the quality of higher education (HE) is conditioned by the introduction of a new Federal Law "On Education" and integration processes associated with the establishment of a network of Federal Universities and universities of the category "National Research University" in Russia. For KubSTU community, these changes meant changing the long-term practice of educational activity in the absence of real competition. The University analyzed the world trends in the development of HE and elaborated new strategic priorities and system-wide measures for the education and training of engineers of new generation.

The University strengthened its ties with industrial enterprises, engineering and research organizations and small business in high-tech sectors of the economy interested in personnel training. The University increased requirements to the content of the HE programs focused on the graduate intended learning outcomes (LOs) coordinated with the key stakeholders. The University introduced new active and interactive teaching and learning methods, developed e-learning resources, and created student-centered learning environment. The University paid special attention to internationalization of HE and development of academic mobility.

The University continues working on integration of internal monitoring of the design and implementation of the HE programs in the QMS, taking into account international standards and the best practices of the world leading universities. The University has created and is developing an expert groups that consist of leaders of the academia and industry as well as representative of the governmental and public organizations.

Among the experts are: certified experts in the field of the state accreditation and AEER professional accreditation, experts of the Government of the Russian Federation and CIS, members of committees of the Russian “State Standard” organization and the “Russian Foundation for Basic Research”, experts of the Legislative Assembly of the Krasnodar Region, members of Chamber of Commerce and Industry of the Russian Federation, Union of Industrialists and Entrepreneurs, experts of the Russian and international professional societies and associations.

EMBRACING THE FUTURE

Improving quality of research and higher education has become the principal target for KubSTU. The University's understanding of the society needs and consumer expectations are defined in the Mission. According to KubSTU Quality Policy and Strategic Development Plan for 2017 – 2022 the main tasks for the University are the following:

- development of the Centers of Excellence in priority areas of research and higher education based on networking with leading Russian and foreign HEIs, research centers, Russian and international high-tech companies, and leading enterprises,

- creation of the regional platform for popularization of engineering education and engineering profession on the basis of the University,

- creation of the internal competitive environment for KubSTU staff to achieve the strategic goals of the University,

- improvement of mechanisms for increasing the efficiency of KubSTU staff research and educational activity,

- integration of research and education to improve the quality of student education and practical training,

- integration of the KubSTU into the international academic community through developing academic exchanges and joint degree programs,

- development of the culture of creativity, innovations and self-realization of the University students through problem-based and project-oriented learning,

- systematic monitoring, analysis and improvement of the effectiveness and efficiency of the KubSTU activities in the design and implementation of HE programs based on criteria of competitiveness (topicality, uniqueness, demand, efficiency and partnership) in order to identify strengths, areas for improvement and opportunities to be realized,

- integration of the University HE programs into the national and international system of qualifications.

The main directions of the future KubSTU QMS development are as follows:

- modernization of QMS based on new (2015) version of "Standards and Guidelines for Quality Assurance in the European Higher Education Area" (ESG),

- implementation of new (2015) version of the "European Credit and Transfer System" (ECTS) when organizing the educational process,

- focus on new (2015) version of the "EUR-ACE Framework Standards and Guidelines" when engineering Bachelor and Master programs design and delivery,

- focus on the "IEA Graduate Attributes and Professional Competences" when defining intended LOs for engineering Bachelor and Diploma Specialist programs,

- application of the CDIO Approach to engineering BSc, MSc and PhD programs design and delivery (Chuchalin, Daneikina and Fortin 2016).

The HR Management System as a part of the KubSTU QMS will be developed based on newly (2015) introduced Russian Professional Standard “Instructor of Vocational Training, Higher Education and Professional Development" and the requirements of the International Society for Engineering Pedagogy (IGIP) to competences of engineering educators. To meet the requirements of the Russian and international standards the University teaching staff should be able to:

- conduct educational activity in accordance with the legislation of the Russian Federation based on the local HEI regulations governing the work of instructor, take into consideration the global trends and developments in higher education,

- contribute to the implementation of the HEI mission, to form its positive image, strengthen the authority, to develop the HEI traditions, values and corporate culture, to build relationships with colleagues based on mutual understanding and cooperation,

- organize the educational process in the student-centered learning environment with a priority of student self-study under the guidance of instructor vs traditional teaching,

- communicate effectively, to ensure the unity of education and training, to develop student creativity, motivation and semantic values,

- follow the principles of tolerance and humanism, to respect student rights, teaching ethics, moral and ethical standards of communication with students and colleagues, to work in a multicultural environment,

- design educational programs and courses in accordance with the Russian Federal State Educational Standard requirements and (or) HEI educational standard, to define program objectives, intended LOs, and choose the best strategy to achieve them in cooperation with key stakeholders and strategic partners of the HEI,

- use educational technologies, optimally combining various forms of organization of educational process and methods of activation of student activity to achieve intended LOs and objectives of higher education program,

- participate in networking with partners to develop and implement joint programs and academic mobility programs, including international ones,

- use modern ICT tools and technologies for the organization of educational process and students' self-study with on-line and off-line use of e-learning resources,

- apply adequate and objective methods and tools for monitoring and assessment of students LOs and HE program objectives,

- objectively and adequately perform self-assessment of educational activity, adjust it according to the needs of the educational process, continuously develop pedagogic competences and improve professional qualification in the subject area.

CONCLUSION

Kuban State University of Technology, the first HEI in the Caucasian South of Russia, has developed Quality Management System based on the requirements of international Standards ISO 9001:2008 and EFQM Model. The KubSTU QMS is certified and registered in the Euroregister. The University engineering programs are accredited with a quality mark "EUR-ACE Label". In 2018, Kuban State University of Technology will celebrate the centenary of its founding. On the eve of the anniversary, the University plans for the future. The KubSTU Strategic Development Plan for 2017 – 2022 is focused on the Centers of Excellence in priority areas of research and higher education, popularization of engineering education and engineering profession, integration into the international academic community. One of the KubSTU's main priorities is improving the quality of engineering education to the level of international standards (ESG, EUR-ACE, CDIO, etc.) and best practices of the world's leading engineering schools. To solve this ambitious task, the University mobilizes its scientific and educational resources, develops international cooperation, increases the qualification of personnel and improves the quality management system.

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Educating our Engineers to Preserve What we have

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ABSTRACT

Structural engineering education has not kept pace with the need to preserve our infrastructure. Though it covers the analysis, design and construction of new structures such as buildings and bridges, it does not include the information required to preserve our infrastructure. Our bridges, buildings, dams, etc., are normally designed for long life spans, but changes in loads, deterioration with age and random actions can cause structural damage which if not fixed early can lead to structural collapse with adverse consequences. Research has however progressed to develop methods for monitoring the health of infrastructure and detecting any distress at its on-set. This paper argues for a paradigm shift in structural engineering education in order to include this new research knowledge on Structural Health Monitoring (SHM). To this end, SHM is first explained and illustrated in this paper which then provides a brief coverage of the basic material that needs to be embedded into the structural engineering subjects to educate engineers on preserving our infrastructure in a healthy state.

Keywords: *Engineering Education, Preserving Our Infrastructure, Health Monitoring, Vibration Characteristics, Damage Detection, Computer Based Methods*

INTRODUCTION

Construction and development are on-going activities around the world. New buildings, bridges, pipelines, dams, multi-purpose towers etc. are being designed and constructed to keep pace with the development. Despite this thrust for new infrastructure, there is already a large amount of existing infrastructure that keeps our cities and countries functional. In all universities, engineering undergraduates are taught the analysis, design and construction of new structures and this is important and must go on. But, are they taught how to preserve what we already have? Some of the buildings, bridges and dams could be several decades old and may be subjected to age or load related deterioration. Under these conditions, they may be in distress and if left unattended can result in failure or collapse of the structure, with catastrophic consequences. We have seen the sudden collapse of many structures, especially bridges, around the world, despite the routine

inspections. As engineering educators, what can we do to help prevent this? Our engineers must be taught how to monitor and evaluate the health of these valuable structures and to carry out the necessary retrofitting at the on-set of damage to prevent the failure of these structures. This will prolong the lives of these structures and enhance their safety and that of the users.

Civil infrastructures such as bridges, buildings, dams, etc., are normally designed to have long life spans. Changes in load characteristics, deterioration with age, environmental influences and random actions such as impacts, may cause damage in these structures. Real world example of an aging infrastructure is the 75 year old Story Bridge in Brisbane shown in Figure 1. It needs continuous monitoring of its structural health as it is now subjected to increased and faster moving loads and might have also suffered deterioration due to environmental effects. Structural Health Monitoring (SHM) has emerged as a viable method to monitor the health of structures and to predict the on-set of damage (Chan and Thambiratnam, 2011). If damage is detected during such an evaluation, appropriate retrofitting can be carried out to prevent collapse of the structure. Vibration based (VB) SHM methods, which give a global damage assessment, are promising and have attracted much attention in recent times. The principle of VB methods is that the vibration characteristics (natural frequencies and mode shapes) of a structure are functions of its stiffness and mass distributions. When there is damage in a structure, its stiffness changes which in turn causes variations in the vibration parameters, which can hence be used as an effective indication of structural damage (Shih et al, 2009). SHM has been implemented in many bridges and in some other structures. The Australian Bridge Design code has made it mandatory for all new bridges to have a SHM system. This is because visual inspections are not comprehensive due to difficulties in accessing the entire bridge, especially the larger bridges. In the area of SHM both research and education merge, as they should, and the benefits of research are captured in formulating the SHM knowledge that needs to be imparted to our engineers.

At the Queensland University of Technology (QUT), VB SHM research has been progressing at a rapid pace during the past decade. Using the new knowledge from research, we have introduced SHM in the curriculum of the Structural Engineering major. The students will not only study the basic theory, but also carry out computer simulations to establish that SHM does work. We also have some final year projects that will enable our undergraduates to capture the benefits of SHM through simple experiments and computer simulations. VB SHM can only be introduced after some knowledge in structural analysis, structural vibration and computer modeling are imparted to the students. These young engineers will then be armed with the knowledge to apply SHM in practice. We propose postgraduate and continuing professional development courses to practicing engineers who may not have had the privilege of learning SHM during their undergraduate studies.

SHM has proved to be a very important research area due to the importance of preserving our infrastructure. Fast computers, sophisticated instrumentation and comprehensive numerical methods have enabled the rapid growth in SHM research. At QUT, we have been able to incorporate some of the important research findings into the structural engineering curriculum. This paper will first present the basic

theory of VB SHM, highlight some of the applications of SHM through research carried out by the author and his colleagues and then capture the relevant knowledge that needs to be embedded into structural engineering education to enable our engineers to apply SHM techniques in real life. To the best of my knowledge, this is the first paper that argues for the inclusion of SHM into the structural engineering curriculum. An engineer with knowledge of SHM will be able to monitor the health of a structure and determine the presence of any damage and its location. This technique will be especially valuable when the damage location is not readily accessible. The outcome of our proposed SHM education will contribute towards the safe and efficient operation of our infrastructure during their intended service lives.

Figure 1: story Bridge, Brisbane.

VIBRATION BASED STRUCTURAL HEALTH MONITORING – THEORY

There are 4 levels in damage assessment (Shi et al, 2009, 2011). They are detecting damage (Level 1), locating damage (Level 2), quantifying damage (Level 3) and predicting the remaining service life of the damaged structure (Level 4). Most of the work done to date pertains to stages 1 and 2 while a small amount of work has ventured into stage 3. The theory presented below will hence pertain to stages 1 and 2. The two basic VB damage indices (DIs) for damage assessment are those based on the modal flexibility (MF) and the modal strain energy (MSE). They depend on the changes in the modal properties of the structure due to damage. Only the theory of the MF based DI and its applications are treated in this paper for want of space.

The Modal flexibility MF at a location *"j"* (in a 1 dimensional structure such as a beam) includes the influence of both the mode shapes and the natural frequencies, as shown in Equation (1) below where the summation in *"i"* includes the number of modes to be considered (Shih et al, 2009).

$$[F_j]=\Sigma[\phi_{ji}]^T[\phi_{ji}][1/\omega_i^2] \quad (1)$$

In the above equation, $[\phi_{ji}]$ is the value of the *"i"*th mode shape at location *"j"* and $[1/\omega_i^2]$ is the reciprocal of the square of natural frequency of mode *"i"*. MF decreases as the frequency increases and hence it converges rapidly with increasing values of frequency. Therefore, from only a few of the lower frequency modes, a good estimate of the MF can be made. The change in MF due to structural deterioration is given by

$$\Delta F_j=[F_j]^d-[F_j]^h \quad (2)$$

In the above equation superscripts 'd' and 'h' refer to the healthy and damaged states respectively. In some cases a modified form of this DI gives better results in damage assessment. It is defined as

$$(\Delta F\%)_j=\{([F_j]^d-[F_j]^h)/[F_j]^h\}x100 \quad (3)$$

The subscripts in the above equations will be *"jk"* to indicate a location in a 2D plate structure such as floor slab or a bridge deck.

RESEARCH – APPLICATIONS OF SHM

Research at QUT has seen the application of SHM to a variety of structures. It used both the VB DIs for damage assessment in (i) beam and plate structures which are important flexural members in buildings and bridges, (ii) bridges of different types and (iii) dams. Some the results using the MF based DI are presented below.

Damage Detection in Beam and Plate Structures

Beam and plate structures are important structural components of many buildings and bridges. Finite Element (FE) models of the beam and plate structures are first developed and their modal responses are obtained using the FE software package SAP2000. After validation of these initial FE models through limited experimental testing, additional FE models of the beam and plate structures, first without damage and then with different damage patterns are selected for investigation. In the present example, the beam is of steel with a length of 2.8m and cross-sectional dimensions of 40mm width by 20mm depth. The Young's Modulus, Poisson ratio and density are 200GPa, 0.3 and 7850 kg/m^3 respectively. It is modelled using plane stress elements. The plate is also of steel and is 2.5 m long x 1m wide and 2mm thick. Young's Modulus, Poisson's ratio and density of the plate are 210GPA, 0.3 and 7800 kg/m^3 respectively. It is modelled using plate elements.

As shown in Figure 2 (L) two damage sizes, size A and size B are considered in the beams. Size A represents a smaller damage size than size B. Dimensions of size A are 10mm long x 5mm deep x 40mm wide while dimensions of size B are 20mm long x 5mm deep x 40mm wide. The top part of Figure 2 (L) represents a single damage at mid-span of a single-span beam while the bottom part of this Figure shows a two-span continuous beam structure (having equal spans) with size A and size B damages at the middle of the first and second spans respectively. To simulate damage in the beams, the selected damaged elements are removed from the bottom of the beams in the FE models. The damage in the plate as illustrated in Figure 2 (R) is simulated by reducing the Young's Modulus of the selected element by 40%.

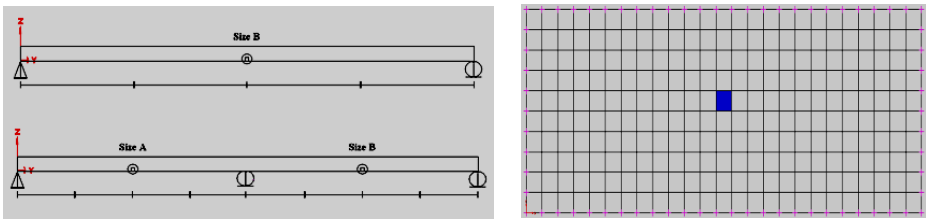

Figure 2: Damage cases: (L) single (top) and double (bottom) beam damages and (R) plate structure dmage.

The primary vibration parameters of natural frequencies and mode shapes of the first five modes of these structures, before and after damage, are extracted from the results of the FE modal analysis. These parameters are then used to calculate the DIs using Equation 3. The DIs are then plotted along the 2 beam structures and across the plate structure. The peaks of the DIs indicate first that there is damage and then the locations of the (simulated) damage in the structures under the particular damage scenario. The details of modal testing, FE modelling of beams and plates and validation are described elsewhere (Shih et al, 2009).

Figure 3 shows the plots of the DIs in the beam structure with single and two damages respectively, while Figure 4 shows the plot of DI across the plate structure. It is evident that in all cases, the peak values of the DIs accurately predict the location of damage in the structure. Furthermore, it can be noticed from Figure 3 (R) that peak value of the DI is higher when the damage size is larger. This information can be used in damage quantification (level 3 of damage assessment) which is currently being pursued. The above results confirm that the MF based DI can successfully detect and locate damage in beam and plate structures. Several other cases were also treated to establish this feature and the details can be found in Shih et al (2009). Research has progressed to apply damage detection techniques to slab-on girder bridges (Shih et al, 2013) and more recently to quantify the damage in beam structures (Tan et al, 2017).

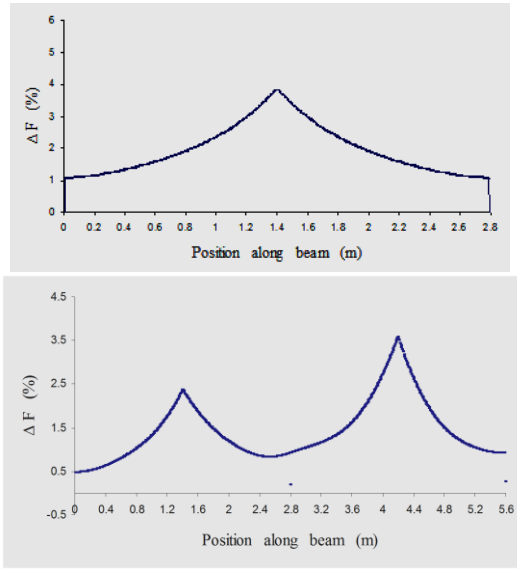

Figure 3: Plots of DI along beam: L single damage and R 2 damages.

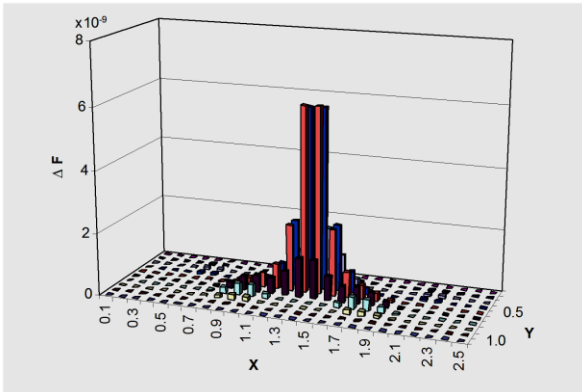

Figure 4: Plot of DI across plate

Damage Detection in the Cables of a Suspension Bridge

Suspension bridges are large structures and onset of damage in their cables can often be missed as the cables are usualluy covered by tubing. The importance of SHM and damage detection in these structures is hence evident. Figure 5 shows the Ölfusá Suspension Bridge in Iceland. This bridge was selected for the SHM research as it had been tested and the vibration data was available to validate the computer model.

Figure 5: Ölfusá Suspension bridge, Iceland

A FE model of this bridge was developed and validated by comparing the numerical results for frequencies and mode shapes with the measured results. Two damage scenarios were considered: (i) damage at mid span and (ii) damage at three quarter span, both inflicted on the upstream (blue) cable. The DI used in this research was also based on the MF, but considered the first 5 natural frequencies and only the vertical components of the first five mode shapes. Figure 6 shows that the modified form of the DI is able to accurately detect and locate the damage in the 2 cases.

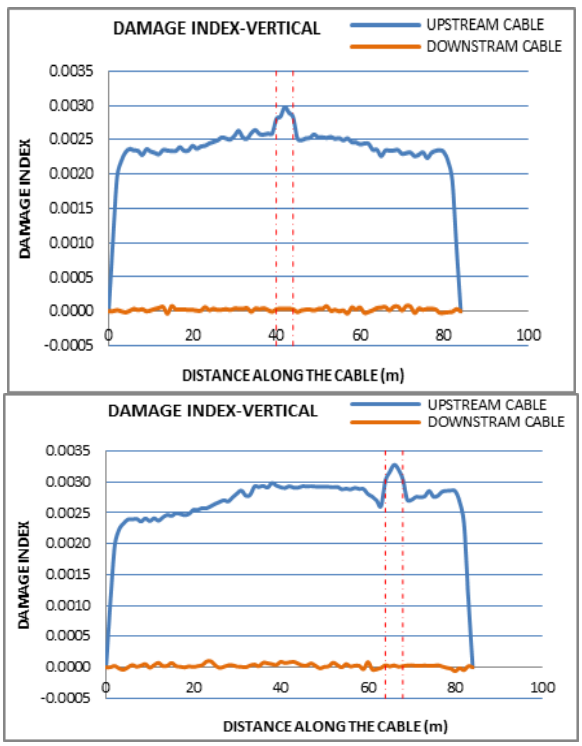

Figure 6: Damage in upstream cable L mid span damage and R ¾ span damage.

Other damage scenarios involving different damage intensities and multiple damages were also treated. Results showed the versatility of the selected DI to detect and locate damage in the cables of the suspension bridge (Wickramasinghe et al, 2016).

Damage Detection in a Dam

As shown in Figure 7, dam structures are large structures. Damage in a dam structure can be catastrophic and must be avoided. It is quite possible that initial distress in a dam can be missed and this can lead to dam failure. SHM research in dam structures is hence important to avert the drastic consequences of dam failure.

Damage detection in a dam structure will involve 2 stages. At first the damaged cross-section must be identified and then the damage in that cross-section must be located.

Figure 7: Sutton Dam in West Virginia, USA.

Towards this end, damage detection in the longitudinal direction of a typical dam structure was first carried out by using the MF based DI (Equation 3), but using either the vertical or the horizontal components of the mode shapes. Figure 8 shows the FE model of the dam and the damage in section 2. Figure 9 shows that both the component specific DIs are able to detect the (red) damaged cross-section accurately.

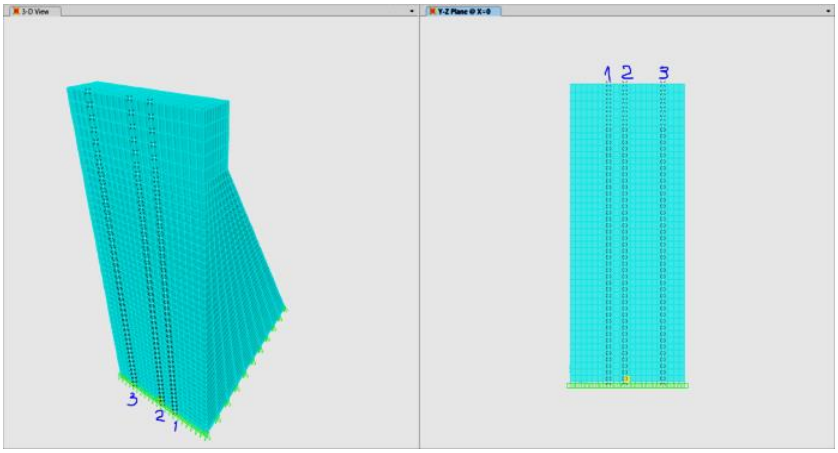

Figure 8: Model of dam structure and damaged section.

Once, the damaged cross-section is identified, the location of damage in that cross-section needs to be determined. In this example, damage was inflicted at the base on the up-stream side of the dam as shown in Figure 10 (L). This damage location was correctly identified by the DI based on MF. Figure 10 (R) shows the successful outcome of the MF based DI using only the first mode of vibration. This research is in progress and some of the interesting results have been presented in (Le et al, 2016).

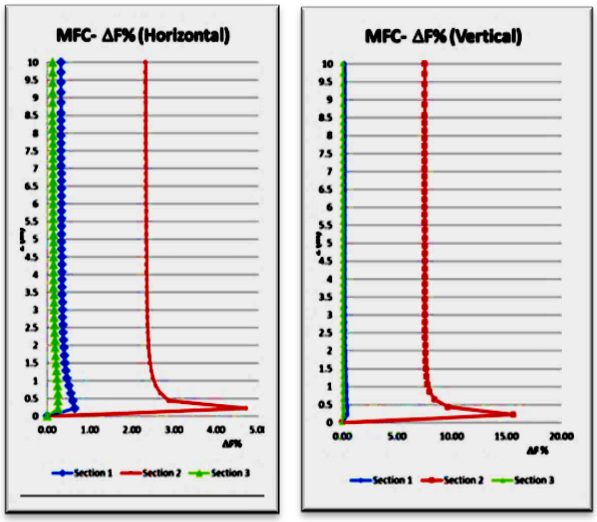

Figure 9: Locating damaged cross-section.

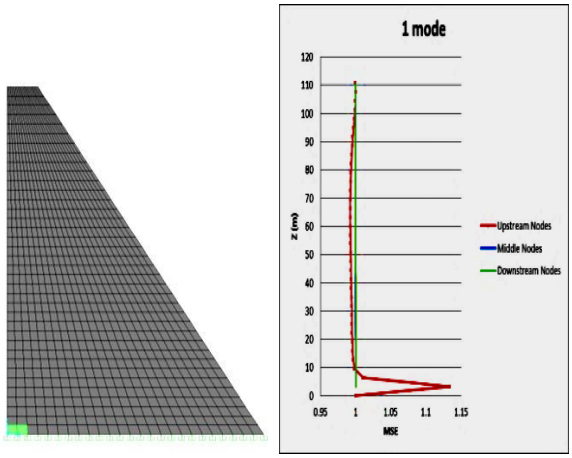

Figure 10: Locating damage using 1 vibration mode.

INTRODUCING SHM INTO STRUCTURAL ENGINEERING EDUCATION

Research at universities must find applications in real life in order to be meaningful. This is best achieved by bringing the research findings into our lecture theatres so that this new knowledge can be imparted to our engineers who in turn will apply this to benefit the community. SHM is a classic case in which research feeds into engineering education. Structural engineering education in all the universities will include subjects such as (i) structural mechanics, (ii) structural analysis and (iii) structural design. Few universities will include FE modelling, structural dynamics and vibration. The following is a 3 stage procedure to impart the required SHM knowledge to our future engineers to enable them to preserve our infrastructure in a safe and efficient operating condition. The SHM specific material is at undergraduate level and can easily be taught and applied within a semester (3 months). This is what we are doing in our university, through a 3 stage process.

Stage 1: Fundamentals of structural engineering – available in most universities:

It is necessary for the following topics to be taught at stage 1 as a part of the usual structural engineering syllabus, prior to imparting knowledge in SHM theory and applications.

1. Structural analysis – especially the stiffness method
2. Structural dynamics and vibration
3. Finite element method (FEM)

4. Computer solutions including free vibration analysis of typical structures such as beams, frames, trusses and free vibration problems under plane strain conditions such as in dams, pipelines, etc.

Stage 2: Additional topics required to cover the basics of SHM

1. Vibration characteristics: mode shapes and frequencies (i) how to measure them in real structures and (ii) how to obtain them from computer simulations.
2. Mode shape vectors and calculation of Modal Flexibility based DI
3. Instrumentation and their use: accelerometers and data acquisition systems

Stage 3: Applications through projects using computer simulations and/or experimental testing

Some examples include:

1. Beams – 1 span and 2 spans
2. Cables as part of a suspension bridge
3. Dams – treated as a plane strain problem (theory already taught under FE modelling in stage 1). Only the cross-section of the dame needs to be treated and this is well within the scope and ability of undergraduate students.

CONCLUSIONS

Preserving our infrastructure is important, despite the thrust for new construction. At present structural engineering education does not cover the information required for this, despite the considerable amount of research on preserving our infrastructure through health monitoring. The availability of sophisticated instrumentation, fast computers and dynamic computer simulation techniques has enabled such research. In this paper I have briefly explained the benefits of structural health monitoring (SHM) and highlighted some of the relevant research carried at QUT. I have then argued for the need to include some of the research findings into the structural engineering education. This will inform our engineers on how to preserve our infrastructure. The outcome will be safer and more efficient infrastructure with socio-economic benefits to the community.

I wish to thank my co-researchers Professor Tommy Chan, Dr. Henry Shih, Dr. Wasanthi Wickramasinghe and my PhD student Tony Le for their contributions.

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ORGANIZE EXPERIENTIAL LEARNING ACTIVITIES IN TRAINING THE COLLABORATIVE PROBLEM SOLVING SKILL OF STUDENTS AT HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY AND EDUCATION

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ABSTRACT

Collaborative problem solving (CPS) skill is a combination of collaborative skill and problem solving skill which is a very necessary for people at any work position. However, many researches on CPS have concentrated on assessing the skill than developing it. Therefore, this research has been carried out to find solutions to develop this skill through organizing teaching and learning activities especially experiential learning activities. Based on a combination of experiential learning (EL) cycle and CPS process, a proposed CPS skill training solution was integrated into teaching methods. A pilot experiment was used to test the relevant of the proposed framework in developing students' CPS skill for Planning Skill subject. As a result, a framework for training CPS skill along with other subjects' knowledge and skills through organizing experiential learning activities was propounded. The pilot application showed that it was quite easy for teachers to apply the proposed framework in designing and implementing activities for the subject. In addition, the results also indicated that students' performances were developed in both related subject's skills and CPS skill. However, this framework needs to be further tested through other subjects, especially in technical subjects.

Key words: *collaborative, problem solving, collaborative problem solving skill, experiential learning, experiential learning activities.*

INTRODUCTION

It is obvious that graduated students need to have professional as well as general or core competencies (teamwork, communication, problem solving and so on). Professional competencies refer to competencies directly related to specific jobs, while general or core competencies are not professionally relevant, but essential for performing tasks. To meet this expectation, the CDIO (conceive, design, implement and operate) approach in developing curriculum has been applied since 2012 at Ho Chi Minh City University of Technology and Education (HCMUTE) for all majors. In every syllabus, problem solving and multi-disciplinary teamwork skills are required among 17 learning outcomes of any subject (Edward Crawley, 2007). The two skills are classified in two different categories, the former belongs to personal and professional skills while the latter is classed in interpersonal skills. Those are very close together, in which collaborative skill seems to be the most important tool to solve problem, and problem solving is the purpose of cooperation. Thus, to combine these two skills, the CPS skill with the purpose of emphasizing the cooperate role of group members in solving problem has been developed. In addition, this skill has been implementing in PISA 2015 to assess high school students by OECD. Therefore, CPS skill need to be trained to meet society's requirements. In schools, applying experiential learning approach in training is one of the effective ways to develop the CPS skill.

Experiential learning (EL) is a teaching approach requiring students participate in practical learning contexts to self-construct their experience. It is the main method in conducting the CDIO curriculum. Many researches indicated that EL helps students develop professional competencies as well as general competencies (Hollis, Francine H.; Eren, Fulya, 2016; Wei Wu, Brad Hyatt, 2016; Jack and Kristen, 2011), such as leadership skill (David Kolb, 1982; Ellen Van Velsor và Joan Gurvis, 2007; Gregg Morris Warnick, 2014), teamwork skill (Hoa Le Thi Minh, 2015; Kevin Eikenberry, 2007), interpersonal skills (Philip Burnard, 1989; Mel Silberman, 2007). However, applying EL in training and developing CPS skill has not been researched. Therefore, our study concentrated on studying this matter. Based on the literature framework of organizing EL activities and CPS skill we will propose a solution to train the CPS skill by organizing EL activities in different subjects of the CDIO curriculum at HCMUTE. We tested this solution in teaching Planning Skills subject.

LITERATURE REVIEW

Organizing Experiential Learning Activities

The development of EL, or learning based on experience existed in philosophy for a long time (Jitka Kujalová, 2005; Adamson, 1911; Colin Beard and John P Wilson, 2006). However, Dewey was, arguably, the foremost exponent of the use of experience for learning, and the word occurs in a number of titles of his books (Colin

Beard and John P Wilson, 2006). After his work, many researchers have studied in this field with different definitions and approaches. These definitions can be classified into two main ways. The first approach emphasizes learning form experience or beginning with experience (Hutton, 1989; Saddington, 1992; Jarvis, 1999; David Kolb, 1984; Colin Beard, John P. Wilson, 2013) to provide direction for making of judgments to choose learning actions (Hutton, 1989), or transforming to create knowledge (David Kolb,1984), skills, attitude, emotions, values, beliefs, senses (Jarvis, 1999). The second tendency focuses on the direct and positive participation of learner in learning process to form and develop personal experience (Dewey, Colin Beard and John P Wilson, 2006; Chickering, 1977; McGill and Warner Weil, 1989; Cantor, 1997; Malinen, 2000; Mel Silberman, 2007). In this paper, we have followed the latter approach by designing and organizing EL activities whereby students can take part in to form and improve CPS skill along with a subject's knowledge and skills.

Although there are many researches on EL model but Kolb's four stages EL cycle has been well-known. The cycle is showed in a figure 1:

The cycle may be entered at any point, but the stages should be followed in sequence. The learning cycle therefore provides feedback, which is the basis for new action and evaluation of the consequences of that action. Learners should go through the cycle several times, so it may best be thought of as a spiral of cycles (Mick Healey & Alan Jenkins, 2000).

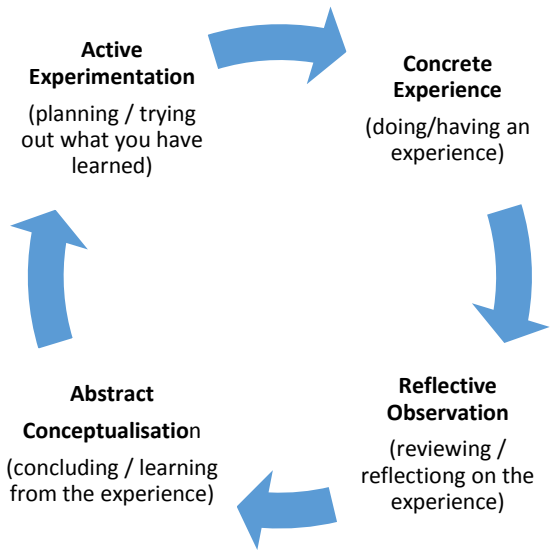

Figure 1: Kolb's cycle of experiential learning.

Researches on EL field has studied not only in definitions, processes but also in experiential teaching methodologies. These methods are associated with the stages of Kolb's EL cycle in the following table (Laird, 2003; Ágota Dobos, 2014).

Table 1: Teaching methods relation in Kolb's experiential learning stages.

Kolb's stage	Teaching methods
Concrete experience	Simulation, case study, field trips, real experience, demonstration, role play, game, project-based learning, job rotation, small group
Observe and reflect	Discussion, small group, designated observers, self-tests, reading, coaching, counseling, mentoring, feedback assessment, workplace observation, networking, shadowing, briefing instructional films
Abstract conceptualization	Sharing content, guide discussion, lecture, presentation…
Active experimentation	Laboratory experiences, on-the-job experience, internships, practice session, job rotation, working in real situation

Collaborative Problem Solving Skill

Collaborative problem solving were defined in different ways such as: "the process people employ when working together in a group, organization, or community to plan, create, solve problems, and make decisions" (David Straus, 2002); "CPS skill is a performance activity requiring groups of students to work together to solve problems" (Kyllonen, 2012); CPS means approaching a problem responsively by working together and exchanging ideas. (Patrick Griffin, Esther Care, 2012). Based on these definitions, in this article, CPS is a process whereby students work together in groups to share ideas to solve problem rather than working alone; CPS skill is explained as performance activities that require groups of students work together to solve problem.

Most of researches have tried to find out structures of CPS and ways to assess it, but have not much paid attention to develop a CPS procedure. However, it is very necessary to have a guidance for training CPS skill in this research, therefore, we will develop a CPS process by combination of collaborative process with problem solving process. The collaborative process mentioned on four main steps: group formation and process design, consensus building, implementing consensus

decision and situation assessment (National Conservation Training Center). The IDEAL problem solving model (Bransford and Stein, 1984), described five stages to solve a problem: **I**dentifying potential problems, **D**efining and representing the problem, **E**xploring possible strategies, **A**cting on those strategies, and **L**ooking back and evaluating the effects of those activities. Because CPS emphasizes the role of group's consensus in problem solving, so five steps will be proposed in the CPS process. They are:

❶: Form a group and consensus in identify potential problems
❷: Consensus in defining the problem
❸: Consensus in deciding possible strategies
❹: Implement consensus decision/solution
❺: Look back and do assessment

PROPOSE A SOLUTION IN TRAINING COLLABORATIVE PROBLEM SOLVING THROUGH ORGANIZING EXPERIENTIAL LEARNING ACTIVITIES

Cater for training CPS skill along with subject's knowledge and skills through organizing EL activities, a combination of CPS process and experiential methods in Kolb's EL cycle was proposed. The framework below shows learning outcomes, suggested CPS steps and teaching methods in each stage of the Kolb's cycle.

Table 2: Framework for training the CPS skill through organizing experiential learning activities.

Learning outcomes	CPS steps	Teaching methods
Stage 1: Concrete experience		
Students get initial experiences toward learning content and CPS procedure.	Steps ❶, ❷, ❸ and ❹	Simulation, case study, field trips, real experience, role play, game, job rotation, small group
Stage 2: Observe and reflect		
Students reflect what they had observed or done about learning content and CPS procedure.	Step ❺	Discussion, self-tests, counseling, mentoring, feedback assessment, workplace observation,

Stage 3: Abstract conceptualization		
Students generalize what they have observed or solved and reflected into concept, theory, rules…	Step ❸	Guide discussion, sharing content, presentation.
Stage 4: Active experimentation		
Students practice skills of the subjects by CPS process in to new/real situations.	Steps ❶, ❷, ❸, ❹ and ❺	Laboratory experiences, practice session, on-the-job experience, internships, job rotation, working in real situation.

ORAGNIZING EXPERIENTIAL LEARNING ACTIVITIES TO TRAIN CPS SKILL AMONG STUDENTS UNDERGOING A SBUJECT ON PLANNING SILLKS AT HCM UTE

Planning Skills subject is two credits subject in 150 credits training curriculum at HCMUTE. This subject support students to develop some skills in workplaces such as: planning, organizing, time management and interpersonal silks. This subject usually is scheduled in second or third semester of every school years. Main learning outcomes of the subjects are:

1. State and explain definitions, structures, roles, characteristics, and classifications of a plan.
2. Describe the procedures of making plan.
3. State and implement time management methods and rules in real situations.
4. Define and write suitable personal / task objectives.
5. Design and implement appropriate strategy plans as well as operational plans for personal and for work.
6. Develop collaboration, time management, planning skills.

After analyzing the subject's learning outcomes and contents, combining with the proposed solution to train CPS skill through EL activities, we designed five EL exercises to train CPS skill. Five exercises belong to four stages of Kolb's cycle. In this framework teaching and learning activities relate to proposed CPS process. These exercises will be described in the order of the Kolb's stages. In addition, in every exercise, will be outlined a name, purposes, expected outcomes, teaching methods, teaching and learning activities, and some results.

Stage 1: Concrete experience

Exercise 1: Work in group within 6 days: Designing and implementing a plan to: Collect designed plans belonging to the classification; Define general structures of collected plans; Make a plan to design a presentation and present the results.

7. *Expected outcomes:* student able to: Design and implement the whole plan to complete all requirements in the exercise; Each group summits in time one file includes: cover page; automatic table of content; Plan of the assignment; collected plans and structures of collected plans.

8. *Purposes:* help students get an initial experience on designing and implementing a group plan; Classify collected plans in to suitable classification criteria and define general structure of each collected plan; Have an overview of all types of plans; Get acquainted with the CPS process.
9. *Teaching methods:* small group, real experience.
10. *Main teaching and learning activities*

Table 3: Teacher's activities (T'sA) and student's activities (S'sA) of exercise 1.

Teacher's activities	Student's activities
Divide students into groups by random (5-7 students/group)	Establish group
Ask students to select: facilitator, secretary, time control, team members… and collect members' contact information (phone number, email, Facebook)	Select: facilitator, secretary, time control, team members… and make a list of contact information.
Assign and guide exercise	Identify potential problems
Guide discussion (use the tablecloths discussing technique)	1. Each member gives his/her own ideas about defining problem and possible solutions by writing down. 2. Discuss to consensus. 3. Design the plan to implement the possible solution.
Contact with students via forum and email	Implement the consensus plan and submit the results as schedule.

11. *Results:* After application in two classes we found that most of groups discussed actively in class, submitted their results timely, collected suitable plans in each classification and defined structure of most of collected plans. However, their group plans were not so well because of lacking some main information and having many unclear parts. Few groups did not define possible strategies in solving the exercise. Some students lost contact with his/her group and did not know how to solve it, so they did not complete the exercise. Worst, there was one group did not summit their results because of all members could not contact with their facilitator, they also did not contact each other and with teacher as well.

Figure 2: Illustration for discussion using tablecloths technique.

Stage 2: Reflective Observation

Exercise 2: All members in group collaborate to present and evaluate the results of exercise 1 in 15'/group.

12. *Expected outcomes:* students able to: Perform presentation without downtime when transition among group members; clear information; Distribute presentation time for each member quite evenly; Self-assess on what had been done well and not well, advantages and obstacles in carrying out exercise 1 and 2; Find out the causes and solutions for the unsuccessful tasks and obstacles.

13. *Purposes:* help students to see back and/or think about what they have done about 3 issues: designed plan, collaboration and solving problems in conducting plans.

14. *Teaching methods:* student's presentation, self-test, feedback assessment, discussion

15. *Main teaching and learning activities*

Table 4: T'sA and S'sA of exercise 2.

Teacher's activities	Student's activities
1. Observe and take note what student's presentation. 2. Give feedback.	3. Present the results of exercise 1 (all members have to present). 4. Self-assessment. 5. Explain the causes for the unsuccessful tasks and obstacles. Give solutions for solving them.

16. *Results:* We realized that most of groups have not yet overcome challenges that required well linkages among members in presentation. They were confused in their performance, linkage between members were not so good, and downtime in the presentation process were so much. Most of groups also self-assessed that they faced with the difficulties such as defining tasks in plan, collaboration between group members in presentation, solving problem when group's member(s) absent and quite difficult in deciding consensus solution, time control…

Stage 3: Abstract Conceptualization

Exercise 3: Based on what had done in exercise 1 and 2, discuss to find out the main steps of designing plans and doing CPS.

17. *Expected outcomes:* students able to: Built steps for making plan; Develop CPS process.
18. *Purposes*: help students develop making plan steps and CPS process.

19. Teaching methods: guide discussion (use the tablecloths discussing technique), presentation.

20. Main teaching and learning activities:

Table 5: T'sA and S'sA of exercise 3.

Teacher's activities	Student's activities
Assign and guide exercise (some groups work on plan steps and the left find out CPS process)	Identify potential problems
Guide discussion	6. Each member gives his/her own plan/ CPS process. 7. Discuss and decide the final process.

Ask all group write their procedures on the board at the same time and some selected groups present.	8. Write the results on the board 9. Representative groups present
Analyze and synthetize the group's results and guide to find out reasonable procedures.	Make questions if is necessary

21. Results: Many groups developed quite accurate about plan and CPS steps, but there were few steps that are not appropriate so teachers gave comments and oriented to decide suitable steps. Our students excited about this activity because they were almost self-build process from the experiences of previous exercises.

Stage 4: Active Experimentation

In this stage 2 exercises were designed to help students apply the procedures of making plan and CPS into other situations. Exercise 4 focused on the application plans in small group while exercise 5 concentrated on applying plans in small group and among groups.

Exercise 4: Select 1 of 2 topics:

Topic 1: Design and implement plans in one day for all members in group to complete the following activities: Visit at least three historical sites in the city by bus; Interview or make conversation with foreigners about 5 minutes; Organize more than two outdoor activities; All group members present the results in front of class and self-evaluate; Fee less than 40.000 VNĐ/student.

Topic 2: Design and implement plans to design or manufacture and promote technical products.

22. Expected outcomes: students able to: Apply the plan process to design various plans of exercise 4; Apply CPS process to collaborate group members and solve the challenges in the exercise; Implement and assess designed plans.

23. Purposes: to help students: Develop planning and CPS skills in small groups; Enrich historical knowledge/ technical knowledge.

24. Teaching methods: discussion, working in real situation

25. Teaching and learning activities:

Table 6: T'sA and S'sA of exercise 4.

Teacher's activities	Student's activities
Assign exercises and present requirements	Identify potential problems
Ask students to establish groups from 5 to 7 members by their interest to the topic.	Establish groups
Remind students to follow CPS steps to conduct the exercise 4.	Design and implement
Take note and give feedback	Present the results

26. *Results:* Nearly all groups chose topic 1 instead of topic 2 because some of reasons: students had not yet visited the city historical sites; really wanted to have outside activities to entertain and to develop relationships group members. When doing topic 1, they met many obstacles such as: choosing appropriate places, time to go; setting up conversation with foreigners in 5 minutes; going in group by bus; spending a little amount of money; presenting by all members… If in the first exercise, students performed the CPS skill in very low level, in the fourth exercise even though they coping many difficulties, but all groups overcame these problems in different ways and they gained quite good results especially in presentation. The transitions of members in presentations were better than previous time, with clear information, without downtime.

Exercise 5: Designing and implementing plans to run a course summary program in 60 minutes.

27. Expected outcomes: students able to: Apply the making plan process to design various plans of exercise 5; Apply CPS process to collaborate all members in class and to solve the challenges in the exercise; Implement and assess designed plans.

28. Purpose: help students develop planning, organizing and CPS skills in larger organization.

29. Teaching methods: discussion, working in real situation.

30. Teaching and learning activities

Table 7: T'sA and S'sA of exercise 5.

Teacher's activities	Student's activities
Assign exercise and present requirements	Identify potential problems
Guide for establish an executive group	Form an executive group
Scaffolding and coaching	10. Decide program 11. Select group members and assign tasks 12. Conduct program

31. *Results:* Students in various classes had designed different programs, decoration; ways to summary; other activities... In general assessment, students had planned, collaborated, organized and linked members to conduct program very good.

Figure 3: Illustration for some activities of exercise 5.

CONCLUSION

The proposed framework to train students' CPS skill through organizing EL activities in Planning Skills subject was based on the EL and CPS literature reviews. Five EL exercises were designed and implemented following the Kolb's model to test the feasibility and usefulness of the proposed framework in develop students' CPS skill. Findings indicated that students' planning and CPS skills have evolved from the low level in the first exercise to the higher level in the fourth and fifth exercises. During the process of conducting the proposed framework and organizing EL activities, teacher did not face with so much difficulties. However, identifying the suitable contents with EL stages and the limit time were the most obstacles in

implementing the proposed framework on developing CPS skill. Therefore, to evaluate the real effectiveness of the solution, the proposed framework should be tested in various subjects, especially in technical subjects. Furthermore, quantitative analyses should be added to measure the development of students' CPS.

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Challenges and Improvement of Undergraduate Engineering Researches: The SMCTI Experience

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ABSTRACT

This paper is aimed to ascertain the challenges and improvement of the undergraduate civil engineering researches of St. Mary's College of Tagum, Inc. The paper utilized quantitative and qualitative approaches. Primary and secondary data were used. Data analysis and interview were taken. Engineering research problems were observed for the last five years. The engineering program took the challenges to improve the research instruction and outputs. Curriculum review and class instruction were made. The undergraduate civil engineering researches underwent improvement and successes in its outputs. Improvement in the research instruction and successes in the outputs were experienced. Academic motivation and willpower to improve its research capabilities shall lead to success.

Keywords: *Challenges, Improvements, Undergraduate Engineering Researchers, SMCTI, Quantitative and Qualitative Study*

I. INTRODUCTION

Why do research? This is the usual question asked to the students when they undergo the process of doing an academic paper. Most of the students have the same views about it and that is, "*For compliance purpose, we do research*." But along their journey, they somehow realize that doing it is fun despite of the challenges faced in every stage of method.

In a study conducted in United Kingdom by the Royal Academy of Engineering, it was revealed that in 2012, there were three point two percent (3.2%) of UK engineering graduates went on to further study and research. This implied that only few students pursue research.

Is doing a research really a difficult thing to do? --- For most it is. In St. Mary's College of Tagum, an RVM school in the region, the tertiary students are highly involved in conducting community-based researches. However, the central challenge of the students in writing their studies is the aim of addressing the current issues of engineering field in the community.

In pursuit of quality understanding the context, this study was aimed to explore the challenges and determine the needed points in order to improve the research culture of the Civil Engineering Education of St. Mary's College of Tagum, Inc. and other Higher Education Institutions (HEIs) in the region.

Purpose of the Study:

The main purpose of this qualitative-quantitative study is to explore the challenges and determine the needed points in order to improve the research culture of the Civil Engineering Education of St. Mary's College of Tagum, Inc.

Specifically, the following were the questions set to guide the conduct of this study:

1. What are lived experiences of the students in doing their researches?
2. How did they cope up with the challenges?
3. What are the points needed in order to improve the undergraduate engineering researches of SMCTI?

II. METHODOLGY

Research Design:

This study utilized qualitative technique with quantitative method. It employed the phenomenological inquiry as part of the research design. This determines the lived experiences of the engineering students in their research journey. Data analysis and interview were taken.

Data Sources and Participants:

The interview data from the research students of the Civil Engineering Program of St. Mary's College were the primary data source of this study. The study was conducted from June 2016 to May 2017.

Research Procedure:

The following was the procedure used by the proponents:

1. Gathering of Information (2) Interview
   (3) Theming (4) Data Analysis

III. RESULTS AND DISCUSSION

Table 1. Lived Experiences of the Students in Doing Research.

Major Themes	Core Ideas
Challenges in doing the research	1. Difficulty in identifying the research problem 2. Scope of the study is broad 3. Time limitations in conducting the study 4. Financial barriers 5. Diversity of the group members; some members find research not important 6. Limited knowledge especially about the nature of the study 7. Less supervision of the advisers 8. Not interested with the topic 9. Panelists expectations 10. Difficulty in the usage of the English language particularly the grammar rules 11. Difficulty in gathering the data

Major Themes	Core Ideas
Meaningful experiences behind the conduct of Research	12. Explored many areas of the engineering field through research 13. Have communicated and interacted with people as our respondents/participants of the study 14. Confidence in dealing with diverse people in the engineering field 15. Have been to places where civil engineering works are highly needed 16. Doing research gathering 17. Learning the statistical tools for the research data analysis 18. Trainings provided for the GIS researches 19. Memorable defenses where all panelists have extracted all corners of our research 20. Countless sleepless nights in researching the literature and supporting studies for our result and discussion 21. Learning the correct grammatical patterns and tenses of the verbs whenever the editors return the manuscripts
Values Promoted	22. Patience and dedication in doing the research 23. Time-conscious with regards to the deadlines 24. Understanding and consideration of others 25. Respect to the people involved in the study 26. Perseverance 27. Praying always for the guidance

Table 2. Coping-up Mechanism amidst Challenges.

Major Theme	Core Ideas
Coping with the challenges	28. Reading a lot of references in the library 29. Consistent consultations with the adviser and the research professor 30. Inquiries conducted to the concerned agencies involved in our study 31. In times of financial constraints, we do ask the teacher for paperless submission of manuscripts 32. Series of brainstorming and group sessions were carried out to fully understand our study 33. Designation of tasks to the members to maximize full participation 34. Follow all suggestions/comments made by the experts/panelists/advisers/teachers

Table 3. Points Needed to Improve the Undergraduate Engineering Researches of SMCTI.

Major Theme	Core Ideas
Improving the Engineering Research Culture	35. Improving the research instruction 36. Consider changing the curriculum for research 37. Research subject should be for two semesters; one semester is not enough 38. Crafting of significant research agenda 39. Strengthening the knowledge of technical writing, the use of English grammar and oral communication 40. The good command of the teachers of research especially in guiding the students' journey

	41. Advisers are encouraged to handle the engineering field of specialization 42. Advisers are technically expert in doing a research work 43. Panelists that are highly expert in the field of engineering 44. Strong ties with the community for better research agenda 45. Revisit and improve the guidelines for the manuscript and oral defenses 46. Consistency in the research formatting (technicalities) 47. Lessen the number of researchers per group for more efficiency and full participation

Engineering research problems were observed for the last five years. The engineering program took the challenges to improve the research instruction and outputs. Curriculum review and class instruction were made. The undergraduate civil engineering researches underwent improvement and successes in its outputs.

IV. IMPLICATION AND CONCLUDING REMARKS

The major themes revealed the lived experiences of the student-researchers, their coping mechanisms amidst challenges and the points needed to improve in the research culture of SMCTI's Civil Engineering Program.

Despite all of these challenges and limitations, the Civil Engineering program has successfully produced research outputs that were presented both Philippines and abroad. It also emerged in the national level and regional level research competitions.

Every year, there are improvements in the research instruction which paved way to the successes of the research outputs manifested in the awards received from the different research congress and fora. Indeed, students were molded to value research as part of their chosen profession, not a mere collegiate requirement but an avenue to help the community and people improve their quality of living.

Thus, the upholding and realizing the tagline, "*We do research, the Civil Engineering way…*"

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Interactive Virtual Classroom

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ABSTRACT

Developing virtual classroom training doesn't have to a chore. In fact, once you know each of the steps involved in the process, you can create deliverables that effectively improve employee skills and job performance, regardless of the subject matter. Even dreaded compliance training can become an engaging and exciting experience for your audience.

Keywords: *the development education, ICT, information technology, learning, interactive virtual. Simple, powerful tools for collaborative learning*

1. INTRODUTION

Present world has become technical drastically. Education also includes its features for to cope the global objectives. This educational technology called virtual education by which everybody can get the accessible education. Virtual education or we can say it gives a new definition to portable education. Virtual education is completely based on electronic, which is needed the eligibility of higher technical user. Therefore, this paper purposes to provide the knowledge about the virtualization of education and required feature for its implication. Pairing visuals with detailed explanations that are thought provoking is always a good idea, especially if you want to boost employee engagement. This is due to the fact that it can spark discussion, as employees will be encouraged to interact with the subject matter and their colleagues, remotely or otherwise. To trigger employee discussion, you may want to integrate some form of online collaboration.

2. AUGMENTED REALITY

Virtual Reality (VR) or Virtual Environments (VE). Using a typical VR system a user can move and interact within a computer-simulated environment commonly referred to as a virtual environment. VE technologies immerse a user inside a synthetic environment. In contrast, AR's main characteristic is that it enhances information, from the real world using computer-generated objects, onto the user's world-view. The ideal AR system will be able to compose computer-generated images or videos with the real world in real time in such a way that the user cannot tell the difference. Vallino states, "An augmented reality system could be considered the ultimate immersive system. The user cannot become more immersed in the real world" [1]. On the other hand the two most important drawbacks that current AR systems face, concern robust registration of the real world with the virtual world in real time and accurate sensing of the user in the real world—both the subject of current research efforts.

Advances in computer technology in recent years has facilitated the study of augmented reality systems and evolved many new applications on a variety of application domains. Typical applications in which AR has been applied are: manufacturing, maintenance and repair, medical, military, collaborative interior design, entertainment, cultural heritage and fashion design. One of the earliest applications of AR is in military training of helicopter pilots. Using specially designed head mounted displays (HMDs) graphical navigation and flight information is superimposed upon the pilot's view of the real environment during the flight [4]. Another example of using AR is for live training concerning ground combat vehicles. This simulation was performed interactively and allowed the soldiers to see virtual objects (vehicles) on a virtual simulated battlefield [2]. Given the success of AR so far, we would like to consider how AR could benefit teaching and learning of the top-down design methodology. The need emerges because classroom instruction is sometimes insufficient, the design methodology is complex, and often limits the range of experience [3]. However, before we consider using AR to support teaching and learning of top down design Virtualization is a powerful technology trend that is happening now. The trend is already underway and the outlook is that it will grow very rapidly. Educators owe it to themselves and their institutions to examine the opportunity very closely and see when and how they can start taking advantage of this exciting capability. Virtualization lets your IT staff deliver better service at lower cost and with greater security and reliability. To find out if your network can benefit from virtualization, ask yourself the following questions:

1. Do you want to improve student performance by allowing student-owned devices to connect to the network?
2. Do you want to extend the useful life of existing lab and classroom PCs?
3. Does your IT staff spend a large portion of its time visiting school sites to perform maintenance on labs or classroom PC?

2.1. Potential Benefits

When investigating the potential benefits of using an AR system in a teaching and learning environment we are considering two issues: the effect it has on the teaching and learning process, and the consequence of introducing new advanced technology in the classroom. Considering this some potential benefits are:

1. Provision of tools that enable the fast and efficient generation and dissemination of learning material, and a set of virtual scenarios and support materials that students can control and interact with.
2. Provision of virtual multimedia course notes that are particularly interesting and stimulating, as they can be immediately made available in the virtual environment. Students can build their own presentations.
3. Reduction of printed material, although the option for the student to print out a presentation could exist.
4. Simplify the teacher's task in providing much more stimulating teaching materials.
5. Enables team working, which is essential when working in industry. Developing team skills is an essential part of the learning process.

2.2. Technological Issues

It is important to consider the technological issues when introducing AR to the teaching and learning process. For example, the system must:

6. Be simple and robust.
7. Enable the teacher to input information in a simple and effective manner.
8. Enable easy interaction between users.
9. Make complex procedures are transparent to the user.
10. Be cost effective. Ideally, such system should be built from off-the-shelf components, thereby reducing costs. It is generally accepted that a major reason for using virtual technology is related to costs.
11. Provide the user with clear and concise information.

1. VIRTUAL INTERACTIVE TEACHING ENVIRONMENT

Having consider augmented reality, virtual design, benefits, technology issues and where to exploit it, we propose an augmented reality environment called the Virtual Interactive Teaching Environment (VITE), which is aimed at improving the

teaching of electronic systems design. The benefits of using AR are clear for applications related to,

Operating system–level virtualization

In this case the virtualization layer sits between the operating system and the application programs that run on the operating system. The virtual machine runs applications, or sets of applications, that are written for the particular operating system being virtualized.

High-level language virtual machines

In high-level language virtual machines, the virtualization layer sits as an application program on top of an operating system. The layer exports an abstraction of the virtual machine that can run programs written and compiled to the particular abstract machine definition. Any program written in the high-level language and compiled for this virtual machine will run in it[4].

Learners can experience and completely reduce the body, think flexibly when immersed in the subject, curriculum or seminar. At the same time, the multi-senses will be activated with unprecedented efficiency for previous classes.

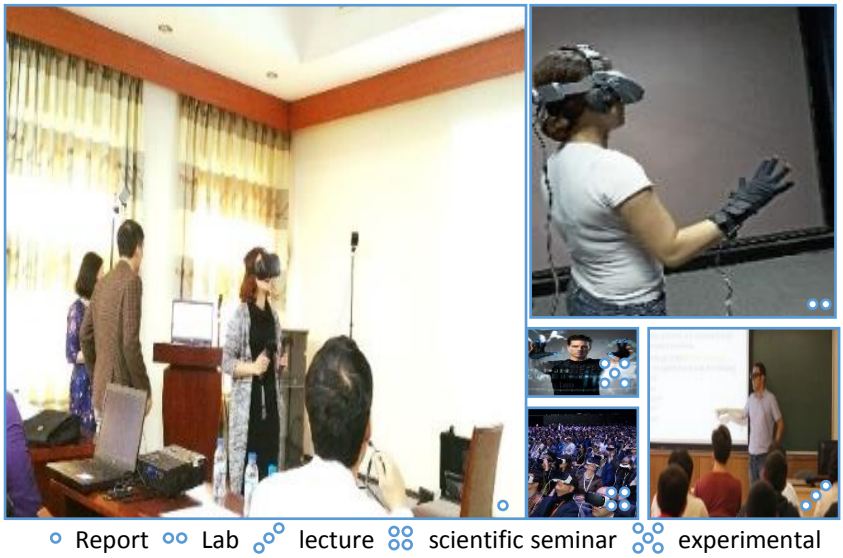

Figure 1: Simulating VR activity increases the ability to stimulate the learner's senses.

When the multi-senses are stimulated for the game may not be considered. But teachers have to consider carefully when entering the classroom: what program is used VR. Limiting the excitement to bring learners back to the curriculum, not stopping abruptly the enjoyment will be a shortcoming in thinking and resistance to the next lesson.

1. The VITE Teaching Model

VITE exploits a horizontal teaching model as opposed to a vertical teaching model. We define vertical teaching models as being specific to one discipline, e.g. teaching methods in an engineering context, see Figure 4. Here we see that the subject taught is defined as vertical because a single teacher would coordinate lectures, workshops and laboratories based around a single subject. Example subjects might be the teaching of Java programming, or VHDL or business studies. Thus, vertical models are defined for specific subjects, and are often different depending on the teacher, with different environments for each subject.

We define horizontal teaching models as being more flexible allowing not only the teaching of single subject areas but also for cross-disciplinary teaching. For example, we may wish to teach top down design with VHDL with this horizontal teaching model, but allow the option to access teaching media from other related disciplines.

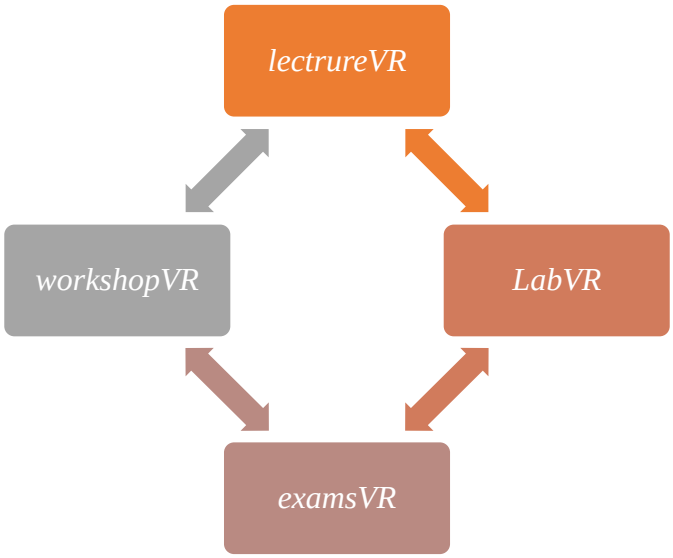

Figure 2: Horizontal teaching model using VR.

This would be ideal for implementing a group project that required software, hardware and a business approach taught concurrently.

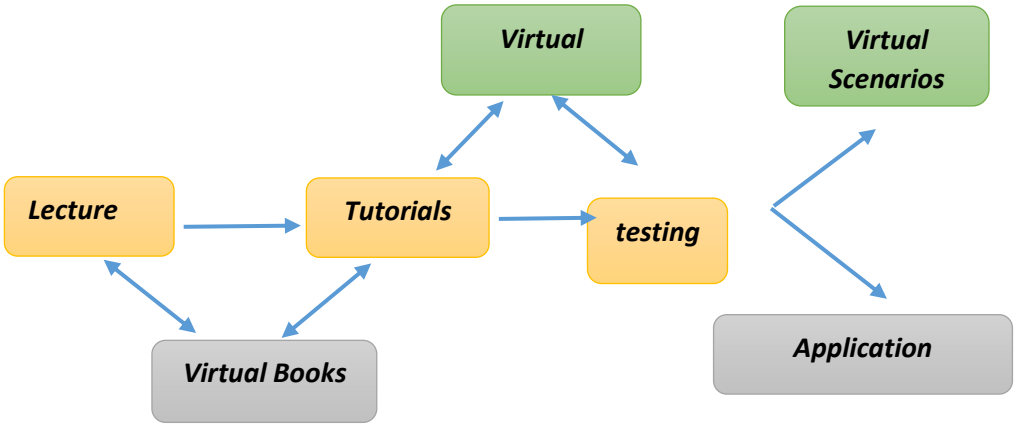

Figure 3: VR technology impact.

Our horizontal model is aimed at the broader teaching community, and is rendered possible by virtual technologies such as augmented reality. In other words, AR technology provides a common cross-disciplinary and interactive environment for teaching

2. Database Multimedia Functionalities

The VITE architecture is particularly suited for teaching as it enables teachers to input information in an easy and powerful way. XML is now widely recognised as being the data description language of choice. Using XML non-programmers can easily describe data and information using custom and predefined tags. For example, there exists an already pre-defined set of XML tags called the Synchronised Multimedia Interface Language (SMIL) that describes multimedia content information and how to synchronise the information in a multimedia presentation [5]. We can adapt SMIL to describe part of the VMC information. Further, work is currently being done on X-VRML—the XML Virtual Reality Modelling Language—that can be adapted to describe the 3D and AR aspects of the VMC information [6]. The teachers existing material, i.e. the notes described in section 2.1 above, are now described in an XML file, with appropriate custom defined XML tags associated with all the different textual and pictorial descriptions or data, e.g. as a minimum each section of the notes would have an XML meta tag. This XML file is added to the database. XML style sheets are used to transform this

data into specific 2D or 3D behaviour that will be performed on elements—text, pictures, multimedia objects, such as avatars, etc.—within the database. This approach could also enable the teacher to build simple models out of basic elements within the database. Because each element corresponds to a XML meta tag, a new XML file can be generated from selected elements to make a new multimedia presentation within VITE. Thus, the database will typically consist of XML descriptions of 2D and 3D objects including behavioural information, text information, and voice data. Our approach to data description using XML greatly simplifies the interaction between the teacher and the system. VITE provides the following major multimedia functionalities:

1. Access to all relevant books, notes and other useful text, images or 3D objects that describe top down design. o The content is stored as XML descriptions in the database and visualised in 3D using XSL style sheets.

2. Visualisation of ready-made electronic design models, rendered in real time in a realistic manner.

3. Avatars to perform predefined or custom presentations and provide answers to a student queries.

4. Tutorials on the use of the AR hardware, e.g. virtual displays, gloves, etc.

5. Tutorials on the use of the AR software, which is responsible for robust registration and tracking.

3. Top Down Design with VHDL Example

As mentioned, we wish to improve the teaching of top down design using VHDL methodology. Students are required to design a simple digital component, see section Using VITE the teaching and learning process, including the Esperan Multimedia tutorials is delivered in an augmented reality environment where the student uses optical see-through glasses to switch their vision between the VMC information and the existing EDA tool design flows.The student will visualise in 2D and 3D all material, including the design assignment, together with the VHDL principles (notes, books, tips, etc.), which are overlaid in three dimensions in front of each student during all the laboratory sessions. Furthermore, avatars—an avatar is a graphical representation of a user, e.g. demonstrator, in the virtual environment that will respond to queries from the student—are used instead of demonstrators to illustrate examples, such as VHDL coding principles and other relevant information. The student can request information from the avatar that will initiate a dialog with the student to refine the question.For example, the avatar may ask the student how they want to visualise the information, e.g. as 3D or as text. The avatar will then make an XML formatted query on the database,

Example : Build a grid and map in space

The ElevationGrip tag allows you to build a grid made up of points of a certain height in space. This tag is useful for building networks or terrain.

Construction images are placed in the space of the OXYZ plane. The starting point is the origin, the remaining points that make up the grid must be in the positive direction of the OX axis avf OZ.

Color, colorPerVexter, convex, solid have the same properties as mentioned above.

xDimension contains the number of points inside the grid on the X axis.

- zDimension contains points inside the grid on the Z axis.

xSpacing is the distance of two consecutive points in the direction of the X axis.

- zSpacing is the distance of two consecutive points in the direction of the Z axis.

- height contains a list of height values for each point in the grid.

These points are calculated in order from left to right from top to bottom.

Figure 4: An example is the robotic arm program that is assembling the robot.

which is parsed into a set of XSL tags and an SQL query. The XSL tags select the appropriate style sheet that will translate the query results into the appropriate display medium, e.g. HTML on a browser, VRML in the AR display, or even simple text formatted for print. Further, there are several avatars dedicated to different queries.

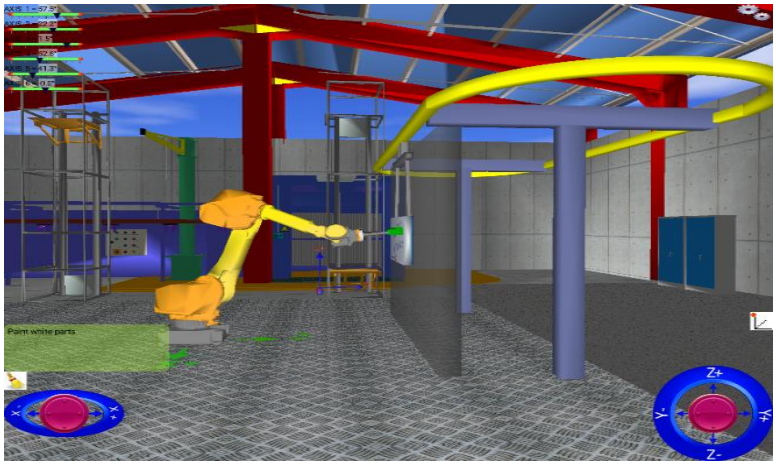

Figure 5: An example of a robot arm program is painting.

Here is a practical program with the robot arm. With the robotic arm of the industry, the practical experience for school hours is not possible because of the cost of the multi million dollars. But with this program using VR technology, learners can fully experience, understand and control industrial robot arm for various tasks such as car assembly, painting ...

With a 6-arm robot arm, each joint is easily controlled in four different directions for flexible movement. For learners to learn as they learn and play, learn how to operate a robotic arm, learn the robot control arm close to the actual control buttons but not too pressure on the learner. Easy to understand and study hours, give the comments and analysis later class.

CONCLUSIONS

we believe that more complex electronic system designs could be attempted that would be impossible to do with the current teaching methodology. The only disadvantage is the cost but our proposed system is much more cost effectiveness than a fully VR immersive system

It offers the teacher the ability touse more sophisticated techniques that enable better user interaction with teaching materials and complex EDA tools. It gives students a high degree of flexibility and understanding of the teaching materials by providing them in an interactive and augmented way. We believe that a VE will provide a rewarding learning experience that is otherwise difficult to obtain.

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Use Virtual Interactive Technology in Teaching

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ABSTRACT

This paper points to some of the characteristics of virtual manipulative tutorials that may be beneficial for students as they are learning electronic devices concepts. One characteristic afforded by the virtual manipulative concept tutorials used in this project was their design that combined both visual and symbolic images in a linked format. This may have encouraged students to make connections between these modes of representation and, thereby, developed students' representational fluency,particularly for visual learners and excitement learning. Virtual interactive technology is changing the way people interact with the world around them. The emergence and boom of online gaming has shown us the huge application potential of VR, AR technology in the entertainment field. However, not only that, VR,AR is also being put to use in education and technical services, promising huge changes in these areas.

Keywords: *the development education,interactive virtual. Simple, powerful tools for collaborative learning*

1. INTRODUTION

Nowaday, many teachers are not aware of the capabilities of virtual manipulatives and do not currently use them in lessons during regular mathematics instruction [1]. We found it challenging to find resources and research on which to base the design of this project. For this reason, we chose to create teacher-made handouts and assessments to guide and evaluate the students and their use of several virtual fraction manipulatives in this exploratory classroom project. We were particularly interested in answering the following question: (1) What learning characteristics are afforded by the use of the virtual fraction manipulatives for understanding fraction equivalence and addition?

Virtual fraction manipulative concept tutorials were used in three one-hour class sessions to investigate the learning characteristics afforded by these technology tools. The virtual fraction manipulative concept tutorials exhibited the following learning characteristics that supported students during their learning of equivalence and fraction addition: (1) Allowed discovery learning through experimentation and hypothesis testing; (2) Encouraged students to see mathematical relationships; (3) Connected iconic and symbolic modes of representation explicitly; and (4) Prevented common error patterns

2. DIFFERENCE BETWEEN PUTTING VR AND AR INTO CLASS

VR: When the VR application experience, users will be brought into a world completely bogus, simulated by the computer, then the user seems to be no longer aware of the real world around him. half. For example, when wearing VR glasses, you get lost in a beautiful classroom full of electrical appliances, the electronics they need are completely created by the computer.

AR: is a technology that allows the integration of virtual objects into real-time, screen-based rendering that makes virtual objects appear like they are in the real world.

VR completely replaces reality by a simulated world while AR adds virtual detail to the real world. For example, if you use a smartphone, project a camera into a car, the smartphone's AR application will display that car with additional information such as the manufacturer, And how it works. Or the AR application to the electric motor will show engine parameters that include stato and roto, how many coils.

3. AUGMENTED REALITY

With just a phone or tablet, teachers can create a lively lesson by combining paper documents with 3D simulations that students can interact with.

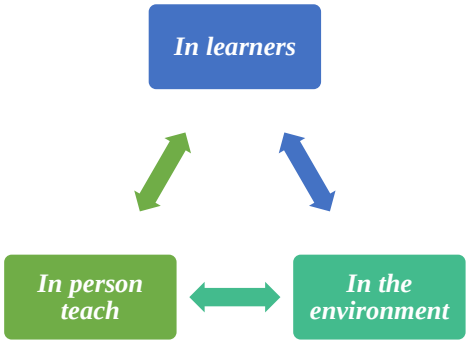

Figure 1: Sustainable impact in AR.

In learners, it is:

1. The attitude of excitement comes from the motivation of learning and the belief in the ability to succeed in oneself;
2. actively and actively participate in all learning activities as well as all other useful activities, of themselves as well as of the group and of the whole class;
3. a sense of responsibility as the main actor (actor) in the learning activity and as a collaborator in the joint activities;

In person teach, that is:

4. comprehensive guidance, first of all through the planning and organization of teaching, the completion of the mission of "transforming" the (regulated) learning program into integrated learning objectives and processes. Be able to with specific class and learner;
5. flexible use of successful pedagogical and pedagogical strategies to motivate learners to learn and be confident in their learning;
6. Always collaborate closely with the learner, demonstrated through understanding, guidance, support, evaluation and motivation, prompt support during instruction;

In the environment, it is friendly and adaptable, ie accessible, convenient, facilitating the implementation of teaching process.

The above behaviors are inherent in each actor but need to be stimulated and promoted in a guided and organized manner to ensure that the teaching process is truly feasible and effective. This problem has long been considered by many educational experts in a field called Class Dynamics.

Just as the dynamics of any system - specializing in studying the laws of structure, interaction, and behavioral states of the system, Integrate and synthesize (or design), for the purpose of creating controllable systems that best meet the requirements for the benefit of the human - Class Dynamics is specialized in studying the dynamics of Teaching and learning, due to the impact of individual behavior (the teacher, the learner) and interpersonal interactions, in order to organize and build the classroom into a community that has the rules of behavior and Cultural behavior so that the learning process is as effective as possible

4. EVALUATING EDUCATIONAL VR AND AR

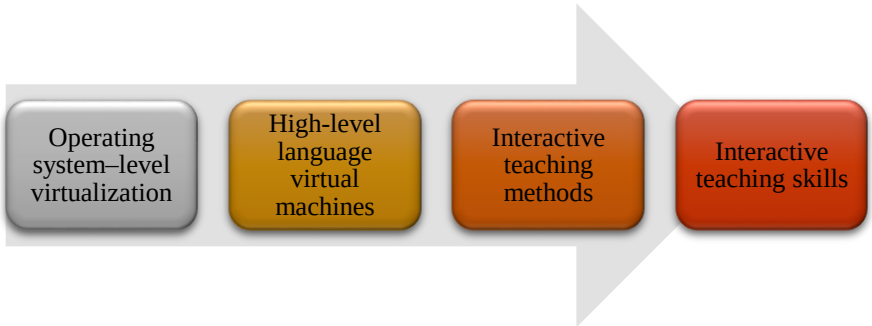

Figure 2: elements required for a virtual school.

As with other uses of computers in learning, experts disagree about how useful virtual reality programs for education and training really are. Some praise such programs for extending the range of materials and learning experiences that students can have. They say that VR, AR makes study material more exciting, so students will be more likely to remember what they learn. Expensive as VR, AR programs are to develop, supporters also claim that creating or buying these programs may be cheaper in the long run than maintaining laboratories in which students do live experiments or letting adult trainees use real machinery.

Critics of educational fear that students who rely too much on virtual reality and other computer programs will miss the personal contact and the lessons about social interaction that a face-to-face classroom can teach.

Similarly, people who question the value of VR, AR training programs say that because such programs cannot completely simulate the behavior of machines or people, they cannot be as effective as on-the-job experience. Because virtual reality programs for training and education, like other VR programs, are still fairly limited, even most of their supporters agree that for the foreseeable future, they most likely will and should be used as additions to traditional classrooms or standard training methods rather than as replacements for them.

Operating System–Level Virtualization

In this case the virtualization layer sits between the operatingsystem and the application programs that run on the operating system. The virtual machine runs applications, or sets of applications, that are written for the particular operating system being virtualized.

High-Level Language Virtual Machines

In high-level language virtual machines, the virtualization layer sits as an application program on top of an operating system. The layer exports an abstraction of the virtual machine that can run programs written and compiled to the particular abstract machine definition. Any program written in the high-level language and compiled for this virtual machine will run in it.

Interactive Teaching Methods

Interactive teaching is a method of applying interactive teaching logic (triad of principles, triad of behavior, ...) and using interactive teaching tools, so that the teaching process is basically Learning process of learners. Specifically, that's the method:

Teaching in an interactive environment (learner-centered) with learner-centered learning, so that research-oriented teaching methods, collaborative learning, etc., in the context of face-to-face or online, Face with the network, are the appropriate method;

Technology-based teaching, the integration of theory with practice, learning by doing, practice and practice can be real or virtual, or virtual Specific conditions allow;

Interactive Teaching Skills

Interactive teaching skills are skills that effectively utilize means and methods of interactive teaching. As mentioned above, the interactive teaching process is essentially a learning process, so it is just like practical teaching skills, interactive teaching skills require instructors to speak Well versed Especially with game-style interactive softwares, learners can "try-and-fail" to create their own, find solutions themselves, and can ask questions that the instructor, if lacking experience or Lack of adaptive capacity, cannot be answered immediately.

Interactive teaching skills, especially virtual interaction, require instructors to keep up to date with the new achievements of modern teaching technology, ie, adhering to the achievements of ICT in teaching. How fast this technology grows, no need to say, everyone knows.

The explosion of Information Technology in particular and of Science and Technology in general are strongly influencing the development of all sectors in social life. In that context, if we want the general education to meet the urgent requirements of the industrialization and modernization of the country, if we want the teaching of life to catch up, we must necessarily reform Teaching methods in the direction of applying IT and modern teaching equipment strongly promote

creative thinking, practical skills and students' interest in learning to improve the quality of training.

In addition, we need to have the proper attention of the faculty and the school so that we can apply the new method of teaching and use the lecture properly.

5. BELOW IS A VIRTUAL TOUR OF THE PROGRAM

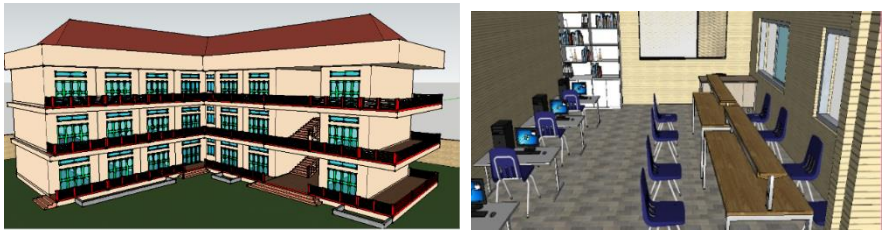

Figure 3: VR laboratory simulation program.

Use the VRML programming language to control, interact with objects and tools in the simulation model.

Use the sensor

In order to make the application more realistic, in addition to the ability to allow users to observe, the application also allows users to manipulate and control objects in the building such as: opening the door, turning the lights on, or use Elevators, etc. To do these things requires the use of sensors that are supported in VRML.

Use drag sensors to create a manual opening and closing effect.

Example:

```
Transform {
   children [
DEF SENSOR1 CylinderSensor {
         enabled FALSE
         minAngle -1.57
         maxAngle 1.57
}
USE Canhtrai
   ]
   ROUTE SENSOR1.rotation_changed TO Canhtrai.rotation
}
```

Identify the future-oriented training sector because of the 4.0 technology revolution that has taken place with clear trends in industrial restructuring. Industrial change trends have also been discussed and clarified at world industry forums. On this basis, universities need to identify key training areas, future-oriented training areas to meet the needs of the times and prepare training resources to meet industry needs.

In addition, training institutions need to design more flexible programs, more up-to-date knowledge, develop skills relevant to the 4.0 technology revolution, develop systematic and interdisciplinary thinking. . For technical training programs in addition to occupational knowledge, it is necessary to expand the supply of social knowledge, information technology and integrated network management into the curriculum. learn through virtual interaction methods ... to make learners adapt quickly to changing technologies, to work effectively in highly connected environments, between fields, between the world virtual and real. Important skills for human resources in a technology-interactive environment should be included in the output of the training program: teamwork skills, creative skills, critical thinking, thinking systems. Decision-making skills in uncertain conditions.

Teaching methods using virtual interactive technology require the teaching staff to have a high level of expertise, information technology, network. Therefore, the preparation of human resources is also a factor that requires the university to prepare thoroughly. Teachers must constantly update professional knowledge, technology.

CONCLUSIONS

We believe that more complex electronic system designs could be attempted that would be impossible to do with the current teaching methodology. The only disadvantage is the cost but our proposed system is much more cost effectiveness than a fully VR, AR immersive system It offers the teacher the ability touse more sophisticated techniques that enable better user interaction with teaching materials and complex tools. It gives students a high degree of flexibility and understanding of the teaching materials by providing them in an interactive and augmented way. We believe that a will provide a rewarding learning experience that is otherwise difficult to obtain.

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Teaching Programming Languages-The Teachers, Learners, and Pedagogical Perspective

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ABSTRACT

In this article authors will discuss the issues being faced by programming teachers and learners, the reasons behind the high failure and dropout rate in programming subjects, and will recommend some pedagogical solutions for these issues. The issues discussed in this article have been gathered from different research articles available online and through the brainstorming sessions with the teachers who have been teaching programming for more than 5 years. This article also proposes some suggestions to overcome these issues and these suggestions are the heuristics of some experienced programming teachers in Pakistan who have successfully reduced the dropout and failure rate in their batches. We have concluded in this article that teaching and learning of the programming courses could be improved by paying some attention towards teaching methodologies and giving students enough room to understand the syntax of a programming language before exposing them to the complex logic and Mathematics.

Keywords: *Computer programming, teaching programming, issues of teaching programming*

INTRODUCTION

Once there was a boom in the field of Computer Science and Information Technology (IT). That was the time when the most competent students were attracted towards Computer Science and IT. All the trends have been set in that era e.g. major subjects, course contents, evaluation system, and job competition etc. All the efforts were put together to produce the graduates who could serve in the IT market with the best of their knowledge. With the passage of time IT industry is becoming saturated and it has become difficult to attract quality students towards this field, while on the other hand market demands more competent professionals than before. Computer programming is a very basic and major subject for Computer Science and IT students. Each Computer Science or IT graduate is expected to be a potential programmer. It is must for a student who learns computer programming to be equipped with basic Mathematics, problem solving skills, logic, quick understanding of syntax and semantics of a programming language (being taught), moreover a lot of practice and self motivation. Most of the universities all around the world are compromising on the quality of the intake in these programs. This results in difficulty for both teachers and students in teaching and learning basic programming subjects which are taught usually during the first year of these programs.

Programming is not just a subject it is an art, a skill and eventually a well-paid career. It is a task of converting a problem into a solution. In recent years on one hand the demand of programmers is going higher day by day but on the other hand the student intake in Computer Science (CS) and Information Technology (IT) programs is going down gradually (Ali & Shubra, 2010). Insufficient intake in these programs has compelled many universities around the world to compromise their merit. But the quality of education and course worth are the most difficult things to be compromised on in order to retain institutes reputation. Learning to program is not an easier job. Programming subjects are usually considered the difficult ones and have a usually high dropout rate (Kelleher & Pausch, 2005).

In Pakistani universities CS/IT students are taught C++ during the first semester and in second and third semester they are given the knowledge of Object Oriented Programming Techniques and Data Structures respectively. To teach Object Oriented Programming and Data Structures concepts, Java is considered a preferable language. Failure rate in programming subjects is usually seen higher in the first three semesters. Students find it tremendously difficult to cope with these subjects during first three semesters. One major reason for their difficulty is that majority of them are from pre-engineering background where they are not taught any programming langauge. They already go through various difficulties of transition from high school educational environment to university system. Subjects like programming become a big hurdle for them to sustain themselves in the university education system. Students find themselves confused when they are taught programming concepts. They not only have to build these new concepts in their mind but they are also required to excel in these concepts to bring them in

practice and go to next level. Difficulties faced by students while learning programming not only affect their grades but it develops negative feelings in their heart for CS/IT too. All these difficulties on student side are not phenomenal they are very genuine and usual. We believe a teacher plays a vital role in the sustenance and success of student in these subjects. Computer programming is the most challenging subject in CS/IT curriculum and students find it the most difficult one to understand. But in the light of the experience of some senior programming teachers effective teaching environment can reduce these complexities and can make it an interesting subject.

In this article, we will discuss about the skills required by an individual to be a good programmer, learning and teaching difficulties of programming, cognitive requirements for this subject, and pedagogical environment for its effective learning. The focus of this article is to provide suggestions to improve teaching methodologies so that the failure and dropout rate could be reduced in programming subjects.

REQUIREMENTS TO BE A PROGRAMMER

In general, we can say that a programming student requires the basic knowledge of programming languages and tools, understanding of logic, skills for solving a problem, and understanding of different strategies to design and implement a solution(program) (Sarpong, Arthur, & Amoako, 2013). A good programmer knows how to interact with a computing machine and is equipped with all the knowledge that is required to deal with the surprises that a machine could throw at him. To be an expert programmer, it is not enough to just understand the syntax of a language for example writing and executing the programs on a smart editor. Rather it requires having hands on error handling, run time exception handling, memory management, garbage collection etc (Avinash, 2016).

Researchers believe that the continuous practice is a must for a student to retain the programming knowledge learnt in the class. If it is merged with active and periodic learning then it develops a sense of achievement in students. If continuous practice is excluded then it becomes next to impossible for a student to learn even the very basic concepts of programming. On one hand if the teaching strategy impacts the learners output then on the other hand learner strategy, lack of study and practice are also major contributors towards the failure of a programming student (Yang, Hwang, Yang, & Hwang, 2015).

A programmer needs good problem-solving skills and through knowledge of programming techniques. Majority of the students can adapt problem solving skills somehow and can design solutions, they can also learn syntax and understanding of concepts but they fail most of the times to implement those concepts appropriately (Ismail, Ngah, & Umar, 2010).

LEARNING AND TEACHING DIFFICULTIES OF PROGRAMMING

Computer Science students suffer from a wide range of difficulties while learning programming. For a programming teacher, it is a challenge to induce the capabilities of a software developer in a student (Sarpong, Arthur, & Amoako, 2013). In some institutes, these difficulties are even more complicated where a teacher has to decide the programming language. It is often seen that such teachers go for Java language instead of C or C++ and they literally terrify their students to face real programming issues like performance optimization, buffer overflow, exception handling, and testing a program (Avinash, 2016).

COGNITIVE REQUIREMENTS OF PROGRAMMING COURSES

Pedagogy of class and lab combination can be seen as a constructive approach (Costelloe, 2004). In classroom, a student learns as a result of reinforcement. This reinforcement can be positive or negative depending on the seriousness of a specific class towards programming. The reinforcement can be a drama, humor, or a polite motivational speech by the course instructor. Lab is a place where a student builds its own knowledgebase by practicing the concepts taught in the class. Encourage students to add the complexity in the successfully executed programs, alter the logic, and try different data structures. Certainly, in each class there are students of different caliper. In lab, they should be provided an exercise comprising of different tasks with low to high complexity. The students who work at fast pace will not find lab activities boring in this way. Once the brighter students are done with all the given tasks, group different students with them who work comparatively at slow pace, so they could work together to get everyone's job done in a given time. The instructor should make sure that by the end of a lab each student in the class must have gone through the probable problems of entire exercise and is able to provide the solutions for such problems in future. In order to get the most out of the class and lab an instructor must follow problem solving approach which should be interactive and collaborative simultaneously. The primary purpose should be "make the students learn how to learn programming" by making use of all instruction materials and web resources.

Visualization is a better way to understand and build mental models of the concepts under discussion (Costelloe, 2004). Show the students step by step execution of algorithms and draw for them different activities being carried out in computer memory on the board along the execution of each instruction.

The cognitive apprenticeship is another way which can help students become independent learners. It starts by an expert, who asks students start a task, provides

help when finds students stuck somewhere and gradually helps them become independent learner (Costelloe, 2004).

PROPOSED SUGGESTIONS

The failure rate in programming subjects is not the reflection of learning difficulties of a student only. We believe the style and methodology adopted by a teacher can certainly affect a student's performance. In the light of our teaching experience, interaction with other colleagues, and the observed impact of different methodologies carried out by different teachers, we can recommend some basic strategies and methodologies if they are combined together they will positively improve the level of understanding of students in programming subjects. The three common methodologies adopted in every university across the globe are delivering lectures, conducting a lab practice followed by each lecture and assigning students a term project in each semester. A major methodology known as "problem based teaching" is not followed by each programming teacher commonly. Even the first three methodologies are usually not practiced by each teacher with a true spirit. Some teachers believe that transferring theoretical concepts to students is an effective way of teaching programming. It provides them an ease in achieving better grades but on the other hand when these students are tested in a practical environment they find themselves totally incapable of implementing those concepts. In some universities of developing countries, the student to computer ratio is not satisfactory in computer labs. This causes a big hurdle in making students practice the taught concepts. On the other hand, some teachers are not bothered about the progress of students in lab work. They do not keep a check on each student under their supervision. They just entertain the queries of those who ask for help when facing a certain difficulty. Some teachers keep the programming subject dependent on term projects. Assigning students the term projects is an effective approach but if affects their learning and understanding when it is made sure that a work presented by a student is purely his own effort.

If the above mentioned, methodologies are practiced together with true spirit they can bring significant improvement in teaching and learning programming subjects. While delivering a lecture a teacher must discuss all the theoretical and practical aspects of the topic under discussion. The best way of this is to show the students how to write a program step by step by using multi-media and executing the programs in a debug mode by illustrating the effect of each line of code step by step. Show them on the screen all probable bugs, errors, and exceptions they might face while practicing the same concept and the required actions to get rid of them. This practice has three advantages for students. First, it will make it easier for students to learn the use of a programming tool; second, they will understand the structure of a programming language more clearly and third equips them with the knowledge of avoiding or fixing errors and exceptions. This practice could be made more effective if the debugging of a program is done interactively with the help of

students. It will boost their confidence and keep their mind active throughout the lecture. The lab followed by each lecture should comprise of two parts; the practice of the programs seen in the class and the application of the learned concepts through an exercise. Students should be assigned related tasks and should be applauded on their completion. Meanwhile the teacher should keep an eye on the progress of each student, generally highlight the problems faced by the majority students and discuss their solutions without addressing any particular student. Politely take a student out of a trouble by explaining him the problem being faced and its reason. After midterm students should be asked to propose their term projects. Later on in each class the topics covered must be discussed in the light of different problems associated with the projects taken by different students. It will not only add a flavor of problem based teaching but will also make students learn about the projects taken by one another, so they could better understand the application of the concepts under discussion. Problem based learning can be considered an effective approach for students. It provides a problem solving environment, where a problem is presented to students. Their knowledge is tested to solve the given problem and it is continuously improved by giving them a feedback and hints. It also helps them clear their misconceptions about different programming strategies (Yang, Hwang, Yang, & Hwang, 2015).

CONCLUSION

Programming skills are a vital competence for CS/IT and engineering students. Programming itself is a difficult subject but some other factors like teaching methodology, student's previous knowledge background, and many pedagogical factors make it even more complicated. In this article, we discussed different complexities of teaching programming courses and other difficulties faced by the students. We believe that if the methodology and strategies of teaching programming could be revised then we can make this subject somehow interesting for students. Just by changing students attitude towards this subject the global issue of less intake in CS/IT programs can be resolved very easily.

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ACKNOWLEDGEMENT

Authors of this article acknowledge EMMA (Erasmus Mundus Mobility With Asia) program.

Designing a Pre-Masters Engineering Program for International Students in RUSSIA: Tomsk Polytechnic University Experience Responses to the Review Feedback

Reviewer 1:

Excellent research article.

Reviewer 2: This paper evaluates the methodological principles in the design of the pre-master programs for international students in Tomsk Polytechnic University (TPU).

No.	Review Feedback	Response
1.	An English grammar and spell check before submission is required.	The entire paper was professionally proof-read and carefully edited as the reviewer requested.

The research used observation and survey as data collection techniques, while the subjects under investigation were the international students. This paper reports the analysis results of the implemented surveys for the pre-master program graduates in TPU during years 2013, 2014 and 2016 with monitoring and evaluation.

No.	Review Feedback	Response
1.	Noted a few typos / grammatical inconsistencies, I will recommend that authors give a thorough read while resubmitting.	The entire paper was professionally proof-read and carefully edited as the reviewer requested.
2.	I have noticed that some of the Tables do not have titles	Tables 1-5 all have their related titles.

Overall, I feel the paper is of great merit and very useful to engineering education community. There are a few observations that I have noted below, which should be addressed:

A new approach for Assessment of Pedagogical Competencies of students in higher education institutions of technology and education in Vietnam

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ABSTRACT

Competence-Based Assessment (CBA) is a new approach for assessing pedagogical competences of students in higher education institutions of technology and education in Vietnam. CBA is the process of collecting evidences and making judgments on whether competence has been achieved. CBA does not provide students with evidences to recognize their own knowledge and skills from dealing with real - world problems, but regulate teaching and learning.

This research mentioned on a brief literature review on CBA and revealed a status of assessing pedagogical competencies in training students to become Technical and vocational education and training (TVET) teachers in higher education institutions of technology and education in Vietnam.

Quantitative and qualitative methods were used to gather data associated with CBA in general and the application of this approach in assessing pedagogical competencies of students.

This research also gave minor suggestions to strengthen the quality of applying CBA in assessing pedagogical competencies of students in higher education institutions of technology and education in Vietnam.

Keywords: *Competence - Based Assessment, Assessment technique, Pedagogical Competence, Competence-Based Teaching.*

INTRODUCTION

To meet requirements about the quality of human resource in the Fourth Industrial Revolution and Education 4.0, changing from Knowledge Based Teaching (focus on knowledge) into Competence Based Teaching (focus on competences) has become the inevitable and general trend in the world, particularly in higher education. In this trend, Competence Based Assessment (CBA) is a very important link to make the teaching process successfully. Based on learning outcomes,

curriculum or professional competence standards, CBA concentrates on finding evidences to prove the various levels of applying knowledge, skills, attitude, value, and motivation in dealing with real - world problems.

CBA can help students motivate and engage them during the learning process. It's a great way to provoke students to recognize the skills and knowledge they are possessing, and empower them to take control of their career development. The more competencies they acquire, the more valuable they will be to their development in the future. Furthermore, integration CBA into instruction is considered to strengthen a variety of applying active and experiential teaching methods. Not only students, but teachers seem to have better opportunities to regulate their activities to achieve learning outcomes.

CBA is not new to the learning environment in the world but it can be the new approach to higher education institutions of technology and education in Vietnam. This paper refers to a literature review of CBA and a status of assessing pedagogical competence according to CBA in higher education institutions of technology and education in Vietnam.

LITERATURE REVIEW OF COMPETENCE BASED ASSESSMENT

Competence-Based Teaching does not focus on "teach knowledge" or "transfer knowledge". It emphasizes the development of holistic competence of students. This teaching approach requires assessment to be shifted from "assess knowledge and skills" to "competence based assessment - CBA". CBA has been drawn attention by researchers in the world. Studying on CBA has concentrated on main issues in the following:

Firstly: Study on identifying the definition of CBA

The similar points of view among researchers on concept of "competence based assessment" are to collect evidences and make judgments on whether competence has achieved compared with learning outcomes or professional standards. Khanh.N.C (2015) believed that, CBA focuses on the purpose of assessment for learning of self - students instead of ranking/comparing among students.

According to Wolf (1995), CBA is a form of assessment that is derived from the specification of a set of outcomes; that so clearly states both the outcomes - general and specific - that assessors, students and interested third parties can all make reasonably objective judgments with respect to student achievement or non-achievement of these outcomes; and that certifies student progress on the basis of demonstrated achievement of these outcomes. Assessments are not tied to time served in formal educational settings. According to Wolf (1995), CBA is a form of assessment that is derived from the specification of a set of outcomes; that so clearly

states both the outcomes - general and specific - that assessors, students and interested third parties can all make reasonably objective judgments with respect to student achievement or non-achievement of these outcomes; and that certifies student progress based on demonstrated achievement of these outcomes. Assessments are not tied to time served in formal educational settings. Alison also suggested that assessors, students and third parties can understand what is being assessed, and what should be achieved based on the learning outcomes and professional standards.

In Guidelines for competency assessment in vocational education and training in Western Australia (2013), CBA is the process of collecting evidence and making judgments on whether competence has been achieved. This confirms that an individual can perform to the standard expected in the workplace as expressed in the relevant endorsed industry/enterprise competency standards (or outcomes of accredited courses if there are no competency standards for an industry).

This paper applies the following understanding of CBA (Oanh.D.T.K, 2016): CBA is an assessment approach based on learning outcomes (subjects or curriculum) or professional standards to make judgments on whether competence has been achieved through evidences associated with flexible application of knowledge, skills, attitudes, values and personal attributes such as motives, interests, needs, beliefs and so on in dealing with real - world problems".

In contrary to "assess knowledge or skills", CBA must be based on learning outcomes or professional standards and applied regularly via formative and summative assessment, especially via formative assessment. Assessors, students (self or peer assessment) and third parties co - participate in making judgments on whether competence has been achieved. Results from CBA do not identify individual's levels of competencies, but also give regulations of teaching and learning.

Secondly: Study on CBA techniques

CBA techniques have been developed by A. Angelo, K. Patricia Cross (1993); Gary D. Phye (1997); Douglas. F and Nancy. F (2007); Alastair. I. (2008); Khanh. N.C and Oanh.D.T (2015) and so on.

The pioneer researchers in developing CBA techniques are Thomas A. Angelo and K. Patricia Cross (1993). Those did present 50 techniques as well as distingue them into 3 categorizes:

1. 27 techniques for Assessing Course-Related Knowledge and Skills such as Minute Paper, Muddiest Point, Word Journal and so on.

2. 13 techniques for Assessing Learners, Values, and Self-Awareness such as Interest/Knowledge/Skills Checklists, Goal Ranking and Matching, and so on.

3. 10 techniques for Assessing Learner Reactions to Instruction such as Group-Work Evaluations, Reading Rating Sheets, Assignment Assessment and so on.

Not only be categorized, characteristics, purposes and ways of applying these techniques were introduced in detail by Thomas A. and K. Patricia Cross.

Gary D. Phye (1997) encouraged teachers to apply various techniques such as multiple choices, portfolios (writing samples, audiotapes of speeches, artwork, lab reports, even mathematics worksheets), rubrics, concept mapping and so on in the classroom.

Alastair. I (2007) introduced some techniques to enhance learning through Formative Assessment and Feedback. Assessment techniques were proposed including diagnostic interviews and tests; project supervisions; multiple choice questions; portfolios and so on.

Douglas. F and Nancy.F (2007) convinced teachers to use Oral Language, Questions, Writing, Projects and Performances, Tests, and Common Assessments and Consensus Scoring to check for understanding.

Khanh. N.C, Oanh.D.T (2015) CBA classified assessment techniques in 3 groups:

1. Techniques for cognitive competence, including Minute Paper, Muddiest Point, One-Sentence Summary, Word Journal and so on.

2. Techniques for application competence, including Paper or Project Prospectus, Directed Paraphrasing, Applications Card.

3. Techniques for self-assessment and feedback on the teaching process, including Group-Work Evaluations, Checklist and so on.

According to Khanh and Oanh.D.T (2015), the application of these techniques should be engaged with learning outcomes and specific conditions of learning environment.

In short, CBA techniques have been drawn attraction of researchers for long time. CBA techniques are very various and link closely with learning outcomes and instruction, so they should be considered carefully before being applied in the classroom.

Thirdly: Study on integrating CBA into instruction

Instruction and assessment are core components of the teaching process. However, instruction seems to be separated from assessment. Albert. O (2003) believed that educational reform efforts tend to emphasize the importance of integrating assessment into instruction. Knowledge should be instructed and assessed simultaneously.

In Competence-Based Teaching, the shift from assessment of learning to assessment for learning has been taken place by integrating CBA into instruction (Dylan. W, 2004; Elui. E. P, 2008; Nei T. H and Kenneth. R. K, 2012; Oanh. D.T.K, 2016). This integration does not provide teachers and students with valuable feedbacks to regulate the way of teaching and learning but give suggestions how the lesson could be improved.

To sum up, CBA has been studied and applied in the classroom since the final decade of the 20th century. Literature of CBA revealed that the variety of CBA techniques and the benefits of integrating CBA into instruction could support teachers to make judgments on whether competence has achieved compared with learning outcomes or professional standards in higher education institutions.

STATUS OF ASSESSING PEDAGOGICAL COMPETENCIES OF STUDENTS IN HIGHER EDUCATION INSTITUTIONS OF TECHNOLOGY AND EDUCATION IN VIETNAM

Outline of higher education institutions of technology and education in Vietnam

Technical and Vocational Education and Training (TVET) plays a significant role in developing high quality human resources for each country. In TVET institutions, TVET teachers are responsible for training apprentices to become laborers. Parallel with technical competencies, TVET teachers must have technical competencies and pedagogical competencies. Pedagogical competencies consist of pedagogical professional knowledge (Content knowledge; Pedagogical knowledge; knowledge about learners; knowledge about curriculum) and skills (Planning; Communication Classroom Management; Teaching; Assessment; Technology) (Roxana Moreno, 2010). These pedagogical competencies should be trained and assessed carefully.

In Vietnam, there are five universities and faculties/schools in universities which are responsible for training students to become TVET teachers. They are:

1. Ho Chi Minh City University of Technology and Education (HCMUTE)
2. Vinh Long University of Technology Education (VLUTE)
3. Hung Yen University of Technology Education (HYUTE)
4. Nam Dinh University of Technology Education (NUTE)
5. Vinh University of Technology Education (VUTE)
6. School of Engineering Pedagogy (Hanoi University of Science and Technology).
7. Faculty of Technical Education (University of Science and Technology - The University of Hue).

8. Faculty of Technical Education (Thai Nguyen University of Technology).
9. And so on.

So, how do universities and faculties identify levels of achieving pedagogical competencies of students? Answers for the question will help institutions propose solutions to improve the quality of assessment of pedagogical competencies of students.

Methodology

Qualitative (questionnaires) and quantitative (interview and observation) methods were applied to gather data on status of assessing pedagogical competencies of students in higher education institutions of technology and education in Vietnam. 27 participants those are teaching pedagogical subjects were invited to participate in this research.

Qualitative and quantitative methods were used to collect information about 64 summative tests in 9 semesters within four the school years (2012 – 2013, 2013-2014, 2014-2015, and 2015-2016) at HCMUTE.

Conducting the research

This research was conducted from March to June, 2017 at HCMUT, VLUTE, HYUTE, and School of Engineering Pedagogy (Hanoi University of Science and Technology).

Research findings

To identify the status of assessing pedagogical competencies of students, items were developed. Every item was chosen and linked with one of five levels by participants:

1. Very rarely or Never (0-10% of the time)
2. Rarely (11 – 25% of the time)
3. Occasionally (26 – 50% of the time)
4. Very Frequently (51 – 75% of the time)
5. Always (more than 75% of the time)

Results will be analyzed in more detail in the following.

Aims of assessing pedagogical competencies of students

In CBA approach, assessment is not directed to rank among student and identify achieved levels of knowledge and skills of students. It concentrates on assessment for learning and identifying the application of previously learned information in dealing with real-world problems (Khanh and Oanh.D.T, 2015).

Results of the figure 1 showed that, there were 14.8% participants assessing to rank among students in formative assessment with more than 75% of the time. In summative assessment, the statistics of this aim is higher than 4.3%. Especially, up to 63% (in summative assessment) and 51.9% (in formative assessment) participants assessed to identify achieved levels of knowledge and skills of students. Obviously, although CBA has been used in higher education institutions of technology and education in Vietnam, but there are the rather high rate of participants misunderstanding about the aim of this approach.

There were less than 50% participants identifying correctly aims of CBA. Only 33.6% participants assess to regulate teaching and learning in formative assessment in comparison with 25.9% in summative assessment. In addition, 40.7% participants assessed to identify the application of previously learned information in dealing with real-world problems in formative assessment. This aim is conducted by 37% participants in summative assessment.

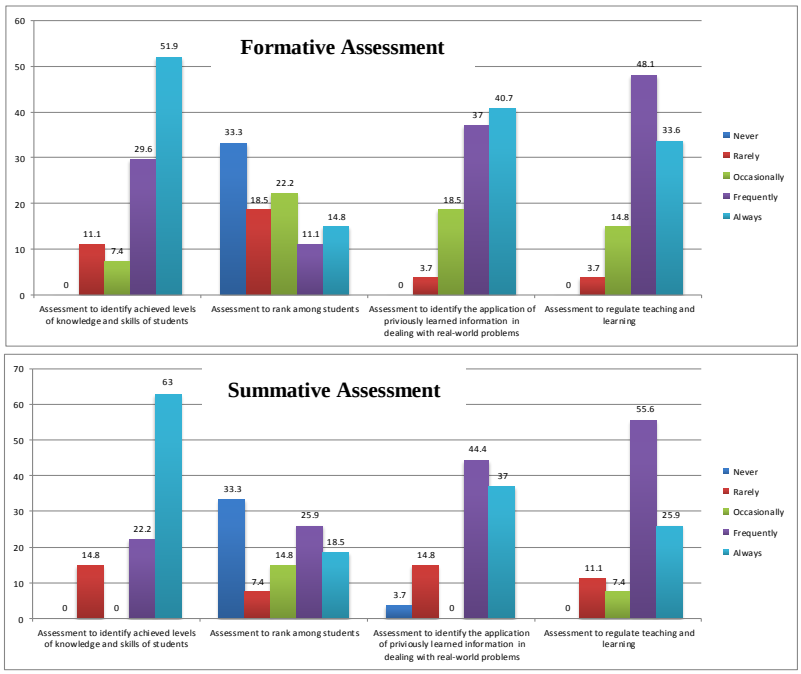
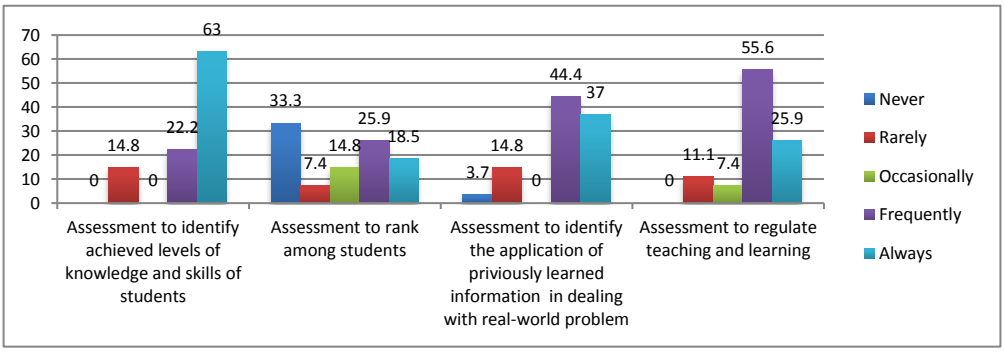


Figure 1: Aims of assessing pedagogical competencies of students.

Criterions of assessing pedagogical competencies of students

Levels of achieving knowledge were the most chosen criterion in more than 75% of the time. It is the most significant criterion of "assess knowledge and skills", not "competence based assessment". The other criterion of "assess knowledge and skills" is the application of previously learned information in dealing with typical examples or situations. This criterion requires students to remember/recall practiced patterns/learned information and apply them to meet requirements of learning tasks. 29.6% participants used this criterion in summative assessment compared with 25.6% in formative assessment. These results proved the close relationship between aims and criterions of assessment.

At the always level, there were not any differences about the rate of selecting criterions according to CBA such as the application of knowledge in solving real-world problems and the performance of students during the learning process. These criterions were only chosen by 33.3% participants in formative assessment and 22.2% participants in summative assessment. An explanation about reasons why not many teachers did apply two above criterions, some participants in interviewing believed that the limited time and huge theoretical knowledge of pedagogical subjects are the biggest barriers.



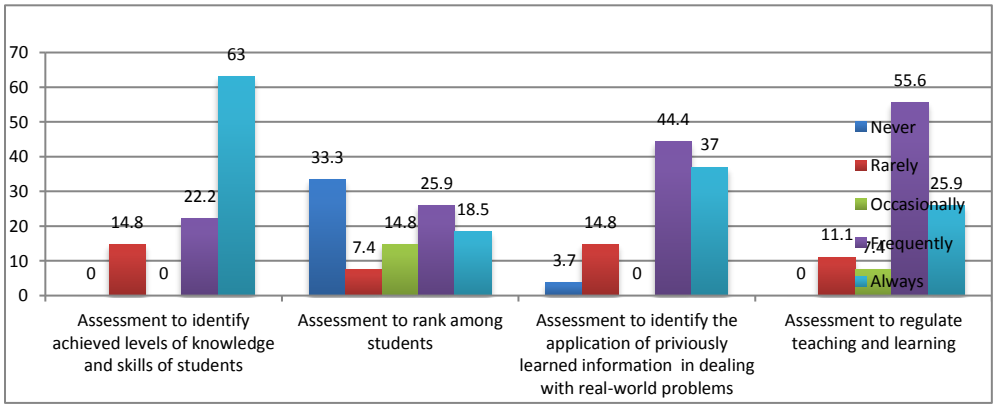


Figure 2: Criterions of assessing pedagogical competencies of students.

Types of learning tasks in assessing pedagogical competencies of students

Learning tasks can be seen as cognitive questions. Those are developed based on the Taxonomy of Education Objectives (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) and the revision of Bloom's Taxonomy (Anderson, L. W. & Krathwohl, D.R., et al, 2001). The Taxonomy of Educational Objectives is a scheme for classifying educational goals, objectives, and, most recently, standards. It provides an organizational structure that gives a commonly understood meaning to objectives classified in one of its categories, thereby enhancing communication (Krathwohl, D.R, 2002). In this research, learning tasks are linked closely with the six major categories in the cognitive domain: remember, understand, apply, analyze, evaluate, and create.

Types of learning tasks in assessing pedagogical competencies of students were identified by items engaged with the nature of the six major categories in the cognitive domain. These items were labeled in the following:

1. *Type 1:* Learning tasks require students to recognize knowledge from memory.
2. *Type 2:* Learning tasks require students to understand knowledge.
3. *Type 3:* Learning tasks require students to apply previously learned information in dealing with typical examples and situations.
4. *Type 4:* Learning tasks require students to apply previously learned information in dealing with new examples or non - typical situations.
5. *Type 5:* Learning tasks require students to apply previously learned information in dealing with real-world problems.
6. *Type 6:* Learning tasks require students to break down materials or concepts into parts and determine how the parts relate to one another or how they interrelate, or how the parts relate to an overall structure or purpose.
7. *Type 7:* Learning tasks require students to relate to parts of materials or concepts into new overall structures/models.
8. *Type 8:* Learning tasks require students to make judgments based on criteria and standards through checking and critiquing.
9. Type 9: Learning tasks require students to put elements together to form a coherent or functional whole as well as to reorganize elements into a new pattern or structure through generating, planning, or producing.

As you can see in the figure 3, learning tasks which require students to apply previously learned information in dealing with typical examples and situations were always used with the highest rate in both formative and summative assessment. In contrary, the higher applying levels, those are the application of learned information in dealing with new examples or non - typical situations or real-world problems were used less remarkably than the above level.

There was not much difference about the rate of participants using learning tasks at understanding versus applying, approximately 3.7%. Although the rate of using learning tasks at remembering was rather lower than mentioned two categories, but it was higher than other categorizes of the higher cognitive domain such as analyzing, evaluating and creating.

Overall, learning tasks belonging to higher thinking levels were used with the low rate in more than 75% of the time. Only 14.8% to 18.5% participants did apply them in formative assessment. The rate of using learning tasks at analyzing, evaluating in summative assessment was similar. Furthermore, the rate of using learning tasks at creating was the lowest with 7.4% participants chosen.

In summary, learning tasks were engaged with the six major categorizes of cognitive domain. Learning tasks at the lower cognitive levels were always used more than learning tasks at the higher cognitive.

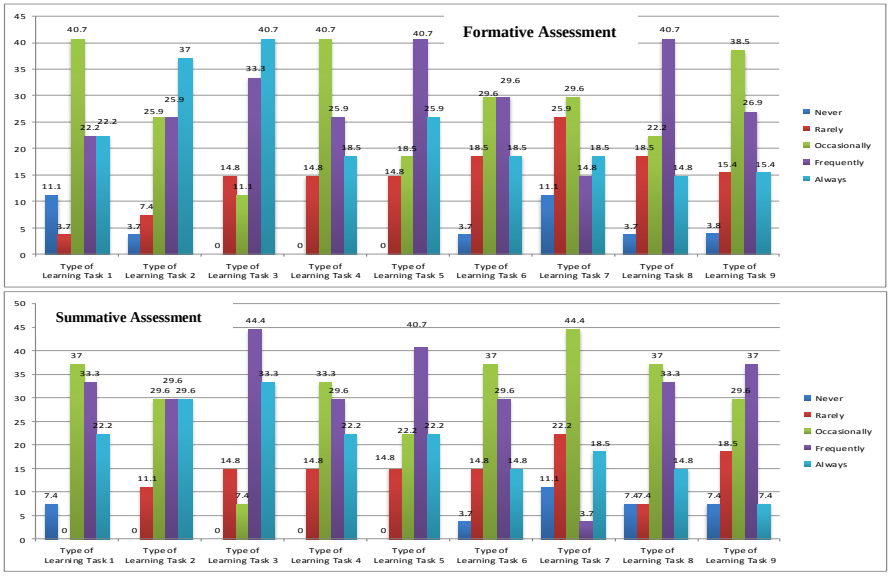


Figure 3: Types of learning tasks in assessing pedagogical competencies of students.

Study more deeply on 64 summative tests with 172 questions in 9 semesters from the school year of 2012 – 2013 to the first semester of the school year of 2016 – 2017 at HCMUTE showed a meaningful relationship among above analyzed results of learning tasks with teaching and assessing pedagogical competencies of students. As you can see the figure 4, questions at the level of evaluating and creating have not been completely applied for many years. This trend seems to be contrary to

requirements of the quality of teachers in the 4th industrial revolution and education 4.0 in which critical thinking and creative thinking are the core competencies of workers. In addition, education is not only a science, but also an art. So, we believe that, lack of evaluating and creating in education will become big obstacles to diversify forms and teaching methods as well as assessment in the classroom.

The figure 4 also revealed that students' pedagogical competencies were assessed at all four levels of cognition. However, the rate of questions at understanding is the highest. On the other hand, there were 13.1% questions requiring students to recognize knowledge from memory. Question at the level of application and analysis were also used but with a much lower rate than the question at the level of understand.

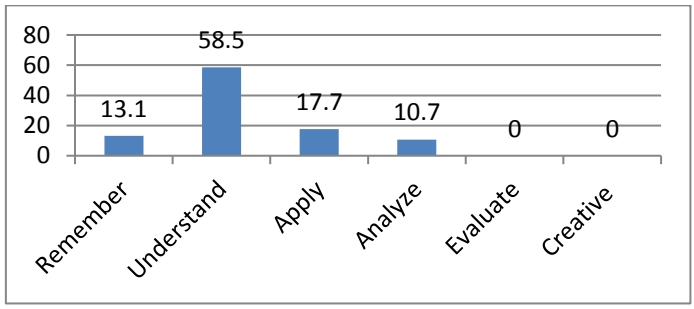


Figure 4: Types of questions to assess pedagogical competencies of students in summative tests at HCMUTE.

CBA techniques in assessing pedagogical competencies of students

As we can see in the figure 5, pedagogical competencies of students have been assessed through applying the diversity of CBA techniques. Those were applied in almost levels. While multiple choices were always used the most widely in formative assessment, written test was the most popular in summative assessment. These technique meets requirements of learning tasks designed based on categorizes of remembering and understanding.

Although essay seems to be suitable to assess learning tasks at analyzing, evaluating and creating, but the rate of using it was lower than multiple choices and written test. There were not any differences about the rate of using oral test and practice in both formative and summative assessment. Only 18.5% participants used them very frequently and always.

On the other hand, checklist was used at least in comparison with others assessment techniques those have been mentioned in this study.

In brief, students seem to be required to remember/understand more than apply/analyze/evaluate and create based on previously learned information.

Are there any relationship between results of applying CBA techniques in general and the case study? A quantitative research concerning with 64 summative tests at HCMUTE revealed that written test, multiple choices and practice were main assessment techniques. If written test were occurred in almost of 64 tests, multiple choices and particularly practice were used with the very remarkably lower rate. These statistics can be clear evidences about using assessment techniques not directed to higher cognitive levels in assessing pedagogical competencies of students at HCMUTE (see the figure 6).

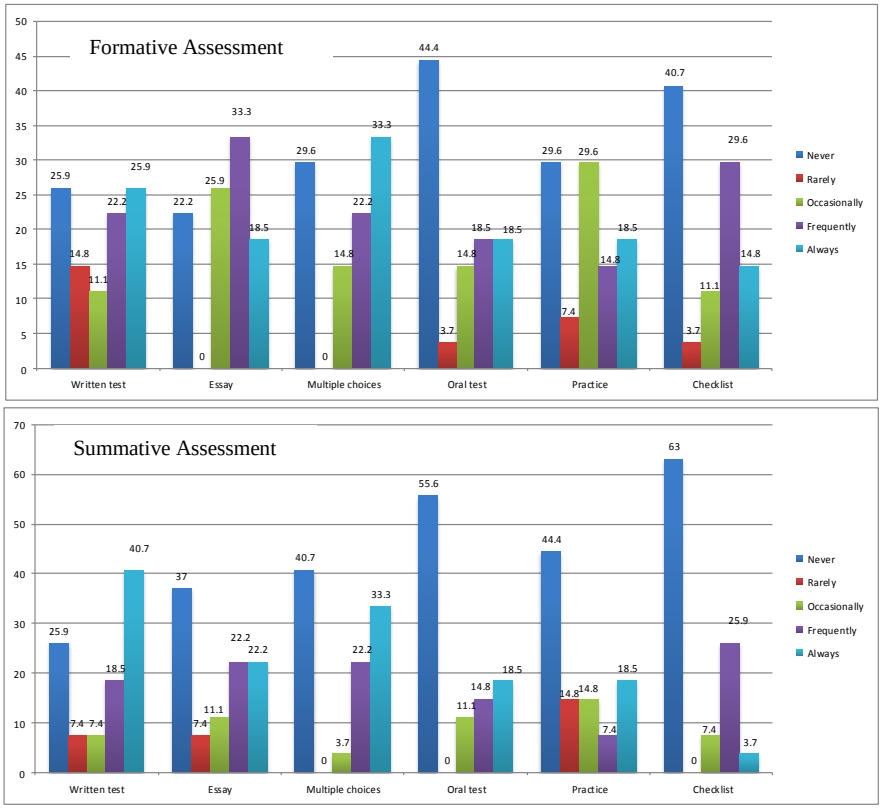


Figure 5: CBA techniques in assessing pedagogical competencies of students.

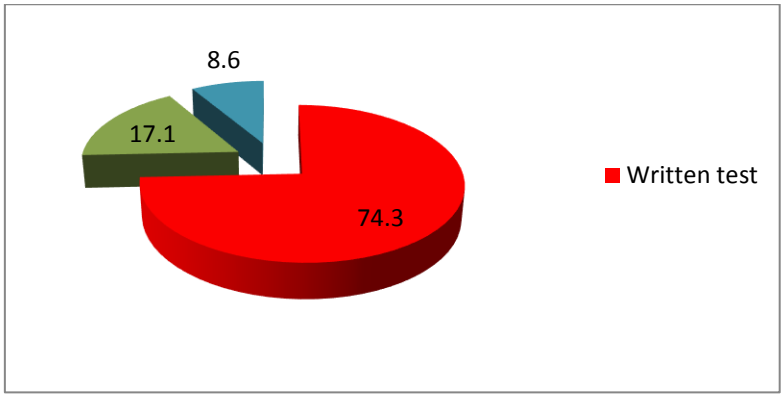


Figure 6: CBA techniques in assessing pedagogical competencies of students in summative tests at HCMUTE.

CONCLUSION

CBA is the new approach for assessing students' pedagogical competencies of students in higher education institutions of technology and education in Vietnam. CBA concentrates on assessing the application of previously learned information in dealing with real-world problems. CBA does not provide students with evidences to self- recognize their own skills and knowledge, but regulate teaching and learning.

Quantitative and qualitative results on applying CBA to assess students' pedagogical competencies revealed that participants misunderstood about aims of CBA. Criterions and learning tasks were directed to assess understanding and remembering knowledge more than applying, analyzing, evaluating and creating. Although CBA assessment techniques were applied quite numerously, but multiple choices and written test were still the most popular technique in formative and summative assessment. These techniques are more relevant to assessing pedagogical competencies at understanding and remembering. We believe that changing the awareness of teachers of aims of CBA and developing assessing tools according to the higher cognitive levels are main measures to strengthen the quality of applying CBA in assessing pedagogical competencies of students in higher education institutions of technology and education in Vietnam.

ACKNOWLEDGEMENTS

I would like to give my special thanks to Hien. Dang Thi Dieu and my colleagues for special assistances throughout the entire research.

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Experiential Teaching Methods for Developing Core Competencies of Technical Students in Vietnam

(a case study at Ho Chi Minh City University of Technology and Education)

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ABSTRACT

This article mentioned on results of applying experiential teaching methods such as Project-Based Learning and Learning games for developing core competencies (problem solving; teamwork) of technical students in Vietnam.

This article also discussed a brief theoretical approach to core competence and experiential teaching methods as well as the way of designing/organizing experiential learning activities. Qualitative methods (observation, interview, practical learning products) were applied to identify the development of core competencies of Technical students. Suggestions for applying experiential teaching methods by carefully considering a consistency of learning outcomes, teaching and learning methods and assessment was given.

Experiential teaching methods are not new to the learning environment. However, they would be a new approach to some cultures, like Vietnam where most of students are not familiar with studying in experiential ways. This approach provides students with opportunities to self - construct their competencies from experience.

Keywords: Core Competence, Experiential Teaching Method, Project-Based Learning, Learning Games.

INTRODUCTION

Core competencies can be defined as personal attributes or underlining characteristics, which combined with technical or professional skills, enable an individual to fulfill a role/job. Core competencies such as problem solving or teamwork are basic/fundamental for technical competencies (OECD). Becoming the member of the ASEAN Economic Community since 2015, together with opportunities, foreign languages and especially an inadequacy of professional and core competencies are great barriers for Vietnamese workers. Employers in Hanoi and Ho Chi Minh City were not just looking for technical competencies to do the

job, but also equally looking for what experts call cognitive competencies, social and behavioral competencies (teamwork, problem-solving, critical thinking, creative thinking and so on.) (Christian. B, Magnusson R.B, 2013). These social and behavioral competencies will be combined with technical or professional competencies, enable an individual to fulfill a job.

In Vietnam, Ho Chi Minh City University of Technology and Education (HCMUTE) is the leading university in educating and training technical and vocational teachers, engineers and technicians for the whole country, especially for the Southern region. Awareness of employers' requirements, a training programme based on a CDIO approach (Conceive; Design; Implement; Operate) has been implemented since 2012 at HCMUTE to support technical students develop holistic competencies (knowledge, skills, attitude and core competencies). With this training programme, technical teachers are required to apply experiential teaching methods (project based learning, situated learning, capstone projects and so on) in the teaching process. However, it is not easy to teach subjects according to the experiential way because of lack of knowledge, skills about experiential teaching methods. This paper describes briefly theoretical approach to core competence and two experiential teaching methods (Project based Learning, learning games) as well as activities of teaching and assessment to develop students' core competencies at HCMUTE.

THEORETICAL APPROACH TO CORE COMPETENCE AND EXPERIENTIAL TEACHING METHOD

Outline of competence and core competence

"Competence" is a very popular concept to express an ability to do something successfully or efficiently. Competence (in the British context) or competency (in the Australian context) is derived from Latin - Competentia, means agreement or conjunction (Deißinger & Hellwig, 2011). Competence is not just knowledge and skills, but an ability to meet complex demands by drawing on and mobilizing psychosocial resources (including skills and attitudes) in particular. According to Hoskins and Crick (2008), competence is best described as a complex combination of knowledge, skills, understanding, values, attitudes and desire which lead to effective, embodied human action in the world, in a particular domain.

This paper based on the following working definition: "Competence is a flexible conjunction and application of knowledge, skills, attitudes, values, beliefs, motivations, interests, needs... to deal with complex real - world problems to achieve good results" (Oanh, 2016).

"Core competence" is constructed based on distinguishing the concept of "competence" in 2 groups: core competence and technical competence (OECD, 2014). Core competence can be defined as personal attributes or underlining characteristics, which combined with technical or professional skills, enable the

delivery of a role/job. Core Competencies do not define individuals' technical roles and accountabilities, nor does it include the technical skills necessary to do the jobs. On the contrary, technical competencies cover the various fields of expertise relevant to the specific work (OECD, 2014). Core competencies and technical competencies link closely together and the development of technical competencies effect on core competencies (Kiem, Ry & Que, 2015). Ry, and Que (2015) classified core competencies in 3 groups:

1. Autonomous activity and personal development competencies, including self - study, problem solving, creative thinking, creative thinking and so on.

2. Social competencies, including communication, teamwork and so on.

3. Tool competencies, including language, computer, calculate and so on.

In this research, we concentrate on developing core competencies of students such as problem solving and teamwork through applying experiential teaching methods.

Outline of Experiential Teaching method

"Experience" is a familiar word with us to know things around through doing or practicing. In Oxford Learner's Dictionaries, "experience" means the knowledge and skill that you have gained through doing something for a period of time; the process of gaining this; the things that have happened to you that influence the way you think and behave. In the philosophy, it means a kind of internal action from heart connected with life and existence (Dongmei Sheng, 2016).

From the time of the first teachers, it has been recognized that an important relationship exists between experience and learning (Knutson.S, 2003). There is a common adage attached to experiential learning: "Tell me and I will forget, show me and I may remember, involve me and I will understand" (Confucius cirea 450 BC). Learning from experience is one of the most fundamental and natural means of learning available to everyone (Beard.C., Wilson.J.P., 2016). Kolb.D (1984) also believed that knowledge is gained through personal and environmental experiences. In its simplest way, experiential learning means learning from experience or learning by doing (Linda.H.L., Williams.C.J, 1994).

Experiential learning links closely with experiential teaching. Experiential teaching method relies on experiential learning (Valerie.J.K, 2012) and is often referred to as the hands-on or problem-based teaching method (Brittany.L.A, 2010). Experiential teaching plays a very important role in creating an experience for the students to learn from. Experiential teaching method enhances a learning process to be student-centered and to allow space for individual student experience, interpretation, and learning. It is easy to find core values of the experiential teaching in developing competencies of learners, especially core competencies like

teamwork, problem solving, creative thinking ... in some principles of experiential education pointed out in the Association for Experiential Education's website:

1. Experiences are structured to require the learner to take initiative, make decisions and be accountable for results.

2. Throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative and constructing meaning.

3. Learners are engaged intellectually, emotionally, socially, soulfully and/or physically.

4. This involvement produces a perception that the learning task is authentic.

5. Relationships are developed and nurtured: learner to self, learner to others and learner to the world at large.

6. The design of the learning experience includes the possibility to learn from natural consequences, mistakes and successes.

Experiential Teaching Method facilitates the experiential learning process, including action learning (Marquardt.M, 2007; Silberman.M, 2006); learning games (Silberman.M, 2006 and Ukens.L, 2007); field trip (Lei Li, Fan Cheung, Ning Wang, Lixing Lao, Yibin Feng, 2016), Project Based Learning (PBL) (Lee Hong Sharon Yam and Rossini.P, 2010; Efstratia.D, 2014) and so on. Experience for students to learn created by these methods would enhance the understanding of concepts as well as the gateway to develop skills.

PBL is a student-centered instructional approach used to promote active and deep learning by involving students in investigating real-world issues in a collaborative environment (Krajcik, Czerniak, Berger, 1999; Lee Hong Sharon Yam and Rossini. P, 2010). PBL engages closely experience of students with school life and provoke serious thinking as students acquire new knowledge (Efstratia.D, 2014). PBL is most often characterized in the following (Seidel.S, Aryeh.L, Steinberg.A, 2002):

1. A series of activities with a sustained focus over time and linked to an outcome of significance - a performance, product, or service that is highly valued by the students as well as a broader community.

2. A group effort that often moves beyond the walls of the classroom or after school, into the community for research, internships, presentations and so on.

3. Clear learning goals that often embrace academic, social, and metacognitive dimensions simultaneously.

4. Assessment that is ongoing with frequent opportunities for students to receive and provide feedback as the work is developing as well as final evaluation from peers, instructors, and the public, including self-assessment.

In its simplest way, PBL is organized with 5 steps, which is suitable to types of learning projects:

1. *Define the learning project topic, time allowed, team size and criteria*: Teachers state learning project topics, time allowed, team size and assessment criteria.
2. *Develop specific plans to implement the learning project:* Students make specific plans to implement learning projects. Plans often consist of the time, resources, contents, intended results.
3. *Implement the learning project:* Students implement learning projects according to their plan. Teachers should be accompanied with students during the implementation process.
4. *Present results:* Students present results and answer questions from teachers and classmates.
5. *Assess results:* Teachers, students and peer-students co-assess results based on assessment tools such as checklists or rubrics.

Learning games are also applied to enhance the experiential learning process of students. Play has been recognized an essential part of human being development as children start learning through play. We can practice behaviors and improve on our mistakes (Ukens.L, 2007). Learning games do not require actions as solving problems and puzzles, analyzing information, making self-disclosure, but refer to the objective of improving the player's level of competency in particular areas (Ukens.L, 2007). So, it provides learners opportunities to overcome obstacles with real feelings of success and real learning (Ukens.L, 2007) as well as to experience the total content before discussing the parts (Silberman.M., Biech.E, 2015).

DEVELOPING CORE COMPETENCES OF TECHNICAL STUDENTS THROUGH EXPERIENTIAL TEACHING METHODS AT HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY AND EDUCATION

Cater for developing core competencies of students, experiential teaching and learning methods must be engaged deeply with both learning outcomes and

assessment in the entire teaching process. With PBL and learning game, students are divided into small groups (typically of about five students) to implement learning projects or learning games. Students must define the problem, collect and analyze information, develop plans, implement proposed solutions and finally evaluate results in every project or game. Students are not only required to learn and work with others, but also relate well to others, co-operate, manage and resolve conflicts in their team. These activities are performance areas of core competencies. Different levels of the core competence development are quantified by assessment tools.

Findings of developing core competencies of students such as problem solving and teamwork through applying experiential teaching methods in System Thinking subject that belongs to the CDIO training programme at HCMUTE will be analyzed in the following.

System Thinking involves a holistic approach, taking into account as many different factors as possible to avoid interpreting problems from a single point of view (Kriz.W.K, 2008). After completing this subject, students will be able to apply the system thinking point of view in building a specific system as well as develop some core competencies such as problem solving, teamwork, critical thinking, and creative thinking and so on.

To achieve this learning outcomes, PBL and learning games are integrated in the process of teaching. An experiential teaching plan to develop students' core competencies is analyzed in the following.

Table 1: The experiential teaching plan for System Thinking subject.

Learning Outcomes	Contents	Teaching Methods	Experiential Activities	Intended findings
***Phase 1*: Overview of System**				
1. Describe a system; 2. Build a system; 3. Develop core competencies: problem solving and teamwork.	1. The definition of system 2. Describe a system 3. Analyze and design a system	1. Group work 2. Project based learning	Learning Project topic Build a system (a bridge, a house, a device, a gift and so on) by recycling waste materials such as milk cartons, plastic bottles, cardboards, papers, textiles (clothes, woolen), aluminum (beverage cans) and so on.	4. A system by recycling waste materials 5. A PPT report

***Phase 2:* Thinking and Technical Thinking**				
1. Present the characteristics of thinking, technical thinking and thinking manipulations 2. Develop core competencies: problem solving, teamwork and creative	1. Overview of thinking 2. Definition of thinking 3. Characteristic of thinking 4. Thinking manipulations	1. Group work 2. Learning game	TRI UAN game Form a specific shape as a given outline by using seven wood shapes in the least time possible	A specific shape as a given outline
	1. Overview of technical thinking 2. Definition of technical thinking 3. Characteristic of technical thinking 4. Structure of technical thinking	1. Group work 2. Project based learning	Learning Project topic Build a tower by 200 straws and scotch tapes. Criteria: The highest tower and stand in the longest time will be the winner Team size: Suggested team size is 5 - 7 students	A tower by straws and scotch tapes

To help students engage closely theoretical knowledge of analysing, designing and building a specific system as well as develop problem solving and collaboration competencies, students are required to implement the leaning project: *"Build a system (a bridge, a house, a device, a gift and so on) by recycling waste materials such as milk cartons, plastic bottles, cardboards, papers, textiles (clothes, woollen), aluminium (beverage cans) and so on".* The time is allowed in one week. The team size is 5 - 7 students.

A group of students from the Faculty of Electrical and Electronics Engineering built a model of Han River Bridge by recycling bamboo sticks, bulbs and wires. Students applied electrical and electronics knowledge to make the bridge model which can be rotated. This product could be used as a visual learning model.


Figure 1: The model of Han River Bridge from bamboo sticks, bulbs and wires.

In this learning project, to build the system by recycling waste materials, students defined the problem through answering questions: How is the system built? Which waste materials are used in building the system? How do they build the system by recycling waste material? What is the system for? The bridge system was built by waste material such as carton, paper, and bamboo sticks.

Besides defining the problem, students collected information to make clear the defined problem: which is the model of the bridge? What are waste materials? What are waste materials for? How do students make the bridge system can be rotated? This information was analyzed and synthesized to serve for proposing solutions. Students analyzed advantages and disadvantages of each solution, the ability and condition of the implementation and selected the best appropriate solution: building the model of Han River Bridge rotated by recycling waste material such as bamboo sticks, bulbs and wires.

After collecting and analyzing information to propose the feasible solution, students made a specific plan to implement the learning project. Some points were done in the plan by students such as:

1. Pointing out activities concerning with building the bridge need to be done;
2. Listing waste material used to build the bridge;
3. Assigning tasks to each member of the group;
4. Determining concrete time for each member to complete the task;
5. Showing intended results.

Students implemented the proposed solution according to the plan. Each member in the group did not only do the assigned tasks, but also combine every member to revise and complete the model. The leader of the team shared: “Each member in our team gave their own ideas to build a system by recycling waste materials. We analyzed and evaluated these ideals together. In the process of implementing the learning project, the lecturer is always accompanied and helps us overcome differences ideas. We learned how to deal with the problem and work together”. When the Han River bridge model done, students evaluated the result by reviewing as well as pointing out advantages and disadvantages of the model. The group revised the rotation system of the bridge when the switch is turned on.

In this learning project, students did not only apply knowledge of analyzing and designing a system to dealing with the real problem, but also define the problem, collect and analyze information, develop the plan, implement the proposed solution and evaluate the result. These performance areas of the problem-solving competence of students were quantified based on the problem-solving competence checklist. In this case, students’ problem solving competence gained 95/100 points.

To experience "thinking manipulations" before discussing about specific thinking manipulations, students were required to play the puzzle game: "*Form a specific shape as a given outline by using seven wood shapes in the least time possible*". Every 5 - 7 student group co-operated to analyze/synthesis/compare the given outline with the puzzled seven wood shapes. Each group presented activities experiencing to play the game. Then teacher combined experiential activities with every thinking manipulation. According to teacher's guidelines, students discussed about thinking manipulations' characteristics and how to apply them in constructing a specific system. Finally, thinking manipulation was summarized by the teacher and students. In this experiential learning game, performance areas of problem solving and teamwork competences were also quantified by checklist.

In our class, 5 groups were required to form a specific shape as 3 given outlines by using seven wood shapes in the least time possible. When the allowed time ended, only groups 1, 2 and 5 formed 3 shapes as the given outlines. These group used activities as thinking manipulations (analyze, synthesis, compare, generalize) to form shapes through identifying the puzzle problem, analyzing/comparing between the given outline and a concrete relationship of 7 wood shapes, forming shapes and evaluating results. Every member in these groups discussed the puzzle problem and ways of forming shape in harmony. The group 4 formed only 2 shapes as the given outlines. They were not successful in the third puzzle game because of not identifying the puzzle problem. About the group 3, they were in the process of finding the way to form the first shape as the given outline when the time ended. This group did not play successfully. A member of the group 3 said that: "Every member in our group played according to their way. We did not identify the puzzle problem before forming shapes". So, through the experiential learning game, most of students could self-construct knowledge on "thinking manipulations" and hands-on to develop performance areas of problem solving and team work competencies. A part of students still faced with challenges in identifying problems in a specific context and dealing with conflicts in small groups.

Figure 2: Technical students participated in the learning game.

CONCLUSION

Experiential teaching methods play a very important role to enhance students to study in the proactive and experiential way. These methods provide students with opportunities to self - construct knowledge, skills, attitude and so on from experience. The consistency of experiential teaching methods, learning outcomes and assessment will create a sustainable change in the quality of education in higher education institutions.

Experiential teaching methods require teachers and students to change their teaching and learning way. Instead of focusing on presenting and requiring students to remember knowledge, teachers design real - world problems and encourage students to co-operate in dealing with them. Students learn how to define and deal with learning tasks effectively. Thanks to experience together in leaning situations, students also learn how to relate well to others.

Experiential teaching methods also provide students with better opportunities to develop core competencies gradually in the learning process. One of main psychological characteristics of most of Vietnamese students is not willing to share their opinions in working groups. Some of them prefer working according to their own way than collaborating with other students. In our class, they were encouraged to overcome psychological barriers to implement learning projects or the learning game successfully. Results of dealing with learning tasks in the System Thinking subject are valuable evidences to assume the development of social competencies of students at HCMUTE.

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Exploring Participation of Students in Software Development: A Survey

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ABSTRACT

The lack of theoretical fundamentals with which participation in software development environments is generally measured, is the motivation for this paper. We have adopted a conception of this term based on the work of Carillo (2014), in order to measure the participation of the students in internships whereas taking the major Engineering in Informatics Sciences of the University of the Informatics Sciences in Cuba. To do that, we adapted a survey to the targeted context. Thirteen students from four different software development centers and two academic years (third and four), returned the questionnaires. Results related to the constructs

Interaction intensity, Mentoring, Supportiveness and Joining structuredness were favorable. But answers to the task-related items showed lack of knowledge about the tasks design and assignment, which do not propitiate the autonomy of the students. This study provides an opportunity to improve the instrument adopted to measure participation in software development. More research is needed to more consciously adapt and validate the instrument to specific contexts.

Keywords: *Participation, software development, survey, workplace learning*

INTRODUCTION

In general terms, participation is about taking part to a process, of having the opportunity to become actively involved in a project, or a program of activity. For Akerström (2014, p. 23) it means involvement in a life situation in a free communicative context where one has the possibility to take responsibility and the agency to contribute to the interaction and decision making.

Kelty et al. (2015), accordingly, disagree with the usual treatment of participation as a one-dimensional concept, and defines it since a multi-dimensional point of view. However, most assumptions of participation in the software development seem to be based on the first perspective: a one-dimensional approach (Koh & Kim, 2004) (Roberts, Hann, & Slaughter, 2006) (Fang & Neufeld, 2009) (Acquia Dev, 2012) (Carillo, 2014) (Balestra, Arazy, Cheshire, & Nov, 2016). For example, participation assumptions in open source software development communities are placed since a code-centric perspective, and with a lack of theoretical fundamentals (Carillo, 2014), that is merely based on the number of knowledge contributions (code lines, patches), posts, views.

Carillo (2014) contributed to the definition of participation, by defining a set of factors of what he called socialization experience. The definition of socialization experience of this author is too close to Wenger's conception of legitimate peripheral participation: a process of engagement in the community of newcomers in the pursuit of becoming old timers, through social interaction, identity construction, and membership progress (Wenger, 1998). The conception of socialization of Carillo (2014) comprises six constructs related to the tasks the newcomers face, their interrelation with other individuals in the community and the community indeed.

However, Tejera-Hernández et al. (2017) described a conception based on the constructs of Carillo (2014) and the dimensions of contemporary participation of Kelty et al. (2015), adapted to the case of the major Engineering in Informatics Sciences (EIS) at the University of Informatics Sciences (UCI for its acronym in Spanish) in Cuba. In this research, we assume the conception of this authors (see

Table **1**), but we want to focus only in the seven constructs highlighted below: six of them assumed from Carillo, and *Task selection* which was defined for the authors mentioned before.

Table 1: Conception of participation in software development assumed, based on Carillo (2014) and Kelty et al.. (2015).

Constructs		Definition
Tasks-related	Task segregation	The degree to which a newcomer has performed tasks that are specifically tailored for newcomers.
	Task purposefulness	The degree to which the sequence of tasks performed by a newcomer follows a logical pattern designed to help the newcomer to become a contributor.
	Task selection	The degree to which a newcomer has participated in the selection of the task sequence that he/she will perform, in order to learn how to become a project contributor.
Individuals-related	Interaction intensity	The degree to which a newcomer is actively involved with other newcomers and community members while learning how to become a project contributor.
	Mentoring	the degree to which a newcomer has been taken under the wing of one or more experienced members while learning how to become a project contributor
Community-related	Joining structuredness	The degree to which a newcomer is actively involved with other newcomers and community members while learning how to become a project contributor.
	Supportiveness	The degree to which a newcomer has perceived a community to be supportive while learning how to become a project contributor.
	Voice	The degree to which a newcomer has perceived that he/she has opportunities to speak back in order to influence the project outcomes, as a way of becoming a contributor.

	Visible metrics	The degree to which a newcomer perceives empirical demonstrations of the connection between his/her participation and outcomes.
	Resource control	The degree to which a newcomer has perceived that he/she is allowed to control (own or use, not merely produce them) the project resources (work products, project methods, etc.), while he/she learns how to become a project contributor.

The purpose of this work is to explore the actual status of those constructs in the students of the major of EIS of UCI.

In this major the existence of real Software Development Centers (SDC) associated to every faculty of UCI, with real software development projects, customers and deadlines; is an opportunity to the development of worth it internships. In consequence, the internships are institutionalized in the subjects its main curricular knowledge area, Professional Practice.

In these subjects, namely Research and Development Projects (in advance PID, according to its acronym in Spanish) from IV to VII, every student must perform a group of well-defined professional roles (usually a predefined pair of them), in the software development projects to which he/she is assigned. The level of the tasks the students must perform and the competence of the students to do them, must gradually increase in every new PID subject they take.

However, a discipline in the fulfillment of these indications is not observed in practice today. The internships take place in a different manner in every faculty: but a group of commonalities that keep the Professional Practice knowledge area from its successful development (DMC-IGSW, 2015) (VRF, 2015). These commonalities are generally related to the students of the third and the fourth years, and they are:

1. The assignment of tasks that are not facing real problems of the project and with a low level of complexity.

2. Students do not need the interaction with other members of the project to do their work. These opinions are in correspondence with Fang & Lu (2015) comments, stating that in some internship experience *content is relatively simple work more relaxed, no real workout, reach the purpose of the course is teaching*.

3. Low commitment of the students with participating in the project, due to the inexistence of a procedure through which they could select the project they want to contribute.

This situation, combined with the difficulties for scheduling and the instability of the workplace hours, demonstrate the existence of problems with the participation of the students in project. In other words, the students are placed in a position where they are not only exposed to face the usual barriers of a newcomer in any new place; but also that distorts the usual dynamics of a software development project.

MATERIALS AND METHODS

The study was conducted with a small sample composed by 13 students of the third and the fourth years of the EIS program and of four different SDC.

Table 2 Distribution of the sample with respect to the SDC (a), the academic year (b) and the genre (c).

(a)

SDC	Number of students
CIDI	4
XETID	2
CESOL	5
DIN	2

(b)

Year	Number of students
3rd	6
4th	7

Genre	Number of students
Female	6
Male	7

(c)

The survey was composed for 38 items, distributed as is shown in the Table 3**.** We selected and made minor changes to the items that Carillo (2014) already validated in his work. We also reduced the seven-point Likert scale by which respondents should answer in his survey, to only five options: I agree, I slightly agree, I don't know, I slightly disagree and I disagree.

Table 3: Distribution of the items of the survey between the constructs.

Constructs	Number of items
Interaction intensity (II)	5
Mentoring (M)	6
Supportiveness (S)	6
Task segregation (TSg)	6
Task selection (TSl)	5

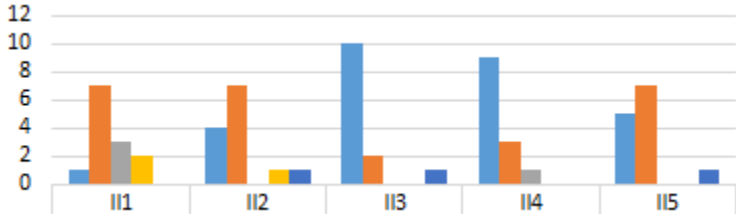
Task purposefulness (TP)	6
Joining structuredness (JS)	4

After the items of every construct, allowed the students to expand their criteria by an open question.

The items for the construct Task selection, which was included by Tejera-Hernández et al. (2017), were prepared mainly by adapting the items of the construct Task purposefulness, through substituting the subject in the sentences. The Cronbach alpha of the construct was 0.87, which is acceptable.

RESULTS AND DISCUSSION

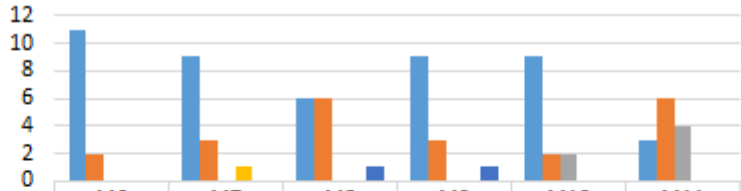
The analysis of the responses associated to the construct *Interaction intensity* did not throw negative results. Most students agree or completely agree with the fact that they can interact with others in their projects and that this interaction contributes to their learning. However, it seems that their connection with others through the communicational technologies of the project (II1) is not well achieved, because only one (1) respondent was completely agree, and five (5) respondents answered with "I don't know" and "Slightly in disagreement".



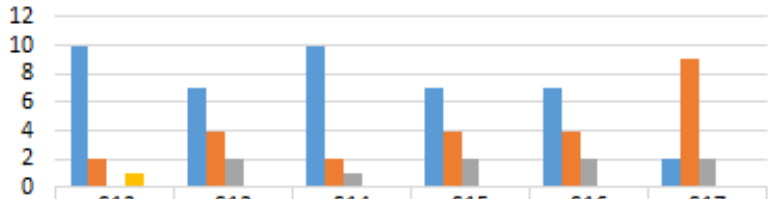
	II1	II2	II3	II4	II5
	Interaction intensity				
I agree	1	4	10	9	5
I slightly agree	7	7	2	3	7
I don't know	3	0	0	1	0
I slightly disagree	2	1	0	0	0
I disagree	0	1	1	0	1

However, we expected to receive feedback in the open question of this construct, about the low relationship with project members that is demanded to perform the tasks they are assigned, which is a recurrent dissatisfaction reported in internships analysis. This suggests the need of improving the survey by including explicit items about this concern.

The constructs *Mentoring* and *Supportiveness* showed better results, all the respondents said to be connected with a project member responsible for them, and that gave them support and feedback while they were performing their tasks. However, due to the small size of the sample, it is worth to pay attention to the inquiries of the student which denies that experienced members supported him/her and that the support of project members influenced his/her contributions and his/her learning (M7, M8 and M9).



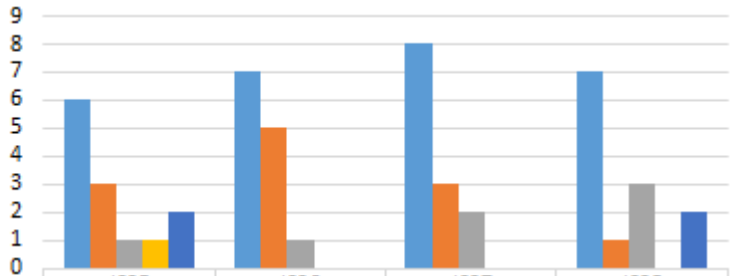
	M6	M7	M8	M9	M10	M11
	Mentoring					
I agree	11	9	6	9	9	3
I slightly agree	2	3	6	3	2	6
I don't know	0	0	0	0	2	4
I slightly disagree	0	1	0	0	0	0
I disagree	0	0	1	1	0	0



	S12	S13	S14	S15	S16	S17
	Supportivenes					
I agree	10	7	10	7	7	2
I slightly agree	2	4	2	4	4	9
I don't know	0	2	1	2	2	2
I slightly disagree	1	0	0	0	0	0
I disagree	0	0	0	0	0	0

A similar behavior show the answers of the construct *Joining structuredness.* Although most students agree with the existence of a structured program to join the

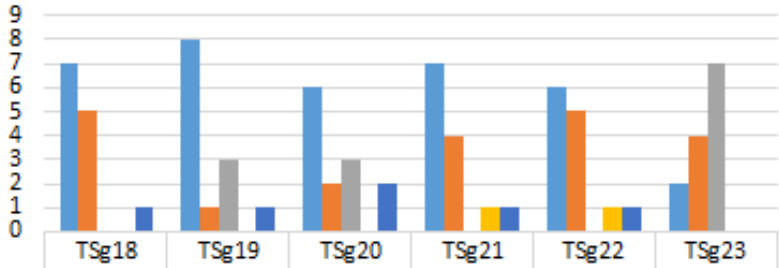
project (JS35), three (3) students disagree; and two (2) others said they cannot access to it in the platform (JS38).



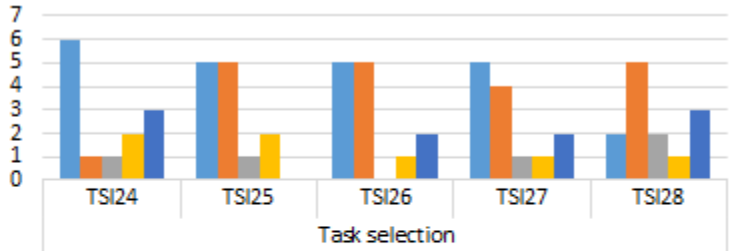
	JS35	JS36	JS37	JS38
I agree	6	7	8	7
I slightly agree	3	5	3	1
I don't know	1	1	2	3
I slightly disagree	1	0	0	0
I disagree	2	0	0	2

In this regard we also expected to receive criticism in the open question of this construct, about another regular dissatisfaction reported: their frequent impossibility to select the project they want to contribute. This fact generally causes the demotivation of the students for the project and the tasks they are assigned. This suggests the need of improving the survey by including explicit items about this concern.

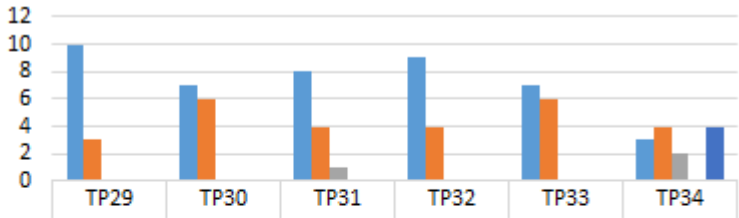
With respect to the Task-related constructs, a higher number of answers are referred to the lack of knowledge about the tasks design and assignment. For example, seven (7) respondents said they did not know whether the tasks were available in the project management tool for them to be examined and selected (TSg23); six (6) of them also disagree with the affirmation that they had access to the tool to select their tasks (TSl28) or to design their logical sequence (TP34). Six (6) respondents said that they did not participate in the selection of the tasks they should do (TSl24); one (1) of them actually does not know. Apparently the modus operandi is to introduce the tasks to the students and to ask them if they feel comfortable because ten respondents assured it.



	TSg18	TSg19	TSg20	TSg21	TSg22	TSg23
I agree	7	8	6	7	6	2
I slightly agree	5	1	2	4	5	4
I don't know	0	3	3	0	0	7
I slightly disagree	0	0	0	1	1	0
I disagree	1	1	2	1	1	0



	TSI24	TSI25	TSI26	TSI27	TSI28
I agree	6	5	5	5	2
I slightly agree	1	5	5	4	5
I don't know	1	1	0	1	2
I slightly disagree	2	2	1	1	1
I disagree	3	0	2	2	3



	TP29	TP30	TP31	TP32	TP33	TP34
	Task purposefulness					
I agree	10	7	8	9	7	3
I slightly agree	3	6	4	4	6	4
I don't know	0	0	1	0	0	2
I slightly disagree	0	0	0	0	0	0
I disagree	0	0	0	0	0	4

These results put forward the use of the project management tool for the task design and assignment as limited; and it also suggest the possible existence of difficulties with the access of the students to the project tools. This behavior limits the possibility of the students to set their own objectives, to self-reflect about his/her progress, to be creative and proactive with respect to his/her own knowledge.

The inclusion of the construct *Task selection* was worth it to extract difficulties of the context. Most disagreements in task-related items were expressed in this construct (TSl24-TSl28). However, we suggest to include items according, to the criticized disconnection of the tasks the students perform, with the business the projects are actually involved, in order to make the students feel the usual dynamic of a software development project.

CONCLUSIONS

In this paper, we have surveyed students of the major the EIS of UCI, in order to explore the status of the constructs of participation in software development assumed by Tejera-Hernández et al. (2017), based in Carillo's (2014) model. The survey was prepared using the items that Carillo already validated.

Most results were favorable, especially the ones related to the constructs *Interaction intensity*, *Mentoring*, *Supportiveness* and *Joining structuredness*, which is mainly in accordance with the criteria expressed in reports and discussions about the internships in UCI. However, the authors suggest the inclusion of items that explore more deepen in difficulties that have been discussed, like the low relationship with

project members that the tasks the students perform, demand; and the need of generalizing the possibility that the students choose the project they want to contribute during their internships.

Task-related items, on the contrary, were responded with a higher number of answers referred to the lack of knowledge about the tasks design and assignment. Apparently, the modus operandi is to introduce the tasks to the students and to ask them if they feel comfortable, which is positive, but coming alone, limits the self-direction and autonomy of the students.

However, it is worth to highlight that the inclusion of the construct *Task selection*, with a Cronbach alpha of 0.87, was effective to gather difficulties of the context.

The value of this work relies not only on the exploration of the actual status of participation of the students of the major EIS of UCI in SDC, but also in its possibility to identify opportunities to improve the instrument adopted to measure it. Further works could be conducted to more consciously adapt and validate the instrument to specific contexts.

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Self-directed Learning Approach in technical teaching At the Ho Chi Minh City University of Technology and Education

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ABSTRACT

Self-directed learning (SDL) is considered as a learning center approach. In the context of knowledge becoming more diversified and rich as today, it has been using popularly in teaching and learning.Through this approach, learners could develop a learning plan meeting their individual conditions and learning needs. With the aim of building a technical teaching (TG) process based on the SDL approach, the article presents the general structure of SDL approach, student's (STs') cognitive characteristics, technical content characteristics, and the suitable teaching process. This learning process is used by students in their learning process under the guidance of their teacher on each learning subject.

***Keywords**: self-directed learning; self-directed learning approach; technical teaching; approach in technical teaching*

1. AN OVERVIEW

In the current context with quick evolution of knowledge and technology, students' learning demand, particularly the students in technology field, becomes diversified. Being the major object in the learning course, the students always have a desire to obtain an individual-tailored method and process to get the best results in learning. Therefore, a study on developing a teaching method in accordance with the students' demand is an urgent issue in which SDL emerges as a appropriate approach for private learning in higher education nowadays.

SDL had been studied by researchers worldwide for about 160 years and built into a theoretical (TH) basis for about 60 years [1]. There have been various schools of SDL; however, a unified theory has not been obtained until now[2]. Therefore, a teaching theory under SDL model needs to be studied further in a more complete and comprehensive manner. SDL has become a major topic in adult educational literature. In general, SDL is defined by Knowles (1975) [3] as a the process by which individuals, with or without the help of others, determine their learning needs, establish their learning purpose, identify human resource and materials for learning, implement their appropriate learning strategies and evaluate their learning outcome. Brockett and Hiemstra, (1991) [4] stated that teaching methods (TMs) and learners' characteristics are the two factors of the same event where learners are personally responsible for teaching experience. Furthermore, Brockett and Hiemstra suggested that research on SDL was derived from Houle's study (1961) [5], in which he conducted interviews with adults participating the continuing education. Knowles (1975) has had a rich contribution in building a knowledge foundation of SDL, especially when he used children to describe adults' learning way. In addition, Tough (1979) [6], who studied learning projects of adults, is a major contributor to the concept of SDL [4]. The use of SDL in the early stage has been a spontaneous phenomenon beyond the school system then gradually introduced into schools. Now day, SDL has been using widely for teaching and learning. In Vietnam, SDL is still a new concept without a worth position in the training process. With advantages of teaching under SDL, and being in accordance with pointview of renewing education to improve self-study and self-learning ability for the students in the context of international integration, teaching under SDL approach is a matter subjected to further research and completion so that it can be applied to education reality of Vietnam. HCMUTE has applied SDL approach in technical TG with the purpose of making a science and technology workforce with high quality who deserve the leading force for the development of the VI industrial revolution in such a context of international integration of the country.

With the aim of building a technical TG process under self-directed approach, the article presents the general structure of SDL approach, STs' cognitive characteristics, characteristics of technical content and the suitable teaching process.

2. RESEARCH METHODOLOGY

The article used the educational and social science research methods as follow:

- Theoretical analysis method: to research and analyse the theoretical content of SDL, to analyze STs' cognitive characteristics and technical learning content, then develop the structure of SDL approach;

- Systematic analysis method: the process of studying a procedure to determine its purpose and purpose and the creation of systems and procedures to

achieve them more effectively.To analyze SDL approach in the technical TG process, from which a SDL process is proposed.

In addition, in technical teaching, the author organizes teaching experiments (SDL approaches) and control classes (traditional teaching) to evaluate the results. Results from the above two groups.

3. FINDINGS AND DISCUSSION

3.1 Self-Directed Learning Approach

3.1.1 Self-directed learning

SDL is used to distinguish from teacher-directed learning. This is a TG method in which learners determine their own learning goal to map their learning plan and research under the individual studying needs.

According to Malcolm Knowles (1975), *"SDL is understood as developing the own learning goals, determining the human resource and materials for learning, selecting and implementing the appropriate learning strategies, and evaluating the learning outcomes"* [3].

Nowadays, SDL has been applied and developed in teaching with various ideas and models, such as self-study, academic study, distance learning, study under personal plan [3], etc.

During SDL process, learners and TEs will discuss together to obtain an action plan, determine what STs should study the content to suit the immediate goal and long-term goal. The purpose of TEs is to meet learners' actual needs. This method is well suitable to develop the human learning skills such as creative research skills, independent skill on scientific research, etc.

3.1.2 Approach structure of self-directed learning

An approach means step-by-step looking into a particular subject with certain methods [7].

SDL approach in technical TG is a utilization of SDL theory to research, select and use an TM in accordance with learning characteristics under learners' private orientation with predefined goals. Thus, in the essence, this approach can be understood to be a learner-centered approach; a TG perspective motto by goal approach and flexible approach; a specific application of personal learning in the

interaction between subjects of the learning process as students and objectives, contents and learning plan in a flexible learning environment.

From the above analysis, the structure of SDL approach is illustrated in Figure 1.

Where:

- Students: subjects of learning activities, actively perform the learning process through learning plan and learning content in order to achieve predefined learning goals.

- Learning goals: learning results which STs need to achieve at the end of their study process.

- Learning plan: scenario, the learning route of STs, including: time, place, method, level of learning content and necessary resources to support learning activities.

- Learning content: is the knowledge level, skills and necessary knowledge STs identify and plan their learning to accumulate in order to achieve learning goals.

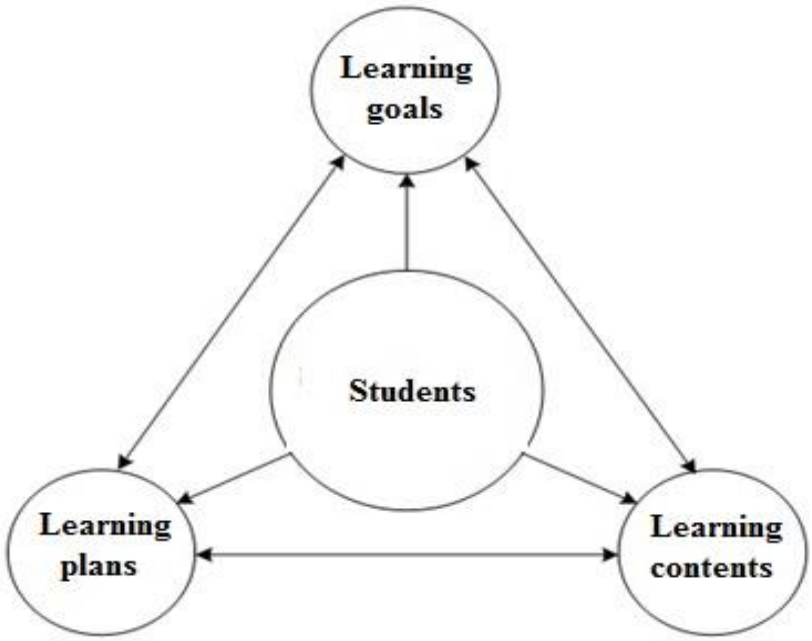

Figure 1: Structure of self-directed learning approach.

In the relationship shown in Figure 1, with the role as subjects of learning activity, STs actively identify their higher academic goals clearly and particularly from that a suitable learning plan will be built an appropriate learning content will be determined. Then, and with the support of teachers, they can manage to actively organize their learning activities according to the plan and learning content to achieve their learning goals. For STs to achieve good academic results, the learning objectives must be determined in such a way being suitable to the cognitive characteristics and ability of STs; the learning plan and content must be developed and identified in accordance with such objectives.

3.1.3 Features of the approach of self-directed learning

From the nature and structure of SDL approach as described in section 3.1.2, this approach has the following characteristics:

- Personalization in the learning activity and taking the learners into the middle point: STs are subjects of learning activity. It is necessary for them to identify the goals, study planning, and the select learning content matching with the needs and cognitive abilities;

- Flexibility and diversity in teaching organization: Each ST has his own learning plan and different learning needs so lecturers flexibly apply methods and forms of teaching organization;

- Specific plans and procedures: To achieve the predefined learning objectives, it is a must for STs to establish the detail learning plan then develop their appropriate learning process to learn and master the learning content.

3.2 Technical Teaching Process at HCMUTE Under the Approach of SDL

3.2.1 Students' cognitive characteristics at HCMUTE

STs at HCMUTE is self-reliant, dynamic and creative in learning. They have the ability of independent and flexibile thinking. Therefore, STs always tend to actively identify their specific learning objectives and tasks. In addition, under the technological influence, STs often build their own learning plan and route to master the learning content. With these remarkable qualities, engineering STs are perfectly suited to the teaching activities with SDL approach. Through this learning method and organization, STs actively choose the manner, content level and learning process suiting their own learning needs. Through this, they can develop their self-study ability, self-research; thinking ability problem- solving ability creatively.

3.2.2 Features of technical teaching content at HCMUTE

- Engineering and technology: Engineering is to creatively apply the scientific principles to design or develop structures, machines, tools, processes or projects using them in individual or in combination; or to build or operate the above objects with full awareness of their design; or to forecast their activity under certain operating conditions; all these above things with attention into the intended functions, economic characteristics of operation, or safety to life and property [8] [9].

- Practicality and application: HCMUTE trains in the direction of application technology, gives priority to develop practical skills, practical application and technical creativity abilities for STs. Therefore, the TG content is selected in favor of practice, application and limitation of academic theory. At the same time, HCMUTE encourage STs to create and promote individual learning capabilities under the supports of LMS digital TG system.

With these characteristics, SDL can be fully implemented at HCMUTE in the present context.

3.2.3 Technical teaching process at HCMUTE under the approach of SDL

With the view that SDL is considered as a learning process, there are many published processes of authors worldwide, including the difference in the division of periods as well as the steps in periods. SDL plays a particularly important role in the context of nation's integration as the amount of knowledge is increasing in society. SDL helps STs to master, consolidate and deepen their knowledge and train the professional skills. It also promotes the proactivity in learning and develop creative and independent thinking and form the capacity, excitement, habits and methods. It turns the training process into a self-training process, which is the basis for lifelong learning. From the analysis above, combining the structure and characteristics of SDL approach, the process of technical TG under SDL approach is illustrated in Figure 2 as follows:

Analyze the teaching goals and set students' learning goals ↓
Determine resources supporting students in learning ↓
Students set their own learning plan

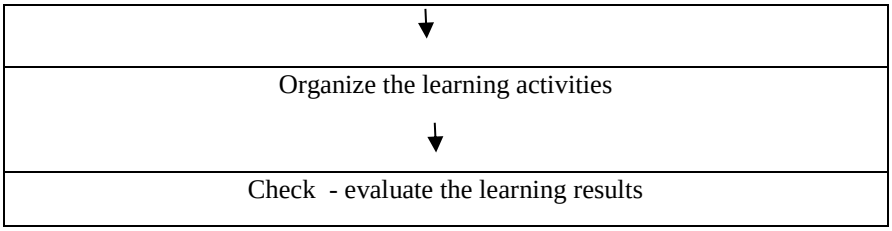

Figure 2: The process of self-directed learning.

In which:

Step 1. **Analyse the teaching goals and set students' learning goals**

The TG objectives have been identified in the curriculum and supplied to STs from the first lesson by lecturers. Based on the learning goals, teachers assign the learning tasks to STs. Based on that, STs develop their own learning goals matching with their own individual needs and learning tasks.

Step 2. **Determine resources supporting students in learning**

Based on their own learning goals, STs actively choose the learning materials, textbooks and the necessary learning resources.

Step 3. **Students set their own learning plan**

STs actively identify the level of learning content learning under their needs and cognitive abilities; choose the appropriate time, learning style and environment to master the learning content and achieve their own learning goals.

Step 4. **Organize the learning activities**

STs actively explore the study content, research and occupy the study content in order to develop the necessary knowledge, skills and knowledge matching with the predefined learning objectives.

Step 5. **Check - Evaluate the learning results**

- STs evaluate their own learning results according to learning objectives.

- Lecturers evaluate STs' learning outcomes according to their assigned TG purposes and learning tasks.

3.2.4 Implementation measure of teaching process

Depending on the TG experience and the update of new information in the subject content, TEs expect and give topics to suggest to STs. Accordingly, TEs design topics to meet the lesson objective and suit levels of excitement, learning style of STs as presented in the preparation stage of TEs. However, in practice, it is difficult for TEs to design many topics for a TH content. Therefore, to favorably implement, TEs can design the topic in the following methods:

• Method 1: To integrate criteria into a topic

In case that a class has a clear distinction in STs' cognitive characteristics, can integrate multiple criteria into a topic to suit many STs. For example, to integrate the criteria of cognitive excitement and cognitive level: to design a topic for ST group with both strong interest and high cognitive level; or design a topic for ST group with strong interest, skill and without experience, etc.

• Method 2: To merge groups with related topics

In case that STs have a clear distinction in the level or excitement in team work, TEs develop a large topic covering a wide range of small topics for STs to work in group. In which, each ST has his own topic, his own work. As such, TEs can also organize for good STs to help weak STs. On the side of STs, they can show their own personal ability and also have the opportunity to pratise teamwork skills.

• Method 3: To design the topic with integration and difference under students' cognitive characteristics

In the case that STs have a high homogeneity at some cognitive trait, TEs can design a topic integrating many cognitive characteristics for STs with the same cognitive characteristic in the first and the different cognitive characteristic in the second or third. An example:

-To design a topic for STs group with the same learning style, in which sets different contents for STs with different levels.

-To design a topic for STs group the same excitement level, in which stipulates different implementation ways for STs with different levels.

• Method 4: To select the majority group

In the case that a large number of STs have the same cognitive traits, TEs design a general topic for STs occupying the majority in the class. For the remaining STs without the above group, TEs support and instruct them to identify suitable topics.Apart from the proposed plans under demands, abilities and learning styles

of the above STs, it is a must for TEs to depend on practical conditions on equipment, TG aids as well as practical laboratories to design the appropriate topics.

4. CONCLUSION

SDL approach in technical TG requires STs a dynamic and self-motivated manner in their studies; at the same time, this method also requires the teachers a high professional skill to meet demands of the learners. It is necessary for TEs to have abilities of organizing and managing the TG and learning.

TG under TH of SDL is to help the TG activities meet objectives of the training program and STs' interests, learning objectives and conditions in order to improve their training effectiveness.

In the higher education of 21th century, THs focusing on learners' active process: to learn autonomy, to set goals and learning plan and to evaluate the learning outcome, to promote experiences and to learn for lifelong will be an advantage; the design of TG models of SDL approach is appropriate and facilitate self-development to meet the requirements of human resources and society.

TG under SDL approach is especially important in the integration context of nation when knowledge is increasing in society. SDL helps STs to master, consolidate and deepen their knowledge and train the professional skills. It also promotes the proactivity in learning and develop creative and independent thinking and form the capacity, excitement, habits, methods. It turns the training process into a self-training process, which is the basis for lifelong research and learning.

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A Dynamic Model to Identify Sensitive Data and Suggest Masking Technique

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ABSTRACT

The latest Government Security Breaches Survey revealed that 74% of small organizations reported a security breach in 2015. In year 2016, 980 data breach cases were noticed, where 35,233,317 records were breached [12]. Data masking techniques are used to provide protection to sensitive data. In this research paper researchers proposed a model, AOIOD to protect data using data masking. This model first analyses the request for data. Based on the requirement data set will be identified. Sensitive data will be identified from identified data set. Masking principles will be applied to generate masked data. Masking algorithm will be created. Masked data will be checked for its use. Finally it will be delivered to request non-production environment.

Keywords: *Data breach, Data Masking, Sensitive data, Obfuscation, Data Sub-setting.*

INTRODUCTION

Providing protection to customers or organizations sensitive data is the demand of industry. Data masking techniques are used to obfuscate sensitive data by modifying it in the way that data is still meaningful. Data masking is used by Security and risk management leaders to protect sensitive data and address the regulatory Standards and compliances. HIPAA, PCI DSS, FISMA and SAS 70 enforces that organizations must establish compliance frameworks for data security. In recent

years, many data breach cases came into the picture, which highlights the growing importance of masking technology [3]. Data masking means providing security to sensitive data by replacing the original values with realistic non-sensitive duplicate values which gives the feel of real data to the user. This new masked data is no longer confidential, is acceptable for use in non-production environments such as development, support, analytics, quality assurance, training and other wide use.

Due to massive amount of data generated through transactions. Organizations face challenges of data security and breaches. Organizations are also required to follow regulatory compliances. It is highly important to understand the necessity to protect not just Personal Identified Information (PII) of customers but Price sensitive Information (PSI) of customers as well. For example, it is necessary to protect monthly credit card bill details.

FEATURES OF MASKING TECHNIQUES

1. Masking should be a continuous and automated process.
2. Masking should provide replica of the original data.
3. Masking techniques should also cover non-sensitive data if that can be used to recognize sensitive data.
4. Mask data should not be converted into any form of original data.
5. Masked data must be in consistence state.

Data masking is easy, but maintaining integrity and preserving value is difficult [9]. Masking techniques should preserve the format of the data, specified data type, integrity, aggregate values, and frequency of data along with uniqueness.

TYPES OF DATA MASKING

There are two types of masking:

1. **Static Data Masking:** In SDM, sensitive elements are permanently removed from the copy of production database. Static data masking is implemented on the golden copy of data. Whenever data is refreshed in any of the environment, changes will be reflected in the golden copy. FieldShield-IRI is the example of SDM.

2. **Dynamic Data Masking:** DDM happens dynamically and on demand. This method enables data residing in a production database to be masked in different ways as per the requests, so that production sees the full record while support sees a masked version. DDM is attribute-based and policy driven. Oracle Redaction is the example of DDM.

TYPES OF DATA MASKING TECHNIQUES

1. Deterministic Masking: This masking technique is applied to ensure that repeatable masked data should in consistent state.
2. Compound Masking: This masking technique is applied to a set of related data as a group.
3. Conditional-based masking: This masking technique is applied on the rows of dataset which satisfy the given conditions.

CHALLENGES OF DATA MASKING

There is always a degree of risk involved in handling a large amount of sensitive data.

1. Data must be secured from accidental exposure, external hackers and malicious insiders.
2. Legal jurisdiction passed regulations that every organization has to follow. Managing multiple regulations and keeping up with changing regulations is the biggest challenge.
3. Production environment of a database has the responsibility and duties to protect the information they maintain.
4. Sensitive PII and PSI needs the protection against theft. Compliance to all norms is mandatory to prove the company's commitment to its customers.
5. In case of data breaching the organization not only lose loyalty of customer but it may suffer revenue loss.

RELATED WORK

1. S.Vijayarani, Dr.A.Tamilarasi[8],In this research paper authors proposed a model to analyze the performance of Data transformation and Bit transformation technique to protect numeric sensitive data and proved that Data transformation is better than Bit transformation.
2. Kamlesh Kumar Hingwe , S. Mary SairaBhanu[5], In this research paper authors proposed framework to support data protection in form of double layer encryption method using FPE followed by OPE.
3. John Haldeman[2],In this research paper author briefed about Optim Data Masking option for Test Data Management allows you to build new data privacy functions using column map exits in C/C++, or by creating scripts in

the Lua language. Data Stage can be extended using C/C++ or BASIC in Transformer Stages, or by creating custom operators in C/C++.[2]

4. XiaolingXia ,Qiang Xiao and Wei Ji[11] , In this research paper authors analyzed the progress of m-invariance method and proposed a method called as NCm-invariance which converts the numerical data into categorical data to overcome from the defects of m-invariance method.

5. Jun Liao, Chaohui Jiang, Chun Guo[4], In this paper authors proposed an algorithm called as SDUPPA algorithm used to analyze dynamic updating algorithm on sensitive data.

6. Data Masking Best Practice [10], Oracle has development a comprehensive 4-step approach to implementing data masking - Find, Assess, Secure and Test (F.A.S.T).

   Find: Focuses on identifying and cataloguing sensitive or regulated data across the entire enterprise.

   Assess: Focuses on identifying masking technique.

   Secure: Focuses on apply masking technique on identified data.

   Test: DBA execute application processes to test whether the masked data can be turned over to the other non-production users.

1. Securosis[9] ,In this paper focused on data masking, how the data masking technique work. Different types of Static and dynamic data masking techniques are discussed.

RESEARCH METHODOLOGY

The main objective of this model is to provide protection to numeric sensitive data.

1. **System Structure**:

   Figure 1 contains Data Obfuscation Model which is used to protect sensitive data.

2. **Proposed Solution**:

   This paper proposes a comprehensive 5-step Data Obfuscation Model - AOIOD (Analysis, Obtain, Identify, Obfuscation and Delivery) to implement data masking.

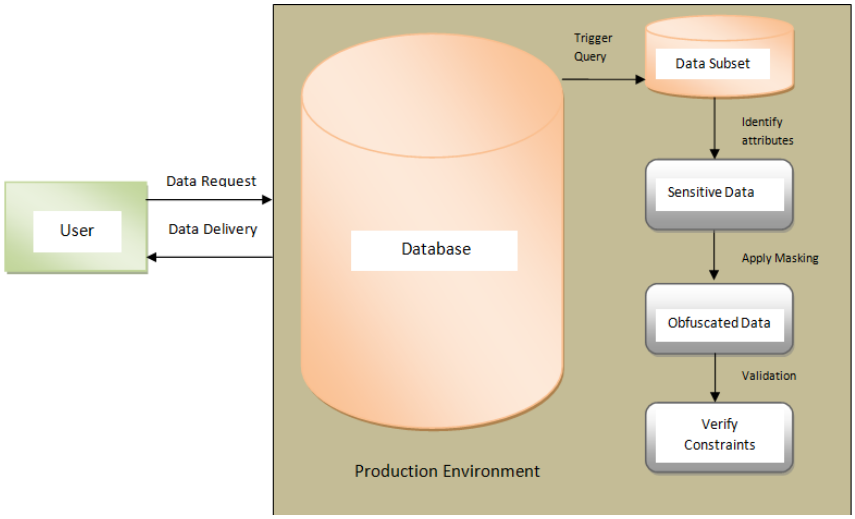

Figure 1: Data Obfuscation Model.

1. **A**nalysis of request: Users request for data will be analyzed in this phase. Request will be analyzed against different areas like:

1. What type of data records is requested (date range or data range)?
2. What will be duration of data?
3. What are the provisions for data security?
4. What is the provision for data remediation?

Date range: Data of specific dates will be displayed. For example bank statements.

Data range: Data of specific criteria will be displayed. For example data of all female clients having age more than 40 years.

Duration: For how long requested data is needed. For example number of days or months.

Data Security: Where requested data will be stored and how stored data is secured?

Data remediation: Requested data must be purged after duration.

5. **O**btain data subset: Data sub setting is the process of obtaining required data from the complete database. It is the process of slicing a part of the Production Database and loading it into the Test

Database. For ex. instead of cloning a 50 TB production database, create a subset based on date range or data range that is only 50 GB worth data and put it back into the Test Database.

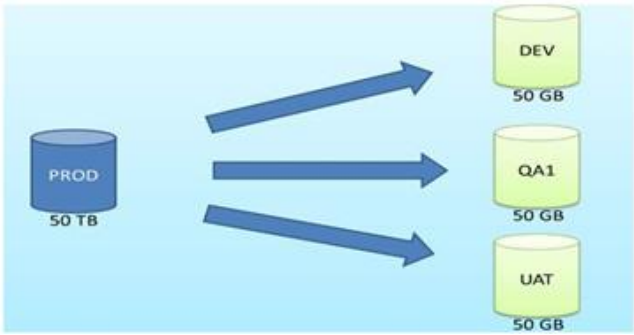

Figure 2: Obtaining data subset.

6. **I**dentify intensity of attributes: This phase will analyze the data subset to categorize attributes as sensitive data. Data discovery engine will execute an algorithm to obtain sensitive data fields. Report will be prepared by the auto brain to identify what data should be masked. For example transaction amount of a customer is sensitive data under PSI in banking system.

7. **O**bfuscation of data: To obfuscate data two features are required:

1. Data masking algorithm: Masking algorithm will define operations which will be implemented on data subset. Existing masking algorithm could be used as well as new masking algorithm can be created based on requirements provided they are approved by compliances and security.
2. Format Library: The format library consists of various masking principles that can be used to mask data. Library contains a collection of masking formats.

This phase is divided into three parts: (Figure 3)

1. Select: Depends on intensity of data, appropriate masking algorithm will be selected.

4.2 Apply: This step will apply selected masking algorithm on sensitive data attributes.

4.3 Test: This step will test uses of masked data. Masked data will also be tested for consistency, reversibility and uniqueness of data.

3. **D**elivery of data: Obfuscated or masked data will be provisioned to users for wide use i.e. development, training, quality assurance, research and public as per the request.

POPULAR DATA MASKING TECHNIQUES

Following are the important data masking techniques:

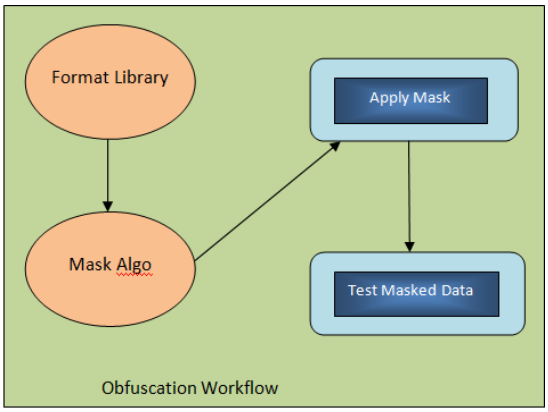

Figure 3: Obfuscation Workflow.

1. **Masking Out:** The Masking Out technique sanitizes the data by replacing certain specified characters with mask characters. If the data is in an unchanging format, then masking out is a powerful and fast option. For example, a credit card number

Original Value	Masked Value
2014 1344 5726 5231	XXXX 1344 XXXX 5231

2. **Substitution:** The Substitution technique replaces the existing data with random values from a pre-prepared dataset. Substitution is very successful in terms of preserving the look and feel of the existing data. For example Customer name.

Original Values	Masked Value
Rama	Acdp

3. **Averaging:** Averaging is an obfuscation technique where individual numbers are replaced by a random value, but across the entire field, the average of these values remains consistent.

Original Value	Masked Value
123	411

4. **Shuffling:** The Shuffling technique uses the existing data as its own substitution dataset and moves the values between rows in such a way that the no values are present in their original rows.

Original Value	Masked Value
Avni	Ranu
Bhuvan	Raahul
Ranu	Avni
Raahul	Bhuvan

5. **Blurring:** Takes an existing value and alter it so that the value falls randomly within a defined range.

6. **De-identification:** De-identification is important for dealing with complex, multi-column data sets that provide sufficient clues to reverse engineer masked data back into individual identities.

7. **Encryption:** This technique offers the option of leaving the data in place and visible to those with the appropriate key while remaining effectively useless to anybody without the key.

8. **Tokenization:** Tokens are non-reversible because the token bears no logical relationship to the original value.

9. **Nulling Out or Deletion:** The nulling out technique simply removes the sensitive data by deleting it simply deleting a column of data by replacing it with NULL values is an effective way of ensuring that it is not inappropriately visible in test environments.

10. **Number and Date Variance:** The Number and Date Variance technique varies the existing values in a specified range in order to obfuscate them. For example, date of joining values could be changed within a range of +/- 60 days.

CONCLUSION AND FUTURE WORK

The intention of data masking to limit the exposure of sensitive data and at the same time data is available at non-production environments. Data breach statistics reports mention that the data records lost or stolen since 2013 is more than 9 billion. Only 4% of breaches were secure breaches where encryption was used and the stolen data was useless. The frequency of stealing data records is very high. Everyday about 5 million records are stolen with different intentions. These records include different categories like banking, business, education, government and healthcare. Data safety measures have become one of the hottest issues of discussion these days. Leakage of sensitive data could be great harm for the organization. As per 1998 Data Act law, lost of one static data record cost is approx. $180 and lost of one transaction data record cost is approx. $95. The cost of data breach will be calculated as per one in seven years rule. Data masking techniques can help the organizations to protect their sensitive data and compliance to regulator. This research paper proposed a Data Obfuscation Model - AOIOD (Analysis, Obtain, Identify, Obfuscation and Delivery) to implement data masking. This model analyze the user request, obtain data subset from large database, identifies the sensitive data, select appropriate masking algorithm based on intensity of data, apply masking, test the masked data for performance and constraints and deliver the masked data to users. Further this model can be elaborated for data profiling and data provisioning. This model can be compared with other model to check the performance with two criteria's: Data size and Cool off period.

ACKNOWLEDGEMENT

The authors are thankful to Abacus Institute of Computer Applications, Pune for providing platform for the research work.

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Teaching Methodology for Developing Prototypes by fusing Design Thinking and Agile SCRUM

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ABSTRACT

The aim of this study is to come up with creative ideas that would provide solution-based method to solve complex problems in information system development process. The author has fused two different methodologies, namely, Design Thinking and Agile Scrum to develop a working product at the shortest possible time. Five phases of Design Thinking and the principles of Scrum are used to ensure that the product is developed addressing three main constraints: time, scope and cost. For the purpose of this study, a real type scenario has been created for a business. A few assumptions are made for developing the prototype to address the business requirements and resources needed to function successfully. Repeated prototype updates and testing are conducted; new ideas and issues have been identified for the launch. Critical evaluation of these methodologies utilised in this study revealed that both Design Thinking and Scrum methodologies are most appropriate in understanding the end users' needs in developing products or services to solve problems. Findings are listed. A few screen designs for the developed prototype are included.

Keywords: *Design Thinking, Agile Scrum, Information System, Pedagogy.*

1 INTRODUCTION

In the context of Information Systems Development, practitioners are expected to achieve IT projects that are impossible to achieve and overcome numerous constraints, including issues with team management, choosing the right processes and making decisions about tools and techniques.

Information System Development Methodology is defined as "a recommended series of steps and procedures to be followed in the course of developing an Information System". In other words, a methodology is "a collection of procedures, techniques, tools and documentation aids" (1).

2 AIM

The aims of this study are

1. to test Design Thinking as a methodology for creativity in project based learning;
2. to generate innovative ideas to develop information systems;
3. to test the feasibility of fusing Design Thinking and Agile Scrum methodologies appropriately;
4. to improve products, services and processes for a business;
5. to work in teams to negotiate, communicate and modify innovative ideas;
6. to develop and test working prototypes at the shortest time and least cost;
7. continuous improvement

3 SCENARIO

A real type scenario in the form of a case study had been developed by the author. The case study was explained to the project participants. They were encouraged to develop a product using different methodologies:

Grill Cilantro is a South American restaurant located in the Inner West suburbs of Sydney. The restaurant has been doing very well as most nights are very busy, especially during the weekends. The problem is that there is only one computer managing and recording the bookings, processing payrolls and being used for printing. This current system lacks the ability to go beyond these straightforward tasks. Most of the operations are manually managed, such as, waiters use carbon paper to record orders by hand, Chefs order materials manually, the customers receive the bill manually prepared etc. at the end of their meal. Another issue is the current inventory system, which is run completely manually through pen and paper consuming much unnecessary time.

Grill Cilantro's objective is to increase their sales through developing a new system, which will replace the current business operations and simplify the tasks. This highly manual operation and administration of the restaurant leads to a slow workflow, and ultimately negatively impacts upon the overall customer service that is delivered to restaurant patrons. Manual restaurant operation also leaves a large opportunity for errors and mistakes to be made as there is no computerised validation or verification. It was determined that the new system being developed would aim for an overall goal of a high degree of restaurant automation, mainly through automatic customer bill generation and printing, automated inventory management, more accurate product pricing, and finally through the use of a mobile app to engage customers by allowing them to view the menu or make reservations.

4 METHODOLOGY

The project started with the hypothesis:

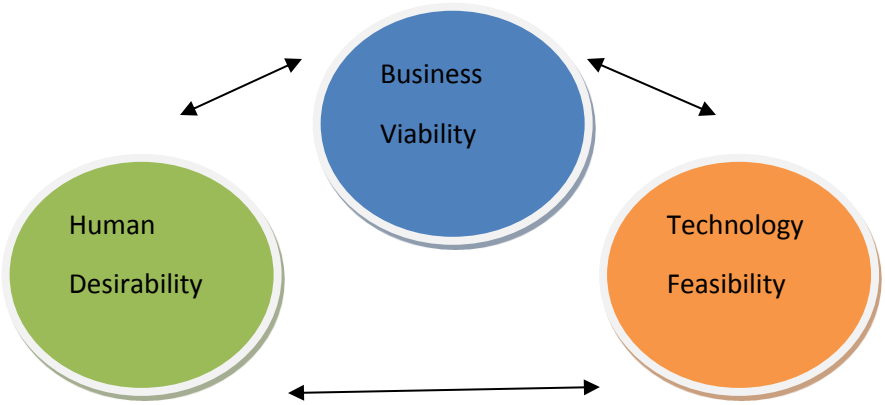
"If we can get individuals to stick with the methodology a while, they will end up doing amazing things. They will come up with break through ideas or suggestions and work creatively with a team to develop something truly innovative" (2).

Participants for this study were selected from Business Information System stream. They were given training in different methodologies for developing information systems. This includes Agile Scrum, Extreme Programming (XP), Design Thinking (DT), Projects in Controlled Environment (PRINCE2), Structured Systems Analysis and Design Method (SSADM), Structured Analysis, Design and Implementation of Information Systems (STRADIS) etc. and the necessary techniques to be used for each methodology. The participants were given full autonomy to choose any methodology or a combination of methodologies to work on the project and come up wwith a solution for the problem stated in the case study. The participants formed groups to design the system for Grill Cilantro. Three groups selected **Design Thinking** and **SCRUM** as a combination of methodologies to create the working system. The process involved the following:

4.1 DESIGN THINKING: A 5 STAGE PROCESS

Design thinking can be described as a methodology that uses designers' sensibility and methods to match human needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity.

In other words, it's a systematic approach to problem solving and converts need into demand.



The Five Stage Process in Design Thinking methodology developed by Stanford design School (d.School) includes (5):

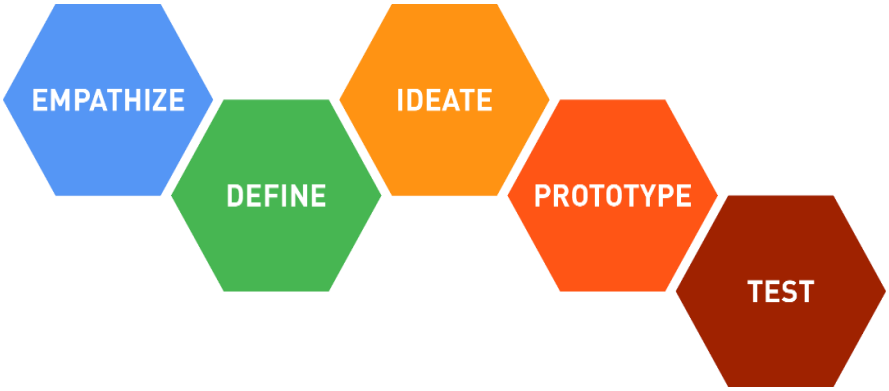


Figure 1: Design Thinking Process.

4.1.1 Empathise

The teams ensured that the prototype they developed must be useful and worth making. Empathizing with the people affected, the teams recognized that customers of the restaurant must be at the center of everything they do. They interviewed their friends, family members and real customers. They also went to some restaurants and interviewed the Head Chef, Owner, Waiters and Bartenders to find the requirements in the real world in order to best understand their needs and create requirements for the project. For instance, the Head Chef and the Owner have expressed frustration over the current system because of the lack or over ordering of stock, which are caused by the error in human judgment. Customers are frustrated they are not seated when they arrive though they have booked a table in advance. Design starts with empathy, knowing stakeholders as people with real problems and establishing a thorough understanding of the issues they were raising. Number of interviews was conducted to go deeper into one particular story.

User stories were written following a basic user story format:

As a <role>

I want <goals/desire>

so that <benefits>

Some user stories are listed below:

User story 1: **AS THE** Owner of the Restaurant

I WANT to make the new system create financial reports at regular intervals

SO THAT I can analyse them and implement new business strategies

User story 2: **AS THE** Head Chef

I WANT to receive accurate orders

SO THAT customers can be served with the right dish within 10 minutes

User story 3: **AS A** Customer

I WANT to view the menu and make reservations on my portable device

4.1.2 Define

This stage helped the team to define the problem faced by Cilantro as

> *"Creating a Seamless day-to-day operations with an efficient automated Booking, Ordering, Inventory Management and Financial System".*

4.1.3 Ideate

The team started to work from **Point of View (PoV)** to "**How Might We (HMW)** achieve the stated objectives?" The teams used **"Yes and"** and avoided **"But" and "If"** while formulating the ideas. At this stage the team generated potential ideas through brainstorming, using post-it-pads and ranked the ideas according to their priorities.

4.1.4 Prototype

Prototypes representing a working model of the new system had been developed after several iterations with the customers. As it was an experimental phase, the teams worked for the best possible solution. They shared and tested the prototypes within and outside the team. The core theme of the prototype was to design an improvised model to bring an experience to life by analysing the user needs based on the user stories they created while interviewing the stakeholders.

A few Prototypes for Cilantro Grill are attached.

4.1.5 Test

Prototypes have been developed and are now ready for testing.

5 FINDINGS AND CONCLUSION

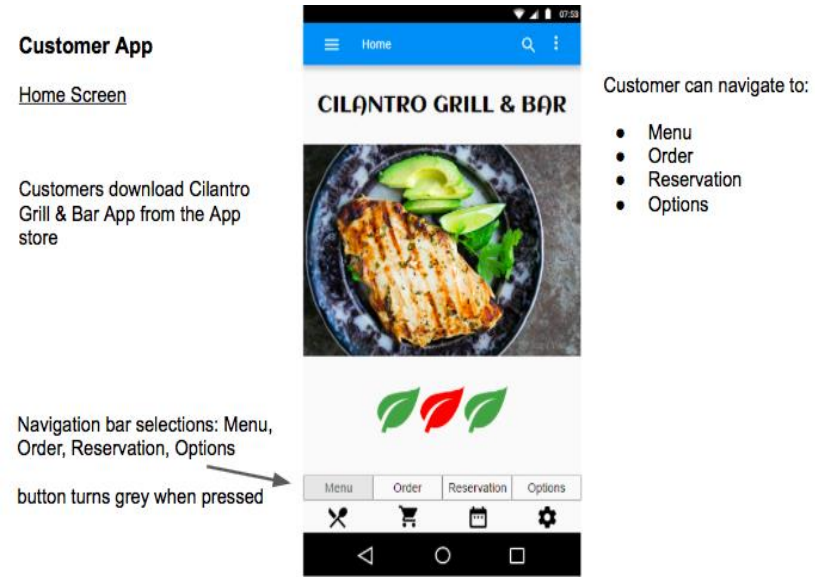
Design thinking helps structure team interaction to cultivate, deepen empathy, and align participants around specific goals and results (4). It tackles complex problems, as it is iterative and focused on collaboration with an emphasis on real life situations (5).

1. Design Thinking helps teaching through "learning-by-doing" approach to problem solving. It could be seen in each stage of progress that innovators interests and abilities through applied learning contribute in achieving the targets. The whole process is action oriented.
2. Teams did not find the method cumbersome instead they were comfortable with change. Further, they were able to connect with users and understand their pain points.
3. The project is focused on customer needs. Participants employed different research techniques such as observational, listening, brain storming to learn more about the needs and tasks in the process of creating a workable prototype. It was all human centric.
4. Participants could understand that Design Thinking method is an iterative process and they will have to define and redefine the problem statement.
5. Participants experience with Agile Scrum relied heavily on practices around time boxing, collaboration, demo and review. These sessions helped teams new to Scrum grasp these concepts quickly and experience the Scrum practices.
6. User stories documented by the teams described functionality that was valuable to arrive at the functionality, fleshing out the details of the story for the new system
7. The teams developed skills such as empathy, creativity, strong communication, problem solving, analytical and team work.

Figure 2: Customer App Home Screen

PROTOTYPE

Customer App Component



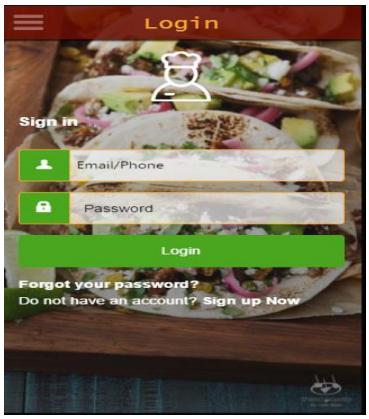


Figure 3: Customer App Login

Figure 4: Customer App Menu Screen.

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Achieving Engineering Competencies Aligned with Engineers Australia (EA) Requirments through Project based learning

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ABSTRACT

Every engineering course is delivered to develop competencies within its graduates so that they can participate in the workforce after completion of the course. Achieving this goal relies on two things; the curriculum and method of delivery. With the advent of learning technologies, it is important to plan the delivery of the course or unit such that the learning journey achieves the key competencies. Thus, Project Management Practice (ABCxxxx) is structured and delivered carefully to achieve the Australian Engineering Stage 1 Competency Standards for Engineering Associate (EA Stage 1). ABCxxxx delivery is structured and delivered such that the students learn project management by actually carrying carefully selected projects based on students aspirations, the level of work involved and challenging enough to maintain enthusiasm and be able to compete in small teams. Findings of this study show that student develops work ready skills and achieve project management elements and attributes listed in the EA Stage 1. Designing learning is key in achieving quality assurance, in this paper it will be described how projects have been carefully selected and qualitative analysis of students reflection has been analysed to gain an understanding of students experience and data mapped to EA Stage 1 competencies.

Keywords: *Project based Learning, personalising learning, learning reflections, teamwork.*

INTRODUCTION

The unit ABCxxxx - Project Management Practice is one of 16 units from XYZxxxx Associate Degree in Engineering. XYZxxxx is a two-year full-time course at PQR

University of Technology. Students join this course as a pathway to Bachelor of Engineering. These students, after completion of XYZxxxx join either Civil, Mechanical or Mechatronics Engineering in their Bachelor of Engineering. Others who wish to join the workforce after completion of XYZxxxx would find jobs as associate engineers.

ABCxxxx is a stage 3 unit. Prior to undertaking this unit, students would normally have completed units in materials, physics, electronic system, mathematics, mechanics and strength of material, AutoCAD, and sustainability. ABCxxxx has 5 learning outcomes; Define Project, Develop Project Plan, Administer and Monitor Project, Finalise Project, and Review Project. In stage 4 of the course, these students undertake cap stone project unit. Figure 1 shows the internal and external factor that affects the design and delivery of ABCxxxx.

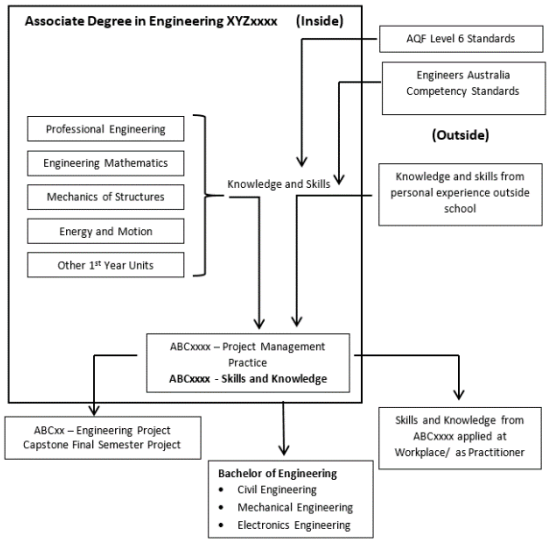

Figure 1: Learning Design for ABCxxxx.

Situated learning theory is used in designing learning activities in ABCxxxx unit. Situated learning is often referred to the community of practice (Clancey 1995). According to this theory, the learning takes place in a context similar to where it is applied (Brown, Collins, Duguid, 1989). As stated in the Australian Engineering Stage 1 Competency Standards for Engineering Associate, students need to be able to engage with basic project management tools, be able to plan the project cycle through application of standard processes, be part of a team, identify resources, be able to assess the scope, scale of effort and cost of project activity, be able to manage project thought its life cycle and understands the role of engineering project

management tools and procedures as a basis for planning, organising and managing resources.

ABCxxxx unit is designed and delivered in such a way that student gets an opportunity to be part of a small project team and work on a well-defined engineering project. As XYZxxxx is a pathway program, and students enrolled in this course either wish to pathway into Bachelor of Engineering course or join the workforce. Those who which to join degree course will most likely either join Civil or Mechanical or Mechatronics Engineering. Having known this preference available to students, ABCxxxx units provide students to choose to work on one of the three projects. These three projects have civil, mechanical and mechatronics aspects in them. In the civil engineering project, the students will build manila folder bride, in the mechanical engineering project, the students will work on a computer-aided design, computer-aided manufacturing and prototyping and in mechatronics project, the students will be designing and constructing microprocessor controlled gadget.

ABCxxxx UNIT DESIGN

Mills and Treagust (2003) recommend that for engineering graduates to be work ready and be able to participate effectively in engineering workforce, they require skills in communication, working in teams, being able to negotiate, be aware of social and environmental impacts of their technical decisions, etc. Students are graduating with good knowledge of fundamental engineering science but they lack the skill of how to apply this knowledge. Mills and Smith (2014) recommends professional skills development should not be left to final year but needs to be applied through the program. In their study, they found project based learning provides an effective and deep learning experience for students with increased teamwork competence and confidence in working inclusively. Patil, Nair et al. have identified that business rate high on graduate attributes like the capacity to work autonomously, capacity to work in team environment, time management skills and ability to cope with work pressures among others.

ABCxxxx is designed keeping in mind the requirements from AQF 6, EA Stage 1 competencies and the requirement of the unit. In order to achieve these overlapping competencies, the unit is designed using small achievable engineering projects that require students to work in small groups. In addition, these projects are chosen to align with the aspirations of the students in XYZxxxx course.

Projects selected in ABCxxxx unit based on

Following criteria were used in selecting the projects;

1. Must be achievable
2. Must have aspects of aspirations

3. Teacher/facilitator able to guide these projects
4. Resources required aren't costly
5. Learning Management System to monitor and lead project groups.

Delivery of ABCxxxx unit

In the first few weeks, all the students are introduced to project management topics and Microsoft Project Management software. They are provided with an opportunity to practice project planning of installation of a new machine to replace an old one. While they are working on this small project, the students are introduced to the three projects; manila folder bridge, computer-aided design and manufacturing and the microprocessor project. Depending on their (student's) aspiration and interest, they choose one of the prescribed projects.

Figure 2 below, shows the weekly schedule of ABCxxxx unit delivery.

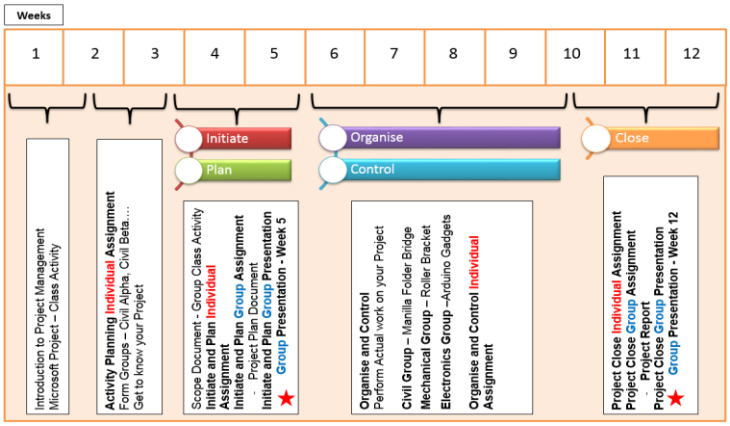

Figure 2: Weekly activity schedule of ABCxxxx.

Once they choose the project, they are they asked to write a scope document for the project in consultation with the facilitator. Following to this, they then write Project Plan Document, which involves writing a detailed plan for their project. All the groups with make a Project Plan Presentation in week 5. During week 6 to 8, each of the groups spends time in learning required engineering skills in order to be able to do the project. Finally, until week 11 they work on their project, write a Project Report, and make Final Project Presentation in week 12.

One of the components of the Project Report is the individual reflection, which each student need to write and include in the report.

METHODOLOGY

Nvivo a qualitative data analysis software was used to capture the experiences of the students as described by them in their personal reflection included in the project

report. Elements from EA Stage 1 was used to compare the nodes created within NVivo and the reflections were coded to respective nodes. This coding was done to understand the extent of students experiences that mapped to EA Stage 1 competencies.

Qualitative analysis of personal reflection

Nodes in NVivo software were created based on the themes emerged as part of the code and then were compared with the EA Stage 1 competencies, roles and skills listed the EA Stage 1 Competency. A total of 25 cases were coded. The coding helped in categorising the similarities and differences among the cases. Following are some of the themes emerged during qualitative analysis.

Theme 1. Project Planning

Project Planning and using various tools to plan a simple project is part of EA Stage 1 Competency for Associate Engineer. While project planning can be taught and a software like Microsoft Project can be learnt, but when used to plan a real project, many challenges are faced by students, like planning for the realistic time duration for an activity which they have not done before. Also, having plan to complete the work within the semester also put students in real project planning scenario. One of the students had following experience:

The idea of creating something from scratch by planning, organising, creating and production was amazing.

Another student working on planning experienced challenge in estimating the time duration:

Also, trying to predict a finish date had its challenges not knowing how long each of the stages would take.

I also gained the knowledge and understanding to what it takes to put a project together. I learnt to convey a clear plan and path for the project using software such as Microsoft project, which I had no prior use of.

Theme 2. Leadership

In the EA Stage 1 Competency's General Description of Role of engineering associate states that an engineering associate may lead or manage teams. Some may establish their own companies. Group projects give students the opportunity to work in a team and some to emerge as team leaders. Some reflections of students are as below:

I felt like I had a real responsibility, even though it was just a university project.

After this whole experience, I have not just gained knowledge by many skills, which will be beneficial for me to acknowledge and take on board in order to be a successful engineer, some being: - leadership.

At the beginning of the project, I was named as the project leader for the team. As a result, I was heavily involved in the planning of the project.

Theme 3. Technical Software

In the EA Stage 1 Competency's General Description of Role of an engineering associate states that engineering associates may develop high levels of expertise in aspects of design and development processes. These may be the use of advanced software to perform design. ABCxxxx provides opportunities to students to take part in an engineering project, which aligns to their aspirations and gives opportunities to use a technical software in their group projects. Some of the reflections of students are as under:

The main skill I have gained by being a part of this project is the ability to use SolidWorks to design parts.

The ability and understating on how 3D printer works are very helpful as it has many benefits in engineering.

The most important skill learnt in order to be able to do this project was being able to use computer software to design the parts we were going to make.

We also learnt how to plan and schedule activities with Gantt Charts and network diagrams in Microsoft Project 2017.

Figure 3: 30 high-frequency words within Nodes from NVivo.

CONCLUSION

This qualitative study identified the attributes of ABCxxxx unit, which portrays the achievements of EA Stage 1 Competency through project-based teaching. Project management skills, planning, working in teams, the importance of communication, leadership, using advanced software for designing form important part of the engineering associate's work. In this paper, we can see how ABCxxxx unit is designed as to achieve these competencies. In the future, there are plans to study such units at different universities and at different AQF level to see how they are designed and achieve corresponding EA Stage 1 Competencies.

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A Combination of Six Sigma tools and Knowledge Management in IT Sector

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ABSTRACT

This paper promotes applying problem-solving tools from Six Sigma sector into IT area, especially server failure management in computer network field. Based on the literature, a crucial technique of knowledge representation, models of knowledge management for Six Sigma methodology, and one of the problem-solving tools used in DMAIC methodology are reviewed. A Failure Mode and Effect Analysis (FMEA)-based solution for managing knowledge of event logs is proposed, and discussion on the solution is presented. Failure Mode and Effect Analysis (FMEA) is one of the effective risk analysis tools. It reveals a problem-solving procedure that can be applied to information technology systems such as determining potential errors and solutions for servers. Also, the combination of FMEA and Ontology is helpful to share and reuse the knowledge of server event logs (SEL). Therefore, the combination enables to not only construct knowledge bases for the event logs but also provide control actions and solutions server failures. Combining FMEA and Ontology is one of the interesting solutions to construct a knowledge base of server failure. It is effective to share and reuse event log knowledge based on risk assessment format of FMEA. Models and solutions involved in KM and Six Sigma have been summarized. A solution to construct a knowledge base in which control actions for server failure modes are included has been developed. These is a basis to motivate applying Six Sigma tools into IT field.

Keywords: *Knowledge management, Six Sigma, FMEA, Server Failure, Event Log.*

INTRODUCTION

In organizations that have been using quality improvement systems and methodologies, knowledge management (KM) plays a crucial role in enhancing quality of products and customer satisfaction. It relates to organizational learning, organizational memory, information sharing, and organizational culture, which promotes active exchange of information and experiences, and activities of knowledge creation, dissemination, and application. KM includes the necessary activities to collect the most out of knowledge resources (Becerra-Fernandez & Sabherwal, 2010). The purpose of KM is to promote the creation, leveraging, sharing, application, and protection of the corporation's knowledge (Stevens, 2006). Therefore, it can be developed into various phases such as creation, capture, organization, storage, dissemination and application. An organization can frame considerable competitive advantages in term of knowledge and innovation to take advantage and enhance knowledge assets of the organization and to achieve better knowledge activities and decisions, excellent behaviors and enhanced performance of the organization (King, 2009). KM is useful to achieve goals of an organization comprising an enhanced customer satisfaction, innovative improvement, enhancement of product quality, and recreate of costs. It is also important to understand customers and markets, to development products and services, and to control improvements and changes.

In recent years, KM has been integrated with several models and techniques in various fields including techniques of knowledge representation in information technology, models of business, manufacturing, and quality improvement. In information technology, new techniques and methods are proposed to convert knowledge from various information resources to knowledge bases with high performance and accuracy. In the fields of business and manufacturing, models of KM are introduced to apply into enhancing business efficiency and reducing the costs as well as to exploit and manage effectively various resources of knowledge. In order to contribute to methodologies of quality improvement such as Six Sigma, KM is integrated with models of quality improvement to improve ability of knowledge access and sharing created by Six Sigma tools.

As one of the effective quality improvement methodologies, Six Sigma is used by more and more organizations. It is a breakthrough approach to enhance performance and quality of manufacturing and business processes. The well-known methodology brings organizational opportunities to decrease error rate of products, costs of business, and increase value for both shareholders and customers (Antony, 2007). Six Sigma has been the main reason for saving billions of dollars in businesses around the world in the current years. For example, Motorola Corporation saved $2.2 billion during 4 years and created a big change in its organization. Following the success of Motorola, hundreds of companies around the world including Nokia,

Samsung, Sony, etc. utilized Six Sigma as a crucial improvement system in order to enhance their performance.

The execution of a Six Sigma project is often planned carefully in many phases of a problem-solving process. It uses DMAIC (Define-Measure-Analyse-Improve-Control) or DMADV (Define-Measure-Analyse-Design-Verify) as a core process to identify, resolve, and eliminate defects from a business or manufacturing process. The activities of Six Sigma are implemented using several tools and techniques such as brainstorming, multi-voting, tree diagram, suppliers, inputs, process, outputs, customers – diagram (SIPOC) diagram, flowchart, fishbone, trend chart, and failure mode and effects analysis (FMEA). These statistical and none-statistical tools are used by members of Six Sigma projects to measure, analyse, and evaluate quality of products or processes. Their knowledge is applied into the tools in order to design new solutions, innovation, and improvement. Therefore, accessing and reusing the available knowledge resource can contribute to quality of the next projects and reduce the deployment time of Six Sigma projects. That is also a reason to integrate KM with Six Sigma.

The one notable trait that is common in both KM and Six Sigma is to create valuable knowledge in the process of management. The deployment of Six Sigma projects can generate knowledge during gate review sessions where discussion is organized to review and assess improvement activities by members of a Six Sigma project, and the knowledge can be found in the improvement solutions (Zou & Lee, 2010), and brainstorming of the project participants. Similarly, knowledge created, shared, and leveraged by knowledge workers, processes and products in the different levels is to promote competitive advantages to support growth and profitability. While KM generates advantages of competition from its management cycle, Six Sigma improves these advantages by eliminating variation and waste in its processes (Chakladar, 2010). Hence, a combination of Six Sigma and KM can enhance quality of products, knowledge, and organizational performance.

In order to combine KM with Six Sigma, a process or procedure of KM can be integrated with a Six Sigma tool such as DMAIC, SIPOC or FMEA. The combination is to collect, organize, store, and distribute knowledge created by the tool. However, a problem arising in integrating KM and Six Sigma tools is that the tools create the different reports and documents with different structured or unstructured formats and procedures. Hence, the combinations can generate different structures of knowledge bases, and therefore can be applied in the different particular applications such as DMAIC knowledge management (Kifor & Baral, 2013), (Nguyen & Kifor, 2015) and FMEA knowledge management (Rehman & Kifor, 2014). Moreover, the combination supports not only enhancing the access and reusing of knowledge created by Six Sigma tools but also applying quality improvement tools to other fields including information technology.

In this paper, we are proposing a combination of KM and a Six Sigma tool to design a new conceptual model for information technology systems. The proposed model should be applied in server systems in which knowledge is found in event logs. We

use FMEA to design a knowledge base for the logs and to support administrators to determine, eliminate and prevent potential errors found in the event logs. In the next section of this paper, a review of some related works is presented including KM procedures, a technique of ontology-based knowledge representation, KM models involved in Six Sigma, and applications of FMEA in Information Technology sector. Afterwards, a conceptual model of FMEA-based KM is represented. The last sections are to discuss the model as well as conclude the paper.

RELATED WORKS

1. The KM Process

Several researchers have contributed various KM processes that can be applied to Six Sigma KM. King, W. R. (2009) has described a KM process with six steps, as follows: Create/Acquisition, Refinement, Memory, Transfer/Sharing, Utilization/ Organizational Performance that supports organizational process in innovation, learning and decision-making. The author believes that KM is a set of relatively new organizational activities that consist of improving knowledge and making practical environment for use related knowledge. According to Haapalainen and Pusa (2012), KM includes three processes; namely, accumulation, protection, and leverage. Knowledge accumulation should be executed when departments in an organization gain new knowledge. The knowledge should be protected using a process, so that their competitors cannot get the competitive advantage. Alavi and Leidner (2001) pointed potential role of information technology in facilitating each of the process steps by creating infrastructure and environment where organizational knowledge would be generated. Andrew et al (2001) have introduced a process of acquiring, converting, applying, and protecting knowledge that is a combination of different processes. The researchers believe that it is important to organizations to manage knowledge both internally and externally, and the KM processes should focus on impact of KM capabilities on KM effectiveness.

2. Ontology-based Knowledge Representation

In general, three typical approaches utilized to manage tacit and explicit knowledge are to base on Documents, Ontology, and Artificial Intelligence (AI) (Ribino, Oliveri, Lo Re, & Gaglio, 2009). As a first step, a document-based approach will use resources of different documents such as txt, doc, xls, pdf, html and so on to create, organize, and share knowledge of the documents. This technique is suitable for the systems managing explicit knowledge. Secondly, an ontology-based approach can be used to represent and manage both tacit and explicit knowledge in hierarchical structure. This approach focuses on using ontologies to describe concepts and their relationships extracted from knowledge resources. Thirdly, an AI – based approach will exploit inference engines in the AI area to solve special problems, and it has been proposed for managing tacit knowledge.

With the help of the Internet and the world wide web technological infrastructure, and Ontology technologies are developed in the areas of web commerce, electronic business and knowledge management. The usage of ontology is one of the most popular techniques to represent knowledge (Ga, Djuric, & Deved, 2006). It supports to structuring data using a modelling language such as ontology web language and supports a knowledge sharing among computer programs as well as human. The technique is based on the triples of Object-Attribute-Value to represent truths about objects and their properties (attributes). An O-A-V triple refers to an attribute value of an object. For instance, the statement "*Tuna is a fish*" can be represented in an O-V-A triple "Tuna-is_a-'Fish'" and illustrated graphically by an oval, arrow, and box as in Figure 1.

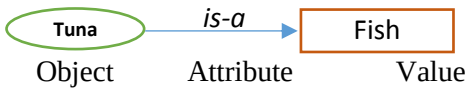

Figure 1. An O-A-V triple illustrates a concept "*Tuna is a fish*".

On the basis of O-A-V-based representation, the concepts in a domain knowledge can be represented completely, systematically, and structurally. The popular achievements of Ontology focus on processing natural language, supporting intelligent information integration as well as corporative information systems, and knowledge management. In the field of artificial intelligence knowledge representation, share, and reuse are usually facilitated by Ontologies whose constituents are concepts, relations and instances (Stephan, Pascal, & Andreas, 2007).

3. KM Models Involved in Six Sigma

Several KM models for Six Sigma have been proposed in recent time. A work found in (Wu & Lin, 2009) points out knowledge creation opportunities in Six Sigma processes. Nold III (2011) introduces models that integrate KM processes with DMAIC execution. For instance, a SECI/SIPOC continuous loop model designed for SIPOC diagram is proposed to enhance the speed and effectiveness of management decision-making, work groups, project teams, and any other value adding activity. Kifor and Baral (2013) introduce the DMAIC-KM model for managing knowledge created by DMAIC processes. Their model is an integration of a KM procedure and the DMAIC steps. Rehman and Kifor (2014) introduce a KM model for FMEA that allows automatically converting and managing knowledge created by FMEA.

Most of mentioned models are designed and proposed to apply to the fields of quality improvement and Six Sigma. Moreover, combining KM and Six Sigma tools can be applied to other sectors including information technology. Nguyen and Kifor (2015) reveals such KM model for collecting, organizing, storing, protecting, and

applying knowledge using the Six Sigma tools. Their model can be used to not only manage knowledge generated by Six Sigma tools but also integrate the tools with knowledge representation on other data sources such as server event logs.

FMEA-BASED KM MODEL OF FOR SERVER EVENTS

This section is proposing a KM model for information technology systems. The model is developed based on the OKMD model (Nguyen & Kifor, 2015). It uses a four-step process of KM named Acquisition, Structure, Protection, and Application in order to collect, organize, protect, and distribute knowledge created Six Sigma tools. In our proposed model, the procedure is combined to FMEA tool to build a knowledge base for SEL. Hence, the model can be applied to not only FMEA reports, but also KM of SEL.

1. Server Event Log and FMEA

Event is an observable action or occurrence detected by a program in a system or network. Events provide administrators with a responding to occurrence systematically. It can be a user action, a system-generated occurrence, or a negative consequence, such as printing a document, keystrokes, mouse clicks, running out of memory, packet floods, unauthorized use of system privileges, unauthorized access to sensitive data, and execution of malware that destroys data (Cichonski, Millar, Grance, & Scarfone, 2012). Events are generated by applications, and their information pertains to the designed purpose of the applications. For example, system events include messages of the components of the system such as memory and hard disk drives; Web events consist of URL, IP address, and users. Event log is a file that contains events of applications on a system. It logs lots of independent text lines (or messages) involving in the events that have occurred within the system (Makanju, Zincir-Heywood, & Milios, 2012). The messages describe information and parameters of every event. For example, system event log contains events involving in services and drivers; application event log includes events relating to software installed on a system. SEL is an event log generated by applications on a server. It records occurrences of applications, services, and hardware components on the server. Each SEL involves in many elements such as time, user, IP address, event name, event type, priority/severity, message, data, configuration, etc. causing on the event. For example, events generated by a server can include a user connecting to a file share, a server receiving a request for a web page, a user sending email, and a firewall blocking a connection attempt.

The SEL are very useful and helpful for system administrators. They provide the system administrators with detailed elements of the occurrences in a continuous chain of time to troubleshoot issues. Hence, the system administrators can determine what caused the errors, attempt to recover any lost data, prevent loss or theft of information as well as outage of services, eliminate the errors from recurring, predict future occurrence on a system, and build reports of the

occurrences. Therefore, most operating systems such as MAC OS X Server, Ubuntu Server, and Windows Server generate SEL to support to the system administrators.

In order to build a knowledge base for SEL, knowledge of FMEA tool is integrated. Failure Mode and Effects Analysis is a methodology to assess failure modes and their consequences in designs and processes. It is one of the effective tools for risk assessment processes and quality improvement processes. For example, during system design FMEA can be used as a well-established and systematic risk assessment method, and integrated with the system as a component of continuous development (Pandey, Singh, Sonawane, & Rawat, 2016). It allows one prioritize process activities or product features that result in failure in the analyse stage, or identifying high-risk process activities in the stage of improve or design (Paul, 2009). FMEA provides an activities-based understanding to evaluating possible errors of processes or products and their effects and determining recommended actions that reduce the possible errors. With FMEA, a failure mode is the way that a component, product feature or function, input, or process could fail to perform its intended function. In IT sector, FMEA was used in software systems and information systems (Vijayaraghavan, 2003). Nowadays, FMEA is researched and applied widely in the sector of software development such as executable models to support automated software (Bonfiglio, et al., 2015), and FMEA-FTA-based methodology for controlling software error (Takahashi, Kosaka, Nanba, Anang, & Watanabe, 2016). For SEL knowledge base, FMEA is used to represent knowledge of SEL in which events is described based on a cause-effect-solution process. Thereby, knowledge can be inferred and extracted to FMEA-based reports, and supports to system administrators in looking for solutions for error events.

2. The Model Architecture

The proposed model (i.e. SELO – SEL Ontology) is a combination of FMEA methodology, techniques of log mining and Ontology building. It is designed to enrich a knowledge base in which knowledge of server events and solutions of the events are acquired. SELO allows one to collect, share and reuse SEL knowledge easily and effectively. It also supports system administrators to learn a problem-solving method in order to look for feasible solutions for server errors in SEL. The proposed model is illustrated in Figure 2. A SELO procedure is deployed using the five mentioned components; namely, SEL ontology, Log Parser, SELO Parser, SELO Reasoner, and Query Generator. Moreover, they are integrated with a Knowledge Portal (Nguyen, Nicolaescu, & Kifor, 2016) for supporting knowledge conversion from event logs to the knowledge base SELO. SEL ontology represents knowledge of SEL using objects, which are concepts of SEL, properties of the objects, and relationships between the objects. A SEL ontology can be constructed using the terms extracted from event logs and FMEA reports. Knowledge of SELO is represented based on the problem-solving process of FMEA tool that allows administrators of server systems to learn and determine feasible solutions for server errors.

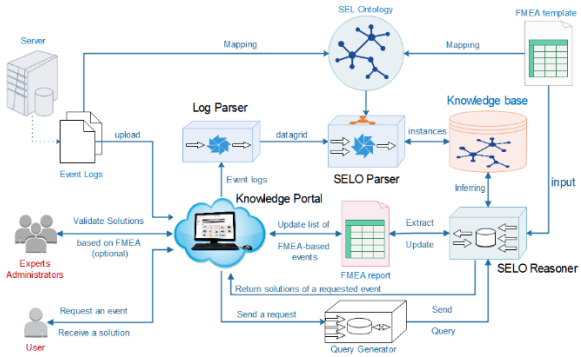

Figure 2. SELO Model.

SELO can be designed and tested using ontology editors such as Protégé. The rest components or modules can be developed using programming languages such as PHP, MySQL, SPARQL, and SPARQL endpoints. Log Parser receives data from an event log and return decoded data. The input data of SELO Parser is provided by Log Parser and SEL ontology including decoded data of an event log and the structure of SEL ontology. Query strings generated by Query generator, instances of the knowledge base, and the structure of FMEA report are input data of SELO Reasoner.

SELO model (Figure 2) introduces a process to transfer knowledge from event logs to a knowledge base. In particular, event logs collected from a server are first decoded to convert to the text-based format such as a data table by a *Log Parser*. Output data collected from the Log Parser is then used to populate instances of SEL ontology using *SELO Parser*. SEL ontology and its instances contribute knowledge to a knowledge base that enables to share and reuse among individuals and computers in the SELO system. Because the knowledge includes only server events without solutions that can overcome causes resulting in failure events, *SELO Reasoner* is responsible for extracting the knowledge from the knowledge base to generate FMEA reports in order to support experts as well as administrators to insert or update the solutions of the failure events. The solutions can be either identified based on the deployment of FMEA methodology or the available solutions that have overcome the failure events. Furthermore, SELO Reasoner is responsible for updating the knowledge base with taken solutions or actions. Finally, a user who is accessing the knowledge base can send requests to SELO Reasoner to look for solutions for some event. In this case, SELO Reasoner should return a FMEA-based report that includes information of relevant events and solutions, and the schema of SEL ontology that facilitates learning of SELO knowledge. Besides, it also allows a user to create and send SPARQL queries, and to display reports formatted based on structure of other DMAIC tools such as FMEA or Pareto chart. Generally, the SELO procedure includes the following steps:

1. Collect event logs through the knowledge portal.
2. Populate SELO's instances from the event logs using SELO Parser.
3. Generate initial FMEA reports using SELO Reasoner.
4. Update the relevant solutions that overcome the failure events using the initial FMEA reports as well as FMEA procedure and tools.
5. Filter and choose valuable events including their solutions or taken actions
6. Enrich SEL knowledge by updating feasible solutions to the knowledge base.

ASSESSING ASPECTS OF SELO MODEL

SELO model is designed based on several functional components and modules such as SEL Ontology, SELO Parser, SELO Reasoner, SELO knowledge base, and Knowledge Portal. Each should be evaluated based on the different aspects such as performance, accuracy, applicability of the components or modules in the proposed model, and the richness of knowledge base, etc. The evaluations should be performed based on experiments, expert's opinions, comparable analyses. In particular, the log parsing time and accuracy of SELO Parser and SELO Reasoner play a crucial role that should be tested and evaluated based on experiments. The experimental results can be evaluated based on statistical methods and comparable analysis to the similar Parsers. Moreover, SELO Reasoner should be experimented on the different servers with different scenarios in order to find the most suitable server for the model. For SELO knowledge base, mathematical model-based evaluations with different attributes such as richness and importance of ontology classes and properties, and connectivity are necessary. Finally, applicability and usability of the knowledge base should be evaluated based on experiments and experts' opinions. It should be also deployed in reality to validate the procedure of KM in the model.

CONCLUSION AND FUTURE WORK

Knowledge management contributes to an organization's competitive advantage and success, and therefore plays an important role in the organization's activities and models including quality improvement models and methodologies such as Six Sigma. Several researches on the integration of KM and Six Sigma have been proposed and shown that a combination of KM and Six Sigma can enhance not only Six Sigma performance but also KM models. This paper has introduced a new combination of KM and Six Sigma tools to enhancing knowledge sharing and

reusing of the tools and applying the tools into IT sector. The proposed model supports to constructing a knowledge base of SEL based on FMEA tool. For the future works, the components of the SELO model will be developed and evaluated based on all mentioned aspects in order to validate the model. Moreover, a knowledge base of SEL including solutions for server errors will be built.

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Service Learning in Graduate Environmental Engineering - Fieldwork Empowering Communities

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ABSTRACT

In this paper, we describe service learning (SL) activities developed for graduate students in environmental engineering working to prepare a Water Quality Atlas for Korratty Panchayath in Geographic Information System (or GIS) format and with full participation of the community. A women self-help group (SHG) water brigade was formed, provided training in water quality analysis by the graduate students of the Environmental Engineering program, and the SHG then trained the local community in water literacy. The student-driven and community based projects enabled students to engage in service while enhancing their engineering education and training and assisting communities. This paper reports outcomes of SL project activities: knowledge transfer to communities, enhanced student learning, empowerment of the communities, and the technology transfer that resulted in community capacity building. These experiences suggest a model for capacity building in communities, through the expansion of such SL pedagogical models across engineering disciplines and across academic grade levels. It is also possible to consider the development of service oriented student organizations, such as Engineers Without Borders (EWB) and more broadly link academic content to community service. Leveraging the teaching and learning of the young offers a mechanism for building capacity and empowering communities.

Keywords: *Service Learning, Project Based, Engineering, Education, Water Quality, Atlas.*

INTRODUCTION

Service learning (SL) is a pedagogical activity in which the learners (students) conduct service activities in a community while engaged in a course-based and credit-bearing educational program that is closely guided and mentored by program faculty. SL must have two major components – (1) engagement of students in a (usually) self-selected, planned and driven, but professionally supervised and advised, service activity, and (2) an opportunity and requirement to engage in reflection and writing on the service activity (Bringle et al, 2004). Service learning is being touted across disciplines. In fact, the value of SL has been anecdotally championed and trumpeted across diverse stakeholder groups, including students, faculty, community partners, the University, society in general and employers. Decades of research demonstrate that high quality service-learning experiences enhance student learning outcomes and engage students more deeply in the educational experience, providing for independent thinking, self-development of resources and general enhancement of educational outcomes (Eyler and Giles, 1999, 2001).

All definitions of service-learning refer to an organized educational experience that both meets needs of the community and fulfills learning objectives of the educational program. However, for the purposes of this paper, service-learning also incorporates credit-bearing courses that include reflection activities that connect the student's experience with course content and the wider discipline (Bringle and Hatcher, 1995).

In this paper, we describe the service learning activities that were developed and conducted as part of a Masters in Technology (M.Tech) program in environmental engineering at the SCMS School of Engineering and Technology (SSET), located in the Koratty *panchayat* of Kerala State in southern India. We reflect on the design, content and implementation of several projects that were focused on engaging the surrounding communities and working with them to develop a database that would provide information on water resources, water availability, water treatment, water quality, and water use and disposal. This data was then used by the students to educate the community (knowledge transfer) and to build capacity in the community (technology transfer): the community could now be engaged in appropriate sourcing of water, sufficient and adequate treatment of water, conservation of water, maximizing water utility, minimizing water wastage, and enhancing and disseminating water harvesting strategies.

TEACHING AND LEARNING

We learn through our senses and our capacity to reason. We look, we hear, we touch, we feel, we taste and we bring whatever information, knowledge, and experience we have at the time to bear on that which we sense. That is how we process information. Different sorts of learning and teaching occur at different points and in different parts of our lives, and in different contexts. As newborns and infants, we

learn through imitation and mimicry and our learning is, hopefully, guided and reinforced by the loving and caring hands and minds of our care providers and nurturer's. Because without care and nurture, none of us would have learned, let alone learned to survive and prevail. This initial early learning is, by its very nature, random and chaotic. The randomness and diversity of information in the pre-school mind would most likely be unfathomable, confusing, and likely terrifying to any rational human or even an educational psychologist.

As we grow into our pre-school years, learning becomes differently organized, as does the teaching. Information begins to become categorized even as those very categories are being formed. Bits and pieces of data and random facts begin to align themselves into various structures; it seems like suddenly one is introduced to the idea of knowledge. Anybody who has been around children would be familiar with that transition from random data to information progressing eventually to knowledge. In our pre-school years, learning happens in many ways – and rote recitation and straight memorization are important components of early elementary school pedagogy. The more enlightened of the pre-schools do incorporate sufficient free un-structured and protected learning typical, say, of a Montessori pre-school, where the teachers serve more as guides and the learning is student-centered. There must also be experience and interaction and this must be connected to exploration and enquiry. But in many parts of the world, where half the worlds children likely sit in a one-room schoolhouse or in a classroom under a tree, that element of rote recitation and memorization has been a constant part of those children's learning, and will unfortunately be the only formal teaching they will have the opportunity to have.

The organization of the information, and the learning of that information, becomes more focused and disciplined as we move up the K–12 ladder. Science becomes chemistry, physics and biology; Arithmetic morphs hydra like into algebra, geometry, trigonometry, and calculus; Social Studies becoming geography, US History, and World Religions; English and literature expand and multiply into a diverse spectrum of humanities courses. Once we reach college we are supposed to use all of what we learnt as the basic foundation upon which to build a specific disciplinary career. This broad exposure, if done right, will engender in the student the necessary understanding and appreciation for a diverse array of subjects that's can form a strong foundation with depth and breadth, upon which disciplinary concentrations of study can be built. This is what differentiates *education* from *training*.

How we do educate the up coming generations, grow those scientists, engineers, mathematicians, architects, psychologists, historians, sociologists and so on, is critical. It is important to examine our pedagogy and ensure the effectiveness of our teaching. This can only be done if there is a continuous and rigorous evaluation and assessment of student learning. The standard university model of teaching of "chalk and talk" is no longer sufficient. University educators have long understood the weaknesses and insufficiency of the "chalk and talk" model. Our academic degree programs have progressed where they now incorporate interactive learning as a core

pedagogical tool. Here students participate in their own education, learning by asking questions and exploring issues interactively with a knowledge provider, whether that knowledge provider is a screen or professor. Our pedagogy has progressed even further. It is now routine to see, as part of every teacher's pedagogical repertoire, the problem-based or project-based learning exercise. Further, we know that when we place students in co-operative groups, learning is enhanced and students are more engaged and motivated, sensing the control they have over their own education.

Service learning takes the problem-based and project-based educational model and develops and extends it further. SL takes learning outside the sterile confines of the classroom and moves it into the field and the community. Problem-based learning in the field can then occur in a real context. It is in this real context that group effort and team participation become important. It is in real world problems that the need for multidisciplinary solutions to complex global problems, in whatever field, becomes clearly evident and necessary.

It is important for our pedagogy to require our students to engage with their critical thinking and analytical skills, with quantitative rigor and scientific rationality, and with their disciplinary strengths and their team player skills, to work together in multidisciplinary teams, developing and implementing real solutions that address needs within communities across the globe.

Service learning is certainly not new. It has arguably been around since our rural forebears had their children doing chores to learn skills necessary to carry on society, ensuring the survival of the community. What this paper suggests is that the current educational paradigms and models need to be expanded to incorporate service based learning opportunities into regular academic curricula and programs that substantively and rigorously tie these experiences directly to regular degree program requirements.

An example of formalized service learning that has been around for a long time can be found in Cuba, specifically at the Cuban equivalent of MIT, Universidad Tecnologica de La Habana Jose Antonio Echeverria, known by its acronym, CUJAE. On a study tour to Cuba, lead by the Howard University Project on Appropriate Technology in March 2003, students and faculty were exposed to curricula with a formal service-learning component. During this educational visit, three faculty and a group of fifteen students from Howard University participated in a study tour that included numerous site visits and meetings with individuals in government, education and the community. There, the faculty and students learnt that in CUJAE, a senior design project is a requirement not unlike at MIT and almost all engineering programs. However, the big difference is that the CUJAE senior project must be conducted outside the university in a community based setting and address a community problem, with the design project being the development and recommendation, with possible implementation, of a real solution to the identified community problem.

Considering the context of the students in the university in Cuba, their senior design projects are student driven but community based, engaging the community in developing sustainable solutions to real world problems that those developing communities would face. The senior design project is always a team based project that usually encompasses a full year of scholarly and research or field work, resulting in a major report which should be able to be extended into a journal paper. The teams is also required to make a formal presentation of their projects. These projects will need to be supervised and mentored by faculty, either inked through particular elective course work or through the across the board design project requirement.

In like manner, Engineers Without Borders (EWB) projects[2], including those undertaken and executed by professional and campus based chapters, initiate and develop projects through a partnership between the chapter and a community that has an expressed need. Communities across the world seek assistance from EWB by posting or listing community needs or problems with the national organization. Chapters then seek out a problem from the listings that the Chapter's leadership and membership may have an interest in, and then partner with the community to develop a project that will address a specific need. The chapter works closely with the community and proposes possible solutions that the community reviews and evaluates, specifically to make sure that specific needs that the community has prioritized are being addressed. In the case of the EWB projects, partnerships are usually multi-year engagements that begin with an assessment visit and proceed from there through solution conceptualization, project design and development and end with implementation, all done through engagement, interaction and feedback with and from the community. A guiding imperative is the avoidance of top-down solutions and handouts, but engagement of the community in addressing their own needs and "buying-in" to the proposed solutions, thus making the community members themselves responsible participants in the improvement of their quality of life and standard of living.

It is clear that it would extremely difficult to incorporate a multi-year team based project into the regular engineering curriculum. However, following the model that has been developed and implemented at CUJAE, final year design projects in engineering curricula can be moved in the direction of community-based problem selection. An example of such an educational approach is the EPICs (Engineering Projects in Community Service) program at Purdue. Another approach is to use parts of the Engineers without Borders model.

The entire EWB process, from project selection to solution development and implementation need not be required. The senior design project can be focused on community problem selection and then the development of proposals and models for solution. This truncated and abbreviated EWB project model can be the basis for enhancing current engineering curricula with real-world problems of critical environmental and social significance with sustainability as a core under-girding

2 Please see http://www.ewb-usa.org

theme. In like manner, specific courses can be expanded to incorporate a service learning component that enables practical applications of the theoretical material being provided in that specific course or program. The activities described and discussed here demonstrate that the graduate students in the environmental engineering program at SCMS College of Engineering and Technology are being provided an opportunity to engage with communities facing water problems and apply the theoretical concepts taught in the classroom in a real world field scenario.

Materials and Methods

Koratty *Panchayat* is one of the 941 Gramma *Panchayats* in the state of Kerala, that needed to develop a water quality atlas. *Panchayats* are the local self governing bodies within the states of India, usually encompassing several village communities. As such, they are local government at the very basic grassroots level, and are an integral part of Indian democratic practice that gives voice to people from the village in their own government. As part of decentralized planning, which has been very effectively implemented in Kerala, Local Self-Government's are now having opportunities to initiate innovative programs to address environmental issues. However, the lack of proper scientific and technological inputs is one of the major limitations they face today. This is where academic institutions can provide critical inputs and support to the local communities. Being a popular technological institution in the area, SCMS School of Engineering and Technology (SSET) took it up as an institutional extension contribution and configured it as an SL activity through the faculty and students of its M.Tech Environmental Engineering (EE) programme. The main focus was to develop a complete water quality atlas that would enable the community members in the *Panchayat* to make scientifically and technically informed decisions about this critical resource. This followed very much after the need for periodical water quality analysis that had been expressed by the Panchayat Council to SCMS School of Engineering and Technology.

Figure 1: Graduate students in the EE program at SEET teaching the local self-help group women how to analyze drinking water for various water quality parameters.

Undertaking this community request, the faculty of the MTech EE program developed a strategic plan and a set of activities that the students could engage in, closely tied to the academic work that they were pursuing in the classroom and laboratory. The graduate students were tasked with developing a plan of action and the necessary materials and methods to create the water quality atlas for this particular *Panchayat.* The region was mapped in terms of the various constituent wards in the *Panchayat* and water samples were collected from all these 19 wards (which are small divisions with administrative boundaries within the P*anchayat*). All the samples were analysed using the water analysis kit based on colorimetric analysis and H_2S strip test (for bacteriological analysis). The parameters monitored included pH, water hardness, sulphate content, nitrate content, iron and fluoride levels, and *faecal coliform* bacterial presence. Water quality analysis kits were not familiar to the Water Brigade self help group nor the Panchayat authorities before. It was introduced to the self-help group women by the students of the SCMS School of Engineering and Technology (SSET). Since the analysis did not involve complicated procedures, they could learn how to analyse drinking water from their own houses, easily and quickly.

The students, along with the faculty, developed materials that would form the basis of a *water literacy* campaign. This water literacy campaign was conducted on a house-to-house basis, with all graduate students participating in the education of the *Panchayat's* community members. The students discussed the water quality results and created awareness on various possible technological solutions for common water quality issues faced in the *Panchayat*. A series of training sessions were organized for another women's SHG within the *Panchayat* for easy and quick analysis of drinking water samples at periodic intervals. This group later came to be known as the Water Brigade within the *Panchayat*.

Figure 2: Students of the SSET EE MTech program conducting water quality analysis tests on water samples from the *Panchayat* for making Water Quality Atlas by students.

Subsequent to the water quality analyses, a geographical information system (GIS) based water quality atlas was prepared with the participation of all elected members and resource persons of the *Panchayat*. An opensource GIS application[3] named QGIS was used in preparing the water quality atlas. The atlas contained georeferenced data layers such as ward map, cadastral map, road network, well locations with owner's address, type of wells, and water quality parameters. These data layers were overlaid for the spatial analysis of water quality parameters. GIS based water quality atlas helped the panchayat administration to understand the spatial variability in ground water quality within the panchayat, identify the patterns in water quality degradation, decide on the method and the extent of water treatment required, prioritize fund allocation for well restoration in the wards and monitor their progress. The developed system had the flexibility for any future updates. Later, 20 women of another SHG were given training on roof top rainwater harvesting by the students. This women's SHG became a community resource. They could work as a group and they offered to take on the projects of establishing rainwater harvesting system's at any community member's residence who chose to have on set up. Thus, this SHG became a local technical resource group for any community member who was willing to have their roof tops set up with rain harvesting systems which channelled rainwater into open domestic wells, resulting in the implementation of an appropriate technology to address the water scarcity issues that comes up during each summer.

Results and Discussion

The outcome of this SL engagement was the creation, for the first time in Kerala state, of a water quality atlas directly by members of a *Panchayat*. This atlas will provide the basis for a decision support system that the local government can use to make decisions about the status of water quality in the area. Since the atlas has been developed on a GIS platform, it can be renewed at regular intervals to understand the changes in water quality, if any, as a result of seasonal changes in rainfall and water use. Through this SL activity, the graduate students of the EE program developed water analysis skills, presentation and teaching skills, interpersonal skills and communication skills through their interactions with common people. It was the case where formal education was blended with real-world experience.

3 http://www.qgis.org

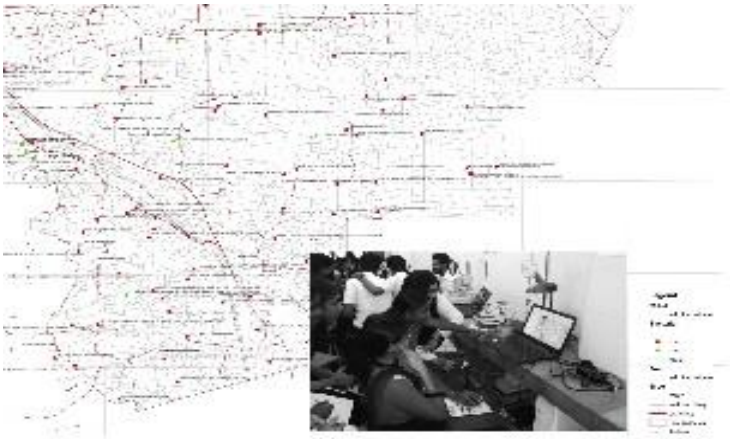

Figure 3. SSET students of the M.Tech EE programme working with GIS for the preparation of water quality atlas

The water brigades of the SHG of women are now engaged in disseminating water literacy among the general public within the *Panchayat.* It has increased the scientific and technical capability of the residents of the *Panchayat* and it is enabling and empowering them in understanding the techniques for conserving water, harvesting roof top rainwater and to be able to independently analyze water quality without seeking much external technological assistance. It will have a strong impact on restricting the spread of water borne diseases and increasing the quantity and quality of water that is available to the community.

This was a unique but very significant partnership between scientifically educated and technologically trained students of an engineering school and members of the neighboring communities, who were badly in need of this support. It was a win-win situation where students gained hands-on experience and understood the pulse and need of the society in which they are likely going to work in the future. This strong connection with the community that has been engendered between the students and it's members was able to be realized only through the engagement of the students in various SL activities. As such, this is extremely valuable for the graduate environmental engineering program they are enrolled in and will result in enhanced outcomes for the students, especially in terms of the soft skills so highly prized by industry and academia as critical determinants of the students' future professional and personal success.

Kerala is a State which has effectively implemented decentralization of powers in India. That is why *Panchayats* in Kerala are having adequate powers to take decisions and implement developmental activities for the welfare of their own community members. However, *Panchayats* may not be having proper scientific support for implementing programs and projects with significant scientific backing. As part of decentralization of powers, *Panchayats* are having better responsibility

for governance, and at the same time they need to build capacity for systematically developing and implementing projects. The above case of development of a water quality atlas is a good example where the *Panchayat* used its powers to use a scientific tool for assessing and periodically verifying the changes of drinking water quality in domestic wells within its area of operation.

Whereas the role of a technological institution is not only in teaching its students exactly as per curricula and producing good results but also to make the students understand their commitment to the community in responding to socially relevant requirements. Students groomed in such an environment will become much more responsible citizens of the nation. Moreover, through addressing the technical needs of a community, these students gained hands-on experience, developed a better understanding of practical application of the theoretical material they have studied, fine tuned and standardized analyses techniques, and developed better usage of equipment in the field. In addition, and as important in their education, the students understood how to effectively and convincingly communicate to the community; they were also able to find solutions to unexpected problems, resulting in the development of resourcefulness amongst them. This model, whereby a class of students with scientific and technological skills are able to work with a local community, is a remarkable example of a mechanism whereby formal classroom education got linked with real world experience.

The technical skill's developed by the rural water brigade self help group women and the awareness about water quality and need for its conservation through the interaction and training given by the students is noteworthy. This has resulted in an enhanced level of environmental awareness being created among the community in general as the women could disseminate these ideas to the community. In addition, the self-help group women could also make recommendations to the community about what measures might need to be taken whenever there are changes of water quality in the domestic water sources. The water brigade, who received training in roof top rain water harvesting, provided technical help in installation of roof top rain water harvesting structures in several houses and local schools. This is an added advantage in spreading the idea of harvesting of rain as a climate change adaptation strategy in this *Panchayat*. Such an initiative has great scope in Kerala since it is a region which, although receiving on average 3000 mm of annual rainfall, has many locations which still face drinking water scarcity from January to May, when the state receives practically very little rain (a few summer rains which is unpredictable).

CONCLUSION

It is imperative that we move our pedagogy, and more importantly our curricula, in the direction of student-engaged, participatory, service oriented projects to enhance teaching and learning in a meaningful direction and towards application-oriented real-world problem solving. Numerous surveys of current college age students both informally and formally have always demonstrated the need the college generation

has to be able to engage in service to the community. In high schools, it is often part of the graduation requirement that students engage in a minimum number of hours of community service. The one thing we know about our students is that most of them want to make a difference in their world, especially those in the millennial and following generations, be they generation X, Y or later.

It is time to build on the high school experience and extend and deepen it into one that is more mature and rigorous and addresses the educational and growth needs of today's college students. This is how we can engage them and help them achieve the goal of engagement in service, and contributing in the process both to student development, community development, improvements in the quality of life, and enhancing the sustainability of communities as they seek to improve their standard of living. This is an invaluable contribution to the education of a student and connects their academic world to the real community in a positive and inclusive manner. Institutionalizing a service learning experience into formal undergraduate engineering curricula will address these needs and go a long way towards making an engineering education a more attractive and rewarding one.

ACKNOWLEDGEMENTS

The author would like to acknowledge The United States India Educational Foundation (USIEF) and the Fulbright program which provided the support for the research and writing of this paper. A version of this paper was presented and published as an extended abstract in the *Proceedings 7th International Conference on Appropriate Technology*, Victoria Falls, Zimbabwe, November, 2016 (Tharakan et al, 2016). Any opinion, finding and conclusion or recommendation expressed in this material is that of the authors and the USIEF or Fulbright does not accept any liability in this regard. Our sincere thanks are also due to the Koratty Grama Panchayat and to the Management of SCMS Group of Educational Institutions, Kochi, especially for the support extended to conduct this study, with special acknowledgement to the faculty and students of the MTech program of the Department of Environmental Engineering, SCMS School of Engineering and Technology, Karokutty, Kerala, India and the women self help group members of Koratty Panchayat, all of whom provided their whole-hearted support for this study.

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Short term Training for minimizing the skills gap of textile engineering graduates integrating Problem Based Learning (PBL) method

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ABSTRACT

The purpose of this paper is to explain the impact of introduced short term training program integrating the PBL methodology instead of structured basic PBL activities aiming to minimize the skills gap of textile engineering graduates. In this research, a short-term (70 hours) training program, structured with 3 modules including skills development oriented topics, has been designed integrating the PBL methodology and applied instead of semester long PBL activities. The training has been provided to the fourth year second semester textile engineering students along with their normal curricular activities by the academician and factory experts. Then their skills gain has been assessed by conducting a survey. The results from the study unveiled that all the participants have significantly gained skills such as communication ability, Team work capability, Leadership quality, Real life problem solving ability, Researching ability, CV writing ability and Interview facing techniques, which were lack in their normal academic activities. This study revealed the necessity of short-term PBL based customized training program instead of semester long basic structured PBL activities where necessary. In the existing research, structured PBL methodology was the main focus but in this study a need based customized form of PBL oriented training has been introduced which is not common in the PBL research.

Research/Practical implications and limitations*: This study has been done only on the small group of textile engineering students. If large group of students from different domain of engineering were involved in this study then more specific outcomes might be achieved.*

Keywords: *PBL, Short-term Training, Solutions, Skills, Textile Engineering*

INTRODUCTION

Engineering is an activity that is essential to meeting the needs of people, economic development and the provision of services to society. Engineering involves the purposeful application of mathematical and natural sciences and a body of engineering knowledge, technology and techniques. Engineering seeks to produce solutions whose effects are predicted to the greatest degree possible in often uncertain contexts. While bringing benefits, engineering activity has potential adverse consequences. Engineering therefore must be carried out responsibly and ethically, use available resources efficiently, be economic, safeguard health and safety, be environmentally sound and sustainable and generally manage risks throughout the entire lifecycle of a system (IEA, 2013).The fundamental purpose of engineering education is to build a knowledge base and attributes to enable the graduate to continue learning and to proceed to formative development that will develop the competencies required for independent practice. The second stage, following after a period of formative development, is professional registration. The fundamental purpose of formative development is to build on the educational base to develop the competencies required for independent practice in which the graduate works with engineering practitioners and progresses from an assisting role to taking more individual and team responsibility until competence can be demonstrated at the level required for registration. Once registered, the practitioner must maintain and expand competence (IEA, 2013).

To be a successful professional Engineer in the International corporate world of the 21st Century, they must be equipped to be global engineers who are technically versatile (multi-disciplinary), able to solve problems from a system-level perspective, effective communicators, function in diverse ethnic teams and demonstrate social responsibility (Richard et. al., 2003).

Presently the undergraduate engineering educational curricula are facing an emerging challenge to be compatible with the rapid technological evolutionary changes. The realization that for the engineers to retain a competitive edge they need the knowledge, skills and attitudes that will provide them with futuristic problem solving skills, the expertise to visualize the ability to adapt the change (Richard et. al., 2003).

The Journey of Bachelor education in Textile Engineering of Bangladesh started in 1978 with the establishment of former College of Textile Technology; recently it has been upgraded as Bangladesh University of Textiles (BUTex). Alongside Bangladesh University of Textiles (BUTex), three other public universities and some private universities are also offering textile engineering degree. The education system is running based on the old and few modified British undergraduate curriculum of those entire institutes, where education is more

or less instruction-based and focused on teaching rather than learning. Scoring good grade is the main concentration for students (Baral et. al., 2012). Due to this old existing curricular and traditional teaching methods, the textile engineering students of Bangladesh are graduating with a remarkable skills gap to perform effectively in their working place as the employers also claim frequently.

To equip with above mentioned skills, some changes are needed in the textile engineering curriculum, teaching methods and delivery modes. To cope with the changes and advances in the technological fields, as well as , to bear out the requirements of a developing country, the textile engineering curricula in Bangladesh needs to go through continuous modernization (Kabir et. al., 2008).

In engineering education system real-life problem-based learning (PBL) is an effective method as it helps students to solve open-ended engineering problems (Edens, 2000). A potentially effective approach to prepare students to solve authentic problems is problem- based learning (PBL), an instructional methodology that focuses student learning on relevant problems (Jonassen, 2011). Beside that the Training is also an effective way to improve skills quickly in the textile field like other sectors as researchers opined (Radulescu, et. al. 2015).

Thus the purpose of this paper is to explain the impact of introduced short term training program integrating the PBL methodology instead of structured basic PBL activities aiming to minimize the skills gap of textile engineering graduates.

STRUCTURE OF THE TRAINING MODULES

In this research, a short-term (70 hours within three months duration) training program titled "Skill Development Training Program for Textile Graduate using PBL Techniques" has been designed including the PBL methodology and implemented instead of semester long PBL activities (Kolmos, et.al.,2004; Baral et. al., 2012).The Training Program has been structured with three (3) modules including skills development oriented topics, which is depicted in the Table: 1 and a brief description of those modules are given in the following sections.

1. Module-1 (Soft Skill Development)
2. Module-2 (PBL and Research Methodology)
3. Module-3 (Learning Through PBL)

Module-1 (Soft Skill Development):

The Module-1 includes soft skill development related topics aiming to enhance the participant's knowledge on CV writing techniques, Interview facing techniques, Language Communication, Leadership ability and Teamwork capability. Above soft skills are very much important for a textile graduate to perform in the practical field for their diversified professional workplace. But in the present curricular (BUTex Academic regulation, 2012; AUST Academic regulation, 1998) those types

of topics were not included. Module-1 will be able to contribute to overcome the lack exist in present curricular related to above mentioned soft skills.

Table 1: Modules and Contents of Skill Development Training Program for Textile Graduate using PBL Techniques.

Module-1 (Soft Skill Development)			
Srl. No.	**Topics**	**Contact Hours**	**Source of Resource Persons**
1	Orientation, Introduction on Training Objectives and PBL	3	University
2	Discussion on CV Writing and Interview facing Technique	3	Industry
3	Language Proficiency and Higher Education on Textiles	3	University
4	Developing Leadership Quality and Teamwork Ability	3	Industry
	Total (Module-1)	**12**	
Module-2 (PBL and Research Methodology)			
12	Detail Discussion on PBL Methodology	3	University
13	Research Methodology and Literature Review Technique	3	University
14	Project Report Writing Technique	3	University
15	Presentation Preparation and Delivering Technique	3	University
	Total (Module-2)	**12**	
Module-3 (Learning Through PBL)			
16	Team Building, Mentor Selection and Problem Selection	3	University and Industry
17	Problem Solving Methodology and Plan Preparation	3	University
18	Problem Related Literature Review	3	University
19	Data Collection	18	University and Industry
20	Data Interpretation	3	University
21	Presentation Preparation	3	University
22	Final Presentation	9	University and Industry
23	Celebration	4	University and Industry
	Total (Module-3)	**46**	
	Total (Module-1+2+3)	**70**	

Module-2 (PBL and Research Methodology):

In this module, the general Research methodology and PBL techniques were included to give the clear understanding and knowledge on different types of researches and also how to use PBL techniques during conducting research. In the existing undergraduate curricular (BUTex Academic regulation, 2012; AUST

Academic regulation, 1998) of textile engineering education, a research based project work has been included, where a project should be executed by the students and submitted a report to the evaluation committee. More over students have to present their contribution in front of committee members. But the course like Research methodology, Business communication are not available to provide the basic knowledge on different types of researches, report writing and presentation delivering techniques. So, the textile graduates have lack of skills in this area of education. In order to minimize those skills gap this module has been designed including related topics.

Module-3 (Learning through PBL):

This module supposes to be the core of the training program, which aims to provide knowledge learning by field site study. This module has been designed including the sequential PBL activities (Richard et. al., 2003) in order to solve a real life problem occurred in a textile industry through a PBL project with active participation of academician and factory mentors. During execution of this module participants will be given a problem assignment using a project based approach. The project study will be delivered using a problem-based training idea, which is a strategy that uses a problematic stimulus for participants to develop, acquire knowledge, and presented with a problem to solve rather than a lecture to absorb. After completing the activities, the project outcomes will be presented publicly through power point presentation. The aim of this module is to teach the participants about real life problem solving techniques and solution presenting techniques by using the knowledge gathered from module 1 and 2 as it is the important tasks of a textile graduates in their working place.

EXECUTION OF TRAINING MODULES

The training has been provided to a group of 24 students of the fourth year second semester (fall -2016) from Department of Textile Engineering of Ahsanullah University of Science and Technology (AUST), Bangladesh along with their normal curricular activities. The newly designed training program was conducted by the academician from Department of Textile Engineering, AUST and experts from a reputed Textile Industry in Bangladesh.

It may be mentionable that the Department of Textile Engineering of AUST plays a vital role for Textile Engineering Education in Bangladesh providing 4 (four) years bachelor degree (B.Sc. in Textile Engineering).The 4 years program is running with the bi-semester system has two 14 week semesters in a year. The students are taught common subjects 6 (Six) semesters out of total 8 semester. In Last 2 semesters, the specialized subjects are allocated among the students according to their choice like; Yarn Manufacturing, Fabric Manufacturing, Wet Processing and Apparel Manufacturing (Baral et.al., 2012). In

this study the training has been provided only on the students who are specializing in Apparel Manufacturing. After completing the offered training course, the skills gain of the participants have been assessed through conducting a survey.

ASSESMENT OF SKILLS DEVELOPMENT

A set of 5 scale Likert-type (1- Poor, 2-Satisfactory, 3- Good, 4- Very Good 5-Excellent) survey questionnaire were sent directly to all the participant's, those who participated in the newly developed Training program.

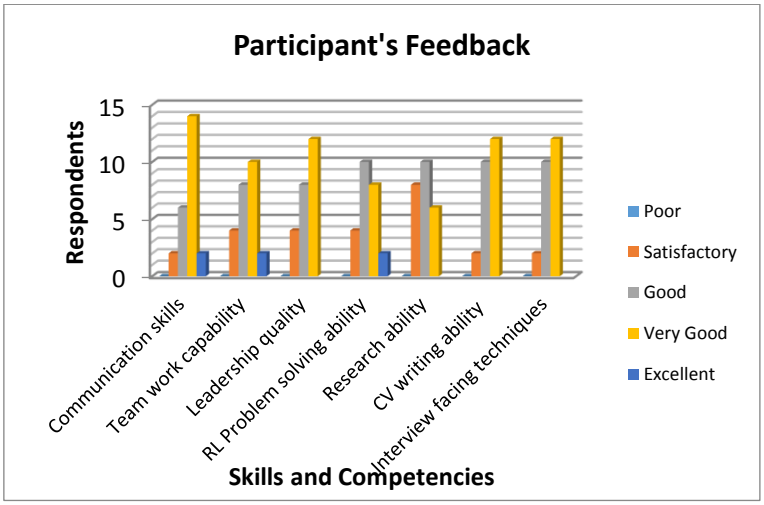

Figure 1: Student's acquired Skills and Competencies after Training.

The questionnaires were formulated relating to their skills acquiring experiences during the Training period such as: (i.) Communication skills, (ii) Team work capability, (iii) Leadership quality (iv) Real life problem solving ability, (v) Researching ability, (vi) CV writing ability and (vii) Interview facing techniques. The survey result and the responses regarding the participant's acquired skills and competences are presented in the Figure1.

1. According to survey results, a majority (58.33%) of participants considered that they acquired very good "Communication skills" after complementing the PBL based Training.

2. 50% of participants mentioned that they learnt very good "Leadership quality", "CV writing ability" and "Interview facing techniques" through the PBL based short term training that was not achieved from the ongoing university education.

3. 41.66% of respondents agree that they gained good "Teamwork capability", "Real Life Problem Solving (RLPS) ability", "Researching knowledge", "CV writing ability" and "Interview facing techniques" from training activities.

4. Above 8% of respondents also mentioned that they achieved excellent "Communication skills", Teamwork capability", and "Real Life Problem Solving (RLPS) ability" after complementing the PBL based Training.

CONCLUSION

The results from the study unveiled that all the participants have significantly gained skills such as communication ability, Team work capability, Leadership quality, Real life problem solving ability, Researching ability, CV writing ability and Interview facing techniques , which were lack in their normal academic activities. This study revealed the necessity of providing short-term PBL based customized training program instead of semester long basic structured PBL activities where necessary. In the existing research, structured PBL methodology was the main focus but in this study a need based customized form of short term PBL oriented training has been introduced which is important for those institutes where introducing the basic structured PBL is difficult due to some limitations. This study has been done only on the small group of textile engineering students. If large group of students from different domain of engineering were involved in this study then more specific outcomes might be achieved.

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Augmented Reality Robot Teaching Application

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ABSTRACT

This paper reveals the recent popularity increase of Augmented Reality (AR) which is mainly due to the recent technological advances. For this reason, the evolution of scientific papers and internet searches on AR are investigated. In addition, the key technological requirements for a functional AR application development are presented. This research uses a practical approach to demonstrate that AR is an appropriate addition for the current training tools, and it can be successfully applied to assist its users in performing various tasks.

Keywords: *Augmented Reality, Robot programming, Training tool*

INTRODUCTION

In recent years, the popularity of augmented reality (AR) grew, being adopted in various fields, from the military to entertainment. This popularity is mainly due to rapid technological change in recent years. But AR became accessible with the mobile phones and portable computers revolution.

The development of successful AR applications is a difficult task. Despite the technological advances over the past decade, most AR systems developed so far are based on laboratory implementations. Worldwide, they were conducted extensive

research to address critical issues in AR technology. Tracking real-time benchmarks are real challenges, because the synchronization between the real world and virtual worlds must be completed within a timeframe as short as possible. AR applications requires both hardware and software resources.

The tech level required for AR implementation is quite high, which contributed to the late maturation of AR technology. However, due to the latest tech developments, the hardware and software resources required are not expensive. Moreover, the key components needed to build an AR system remained unchanged from the first prototype developed in 1970 by Ivan Sutherland: display devices, tracking methods, computer generated graphics and AR software are essential in most experiences with AR.

Another way to observe AR's evolution is to analyze the number of scientific papers published on this topic. As it can be seen figure 1, the number of papers from Web of Science (WoS) which contain AR in their topic has doubled in the last 6 years. The same evolution can be observed in the Scopus Database, which has 2025 indexed AR papers in 2016 almost double than in 2011.

This ascending tendency can also be seen by analyzing internet search trends. Using Google Trends, there can be seen a major increase in AR's popularity in the last few years, the peak in AR searches on Google being set in July 2017.

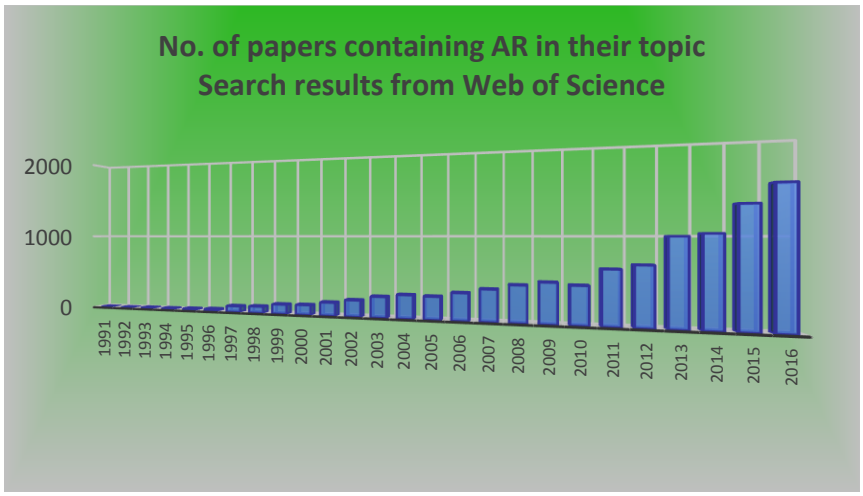


Figure 1: Papers from Web of Science containing AR in the topic.

Motivated by these facts we have started to develop AR applications to improve educational activity and to assist humans in various industrial processes. For educational purposes, we have developed a CAD/CAM AR aided application that

was used by students from 3rd and 4th year of study (Bondrea Ioan, 2015). For industrial purposes, we have developed a method to manage cutting tools using AR (Petruse Radu Emanuil, 2014) and we have studied how AR can improve the assembly and maintenance processes (Bondrea Ioan, 2013)

Augmented Reality Robot Teaching Application

The crucial factor for the successful use of AR is correct and accurate referencing to the real and virtual world. Before an AR technology can display virtual objects in a real environment, the system must be able to measure and track the user's approximate movements, preferably with six degrees of freedom.

In most cases, AR applications are developed based on the structure presented in figure 2.

An AR application that can be used for educational and/or industrial purposes must include all the modules from figure 2 plus a human interaction method. The AR's user must be able to adjust and interact with the superimposed digital contend using gestures, vocal commands or other human machine interfaces (HMI).

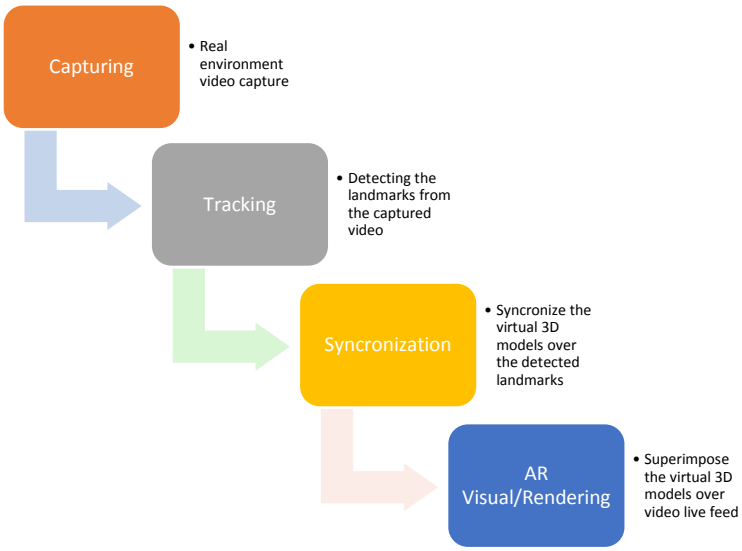


Figure 2: AR deployment framework.

1. Hardware and software requirements

In order to make a fully functional AR application, in its most basic form, there are some mandatory hardware and software requirements as follows. Hardware (HW)

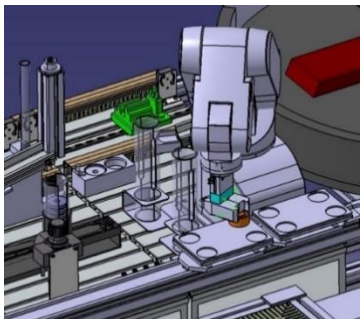
requirements must be able to provide: computational power, visual tracking; a display and a human interaction method (DMDII Institute, 2016). The software (SW) should be able to track the real environment and to overlay the digital content over a video live feed of it.
To develop a superior AR application, extra HW equipment are required, such as: Mobility enhancement devices (e.g. batteries, wireless communication - Bluetooth Wi-Fi, GPS), 3D Visual tracking devices (depth camera, environment understanding cameras, ambient light sensor), Human interaction capabilities (gesture recognition, voice support, eye tracking), Improved optics (see-through display with holographic capabilities). All these equipment should be incorporated in a portable wearable device. An on-board OS may also improve an AR app development process by simplifying the access to digital resources available on the web and by improving the security of the AR device.

Currently on the market the most evolved AR devices, that incorporate most of the features described above, are HoloLens (Microsoft, 2017) from Microsoft and Daqri's Smart Helmet (DAQRI, 2017).

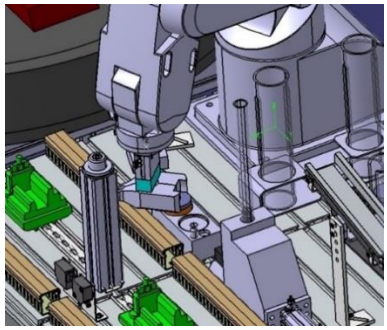
2. AR application development

Beside the essential HW and SW requirements, the digital content that is superimposed over the perception of the real world is also very important for a functional AR application.

The robotic arm, a Mitsubishi RV-2AJ, for which this AR application is made performs an assembly task on a FESTO flexible manufacturing line. Because the robot can also be simulated and programmed using a digital manufacturing software, it was 3D modelled using DELMIA. These 3D models were afterwards converted to *.wrl files that are compatible with the AR software used. For this application 17 different 3D models were created that represents the robot in each position required for the assembly process (figure 3).



Step 1 Take the cylinder from the conveyer

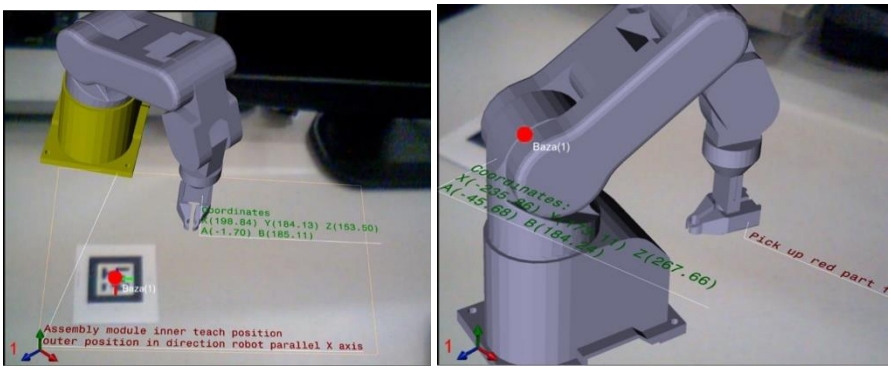


Step 17. Position the assembled part on the conveyer

Figure 3: 3D models created to be superimposed with AR.

The AR software that is used was developed using Metaio Workflow Authoring Tool, an AR SDK. In order to reduce the programing skills required if the AR application must be modified we have created a modular AR application. To modify it, its user should choose the version of the application which contains the suitable number of AR instructions (e.g. number of steps, in this case 17) and simply replace the 3D models that are required to be superimposed. Both these changes can be made from a cloud storage service.

This application uses 17 different 3D models which shows its user in which position the robot joints are supposed to be and the X, Y, Z, A, B coordinates of the gripper. A text message with information about the robot's task in each position is also displayed to guide the user during the robot teaching operation (figure 4).



Assembly step 1 AR position Assembly step 2 AR position

Figure 4: RV-2AJ robot's AR aided teaching.

In this application, a 6 step AR aided maintenance instructions are included that assists the user in defining the robots' default origin point for the specified assembly task.

The user can interact with the superimposed content using the mouse buttons (left click to advance to the next instructional step and right click to go back one step) or tap and double tap if using a device with touchscreen.

This application can be used on any device running Windows OS and with internet access.

CONCLUSIONS

The AR application received good reviews among the students that used it to teach the robot the required assembly positions. From these benchmark tests, we can draw the conclusion that AR has the potential to replace current training tools such as printed instructions and in the near future, these applications can and will be used to provide human assistance in various tasks.

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A Comparison of Student Performance and Satisfaction in Traditional vs. Flipped Style Classroom Formats for an Engineering Course in Numerical Methods and Programming

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ABSTRACT

The purpose of the current work is to compare two class formats for Engineering 11: Programming and Problem Solving in MATLAB (ENGR 11) taught at Foothill College in Los Altos, California. The methodology employed here involves assessing student grades and surveys for two quarters of the same course taught using "flipped" and "traditional" classroom formats. The findings of this investigation indicate that the "flipped classroom" format was associated with a higher student performance, higher student satisfaction, and higher student retention rate than the traditional class format. Also, the structure of the "flipped classroom" activities may have played an important role in the observed positive effects of the "flipped classroom" format.

Keywords: *Flipped Classroom, Comparison, Numerical Methods, Engineering*

INTRODUCTION

Although there is no single definition of a "flipped classroom", most definitions will agree that in a flipped class: (1) content acquisition happens before coming to class, and (2) time in class is used to work on the development of higher-level cognitive skills. Being a relatively new concept, studies up-to-date are inconclusive about the effect of the "flipped classroom" on student learning. (Braseby, 2016)

In this investigation, two quarters of an engineering class that were taught using "flipped" and "traditional" classroom formats are evaluated. Student performance

and satisfaction are assessed in Engineering 11: "Programming and Problem Solving in MATLAB" (ENGR 11) for each quarter.

ABOUT ENGINEERING 11: "PROGRAMMING AND PROBLEM SOLVING IN MATLAB"

"Engineering 11: Programming and Problem Solving in MATLAB" (ENGR 11) is an in-person engineering course taught at Foothill College in Los Altos, California. The course teaches the basic structures of programming using MATLAB software and various numerical methods. Students learn how to code numerical methods in MATLAB as well as how to use built-in MATLAB functions to solve problems in the fields of engineering, physics, and mathematics. The course has a lecture and a lab component, with a total of 6.5 contact hours per week. A new addition to Foothill's curricula, the course had been taught twice before the winter quarter of 2017. In the short time that ENGR 11 has been offered at Foothill, it has been observed that there are two types of students that take the course: beginner programmers looking to learn how to program, and experienced programmers looking to become proficient in MATLAB. For example, in Spring 2017, 29% of the students initially enrolled in ENGR 11 reported themselves as a "beginner (never programmed before)". The same data is not available for other quarters of ENGR 11, but similar beginner percentages were observed in Winter 2017, and in previous quarters by previous instructors of the course.

TWO CLASSROOM FORMATS FOR ENGR 11

During winter quarter of 2017, the "flipped classroom" format was adopted in ENGR 11 as a solution to having no off-campus access to MATLAB software. Student access to MATLAB software was limited to the lab room, the STEM Success Center (tutoring center), and their own personal copy of MATLAB (if the student could afford one). Thus, it did not seem reasonable to expect students to be able to complete lab assignments that required MATLAB outside of class. The "flipped classroom" format allowed students to watch video lectures pre-recorded by the instructor and posted to the course's Canvas (online course management software) site before coming to class, and to use their time in class to work in small informal groups and interact with the instructor to complete lab assignments based on the pre-recorded video lecture. Additionally, a short (1-3 questions) paper and pencil quiz on the material was administered, collected, and discussed to help keep students on track and to motivate them to come to class to work with others. Lab assignments were submitted online in the form of MATLAB program files (m-files). Exams were practical in nature, and thus, very similar to lab assignments. Half an hour of office hours was held before and after every class. Initially, quizzes were administered at the beginning of class. However, as the quarter progressed, the students asked if the quiz could take place at the end of class, so that they could review the notes, attempt the corresponding lab, and then take the quiz. Thus, the

quiz was moved to the last 15 minutes of class time. This final ENGR 11 format is summarized in the "Winter" column in Table **4**.

Table 4: ENGR 11 classroom format for 2017 Winter and Spring quarters.

2017 Quarter	Winter	Spring
Office Hours	½ hour before and after every class	½ hour before and after every class
Lecture format	Pre-recorded video lectures	In person lectures
Quiz format	Pen and paper quiz at the end of class time	Online quiz at the beginning of class time
Labs format	MATLAB program files submitted online	MATLAB program files submitted online
Exams format	MATLAB program files submitted online	MATLAB program files submitted online

The flipped classroom format allowed the instructor to spend time guiding different student groups at the right level of preparation, to participate in meaningful discussions, and address general issues as a class.

By the time spring quarter 2017 started, remote access to MATLAB was available at Foothill College, and, therefore, there was no longer a need for a "flipped classroom" format in ENGR 11. Thus, the course returned to a more traditional in-class lecture format. In-class quizzes were administered at the beginning of every class via Canvas. Labs and exams were very similar in format to winter 2017 quarter. Office hours were held in the same way as in the winter quarter. The "Spring" column in Table **4** summarizes the format used in ENGR 11 during the Spring 2017 quarter. As the spring 2017 quarter progressed, not many students would stay to work in groups.

STUDENT PERFORMANCE COMPARISON

Student performance was assessed by looking at winter (flipped) and spring (traditional) ENGR 11 class grade distribution, as well as mean grades. The difference between winter and spring quarters' grade component distribution is the percentage the extra credit project contributed to the students' grade; in the spring

semester, the extra credit project was worth half of of the value it was worth in the winter quarter. It is important to note that half of the grade in ENGR 11 comes from exam performance, while the other half of the grade comes from labs (40 %) and quizzes (10 %). The ENGR 11 grade components and the corresponding weights are summarized in

Table 5.

Table 5: ENGR 11 Grade Components.

Grade Component	Percent of Grade in Winter 2017 (Flipped)	Percent of Grade Spring 2017 (Traditional)
Quizzes	10	10
Labs	40	40
Mid-Term Exam 1	15	15
Mid-Term Exam 2	15	15
Final Exam	20	20
Extra Credit Project (optional)	4	2

The distribution of letter grades in the winter (flipped) and spring (traditional) quarters of ENGR 11 are very different.

Table 6 lists the number of students that earned each letter grade in each quarter, where the letter grade cuttoffs are given in Table 7. Letter grades C and D are ommitted from the table, because no students earned these letter grades in neither the winter nor spring quarters. If letter grades A+, A, and A- are grouped into the A category, it is apparent that a higher percentage of A's were earned in the winter than in the spring quarter. If B+'s, B's, and B-'s are grouped into the B's category, the winter quarter class earned a slightly higher percentage of B's than the spring class. The spring class earned a few C's, while the winter class earned none. However, the winter class earned a higher percentage of F's than the spring class. The letter grade distributions listed in

Table 6 lead to slightly different "mean class grade" as shown in Table **8**. The winter quarter's "mean class grade" is 0.59 % higher than the spring. Overall, the winter class performed better than the spring class in quizzes, labs and the first exam, and worse than the spring class in the second and final exams, as well as the extra credit project completion rate. However, it is very important to note that the winter class' retention rate was 100%, while the spring class' retention rate was

18.18 % lower. This means, that 4 students dropped the class in the spring, while no one dropped the class in the winter.

Table 6: Grade distribution for Winter and Spring 2017 quarters in ENGR 11. Sample size, N, is indicated for each population.

Letter Grade	Winter (Flipped) N = 23		Spring (Traditional) N = 18	
	Number	Percent	Number	Percent
A+	5	21.74	3	16.67
A	6	26.09	8	44.44
A-	6	26.09	1	5.56
All A's	17	73.92	12	66.67
B+	0	0	1	5.56
B	2	8.70	1	5.56
B-	2	8.70	1	5.56
All B's	4	17.4	3	16.68
C+	0	0	2	11.11
F	2	8.70	1	5.56

Table 7: ENGR 11 grade cutoffs.

Grade	Required Percent
A+	≥ 97
A	≥ 90
A-	≥ 88
B+	≥ 86
B	≥ 80
B-	≥ 78

Grade	Required Percent
C+	≥ 75
C	≥ 67
D	≥ 60

Table 8: Student Performance in ENGR 11 for Winter and Spring 2017 quarters.

2017 Quarter	Winter (Flipped)	Spring (Traditional)
Mean Class Grade	86.29 % (B+)	85.70 % (B)
Quiz Mean Class Grade	87.02 %	79.78 %
Lab Mean Class Grade	88.71 %	81.96 %
Exam 1 Mean Class Grade	91.78 %	88.22 %
Exam 2 Mean Class Grade	88.65 %	94.41 %
Final Exam Mean Class Grade	72.57 %	88.33 %
Percent of Students that Completed Extra Credit Project	21.74 %	33.33 %
Student Retention Percent	100.00 %	81.82 %

It should be noted that the student performance data for previous semesters of ENGR 11 is not available. Therefore, it is not clear if the difference in student performance found between 2017 Winter and Spring quarters of ENGR 11 is significantly different from the natural variability that might be expected in any class that is taught multiple quarters using traditional delivery.

STUDENT SATISFACTION COMPARISON

Student satisfaction was assessed using the “End of Quarter Survey”. The questions in the survey are not directly related to student satisfaction, but a general sense of satisfaction can be gleaned from the results. The students rated statements about different aspects of the ENGR 11 by indicating whether they Strongly Agree (5 points), Agree (4 points), No Opinion or N/A (3 points), Disagree (2 points), or Strongly Disagree (1 point). The proximity to 5 of the “Overall Mean Student

Rating" listed in Table 9 demonstrates that both classes were fairly satisfied with the course. However, the winter (flipped) class scored a mean of 0.28 points higher than the spring (traditional) class. Thus, the students were slightly more satisfied in the flipped class than in the traditional class.

Table 9: End of quarter survey results for ENGR 11 in Winter and Spring 2017 quarters (out of 5).

	Winter (Flipped) Mean Rating	Spring (Traditional) Mean Rating
Overall Mean Student Rating	4.56	4.28

Once again, here too, it should be noted that the student satisfaction data for previous semesters of ENGR 11 is not available. Therefore, it is not clear if the difference in student satisfaction found between 2017 Winter and Spring quarters of ENGR 11 is significantly different from the natural variability that might be expected in any class that is taught multiple quarters using traditional delivery.

CONCLUDING REMARKS AND FUTURE WORK

According to the current investigation, the "flipped classroom" format is associated with a higher student performance, higher student satisfaction, and higher student retention rate a than the traditional class format, but the timing of the daily quiz may have played an important role in the observed positive effects of the "flipped classroom" format. As previously mentioned, a quiz was administered every day in both quarters. In the flipped classroom format, the quiz took place at the end of class time motivating students to stay for the duration of class to take the quiz, while many students in the traditional classroom left right after lecture. For the students in the flipped classroom, having to stay until the end of class fostered a higher degree of cooperative and collaborative learning (Barkley et al., 2014) than in the traditional classroom. Thus, the timing of quizzes may have been responsible for the higher student retention rate and satisfaction observed in the flipped classroom format in comparison to the traditional classroom. This observation suggests that it may be necessary to pay closer attention to the structure and content of the class activities planned for a "flipped classroom".

In the future it is of interest to measure the natural variability in student performance across quarters of ENGR 11 taught using traditional delivery, and to evaluate and compare the development of specific skills by students in each quarter of flipped and traditional classroom formats. For example, it is of interest to evaluate and compare how well students were able to "recall and apply basic computer

environment and basic algorithm flows" or "describe types of error caused by computations".

ACKNOWLEDGEMENTS

The author would like to thank Professors Nikos Mourtos and Heidi Diefes-Dux for their encouragement and support. The author would also like to thank Professor Sarah Parikh and Foothill College.

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Collaborative Platform for Transferring Knowledge from University to Industry - A Bridge Grant Case Study

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ABSTRACT

The partnership between universities and private sector has become a defining factor for the growth of innovation and quality in the research area.

Starting from the philosophy of a Bridge Grant project, financed through the National Research Programme and having as scope to improve the competitiveness of the Romanian economy, the current paper is proposing an university – industry collaborative model that facilitates the transfer of knowledge in both directions, with structured channels of communication that promote innovation; it provides

benefits for both involved parties, a formalized research structure for the industry partner and a more pragmatic approach for the university.

A multi-level architecture of a Big Data Analytics Platform for extracting useful insights from available data regarding the employees of the industrial partner and for taking complex and strategic decisions, was also designed and implemented and some results are briefly presented.

Keywords: *University-industry partnership, collaborative model, automotive organization, academic sector.*

INTRODUCTION

It is well known that the universities' main role is to serve the public interest, through education and research, and to participate in the spreading of knowledge and support of industry. The interdisciplinary research that brings researchers from university to work on real problems (with industrial, economic or societal applicability) with real users exploring real cases, raises the quality and impact of basic research and lowers the barriers to technology transfer. Lately, the collaboration between universities and industry is recognized as a driver of innovation through knowledge exchange (Ankrah, 2015). This is in contradiction with the initial mindset of sponsorship as a model of collaboration, where the industry was only providing funds without a foreseeable outcome, and the researchers had full control regarding results. This model was seen as a source of frustration for the funder, also taking into consideration the limitations of Intellectual Property Rights (Jacob, Hellström, Adler & Norrgren, 2000). Studies show that it's more likely to have a partnership if the industry partner is involved in exploratory internal R&D, is mature and large and there are no underlying IP issues between university and business (Cunningham, 2015).

Such philosophy can be found also in the Bridge Grant program, as part of the Romanian National Plan for research, development and innovation 2015-2020, and is designed for knowledge transfer from academic researchers to economic environment.

The purpose of this programme will be broadly presented in the next sections of the paper, together with some statistics regarding application in the 2016 competition: the financed research domains, the proportion of funded projects, the allocated budgets and also the number of partners involved in the grant. Based on a literature review related to models of collaboration in Public Private Partnerships (PPP), a collaborative model for R&D projects is introduced, and the initial results are presented. The output of collaboration project is an Intellectual Capital measurement Platform, based on Big Data processing, scalable and adaptive to other industries or academic demands. Finally, the paper ends with directions for future work and concludes the paper.

STATISTICS REGARDING BRIDGE GRANT PROJECTS INVOLVED IN 2016 ROMANIAN PNIII COMPETITION

The purpose of the Bridge Grant program is to use the expertise that already exists in universities to support the performance and competitiveness of the companies, and the main objectives are: interconnecting existing expertise in universities with industrial needs; intensifying cooperation between universities and the economic environment; transfer of knowledge to the market; developing the entrepreneurial skills of the researchers.

Out of the total number of registered projects - 463 in this Bridge Gant program, there were 126 projects approved for financing, with a 27% success rate (details in figure 1).

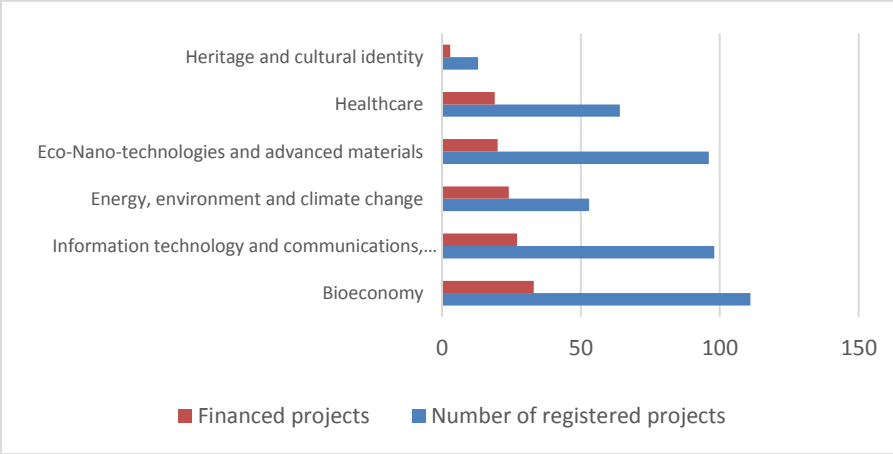

Figure 11: Registered vs. Financed Projects - Bridge Grant 2016 Program.

The projects are proposed by universities with expertise in these strategic areas and aiming to transfer such knowledge to a company in order to improve its performance.

The strategic areas of research in this programme are: Bioeconomy; Information technology and communication, space and security; Energy, environment and climatic change; Eco-Nano-technology and advanced materials; Health-care; Patrimony and cultural identity (figure 2).

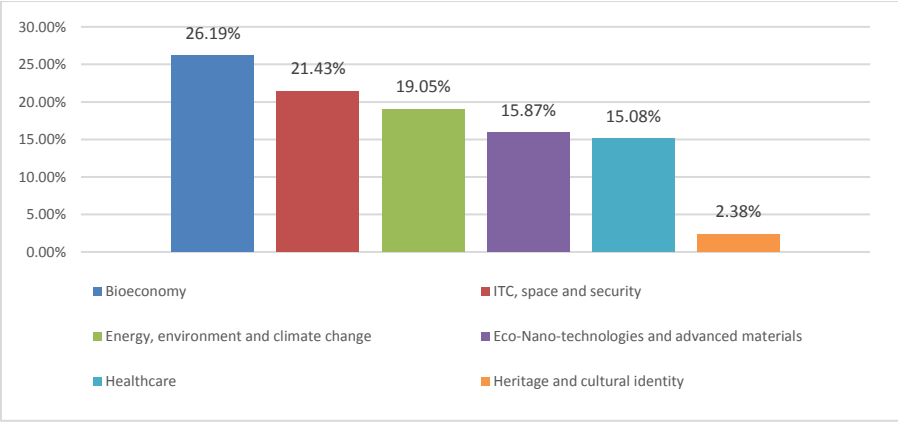

Figure 12: Main domains of financed project from Bridge Grant 2016 Program.

Ninety-eight projects were proposed for the ITC area, from where 27 were accepted (27.55% acceptance rate). An aspect that worth mentioning is that the keyword "*Platform*" was found in 12 projects out of the registered ones for ITC domain (12.2%) with 3 of them having the "*collaborative*" keyword in addition.

The Bridge Grant projects provide a foundation for creating stable models of collaboration between the economic local industry partners and Academics, as the grant winners.

These models will be the continuous motor fueled by innovation and research results applied in industrial field that strive to promote knowledge transfer to industry as "a recurring event" and a management strategy (D Rusinaru et all, 2017). Their Bridge Grant research Hub, INCESA, overview of the KT to the industry (http://bridge75.incesa.ro/), together with presented model (http://grants.ulbsibiu.ro/icarnd/) are examples of effective Models of collaboration in Public Private Partnerships.

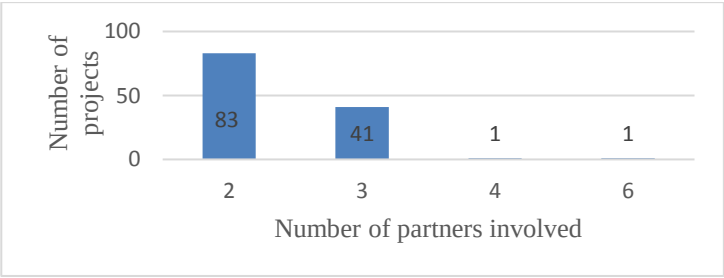

Figure 3: Project funding by number of institutions involved.

The analysis of national statistics for Bridge Grant projects in 2016, across all areas, highlighted (figure 3) the following:

1. From the 126 funded projects, 83 projects were realized through the collaboration of 2 institutions (University + Economic Agent).
2. The number of funded projects involving collaboration between 3 institutions (University + Economic Agent + Public or Private Institution) is 41.
3. A single project was funded involving 4 partner institutions (University + Economic Agent + two public or private institutions) and a single project was funded involving 6 partner institutions (University + Economic Agent + 4 Public Institutions or private).
4. Regarding just ICT projects, 81% of them received budget between 100 and 110 thousand Euro showing the awareness of Romanian Govern regarding the importance and necessity of Bridge Grants.
5. Continental Automotive Romania was the main economic partner in these projects, having 14 proposed projects from the total number of submissions.

MODELS OF COLLABORATION IN PPPs

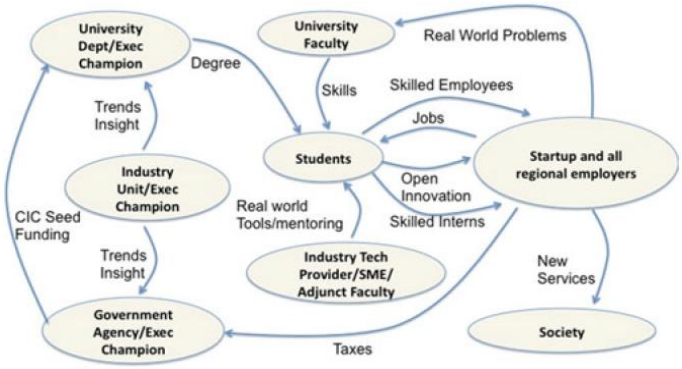

Figure 4: Simplified CIC collaborative value model from (Ouyang et al., 2017).

A surge in PPPs collaboration have been noted in the academic-industry community. With various collaboration models emerging, different outputs and agendas, the partner entities remain the sole constant (with their relations in a constant mutation).

There are many ways for the private companies to engage with the Universities, various models have evolved in close dependency on "collaborative focus and desired outcomes" (Ouyang et al., 2017). Collaborative Innovation Centers (CIC) is a type of service system at the intersection of academia, industry and government alike that collaborate on high-skill job growth and economic development, regional focused - seen in Figure 4.

Regional hubs and a focused scope research university is a PPP collaboration model with appraised results also from Georgia Tech University (USA) (Cross & McConnell, 2017). Their approach of a "regional innovation ecosystem" is based on the lessons learned through leading a regional innovation ecosystem in Atlanta and has identified the following Critical factors for success: a systems approach is effective, alignment is necessary throughout the system, effective communication and trust are fundamental, excellence in scholarly output is a necessary condition.

The same view regarding PPPs is also applied in other unrelated fields like Biobanking (Lawlor & Scarpa, 2017) where various PPPs collaborative models (Service based collaboration, Research agreement collaboration, Onconetwork Consortium) are presented with advantages and limitation, but after analyzing various aspects, the authors conclude the benefits of any collaborative models are a boost to public trust and advancement of research.

Osei-Kyei, Chan and Ameyaw, in a recent Fuzzy evaluation study based on 18 countries from 5 global regions, identified 19 Critical Success Factors (CSF) in a wide study with the most important being consistent project monitor and Suitable stakeholder management mechanism (Osei-Kyei, Chan & Ameyaw, 2017).

Another study (Chai & Shih, 2016) also took into account the size and age of the enterprise (ex: startups) when considering Success Factors. Their results suggest that governments can motivate companies to undertake research with broad applicability considering as "evidenced the increased publications with cross-institutional collaborations". Zou noted the most important factor as the commitment and participation of senior executives (Zou, 2014).

The Key success factors considered in our model are based on the literature studies and review but also from the authors' management experience in the industry field and their University view set:

1. Senior executive's involvement;
2. Effective communication approaches/channels between the PPP main parties, previous authors published research; (Palade, Nicolaescu, Kifor, et al. 2016)
3. Publishing/disseminating the objectives, benefits and implications of the project to all the staff (Chai & Shih, 2016), thus becoming the OUTPUT of the model.

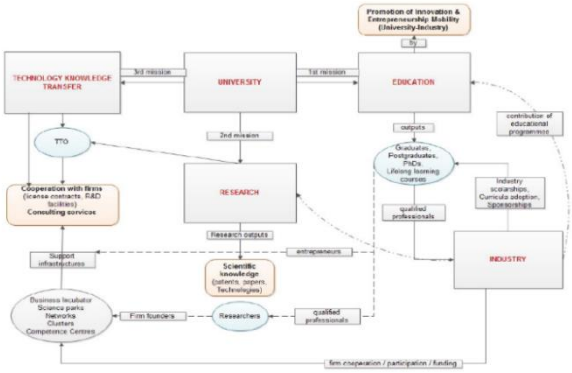

Figure 5: Model of university with three strategic priorities (Kalnins, 2015).

A structural connection between the science and economic development level of society is needed to offer competitive research. The model proposed by Kalnins and Jarohnovich (figure 5) incorporates three strategic priorities for University: education, research and technology knowledge transfer. The education and research are normal development axes for Universities that are their main purpose since their creation. The 3rd mission is creating a bridge between university and the private sector through cooperation with firms and the technology transfer.

The authors' initial collaboration model was adapted and applied in the Bridge Grant Program. (Palade, Nicolaescu, Kifor, et al. 2016) considering the identified Key Success Factors; detailed in the following chapter.

THE PROPOSED MODEL OF COLLABORATION

The research realized in academic environments is often hard to be translated into marketable products. The overcome this, the bridge partnerships between university and industry are implemented. With this approach, the transfer of knowledge will be made in both directions; first, the academic human capital will learn how to create a product that needs to incorporate customer's demands and that will be available in the market. On the other side, the industry will benefit from academic research, accessing a different pool of knowledge and experience. This dual flow of *practical sense and formal research* is seen on the external side of the model.

Collaboration can be ensured by defining a goal that is accepted by both camps; accomplishing this, several groups / teams of people create a diverse team working in the same direction, with same purpose. A collaborative model that can be applied

to projects developed by Universities in association with the private sector is proposed in figure 6.

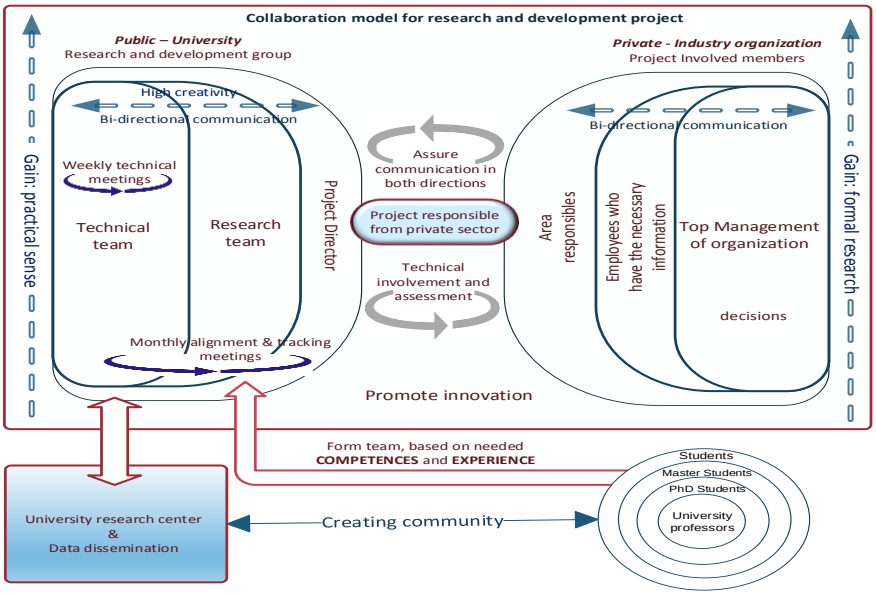

Figure 6: Collaborative Model for R&D collaborative project.

The collaborative model enhances the free idea and advice exchange with the University Research Center/ the group of top researchers through their involvement in the kick-off project phase and the important milestones. By doing so, they can evaluate and guide the project status and can bring new ideas as the project goes on.

The University Group is led by the project director. The communication between members is a bidirectional one, maximizing the level of creativity; being a research project, the creativity is the key to project success.

This group is proposed to be divided in three (complementary) specializations: research team, technical team and project director.

1. The research team is responsible for review the state of the art, use their expertise in order to introduce domain knowledge in the design process and developing of the products, creating the specifications, architecture and models to be analysed; both data processing and analysis. Members are more focused on developing the models and assure the customer needs.

2. The technical team is responsible for the development and realization of the final product. Mapping unstructured data gathered from industrial partner in software parameters is another duty of technical team. The research needs to be validated and enhanced, thus the development is necessary. Members are focused on developing the final product. A critical issue faced by technical team in such Bridge Grants is the privacy problem, and what the companies, proposing to apply the product developed by academic research, give up when they make their data available. Sometimes to provide a better accuracy of results larger datasets are required. On the other side, this information is quite private and cannot be exposed to large audience (people), confidentiality agreements being closed between the involved parts (the company and their employees). In such cases the technical team need to do additional work in order to may use the data but in the same time to keep the confidentiality.

3. The project director assures the correct management of project activities and tracks the progress.

The **industry Group** is proposed to be formed by:

1. Area responsible: member of organization, involved or responsible for area where data / knowledge is needed (for example in presented project Human Capital).
2. High management of organization are the members that can have the final decisions regarding the project.
3. Employees who have the necessary information - members that own the knowledge or that will further use the output of research.

The project responsible (from private sector) has two main duties; first is assuring the communication between the two groups, through his direct involvement. The second one is being part of the technical project team, thereby providing an agile approach that ensures that the partner's requirements are incorporated into the technical solution. Questions from both groups are also handled by him, he has the overview on all project goals and activities.

The members of presented project are: 3 university professors, 2 PhD students, 2 master students, 1 project responsible from economic agent side,1 responsible from Human Resource department, management of organization.

EFFECTIVE OUTPUT OF COLLABORATION

The first results of the collaboration model, supported through the Bridge Grant Program described in the first chapter, are already applied on a Big Data Analytics Platform. This effective output that proves the usability of the collaboration model is described below. The platform is dedicated to higher management for extracting useful insights from available data regarding Human Capital from company which is not quantified and appropriately exploited in order to notice in advanced some evolutions, trends or problems that might encounter.

A survey on Google Scholar shows that as of 2012, 19,400 articles on business analytics, the equivalent of an article per hour, were published (Acito, F., & Khatri, V., 2014). Business analytics and Big Data mainly refer to the use of intrinsic value found in data to achieve the identified Intellectual Capital goals in the organization.

Predictive Analysis using Big Data (BDPA) involves the tools and methodologies used by organizations in various ways to improve their operational and strategic capabilities (Hazen, B et al., 2016) and finally to bring a positive financial impact.

An analytics platform is a unified solution designed to process large amount of data and extract useful information. The RDBMS - relational database management systems - are inadequate on providing contextual insights from the stored data, therefore new technologies needs to be used for storing and managing of data. Research was made in finding a scalable and fast-pacing architecture presented in figure 7.

On the performance side, we identified two comparative analysis, one conducted by OrientDB (OrientDB, 2016) by ArangoDB (ArangoDB, 2016). Because there is no point of view from an independent entity, and the results of the two analysis do not give us a clear picture of the best, we have chosen to use ArangoDB on the basis of superior features.

In conclusion, the research platform will be developed using the ArangoDB platform and the Java, Java-script and Python languages. The following components will be used to build a multi-level architecture of the project:

1. ArangoDB - the main application server, this is the community-supported open source server; as the data are presented in different format this NoSQL architecture allows the extraction of raw data from the organization internal tools and data formats, following the Big Data approach
2. Java SE - for interactions with the various databases to be interrogated; connectors are being implemented to import/ export the various data in the NoSQL DB
3. Scikit-learn - a library developed in Python that integrates a wide range of machine learning algorithms for supervised and unsupervised problems (Pedregosa, 2011).

4. AngularJS - for presentation and user interface, input of application parameters and settings

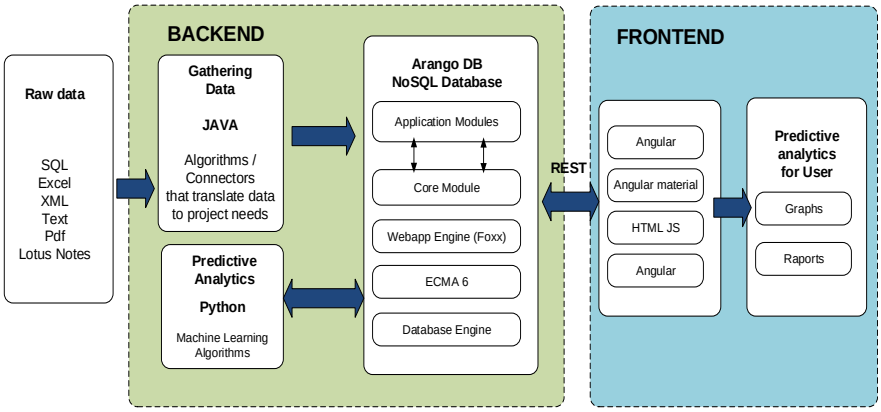

Figure 7: BDPA Static Architecture: iCAR&D.

Because data is found in various forms (unstructured), the architecture is designed to provide the ability of extracting it directly from used tools or existing raw formats. Connectors are deployed to retrieve / translate data and import it in the non-relational database.

The application is structured around a core module - that contains business logic for data views, security, session management, main menu - and modules that are dependent of the core and contain specific code for CRUD (create, read, update and delete) operations and custom business logic. The backend is provided by the V8 engine and ECMAScript 6. REST services (representational state transfer) will be used are used to communicate with the backend of the application- an architectural style that specifies constraints, resulting in high performance, scalability and ease of updating. The Frontend web interface uses a framework for dynamic web applications (Angular JS and Angular Material) that assures flexibility, modern design principles and portability between browsers.

CONCLUSION AND FURTHER APPLICABLE WORK

The presented model implements a strong collaboration between the academic and private sector. The collaboration is focused on technical work, not only management and knowledge share. In this way, the academic group will benefit by the experience of creating a marketable product and the private sector from the formal experience of researchers.

The architecture of Analytics Platform is a framework for future research in the processing of large amount of data. The implementation is in progress, following deployment of analytics at the economic agent, one of the top automotive tier one suppliers.

With a high degree of capitalization, the results will have the potential to be used in various subsequent research collaborations but also to be used by higher management to extract useful insights for the complex and strategic decisions. As further work we will continue to implement the platform components: frontend, backend, database and machine learning algorithms with the validation on real data.

The new mantra in industry and academic PPPs will be: never miss a technological shift and embrace collaboration.

ACKNOWLEDGMENT: This work was partially supported by a UEFISCDI Bridge Grant, PNCDI III financing contract no. 44 BG/2016.

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Reviewer 1:

	Review Feedback	Response
1.	Reconcile an inconsistency that pedagogy can apply to both children and adult learners	It has been an on-going debate amongst the scholars and cannot be reconciled easily as the reviewer requested. Pedagogy is traditionally used for teaching to enhance student learning. Different scholars see a same term 'pedagogy' with different orientations. As human beings show both child and adult learner orientations, this is a chicken-and-egg question not easy to obtain appropriate definite answers. No changes.
2.	… qualitative research but then discusses a survey …	'Open-ended questions' has been added to clarify the qualitative survey came with open-ended questions.
3.	last sentence of the abstract the author discusses a solution but does not go on to clearly explain what it is a **solution to** any teaching members…	'Solution to' is now changed to 'useful approach for' to avoid confusions in reading as below: 'It is recommended that a teaching approach using both andragogy and pedagogy is a realistic **useful approach for** any teaching members, whenever a classroom involves students who form a mixture of both self-motivated/ self-directed and teacher-motivated/ teacher-guided students'
4.	clarify the distinction between a child and an adult	It is clear enough for its purposes. All efforts were made to state a child learner is teacher-guided and teacher-directed, but an adult learner is self-guided and self-directed.

5.	…an abrupt introduction to Moodle - perhaps it could be better introduced	'Moodle is a learning management system used in CQU.' Has been changed to 'A learning management system called Moodle is used in CQU'.
6.	last paragraph of the introduction discusses … expand on the bullet points earlier	Numbered items were added to expand bullet points earlier.
7.	dated references - the latest one being 2007	Later references from 2015, 2016 and 2017 were added.
8.	Within the 'Research Method' section I am not sure you can say this is a "new unfamiliar phenomenon"…	The reviewer is unfamiliar with case study research. For clarity, a citation from Yin (2007) is added as 'To have a better picture of a new unfamiliar phenomenon (Yin, 2007)…'
9.	In the Data Collection and Analysis section, validity checks… needs to be made clear… observations… needs to be dressed up a bit more…	Several changes in this section were made as advised.
10.	You conclude teacher guidance and feedback by teachers is useful - again this is what you would expect but you do not indicate how - based on your qualitative survey how you managed to reach this conclusion	In the sections before conclusion, several of the related points were added to clarify that teacher guidance and feedback by teachers is useful. So that readers can understand and accept that teacher guidance and feedback by teachers is useful in the conclusion.
11.	…corrects grammatical errors, picks up on the comments noted above and ties all this up in the results and discussion section…	Changes were made as requested.

Reviewer 2:

No.	Review Feedback	Response
1.	The suggested improvements are highlighted in the attachment in red.	All the suggested improvements highlighted in red in the attachment were revised accordingly.
2.	However, do further improve the language to improve the readability of the paper.	The entire paper was proof-read and carefully edited as the reviewer requested.
3.	The title of Table #1 is missing.	Table 1 is now 'Table 1 Student Performance in Term 1 2017'.
4.	One comment on the research result is that only Term 1 of 2017 result is presented in Table 1. Term 1 of 2016 result is not presented but it should for making comparison.	Term 1 2016 result is now presented after the Term 1 2017 result to help all readers to make comparison.

Reviewer 3:

No.	Review Feedback	Response
1.	Will an international audience understand the Australian name "unit" as being a specific subject or "course" in the American sense of the word?	The paper previously contains subject and unit which resulted in the reviewer 3 feedback as such. To help all international audience understand and follow, the word ‘unit’ was replaced with ‘subject’ throughout this paper for consistency purposes.
2.	Could there be a reference to a paper (conference or journal) that introduces CQU to the academic community? Something historical perhaps?	A reference to a paper that introduces CQU to the academic community was added.
3.	The paper should make it clear that the authors are presenting preliminary results of the study.	The Abstract, Introduction and Conclusion sections in the paper have clarified that this paper shows the preliminary results of a study.
4.	The reviewer has scribbled come comments on a printout of the manuscript.	All changes, as in a printout of the manuscript with the reviewer’s scribble, were effectively made based on more feedback.

Industry Based Learning for Mining Engineering Students

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ABSTRACT

Industry based learning and work integrated learning programs have been put in place to allow students to understand the practical implications of their studies. Within the mining industry, work experience is highly valued as it may demonstrate the student is 'work ready'. The industry based learning program allows students the opportunity to develop skills not already used within university. It allows the student to develop their own career independence whilst working in a team.

INTRODUCTION

Due to the requirement for students to be 'work ready', the need for engineering students to undergo a comprehensive professional development program has increased. Industry based learning (IBL) and Work-integrated learning (WiL) programs have hence been developed to assist in student learning whilst providing opportunities for students to receive practical experience before graduating (Orrell, 2004), The IBL and WiL placement also allow the students to develop skills not already enhanced in university which are essential in a workplace environment. This is important as within the mining industry, there is a boom and bust period, thus causing employment instability. This produces a highly competitive market which

results in the inexperienced students remaining unemployed or be the first ones to be made redundant (Sheerin, 2014). An IBL based learning program has therefore been implemented for mining engineering students to provide practical experience allowing them to further develop the necessary skills.

WORK-INTEGRATED LEARNING (WIL)

According to Mills and Treagust (Mills, J, E. and Treagust, D, F. 2003), engineering curriculums are too stressed on developing student's scientific and technical abilities but not on the industrial implications of their learning. However, due to growing competitiveness between the transfer of academia to workplace for graduates, a growing trend has been observed among Australian institutes on implementing WiL in their course (Corrin, L. Smith, M. 2007). This competitiveness in employability has led some universities to introduce new curricula and run work related workshops such as leadership programs (Choy, S. 2007). The introduction of WiL to curriculum has shown a meaningful outcome to both academic and personal growth of graduates beyond the capabilities of traditional educational systems (Schembri, S. 2007).

DIFFERENCE BETWEEN UNIVERSITY AND IBL

The academic experiences in university have a large range of differences when compared to an industry placement. The learning method alters from a classroom experience to a more practical approach which have set goals and targets. Although different, both methods have their own advantages and disadvantages thus developing different skill sets. Some skills required in the mining industry include fundamental technical literacy, communication, adapting to change, leadership and management (Lefaso, Schultz, & Bezuidenhout, 2013).

The university classroom setting allows for an opportunity for the initial theory to be developed. The collection of students provides more of an opportunity for a collaborative discussion. This can be limited in the workforce where a task can be assigned and it is expected to be completed correctly. Previous research has indicated university is more likely to improve skills such as presentation skills, writing skills and ability to design and conduct experiments (Lee, 2008).

The industry based learning program allows the opportunity to further develop the theories learnt in university. It allows the opportunity for the students to put the theory into context and realise potential limitations. The industry placement program provides a more realistic insight on the day to day operations. Previous research has shown that IBL enhances professionalism, leadership skills, self-confidence and adaptability (Lee, 2008). Time management skills are also essential in a workplace; the requirement to be in and out at set times adds a set time constraint onto task completion rate.

METHODOLOGY

To assess the effectiveness of IBL programs, three Bachelor of Mining Engineering students in their final year of study were placed in the Loy Yang Coal Mine. The students have no relevant industry work experience and having only observed mine sites through field trips. The placement lasted 12 weeks and the students were expected to assimilate the daily work life. The students are required to create their own professional networks whilst on the mine site and inquire and complete tasks set by the employees. Funding from the Australasian Institute of Metals and Metallurgy (AusIMM) was provided to the students to account for any travel and accommodation expenses.

It is difficult to directly assess the successfulness of the placement program. Instead, student reflections on the outcomes of the program will be documented in this report.

STUDENTS DEVELOPED CONNECTIONS BY THEMSELVES (PROFESSIONAL NETWORK LINK)

Within any industry, the development of connections is pivotal not only in the present, but going into the future (Stobbe et al. 2013). Previous acquaintances and work colleagues can be drawn upon to help with certain tasks and issues can lead to faster, safer and more optimal outcomes in the future. Especially within the mining industry, it is very rare that a single person is working on a task by themselves, but instead teamwork is imperative and working with different people is essential.

When establishing a connection with a professional, it is important to want to build a relationship with that person and to be genuine in the way interactions are done (Chichester, 2014). General conversations such as greetings in the morning lead to a certain amount of familiarity so that when it came time to ask for help, there was already a familiarity there which made the exchange seem more natural. As tasks were delegated by different people, the necessary exchange of cards and phone numbers was done and in doing so the connection was strengthened.

When completing tasks the students were made to not feel hesitant to contact any of the rehabilitation employees if unsure of anything. The culture at AGL suits the development of networks as everyone has a vested interest in the outcome of tasks, meaning everyone is open to accept as well as willing to help.

The benefits that arise from being able to make connections and having an extensive network are not only limited to being able to get help and advice on projects. When a person is well connected with the people around them, they are more likely to be told of unadvertised jobs, progress of other important projects around them as well as even job security when there are positions to be cut (Kiefer 2011). The experience of Loy Yang was beneficial to the students in the sense of creating their first

connections and learning how to network in a professional environment. Which is not explicitly taught in the classroom.

DIFFICULTIES WHICH MUST BE WORKED AROUND

Adapting to any professional environment has many difficulties that are encountered (Grinke, 2013) and exacerbated by the fact the students were only there for a limited period. Such difficulties included driving and navigating such a foreign environment as well as making sure to always keep safety as the number one priority.

Driving around a mine site as well as in the pit has many challenges for a driver inexperienced in those sorts of conditions. The safety induction carefully outlined the rules of driving and although very similar to road rules, it was still difficult to drive correctly and confidently. Some aspects such as the 60 km/h speed limit, keeping left and obeying the signage were simple to do whereas the difficulties lay in the unnatural road conditions. The steep hills with the potential of trucks coming over from the other side, overtaking large equipment and having to radio in to gain permission to certain areas were very unfamiliar. The way in which these challenges were dealt with were very simple to think of doing, but took concentration to actually do. Examples include keeping well left but not too close to the berms, slowing down over certain roads to be able to perform evasive maneuvers if necessary as well as always being vigilant of the surroundings and listening to the radio to try and get an idea of where all the other vehicles and equipment are on the road.

Safety is of the utmost importance at Loy Yang (AGL, 2017), and this culture is something that people outside the mining industry do not consider in their everyday lives. Although it is stressed heavily in the classroom, the change is somethings that takes effort to adopt and exhibit. Many of the measures are second nature to the employees, however, due to the lack of experience, the students had to actively think. Some examples include:

1. Pre-start vehicle checks.
2. Knowing where and how to drive on the rehabilitated slopes.
3. Having to actively think of putting on hard hats every time out of a vehicle.
4. Habitual actions such as scanning the key pass to gain access to the site.

Although the last two points are very basic, at the start of the placement it was something that the students had to remember when leaving a vehicle, but even in the short amount of time the students were there they noticed changes in their behavior. Putting on the required PPE became second nature and the students

intuitively started to spot potentially dangerous areas to drive through and simply avoided them.

ADAPTING TO A NEW ENVIRONMENT

Adapting to new environment is an essential part of success within any aspect of life, especially working life. The acclimatization takes part both mentally and physically, with having to change the way the students thought as well as behaved.

The mental change occurred as they had to employ a new way of thinking that they had never done due to never being in a position where it was necessary. At the Loy Yang mine when performing tasks such as calibration of inclinometers, although it had never been exposed to the students, they had to think about the way in which they were working. The way in which they were able to understand it was to break it down into individual components such as; how deep is this borehole?, which way is the slope expected to move?, what factors affect whether or not it will move?. Breaking the problem down into smaller pieces is not a new development, but in that environment, the students had to make sure they had a grasp on the little things before they were able to understand the entire concept. Additionally, cooperation was shown to be important as most people are able and willing to help provided a request is made. Going up to a professional and asking simple questions was tough as initially it felt their time was being wasted on less valuable work, but it soon became obvious that that sort of cooperation and teamwork was encouraged at the site. Coming from university, where it is not as openly encouraged, it was a change that was a necessity to make to achieve set tasks in the new environment.

Similarly, another change that needed to be made was in the physical environment, one of which the students had only ever experienced on a tour. It is easy to be distracted by such a different landscape to just sit back and observe the operations occurring, but in doing that time is being wasted. When completing activities, it is a necessity to stay focused on one task at a time and not to get easily distracted. Having to drive around and navigate in such an atmosphere was an adaption that needed to be made extremely quickly, otherwise the consequences of having an accident on a mine site can be fatal. Through driving on the less busy roads first and working up to the high traffic areas, the students were able to acclimatize relatively quickly making an extremely pivotal activity in a mine setting feel very comfortable.

LEARNING IN WORK PLACEMENT

Learning in work placements need to be intentional and unhurried, facilitated by the inductions of students by supervisors to ensure that the duty of care towards students is maintained to comply with high standards (Washbourn, 1996). During the work placement, students were placed in the civil and environmental department of the mine to work on tasks assigned by the department staff. Students were assigned tasks such as:

1. Conduct haul and mine road safety audits
2. Rehabilitated mine area audits
3. Assist in installing slope monitoring equipment
4. Interpret and report data from slope monitoring equipment

During these activities, the students had to utilize curriculum knowledge such as project, risk and safety management, mine systems planning, environmental impact assessment and management systems, water systems, soil and rock mechanics etc. Through the knowledge acquired during university and additional research into their allocated tasks, students were able to effectively complete each task. The students found the work placement to be enlightening and educational because it allowed them to think intuitively towards good engineering solutions of their tasks by utilizing the knowledge gained from school curriculum. Through their experience, students learned that some engineering theories fail in practice which gave them an opportunity to reflect on why and search for alternative methods to apply to their work to achieve an adequate solution.

EFFECTIVENESS AND IMPACT OF WIL PROGRAM ON STUDENT

At Monash, students are encouraged to attend work related workshops such as "Leadership and Mining Program" to help them understand what's required of them by employers and what they need to bring in terms of skills and personal attributes to be work ready. The effectiveness of academic learning and workshops on student's ability to be work ready was tested during their work placement.

During their experience at Loy Yang, it became clear very early to students that they needed to further improve their verbal and written communication skills. Theoretical knowledge was only a minor part of long set of skills they required to work effectively. Other vital attributes such as excellent presentation, numeracy, analytics & maths skills, software, economics, risk and hazard identification and team work were some of the other skills they had to develop and rely on heavily during their time at Loy Yang. Perhaps the most over looked attribute required for working at mine site which students realised was the ability of safely operating a manual vehicle.

For this work placement, students also realised they needed to improve their skills in areas such as reporting and communication which would help them become a more productive member of the work force or lead teams to a more effective outcome. According to the students, "*we need to venture into new fields of learning and not only expand on our current field"*. This suggests the students are interested in expanding their knowledge in other related areas. The most important lesson the students learned from this work placement is that, university curriculum taught them

about how the industry was and maybe is, but not how it's going to be, for which they must continuously embrace learning even after graduating.

CONCLUSION

The IBL program allowed the students to develop skills not already used within university. These skills include but are not limited to: adapting to change, teamwork, time management, safety and risk assessment. Whereas university focused on the technical skills. The program also allowed the students to socialise and develop their own professional connections which can provide further opportunities in the future. With the necessary soft skills developed, the students can more easily transition into a workplace scenario and may be considered to be work ready. To allow further learning and development, it is recommended the students expand their area of knowledge in other related areas as the mining technology and methods are constantly changing. This IBL program can further be added upon by assigning research projects from the mine site to further add value to the industry.

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Some Techniques for Updating Programs to Meet Outcomes

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ABSTRACT

We have applied CDIO to Information Technology Program in our university for about 7 years. We would like to share some techniques for updating currently program to meet the CDIO learning outcomes. To update the program, in addition to constructing and making surveys on the learning outcomes, we need to consider how the courses align with program outcomes. Some techniques such as ITU exercises have been applied to identify the gap between our current courses and CDIO-based program outcomes. Up to now, based on the techniques, we have basically completed the update courses to meet the CDIO outcomes. Although improvement work needs to be done through each phase of the development cycle, we know what we need to do and how we do it. We also integrated tools which related with the techniques into our program manager system. In the paper, we have presented some techniques for adjusting current courses. In detail, we applied Black-box exercise and ITU matrix to analysis courses. Next, we use benchmark to check balance of ITU in each course and whole program. After that, we collect data to evaluate our work. The techniques helped us identify the gap between course outcome and program outcome, and achieve a good balance between desired attributes. Over 7 years of implementation, we have adapted and modified

techniques to make our courses more and more responsive to the learning outcomes not only on paper, but also in the practical implementation of the courses.

Keywords: *techniques, update, program, syllabus*

INTRODUCTION

Since 2010, Faculty of Information Technology (FIT), University of Science Ho Chi Minh City is one of the two Faculties of Vietnam National University HCM City has been selected to experiment the applying of the CDIO approach to improve the quality of teaching and learning in the curriculum at the university level. Up to now, FIT has applied this model into the program for 7 years, including the students of the courses from 2011 to date.

According to the 12 Standards CDIO (Crawley et al., 2011), standard 3, 7 refer to the design of an integrated syllabus and integrated learning experiences. The content revolves around the need for goals to be fully covered and throughout the learning process. It is accompanied by skills that need to be integrated and progressively advanced in the course curriculum each semester. Standard 3 should be considered during updating current courses to meet the outcomes. Standard 3 represents the integrated curriculum, i.e. a curriculum is designed with mutual support of specialized discipline, with a clear plan for integrating knowledge and skills together.

Most current university training programs are available prior to CDIO deployment. A common problem is how to update the current training program in line with the continuously updated outcomes that are updated to suit the reality. Commonly available items are: list of courses, teaching methodology system, assessment methods, facilities, etc. While the CDIO has proposed very clearly the required learning outcomes for a graduate student, integrated skills into the course, active teaching methods, and methods for assessing the achievement of the learning outcomes. Thus, how to make changes to the status for respond to CDIO requirements is a question that needs to be given and resolved.

In the content of this paper, we will delve into one aspect of the whole process of changing training program. That's accumulator is currently in the CDIO. Specifically, the analysis of the course response to the program, parsing link of multi courses to complete the given target, the support tools for this integration. Experiences of these methods are implemented in programs at Faculty of Information Technology, University of Natural Sciences based on the context and specific conditions.

The paper is presented in the following: first, black-box exercises will be presented to examine how existing courses meet the learning outcomes; next, the ITU matrix is implemented to determine the level of knowledge and skills covered each semester and course. A benchmark was created to test the validity of the ITU labeling process in the previous step. The next step is to assess how well the

coverage of the benchmarks is going throughout the program. From there, the gap is identified in the placement of courses against the outcomes. The final section is tools for data collection and evaluation to see the level of achievement of each outcome at the course level.

BLACK-BOX EXERCISE

The first, the FIT's outcome is set to Level 4 (x.x.x.x) based on Syllabus CDIO 2.0 (Crawley et al., 2011) with changes to suit the Faculty's specificity. These outcomes are surveyed by stakeholders to ensure that outcomes are aligned with future career requirements of students. Figure 1 is the outcome developed for the Information Technology bachelor program.

CDIO SYLLABUS (X.X.X.X)
FACULTY OF INFORMATION TECHNOLOGY

1			**Fundamental Knowledge**
1	**1**		**Science Knowledge**
1	1	1	Mathemetics
			Analytics
			Algebra
			Discrete Math
			Probability Statistics
1	1	2	Physics
			General Physics
			Applied Physics
1	1	3	Electricity and Electronics
			Digital Circuit
			Basic Electricity and Electronics
1	**2**		**Fundamental of Information Technology**
1	2	1	Programming
			Basic knowledge of programming

Figure 1: Information Technology Syllabus.

The next, we must know how the existing disciplines meet this outcome. Lecturers in the Faculty are invited to attend a study session related to the courses they have been involved in compiling or teaching. The tool that CDIO experts have suggested is doing Black Box exercises (Figure 2) (Crawley et al, 2007). This exercise helps to raise awareness of the overall curriculum. Thereby, the link between the courses that support each other in the program can be identified and clarified.

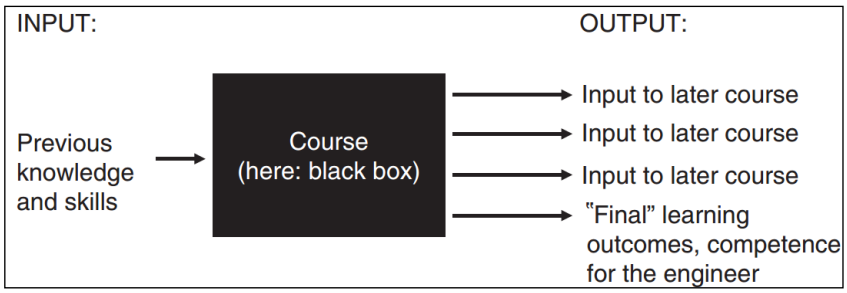

Figure 2: Black-box Survey – (Crawley et al, 2007).

In this exercise, each course is considered only in terms of Input and Output knowledge and skills without regard to the detailed content of the course. The objective of this exercise is to coordinate the clarification of the role of each discipline in the program. All disciplines are performed as a black box. Each individual course, lecturer presented the specific knowledge and skills that students had had before participating the course (INPUT) and students must achieve after the end of the course (OUTPUT). Skills and knowledge are expressed in the expected outcome (what student can solve/explain/identify ...).

Some of the questions that we asked the lecturer to answer during the session were:

1. What *knowledge* do students must *have before* entering this course? (Input)
2. What *skills* and *attitudes* should students *have before* entering this course? (Input)
3. Which *courses* do students must *study first without* having to *pass*?
4. Which *courses* do students must *study first and pass*?
5. Which *courses* should take place *simultaneously* with the current course?
6. What *knowledge* do students must gain *after taking* this course? (Output)
7. What *skills* and *attitudes* do students must achieve *after taking* this course? (Output)
8. Which *courses* will *inherit* the knowledge, skills and attitudes that students have accumulated through the current course?

Each course can be discussed by a group of lecturers who have overseen this discipline. They must to answer the full questions based on rigorous and logical reasoning. In parallel, they can prioritize each of the knowledge, skills and attitudes that they have proposed. This make the re-selection process easier, as some lecturers may offer too much or too little based on the local point of view in their course.

Based on this exercise, each lecture can better shape what is needed for the course to take place, as well as the responsibilities that the course must be undertake so that the training process continues in the next phase. In addition to the knowledge that the subject equips students, lecturers also see more clearly the skills and attitudes that the course needs to integrate. If we only offer courses that teach purely occupational knowledge, some course focus on skills, others focus only on attitude,… then we do not bring anything significant change compared to before. CDIO philosophy is not about this discrete but instead emphasizes the integration of skills and knowledge into one another. Use skills to gain knowledge, apply skills to improve understanding. Therefore, skills need to be integrated into each course. CDIO also requires that the experience be gradual, not just about one course, but to stretch through the course of a student's life. Design goes from simple to complex, with repetition in some parts of the system to improve the maturity of students (spiral model). Therefore, through this Black box exercise, lecturer will understand the intentions that the CDIO-based program leadership want to achieve.

After the lecturers have done the Black Box exercises, they will make adjustments such as updating the content of the course, integrating skills and finally assigning ITU matrix between the course and the curriculum outcome. The skill integration methods we mentioned in the paper at IETEC'13 conference (Bac et al, 2013). So we just mention ITU matrix assignments and related work in the next sections.

ITU MATRIX

CDIO (Crawley et al, 2010) suggests the three levels of acquired knowledge: I (Introduced), T(Taught), U(Used). Level I is about the knowledge that should be introduced to students without going deeply in explaining why and how. Usually at this level, lecturers do not need to evaluate students. Level T requires lecturers to teach in a way that focuses on helping students understand thoroughly the content so that they can use it later in practice. The third one, level U, assumes students already understand the knowledge; as a result, the lecturers expect students to be able to apply or to enhance the ability to apply in other areas. In the same course, different levels can be applied to each element. For example, marking I/T means that the lecturers will both introduce and teach that element to students. It might be the case that students are at initial stages of knowing and understanding new concepts.

		LO 1										
		LO 1.1			LO 1.2		LO 1.3					
Sem	Courses	1.1.1	1.1.2	1.1.3	1.2.1	1.2.2	1.3.1	1.3.2	1.3.3	1.3.4	1.3.5	1.3.6
4	Introduction to AI	U2	-	-	U2	I	U2	-	U2	-	U2	-
4	Automata and formal language	TU2	-	-	U2	I	U2	-	-	-	-	U2
5	Data mining and applications	-	-	-	U2	U2	U2	-	-	-	-	T2
5	Introduction to algorithm analysis	TU2	-	-	U2	U2	U2	-	-	-	-	TU2
5	Data hiding	U2	U2	-	U2	U2	U2	-	-	-	-	TU2
5	Embedded System	-	-	I	TU2	U2	TU2	T2	T2	T2	-	T2
5	Research Methodology	U2	U2	U2	U2	U2	-	-	-	-	-	-
5	Foundations of Computing Systems	U2	U2	U2	U2	U2	U2	U2	U2	U2	U2	U2
6	Knowledege - based systems	U3	-	-	U3	U3	U3	-	-	-	-	U3
6	Machine Learning	U3	-	-	TU3	U3	U3	-	-	-	-	TU3
6	Fuzzy Logic	U3	-	-	U3	I	U3	-	-	-	-	U3
6	Web science	U3	-	-	U3	U3	U3	U3	U3	U3	U3	U3
6	Compiler	U3	-	-	U3	U3	U3	-	-	-	-	T3

Figure 3: Marking ITU for courses and program outcomes.

We used the ITU on two objectives. The first objective is to assess how well each course responds to the program outcome. The second objective is to assess the level of instruction in the syllabus of each course. In this paper, we focus on the first objective. Lecturers in each course will assess what course is covered by the outcomes and to what level. They will use ITU labels with the same meaning as with a verb tense determinant used in the Bloom Taxonomy (Overbaugh, 2013). For example, when they mark TU3, that outcome will be taught and applied in Bloom's third level course. Level 3 in the Bloom of Knowledge is an application. When describing the course outcome, they must use verbs corresponding to this level to express. Thanks to this process of assigning the ITU, we see the development of each of the outcome through the courses.

Figure 3 shows the ITU marking process in our training program. We represent standard from L1 level (Fundamental Knowledge) to level 3 (X.X.X). Courses will be delivered in semesters and assigned with the course outcome. Which course outcome is not covered, we use the symbol "-" to express. As each lecture did a Black Box exercise, they could determine what outcomes were taught ahead and what should be done in the course.

Besides lectures marked ITU, the program leadership also performed this task. This approach we call the top-down approach, in contrast to the bottom-up process from the lectures. The reason that we perform these two processes is because of their objectivity and rigidity. Lecturers are the ones who know the most about their course so they will appreciate exactly what the course needs and can do. But they see only part of the whole curriculum that leads to many outcomes that may be repeated at the same level as taught in the previous course, or they go beyond the role of the course in the semester that the course take place. Conversely, management can see the whole of a training program so they can be more rigidly assigned to ensure that the learning outcomes are fully covered and progressively increased to the next level. Figure 4 is a diagram of the ITU matrix matrices.

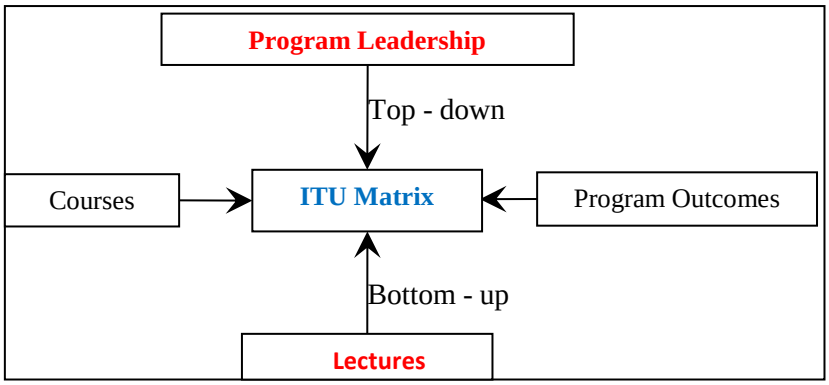

Figure 13: A diagram of the ITU matrix matrices.

The results of the implementation process may lead to a mismatch between the instructor's style and the management's style. Fixing this issue, we will elaborate in the following sections.

In the process of labeling, there is a problem that the ratio of I, T, U on an learning outcome or in a course may be unbalanced. We need to apply a tool to check this balance. The next part we'll cover in detail is a tool called benchmark.

BENCHMARK

When assigning ITU, many training programs also raise the question of whether the ratio between I, T, and U is how to ensure quality. If too much I, we can see a lot of knowledge is only introduced that will not be taught or applied. Or if too much T, the students only know theoretical knowledge, manipulation will not be good or master. On the contrary, if too much U is the student will struggle in the process of implementing knowledge into reality and may be in danger of not having enough knowledge. So how much will the ITU rate fit?

Many studies have been studied such as (Bankel et al., 2005), (Oosthuizen et al., 2007), (Kleemola et al., 2010), in which we've been found the research of the author Bankel (Bankel et al., 2005) matching for practical implementation. There, the author was based on surveys of different programs of universities such as the Engineering Program at Chalmers University of Technology, Engineering program at the Royal Institute of Technology (KTH). Based on this data, the author suggested the ITU as in Formula 1.

$$\text{ITU Index} = \frac{0.1\sum_{i=1}^{N} I + \sum_{i=1}^{N} T + 0.3\sum_{i=1}^{N} U}{(N/10)} \qquad \text{(Formular 1)}$$

where N is the number of standard courses.

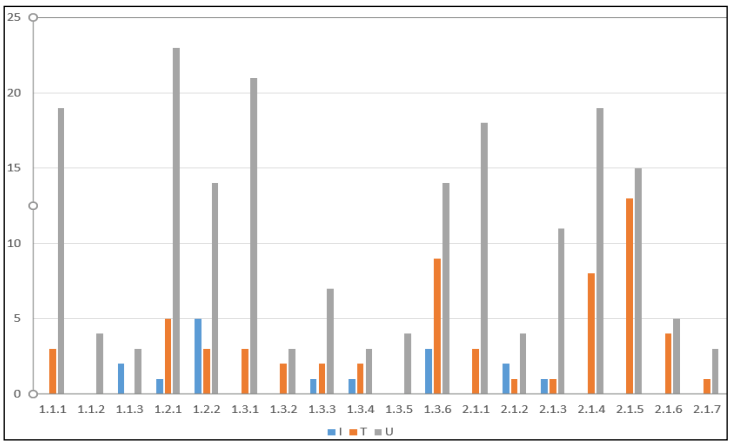

Figure 414: Distribute I, T, U on each learning outcome.

In Formula 1, "I" would account for 10% and "U" would make up 30% of "T". We apply this formula to compare the differences between the outcomes when assigned ITU. Figure 5 shows the number of each I, T, U on each outcome. Figure 6 is the corresponding ITU.

These are indicators that we have just finished implementing the ITU. It is possible to use the benchmark tool we can see quite a lot the proportion of U performance of courses on each of the outcomes. At the same time, there is also quite a difference between each of the outcome taught. This forces us to consider and make appropriate adjustments to avoid potential problems.

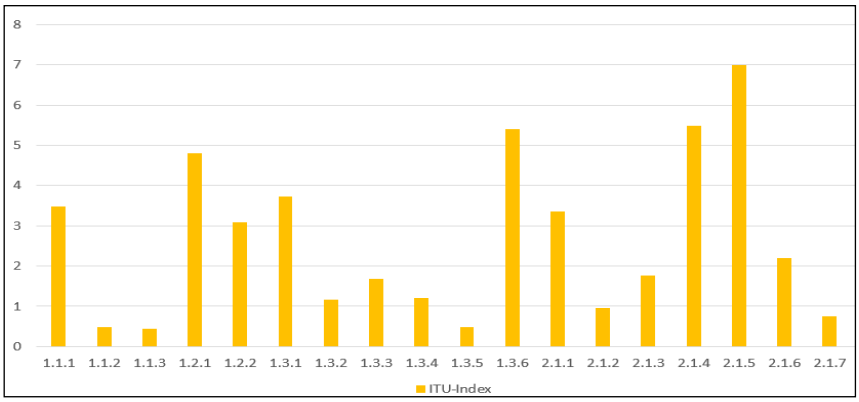

Figure 5: ITU indicator per outcome.

GAP ANALYSIS

As we mentioned in the previous sections, some problems may occur during implementation. Specifically, course outcomes are not on the list of program outcome. On the other hand, there are outcomes that are not covered by the course or are covered by fewer courses. Assigning ITU in a top-down and bottom-up manner results in no match. The level of ITU does not increase by the level of each semester or increasing and then falling down in the next semester. Moreover, the ITUs have abnormalities. For each problem, the first thing to look at is that they exist. The tools we presented above help us to identify these anomalies.

For example, by assigning ITU matrices, we have seen that many outcomes are covered very little or not covered by any course. In Figure 7, criterion 2.3.2 is covered by too many courses while criterion 2.3.3 is not covered by any course. Criterion 2.3.4 is only covered by a few courses. Enhanced level is not suitable for criterion 2.4.2. These problems will need to be considered between lecturers in charge of the course and program leaders to find a way to overcome. Leaderships can also add new courses to meet their goals.

The proportion of ITU is also considered when there is a huge gap between each ITU level in an outcome or between the outcomes together. Figures 5 and 6 show these problems.

		2								
		2.3				2.4				
Sem	Courses	2.3.1	2.3.2	2.3.3	2.3.4	2.4.1	2.4.2	2.4.3	2.4.4	2.4.5
4	Introduction to AI	U2	T2	-		-	U2	U2	-	-
4	Automata and formal language	-	U2	-	-	TU2	-	-	-	TU2
5	Data mining and applications	U2	U2	-	-	-	-	U2	-	U2
5	Introduction to algorithm analysis	U2	U2	-	-	-	U3	U2	-	-
5	Data hiding	-	U2	-	-	TU2	-	-	-	TU2
5	Embedded System	U2	U2		U2	-	-	U2	U2	TU2
5	Research Methodology	T2	T2	-	-	T2	T2	U2	TU2	TU2
5	Foundations of Computing Systems	U2	TU2	-	-	-	-	U2	-	-
6	Knowledege - based systems	-	U3	-	-	-	-	-	-	TU3
6	Machine Learning	U3	U3	-	-	U3	-	U3	-	-
6	Fuzzy Logic	-	TU3	-	-	U3	U3	U3	-	TU3
6	Web science	U3	TU3	-	-	-	U3	U3	-	TU3
6	Compiler	U3	U3	-	-	-	-	U3	-	U3

too tight empty too narrow cluttered order

Figure7: Some issues appear on the ITU matrix.

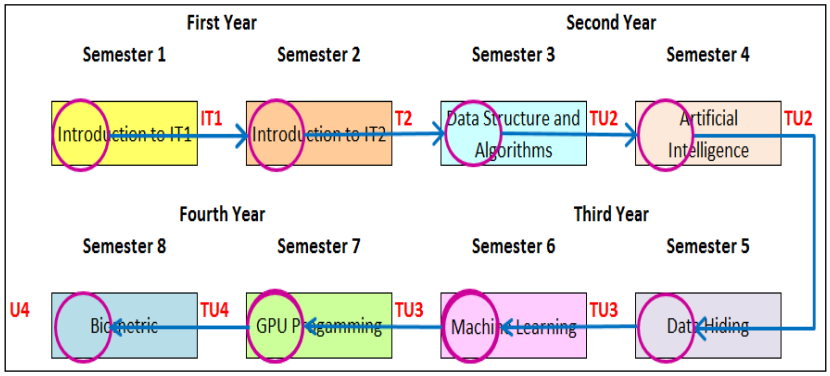

Figure 8: Courses sequence to assess teamwork skill outcomes.

Another problem can also happen and be of interest. Due to credit system, students can have the option of registering courses they think they like and that they are useful. This leads to some outcomes not in the courses chosen by the students. It is not easy to overcome this problem regardless of how well designed and balanced the program are, there can still be "paths" (selection of courses) to avoid a certain outcome. The measure we limit the impact of this problem is based on student enrollment surveys, based on core courses in each major discipline to deliver key outcomes of program. From there we created a sequence of courses. With this sequence, we will focus on tracking the process of the outcome on it. Figure 8 is courses sequence that we choose to evaluate teamwork skill outcomes.

COLLECT DATA AND EVALUATION

In addition to the tools to integrate courses into CDIO training programs, we also develop tools to test the performance of the courses for the expected learning outcomes. Figure 9 illustrates this tool.

During the teaching process and after the end of a semester, lecturers will be required to enter transcripts with multiple components and assessments on each course outcome to the Faculty management system. For example, in Introduction to IT course, we have about 8 learning outcomes. Each year, we have about 500 to 600 students learning this course. The lecturers are required to answer questions such as which learning outcome each student archive or not archive, which learning outcome pass or fail on criteria which are predefined in the program and so on. The exercises/lab assignments/projects are used to collect data to answer these questions because they describe learning outcomes for assessment. Each learning outcome can be assessed in some assignments. Otherwise, each assignment can also include many learning outcomes. The lecturers grade the student's work on learning outcomes in detail. After that, they upload these course scores to system.

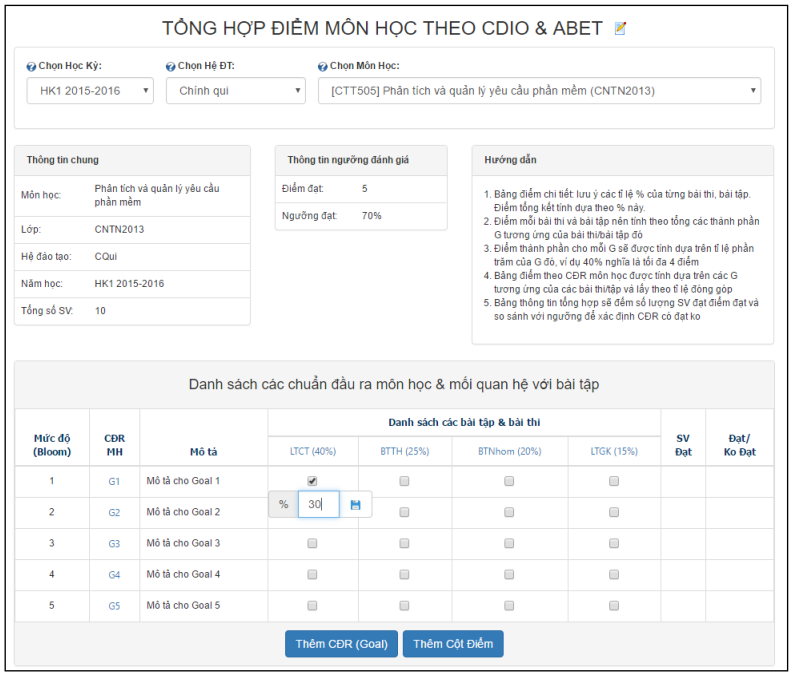

Figure 915: A collection tool to test the achievement of the outcome.

The system will extract scores from assignments on each learning outcomes and calculate learning outcomes' score. Compared with the criteria, we identify which learning outcomes to pass or fail. For example, learning outcome G1 is covered in homework (20%) and final exam (50%). Students are required to get at least 5 of 10 points to archive this learning outcome. Next, we count number of students in the class who archive this learning outcome. If there are about 70 percent of the students in the class, it means that this learning outcome is pass. As a result, leadership can evaluate and adjust the course base on the data to help students meet program outcomes in next phase.

CONCLUSION

We have spent 7 years implementing and adjusting our curriculum to meet CDIO requirements and helping our students meet the requirements of the companies. The techniques we presented in this paper are what we have applied to change discrete courses and integrate them into the CDIO training curriculum. We recognize that they are very helpful in expressing the tightness, cohesion, coverage, and especially for us to find weaknesses that we need to adjust. The courses are updated almost

completely and the work is still ongoing every year, so that there is always an appropriate program that meets the requirements of the society. We are continuing to research and develop techniques to ensure that the learning outcomes are fully understood and mastered by our students.

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A Blended Learning Model in Higher Education: A Case Study of Design and Implementation of ICT course at HUST

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ABSTRACT

This paper proposes a model to design and implement the blended courses based on traditional ones. This model includes two key phases: (1) To analyze the characteristics of traditional courses; (2) To design a blended course. The paper also presents a case study of applying this model in ICT courses at Hanoi University of Science and Technology (HUST). This case study allows us to identify (1) which factors affect the design of ICT course's activities in blended learning; (ii) the best way to use blended classes to make both students and lecturers satisfy. Experimental results of the deployment of the ICT blended courses at HUST have confirmed the effectiveness of the proposal.

Keywords: *Blended learning, Elearning, instructional design, blended course, ICT course*.

INTRODUCTION

Blended learning is becoming increasingly popular in higher education. It is the combination of traditional learning methods with online ones to achieve the best of both advantages [1]. The nature of 'the blending' can be characterized in two ways likes supplemental blending and replacement blending. While supplemental blending incorporates use of computer tools for delivering learning elements of a course without altering the structure of the traditional course, replacement blending

is fully integrated web-base tools and media into the instruction of course and causing changes in the traditional course's structure and methodology [2]. Replacement blending is an innotitated learning in computer-based methodology. Such method typically causes changes in the balance of traditional and online learning environment.

In blended learning, students take part in online multimedia coursework on LMS/LCMS and attend real classroom. At the classroom, they discuss directly with lecturer and classmates either to understand more about lesson or to get their hand-on experiences. The characteristics of this model are using well-defined functions of mediated learning tools and enhancing social interaction among students themselves, between students and lecturers, and between students and contents [3] - [4].

The success of blended learning method mostly depends on the technological challenges in the enhanced learning tools. The new techniques to support collaborative/personal learning, assessment services, mobile services are required to integrate in learning management system (LMS) [5]. There, the LMS [6] - [7] has supported at least the functionalities to manage learners, contents, courses and all interactive learning services. The LMS allows learners to register, to enroll in courses, to trace their process and to self-assessments. Besides, other techniques such as the authoring tools are to make multimedia contents, packaged by content standards (Scorm, IMS, Tincan); networking infrastructures [4] and social network systems like Youtube, Facebook, Twitter are also affected to the way of blended learning [8].

At HUST, lecturers are motivated to transfer from traditional learning to blended learning. Lecturers have to prepare offline learning constructions to adapt to online environment and vice versa [3]. To encourage students to take part in blended learning, when students completed a learning activity, their submission must accurately be evaluated or reviewed. Therefore, it requires HUST lecturers to design appropriate blended learning content packages, blended activities, and blended evaluation methods out of any reference models or real guideline methods. These preparations are time-consuming and make confusion between online and offline activities, as so as online and offline evaluation methods. Actually, there is no guideline of authoring blended courses at HUST. Lecturers could not find out tools that give enough supports for authoring blended courses or for managing the learning procedure as they expected.

With regards to the evaluation, an effective assessment for a subject requires clearly subject statements, consequence of its activities and the overall university policies like universities' outcome standards [9]. HUST defines an outcome standard for all of its regular courses. The standard provides a grid of evaluation criteria on teaching methods: GT, GD and SD. GT means that ungraded measures are used to evaluate students about the basic knowledge and skills they learned. GD means that direct measures like grading are used to evaluate student's learning and performance. SD means that indirect measures like attendance, participation, effort are used to check the student's ability to apply and consolidate the learned knowledge and skills to a

given context. This outcome evaluation standard is pre-established for all courses and could not be changed. So, the way to adapt the evaluation methods to learners' characteristics and learning objectives as expected by an effective blended learning course design is still is an open challenge.

In the next sessions, we focus on how to design a blended course based on traditional regular ICT courses.

PROPOSED BLENDED LEARNING MODEL

In this study, we proposed a learning process for blended course and a case study of regular ICT courses. This procedure is composed of two main phases namely: Analysis the characteristics of these course and, Design blended course model.

1. Phase 1: To analyze the characteristics of ICT courses.

1. **Learners:** these courses are for anyone who interested in ICT and have more than 2 years experiences in ICT major

2. **Courses:**

1. Learning objectives: students must achieve the knowledge, skills, and positive attitudes to resolve research, appliance, and management problems in ICT fields after the completion of these ICT courses.
2. These ICT classrooms includes theory and practice contents. The learning activities such as discussions or Q&A, assessments are on class. The practicing skills are deployed at lab or student must do at home by himself. ICT labs includes assignments or mini project, where students have to submit a report, make a peer-review and defense. The volume is predefined in the syllabus of the course, accordingly to the HUST's creditable rules.
3. Learning materials consist of PPT, PDF files, books, eBooks; these are provided at the beginning of the course or after each lesson to students via email or several social networks like Facebook, Google drive directly.
4. Learning hours: traditionally, a 45-minute unit period is a face-to-face class. Depend on the number of credit course, the learning time is normally 2-3 hours per week.
5. Evaluation: each course has a mid-term evaluation and a final evaluation. The ratio is usually 30% - 70% as predefined in the course syllabus.

In summary, the first phase allows us to find out the significant factors, which are necessary to design blended course in next phase.

B. Phase 2: To design a blended course chart

The design of the ICT blended courses comprises of ICT course's objectives, teaching methodologies, and assessment techniques which are three key points of a successful course [10]. The model of design is shown in the Fig.1:

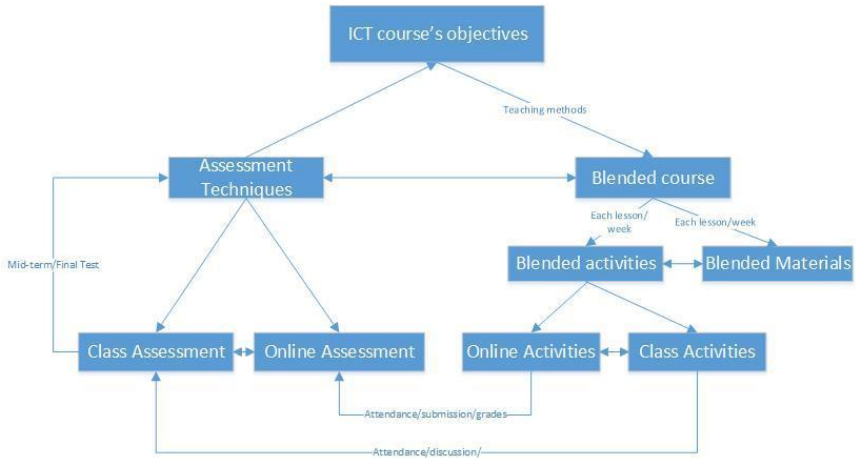

Figure 1: Blended learning flow chart.

The objectives of ICT courses are mapped from the predefined course syllabus as described in Phase 1. Once the objective is well identified, we need to define the teaching method. When blended learning method is selected, the, activities, and materials are then designed conformingly to the designed assessment techniques. These techniques are mixed between the online and offline assessment techniques accordingly to online and offline activities. That means what kinds of activities that could be evaluated by online assessments based on existing LMSs will be determined. Similarly, what kinds of assignments that are provided by these LMSs will be defined.

The assessment methods are determined based on three main evaluation methods, which are diagnostic assessment, formative assessment, and summative assessment [11]. Diagnostic assessment is presented in the form of pre-tests, short discussions, or interview activities before starting a new lesson/topic of the course. This is used to recall or revisit the previous lessons. Formative assessment provides feedback during the learning process to guide improvements in the ongoing course. It is presented in the form of exercises or lab. Summative assessment takes place after each learning session has been completed. It measures the student's' successful or

proficient level at the end of each session [12]. It is presented in the form of homework.

Other activities will be deployed as in-class activities. Then, contents and materials of the online/offline course are mapped to the designed activities. The blended activities and blended materials of a blended course will be described in the following subsections.

B1. To design blended activities

As shown in Fig. 1, the design of the blended activities is conformed to the predefined course syllabus, considering 4 main activities: lecture, quiz, lab, and self-studying/homework. In-class activities are short summaries of online contents, discussions, feedback/reviews about the issues of online activities. Online activities include workshop, forum, assignments, and multimedia contents.

1. Interactive lecture which is one of most important kind of multimedia contents - are designed and developed by authoring tools. They are packaged in form of SCORM packages (Multimedia packages) and HTML5 format. The learning flow of each lesson was designed as follow: Intro (Overview, Keywords, Pre-test) Lecture (List of topics), Outro (Quiz, Summary, Next lesson guide, references) [13]. These packages are uploaded to the LMSs. By that way, students can interact directly with course contents and quizzes. The system logs learning process.

2. Assignments are divided into two kinds of activities: individual and team group. The design of such activities aims at solving issues of the lesson

Besides, lecturers can choose social network tools to enhance interactive learning and overcome limited functionalities of LMS, for instance: Facebook group, fan page groups, email groups and YouTube.

The Table.1 shows the list of blended activities which are transferred from the traditional courses.

Table 1: Design list of activities.

Traditional activities	**Blended activities**	
	Class activities	**Online activities**
Lecture	PPT, PDF file	Multimedia packages,

		e-file (PPT, pdf file lectures, eBooks)
Discussion	Q&A,	Q&A, discussion, notice board
Virtual labs, computer simulation models, project	Q&A, presentation	Individual and group assignment
Test	mid-term, final test	
Survey		Online survey

B2. Learning Materials:

The learning materials of traditional course are PPT, PDF files, and eBooks. The materials for blended course are selected mainly based on student's knowledge level. These selected materials are then uploaded to the LMS. The reference books are showed on-class. In the next section, the operation of a blended course will be explained

B3. To operate a blended course

According to the Fig.1, the ICT courses is deployed for 15 weeks as follows:

1. Week1: The course starts by the first day on-class session. In this session, the lecturer illustrates the course's objectives, discusses main knowledge, skills, and evaluation methods of the course. Lecturer or teaching assistant (TA) will introduce the mediated learning tools which are applied to the course. This session is very important because students know the learning goals, blended syllabus and learning methods. After this session, students are distributed into a group (4-5 members) and take part in group activities in blended course.

2. From week 2 to week 7 and from week 9 to week 14 (two main sessions of a course)

    1. Lecturer enables activities as listed in Tab1 that correspond to each lesson. Every activity has a deadline that is defined by the lecturer.
    2. Learners have to prepare the knowledge of each lesson and submit its assignments before the deadline if any. They also take

part into various synchronous and asynchronous learning sessions such as chat, sending/receiving emails, to discuss with others and the lecturer.

3. In classroom session, the lecturer summarizes the lesson, highlight the important issues. Students can ask the teacher about related topic that they have met, they also discuss anything each other.

3. Week 8 and week 15 are mid-term and final test: Grading is based on offline-assessments (final test, mid-term, and attendance) and online assessment (attendance, grade book of all online activities).

4. Face to face learning hours reduces from 30% to 50%. With basic or overview content, student can study by himself via online system. Thus, instead of off-day class, lecturer can organize the online activities (discussion, chatting) to help students understand more about this lesson.

5. Technical supporters, and lecturers, TAs are required to respond to student about the issues in using system or unclear problems daily. The learning process is traced and reminded permanently to each student via email 2 times before mid-term and final test.

Before closing the course, the last online survey activity is held. It can harvest student's feedback about the course totally. By this way, we can achieve the strong points and weaknesses of course. From this, we can modify, update content, as well as encourage learners to get efficient studying more.

EVALUATION

In this session, we present our experiment of running ICT blended courses at HUST. These courses were designed and implemented on ACU-LMS which was supported by the ACU project [14]. There are 6 e-courses of ICT field: Java Programming Language, Introduction to ICT, LinuxOOS, Mobile Computing, Distributed System, Human – Computer Interaction. Each course included 13 interactive e-contents [15]. ACU- LMS platform consists of minimal functions for delivery learning content, managing learners, learning processes, and learning activity functions.

In each course, student has individual assessments that made them can self-research and understand about the problem of the course. Besides, students were divided into groups. Each group had one or more group assignments, which students participated in a small group to perform one or two case studies to improve collaborative learning and group working skills. In group assignment, students were requested to

design and build an application based on a case study. These tasks were created by the assignment module in LMS.

The discussion and Q&A, notice board activities are conducted and interleaved between online and offline class. Additionally, we used Facebook as an enhanced interactive tool to connect with all learners of class.

Up to now, there were over 20 ICT blended courses have been taken place. The numbers of students enrolled in each blended course per semester were between 50 and 200. Over eighty percent of students have completed all online activities on time. The primary survey in HCI courses with over 100 participants in the current semester shows that the learning hours on class could reduce to at least 30%. Students and the lecturer are interested in blended learning method, especially, they prefer to reduce time in classroom up to 50% and more (Fig.2). Instead of this, they can spend more time to self-study and improve their knowledge and other skills

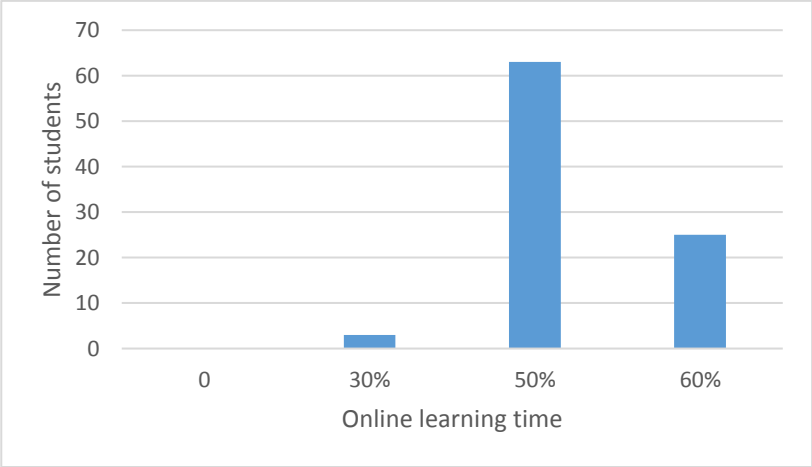

Figure 2: The satisfaction of students on replacement learning time in HCI blended course.

CONCLUSION

The proposed blended learning model has been introduced to show the way to transfer from traditional to blended learning. The use of this model in the scope of the regular ICT courses in HUST has also been described in detail. The performance of this proposed model has been confirmed with the participant of HUST's students and lecturers. Both students and lecturers are much satisfier with the new way of learning.

In the future work, we will consider to systematic university's outcome standard; modeling user and effective blended activities apply for each curriculum's outcome standards as well as interactive learning environment.

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AUN-QA Assessment at Program Level to Improve Education Quality: Case Study in Hanoi University of Science and Technology

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ABSTRACT

Higher Education in the age of globalization in ASEAN region and the world, more and more universities need for a new regulatory framework for recognition, quality assurance and accreditation. Although there are many kinds of criteria applied in Vietnam, AUN-QA (Asean University Network - Quality Assurance) is being considered appropriately and highly feasible by many universities in Vietnam. AUN-QA Assessment at program level help to promote quality assurance; Identifying the weakness that need to be improved to ensure the quality of program, what is more, creating interlinking and mutual recognition among institutions in ASEAN region.

Keywords: *Quality; AUN-QA criteria; AUN-QA assessment at program level*

INTRODUCTION

In education and training, the quality of education and training has always been top priority. However, to understand the quality of education and training, there are many different views. When the government looks at quality, they first look at passing rates, dropouts and study periods. Quality in the eyes of the government can be described as "the number of students completing the program in accordance with the prescribed deadlines, with international quality standards, and at the lowest

cost"[1]; employers, when talking about quality, will talk about knowledge, skills and ethics throughout the learning process: the challenged "product" is the bachelor, the engineer; Teaching staff will define quality as "good academic training based on transfer of good knowledge, good learning environment and good relationship between teaching and research"; For students, quality involves contributing to personal development and the preparation for a social position. Education and training must be connected to the individual interests of the student.

In view of the international network of quality assurance institutions (INQAAHE), the quality is [2];

1. Firstly, to follow the standards set. Thus, there should be standards for quality assessment;
2. Secondly, to achieve the goals set. The goals are set based on the requirements of the society and the conditions of the school.

In our opinion, INQAAHE's view is full on the quality of education and training. Accordingly, quality assessment standards should be in place and goals should be set based on social requirements and school conditions. On that basis, it will set out a way to manage the quality of education. There are many ways to manage the quality of education, but in our view the appropriate management approach in education is quality assurance (QA). This method is also used widely in the world, and currently Vietnam also applies this method [3].

The school evaluation and evaluation of the training program not only affirms the brand of the university in the best way, but also creates the necessary conditions for cooperation with reputable universities in the region and in the world, exchange of credits, students, ...

At present, in the field evaluation and evaluation of training programs, there are many different sets of standards. In Vietnam, the Ministry of Education has issued a set of criteria for evaluating educational institutions (Consolidated Documents No. 06 / VBHN dated 4 March 2014), and a set of evaluation criteria for training programs (Circular No. 04/2016 / TT-BGDDT) [3]. There are currently AUN-QA standards (school and program assessment), ABET (program evaluation), HCRES (field evaluation), CTI (program evaluation). In the context of this article, we only consider the AUN-QA training program from the practical experience at the Hanoi University of Science and Technology.

AUN-QA ASSESSMENT FOR PROGRAM LEVEL

AUN-QA Model

ASEAN University Network Quality Assurance (AUN-QA) recognizes the importance of quality in higher education, and the need to develop a holistic quality

assurance system to raise academic standards and enhance education, reseach and sevice among its member universities. In 1998, it mooted the AUN-QA Netwwork which led to the development of AUN-QA model. Since then, the network has bên promoting, developing, and implementing quality assurance practices based on an empirical approach where quality assurance practices are tested, evaluated, improved and shared. The evolution of AUN-QA Network and its development in quality assurance are depicted in Figure 1.1. [7]

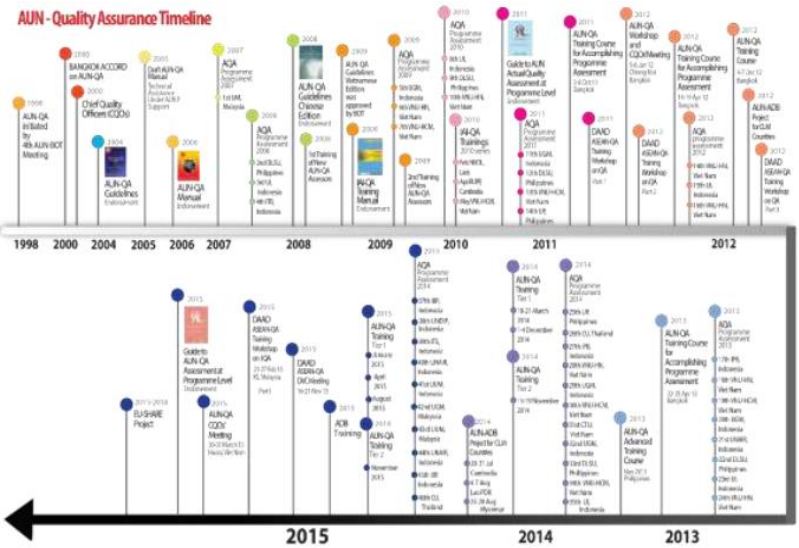

Figure 1.1 – Evolution of AUN-QA Network

Benefits of Using AUN-QA to Evaluate Program

Education and training, especially higher education, play a very important role in providing high quality labor resources to meet the needs of the country's development, especially in the current integration contemporary. Indeed, the evaluation of the program is an important step in the successful implementation of this mission, therefore it should also meet regional and international standards. The Department of Quality Assurance and Accreditation also encourages schools to conduct program self-assessment following the Circular No. 38/2013 / TT-BGDDT [3] for some training disciplines, using quality standards of regional and international organizations such as AUN, ABET, AACSB ...

The AUN-QA model is linked to the quality assurance system of the region and the world, so it can be applied to many universities in Vietnam and ASEAN in general.

It also sets the basic requirements that are important for Vietnamese universities to make adjustments in the basic operations of a university. These requiremtns are defined as standards-based activities which must be evaluated, improved, geared towards the satisfaction of stakeholders and aligned with the universities and programs in the country and overwide. These requirements are fully aligned with the process of higher education reform in Vietnam to improve quality and integration into global education [5].

The set of standards focuses on Curriculum, program framework, facility, teacher, student, quality assurance activities. AUN-QA accreditation gives the schools many opportunities and students are the beneficiaries of this accreditation because they are learning in an environment that is constantly improved. The AUN-QA accreditation can be considered as an affirmation of the school to the society about its output of the program, thus making it easier for students to get appropriate jobs. Accreditation of AUN-QA also enables students to convert academic credits among AUN-affiliated programs. Finally, the employers have a credible basis for finding quality human resources from an internationally recognized quality training program.

In addition to the above-mentioned advantages of AUN-QA acreditation, external evaluation by AUN-QA is reasonable and relevant to the financial situation of universities in Vietnam. Because of these reasons, Hanoi University of Technology has selected AUN-QA as the standard for accreditation of training programs [6].

Practical Experiences from Evaluating Programs Following AUN-QA Standards at Hanoi University of Science Technology

Advantages

1. School leaders define clearly the importance of the assessment of the training programs.
2. Get the technical support and implementation consultancy of the Quality Assurance Center.
3. Make use of the results from the previous assessment according to the Ministry's standards since 2007.
4. The secretary of each training program has tried hard, actively took part in the implementation process.
5. The school has implemented management in accordance with ISO 9001: 2008, so this work has good support for quality assurance.

Disadvantages

1. Leadership does not easily agree with the quality change of quality assurance;

2. The staff at the institutes/ faculties are not in the field of program assessment, the workload is large, so it is difficult to arrange time for QA activities. Moreover, the process of statistics, synthesis, standardization of information, design of survey forms need much of time, that affects the progress as well as the quality of the self-assessment report;

3. In the seprate standards assigned to each different staff, there are duplicate criteria and concepts, so it is difficult to write, synthesize, unclose as a whole;

4. Staff, in some cases, do not understand criteria's implication, so the evidence and profile still need to be completed and improved, leading to difficulties in evaluating and reporting in general;

5. During the implementation process, AUN standards focus on stakeholders's feedbacks (students, graduates, alumni, employers, etc.). However, at school, this work has not really been focused as it was proposed. There are still contrast opinions on this work, participants are not aware of the importance of the survey results, so they do not take it seriously, so the results are not accurate;

6. Expected outcomes for training programs are general and not specified so that learners and other stakeholders do not clearly understand the capacity of the graduates;

7. Facilities: Laboratory, library ... have not been upgraded, supplemented in time with requirements;

8. The cost of implementation, writing self-assessment report training program is very limited, not encouraging participants to ensure the progress and quality of that work.

Discussion and Recommendations

"Quality culture" should be formed because quality culture is a system of values of the organization to create a favorable environment for the establishment and continuous improvement of quality. So that, it is easy to build strong and accurate stakeholder survey systems to ensure system and quality improvement. There should be a specific procedure for each program assessment, then based on results, select the outstanding ones to be external audited.

Training academic staff plays central role in enhancing the training quality. Since Outcomes-Based Education (OBE) is the basis principle of CDIO approach and AUN-QA, SCE should consider pedagogical training for academic staff on Outcomes-Based Education (OBE) (e.g., how to use expected learning outcomes (ELOs) as a basis for designing teaching and learning, and assessment methods, or how to pursue the constructive alignment). It is necessary to develop a systematic

strategy to ensure that the ELOs are used as a basis for designing teaching and learning methods as well as depth of content taught in individual courses. Besides, the school could raise the teacher's awareness of the role and ethics of the teacher, in the process of implementing the training task, by providing and requiring teachers to regularly update the policy in training management, to step by step change awareness and action. Making plans is another regular job of the department, faculty and the school to share knowledge and teaching methods. More regular evaluation of teachers from learners is also an urgent action to boost moral responsibility of the teacher.

Regarding to program and curriculum development, based on the practical needs of periodic assessment of the training program to have additional designs and adjustment, so that the program ensures integration and flexibility. The program should focus on the proper training of 03 issues: Knowledge, Skill, and Attitude to promote students to become a life-long learner. Rubrics for criterion-referenced assessment (e.g., research writing, assignment paper, presentation skills, etc.) should be established to ensure validity, reliability and fairness of student assessment. Furthermore, to adjust the expected learning outcomes and the curriculum relevantly, it is necessary to develop and maintain a systematic and consistant survey mechanism to handle feedbacks from all stakeholders. Stakeholders' requirements should be mapped against the program learning outcomes (PLO) so that the rationale and impact of change can be well established and communicated. In other words, it is could be made clear about which PLO reflects which requirement(s) of the stakeholder(s). Translation of PLOs into specific Course learning outcomes (CLOs) for each course should be conducted.

Teaching and learning facilities are another concern needed to be taken into consideration. There is a strong need to update learning facilities, particularly the laboratories and their equipment, in order to optimize teaching and learning experiences and advance research activities of both academic staff and students, as well as improve the graduates' practical knowledge and work readiness. Classrooms need to be provided with teaching and learning aids that meet the requirements of active teaching and learning. Large size classrooms should be ficiliated from fixed to movable items in order to allow more collaborative activities under the OBE approach, and ensure the flexibility and project-oriented approaches. Labs need to be invested to be update and relevant to the production market. Library resources should be made available and accessible to all interested staffs and students.

CONCLUSION

Quality is always the goal of Higher Education, but the quality does not come naturally. In order to assure quality in Higher Education, the university should have policy plan, resources and implement in a suitable and systematic way. Applying AUN-QA Assessment at program level to improve and develop quality assurance systems, and help to understand which level of HUST programs have been achieved

on the regional assessment. However, Assessment at program and institution level are new issue in the Vietnamese Higher Education system. The process of assessment has encountered some difficulties. Therefore, there is a need for more special attention, forming a culture of quality.

ACKNOWLEDGMENT

This research was supported by Ministry of Education and Training, Viet Nam (B2017-BKA-34).

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Learning Style Based - Blended Learning in Teacher Education

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ABSTRACT

Students and student groups' learning demands at university are diverse, challenging educators to establish learning interventions meeting the demands of the 21st century's students. A model has been developed to support lecturers, especially for new recruits in the education sector using blended learning to design learning interventions significant for students. Learning style - based teaching brings the personalization to students' own styles. The paper presents learning style - based blended learning (LSBBL) and particular teaching methods and strategies for each form of blended learning, and then introduces types of online learning suitable for learning styles towards the model of learning style- based blended learning, meeting the demands for students' own learning styles and enabling students to develop their professional capacity to adapt themselves to the changes of the society.

Keywords: *Blended learning, learning style, face to face, online, education.*

INTRODUCTION

Education in the 21st century has been greatly influenced by the Internet Technology Innovation (IOT) 4.0 and the integration of modern technologies. Thus, online learning has been used as a form of distance learning. The core advantages of online learning are flexibility and accessibility (Wu, Tennyson, & Hsia, 2010). However, online learning does not mean e-learning without its limitations. There are a number of issues needing to be addressed, but not fully following the online teaching method, such as the lack of learning environment, lack of online learning experience, difficulties in learning and understanding without face-to-face instruction and necessary interaction between learner and learner, learner and teacher as well as teacher and learner (Bouhnik & Marcus, 2006, Dutton, Dutton, & Perry, 2001, Wu et al., 2010). Accordingly, in some universities, e-learning cannot apply to some modules. For example, physical

education classes remain norms irrespective of size, location and time (Liu, Chen, 2010). In order to overcome the identified obstacles and get benefits from online learning, blended learning has been widely proposed as a combination of the advantages of traditional methods and digital technology. Blended learning means "the integration of the advantages of face-to-face learning in class with online learning experience" (Garrison & Kanuka, 2004; p. 96). According to López-Pérez, Pérez-López and Rodríguez-Ariza (2011), blended learning can positively affect student satisfaction and performance. Educational institutions around the world in general and Vietnam in particular have applied a number of learning management systems (LMS) such as eFront, Blackboard, WebCT, and Moodle, along with traditional learning methods to provide flexibility and support methods of teaching and learning. In addition, whether in face-to face learning or online learning, students' learning styles should be taken into account to make the teaching process effective. Teachers who wish to use proper teaching strategies and methods to help students develop their capacity need to paid attention to their interests and learning styles. Each student has their own learning habit, cognition and learning style …Therefore, learning style-based blended learning, which is the combination of traditional classrooms and online learning is the proper strategy enabling students to make full use of their capacity in learning.

LEARNING STYLES

Learning styles have really gained so much attention in recent years across different age groups and learning environments. Rayner (2006) also underlines this fact: 'a heady mix of metaphor, sound bites and polemic … an academic and political debate in which far more heat than light is generated'. Thus, "The area of learning styles is complex and many questions are still open, including a clear definition of learning styles, a comprehensive model which describes the most important learning style preferences, and the question about the stability of learning styles" (Kinshuk, Liu & Graf, 2009, p. 740).

In the world, there are many researchers on learning styles and researches on learning styles are very rich and diverse, from different perspectives. According to Coffield et al (2004), there were 71 notable learning styles models worldwide and he studied 13 of them. The ones applied the most include the models by Witkin (1962), David Kolb (1970), Bernice McCarthy (1970) Pask (1976) Entwistle (1979), Miller (1991), Myers – MacCaulley (1985), Felder and Silverman (1988). In 2002, Margaret Martinez proposed the model of Four Learning Orientations including: (1) A Transforming Learner, (2) A Performing Learner, (3) A Conforming Learner, (4) A Resistant Learner and correlation among 3 structural elements: (1) Emotional/Intentional motivational aspects, (2) Self – directed strategic planning & commtitted learning effort, and (3) Learning autonomy suitable for adults and online learning.

1. THE APPLICATION OF LEARNING STYLES TO THE TEACHING PROCESS

According to Sue Davidoff and Owen van den Berg (1990), lesson plans meeting students'learning styles result in:

1. Students learn better and absorb faster if teaching methods are in accordance with students' learing styles;
2. Once learning outcomes are better, learners' confidence is strengthened. This creates the following positive efficiency;
3. Students who are discouraged with learning become interested in learning again;
4. The relationship between teachers and students is improved because the more achievements students get, the more interested in learning they are.

Because learning styles provide information about individual differences in academic preferences, they can show how instruction can best be designed to support learning and increase academic achievement (Akdemir & The Barrel, 2008). Applying the theory of learning styles to teaching is a practical direction, bringing many benefits for learners because it meets the basic principle that teaching must be consistent with learners' psychological characteristics at their age.

2. LEARNING STYLE-BASED BLENDED LEARNING

According to the authors (Fahy & Ally, 2005; Manochehri & Young, 2006; Bezalel & Barth, 2007), if the teaching process was carried out based on students' learning styles, the increase in their motivation and achievement could be observed.

In 2010, Akkoyunlu, B., & Soylu, M. Y studied learners' cognition in a class applying learning style-based blended learning. The results showed that there was a difference in learners' learning styles when Blended learning was applied.

In 2011, the group of authors including Yasemin Gülbahar, Ayfer Alper , Distance Education Center, Ankara University, Gölbaşı, 06830 Ankara, Turkey and Faculty of Educational Sciences, Ankara University, Cebeci, 06590 Ankara, Turkey carried out the research on "Learning Preferences and Learning Styles of Online Adult Learners". The research showed that any student can adapt himself/herself to the teaching process, activities and techniques if he/she knows his/her own characteristics and it introduced different experiences through lectures on videos, mateials and learning methods provided by teachers.

Another important research relating learning style-based blended learning was carried out with 113 students by Jennifer M. Dela Torre, Center for General Education, AMA International University – Bahrain. The results proved that there was a difference in learners' learning styles when the model of blended learning was applied.

In 2015, the study by Ljegatha Deborah et al., Department of Computer Science and Engineering, University College of Engineering Tindivanam, Melpakkam - 604 001, India on "Fuzzy-logic based learning style prediction in e-learning using web interface information" focused on learning styles on the Web by Felder–Silverman and the results showed the relationship between learning styles with this environment.

The research by Laine, Sanna; Myllymäki, Mikko; Hakala, Ismo (2015) on "The Role of the Learning Styles in Blended Learning" pointed out that teaching nowadays need the application of learning style-based blended learning. In Vietnam, the research in 2016 by Nguyen Thi Huong Giang on "Learning Style-based online learning" focused on learning styles by Martinez M. The results showed that there was a tight relationship between online learning and learning styles.

3. THE DEVELOPMENT OF LEARNING STYLE-BASED BLENDED LEARNING.

When attending a blended learning course, learners combine face-to-face learning in traditional classrooms and online learning on a basis of percentage % (from 0% to 100%). Teachers designing the course decide the scenario, learning schedule, contents, goals, syllabus in accordance with the program of a particular module (subject). Learners choose their learning styles and what percentage % between face-to-face learning in traditional classrooms and online learning. The problem should be solved with the model of learning style-based blended learning is how to meet learners' needs when they attend a course combining face-to-face learning and online learning designed by teachers. Thus, the problem put forward is that after learners register their learning styles with the percentage for face to face learning and percentage for online learning, the system will accept and put them in classes based on their learning styles, and then teachers can design contents suitable for their different learning styles.

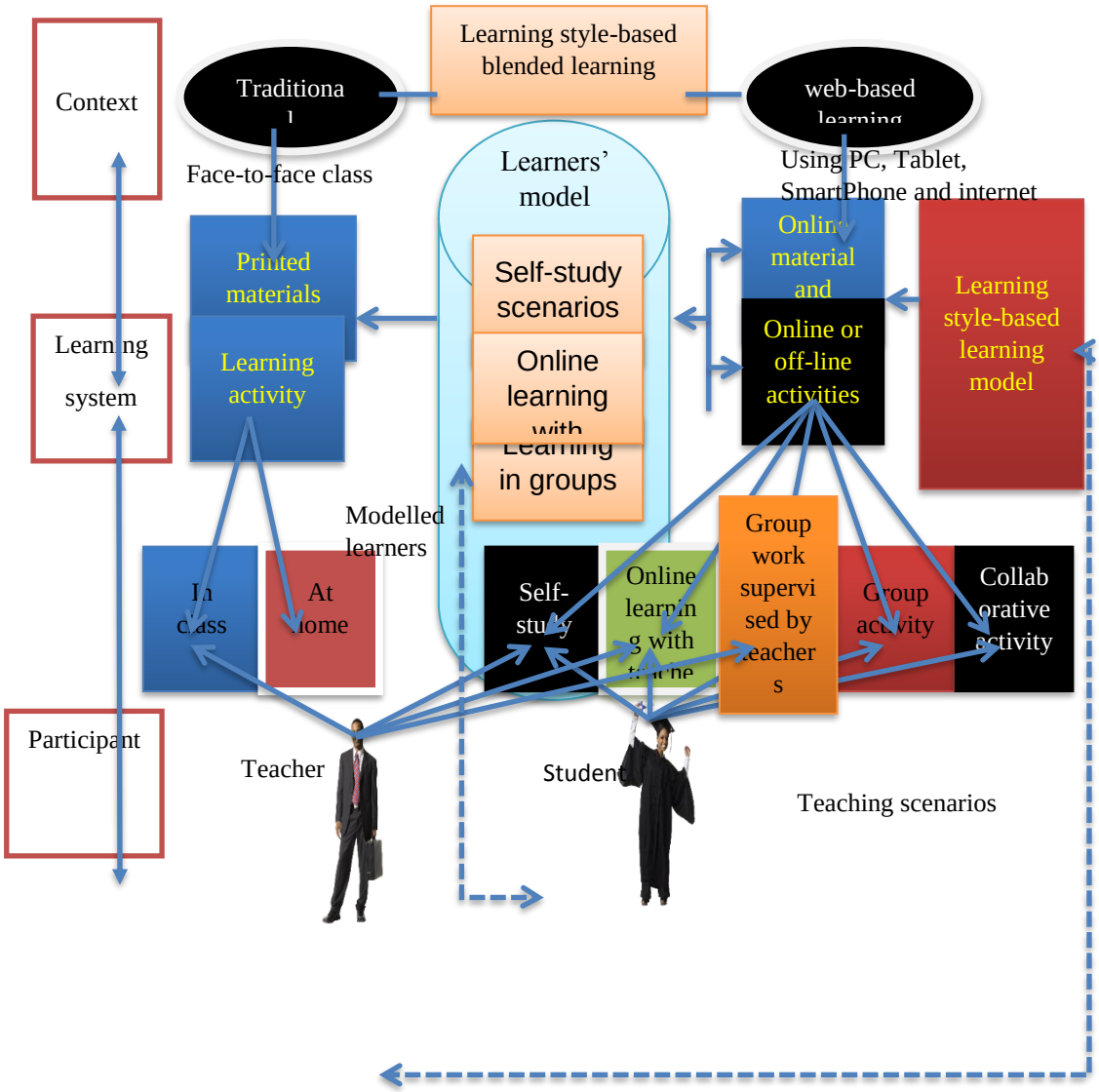

Figure 1: Structure of learning style-based blended learning.

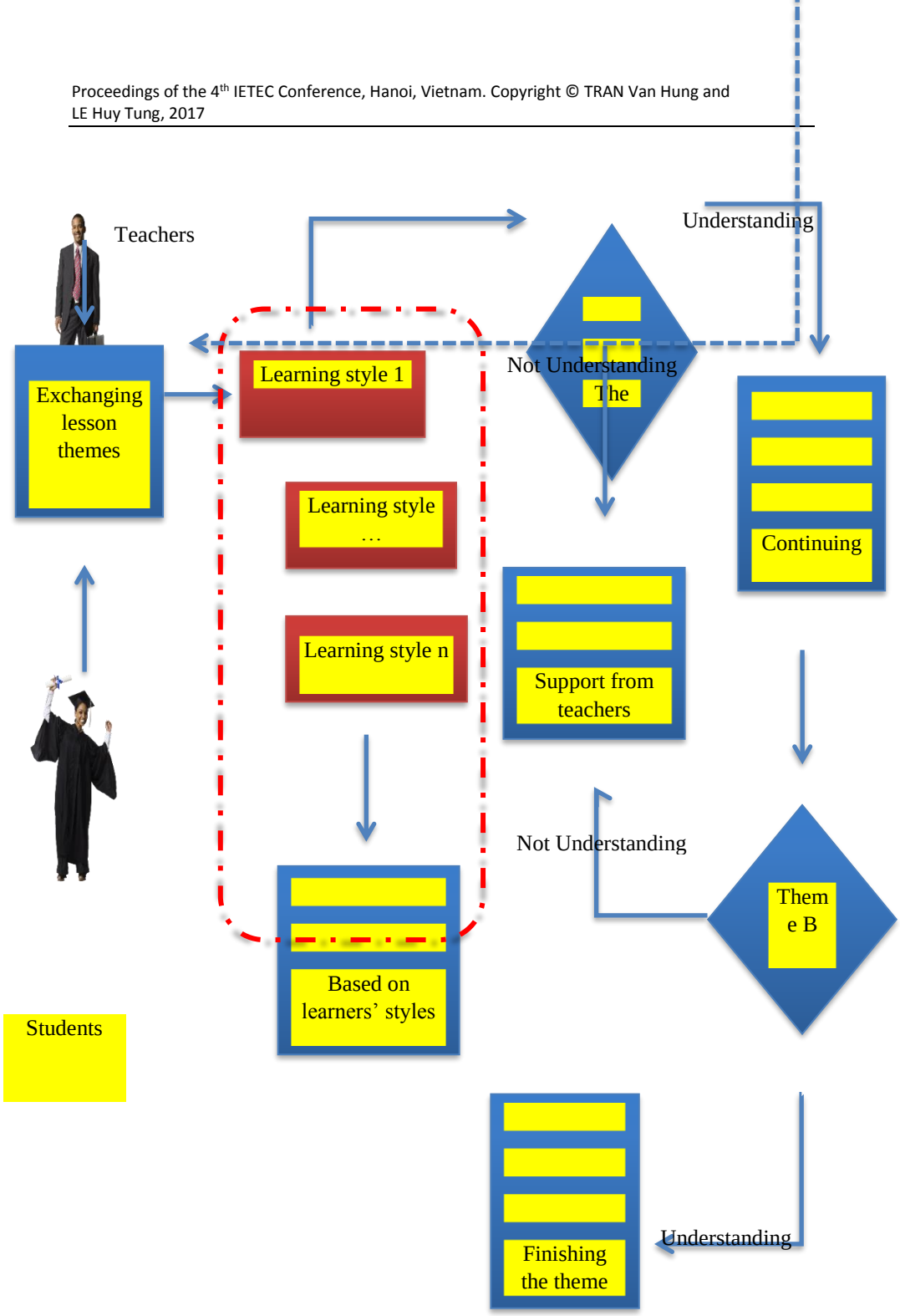

Figure 2: Process of learning style -based interaction between teachers and students/group of students.

4. SCENARIOS FOR COMBINING TEACHING METHODS AND STRATEGIES

Method 1: Online and offline combination according to the ratio 3-7 (30% online and 70% offline) and learning style k.

With this method, schedules, contents and curricula contain proportion of offline learning higher than that of online, and the design of lectures contents and curricula consists of face-to-face learning and online learning. For example, at universities in Vietnam, there are 15 weeks for teaching and 1 week for final exams in a semester; therefore, with the ratio 3-7, lecturers can allocate 9 weeks for interaction with students in class and organize the teaching in a suitable way. However, with this method, teachers design courses in different ways based on students' learning styles. The diagram for learning style-based blended learning is as follows:

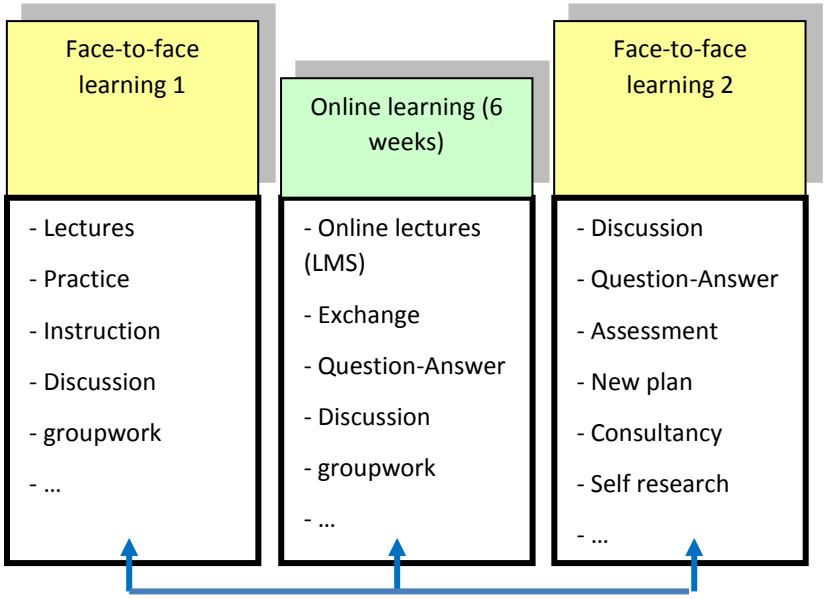

Figure 3: Method 3-7.

With the method focusing on Face-to-face learning, choosing a teaching method is a necessary strategy in the process of teaching in class. The paper introduces a teaching method suitable for method 3-7 based on the procedure designed as in the table below:

Table 1: Teaching towards the steps of problem-based learning.

Steps of problem-based learning	Tasks	Face-to-face (in class)		Online learning (outside class)		Face-to-face (in class)	
		Teachers	students	Teachers	students	Teachers	Students
Step 1: task transfer, knowledge instability	Studying Problem-based cases	Describing situations/ cases, instructing students to use computer networks	Studying cases (experiments, real models…)	Describing situations /cases, instructing students to use computer networks.	Studying cases (experiments, real models…)	Summarizing the situations/ cases and continuing posting situations arising in class and online	Studying the situations online and continuing collecting materials to prepare for solving problems
	Identifying problems	Organizing discussion on the situation, identifying the problem	Exchanging, defining tasks	Organizing discussion on the situation, identifying the problem	Exchanging, defining tasks	Answering questions, supporting online (email, forum, chat room)	Making a plan for solving the next problem
Step 2: Students' independent work, exchange and problem solving	Problem solving: speculation, solution implementation	Supporting, instructing students to solve problems	searching, discussing, solving the questions the teacher gives in the situation	Online support and explanation of problematic questions when it is needed	searching and proving results in the situation	Answering questions, supporting online (email, forum, chat room)	Exchange, speculation, solution implementation
	Examination, validation of results: consideration of the suitability of theory and experiment	Supporting students to check the results with experiments in the lab	checking the results with experiments in the lab	Supporting students to check the results with experiments in the lab	checking the results with experiments in the lab	Answering questions, supporting online (email, forum, chat room)	Checking the results using software on your computer or proofs to give accurate reasoning
Step 3: Discussion, institutionalization, application of	Presentations, notifications, discussion	Discussion and knowledge	Presentations, notifications, discussions,	Discussion and knowledge	Presentations, notifications, discussions,	Reviewing group results, answering questions,	Notification of group results and submission of the final

new knowledge	s, defence of results	institutionalization	1st defence of results	institutionalization	1st defence of results online	supporting online	results to the teacher
	Application of new knowledge to solving the next task	Assigning tasks, giving instructions on research	Defining tasks	Assigning tasks, giving instructions on research	Defining tasks	Answering questions, supporting online (email, forum, chat room)	Application of new knowledge to solving the tasks

Method 2: Online and offline combination according to the ratio 7-3 (70% online and 30% offline) and learning style k.

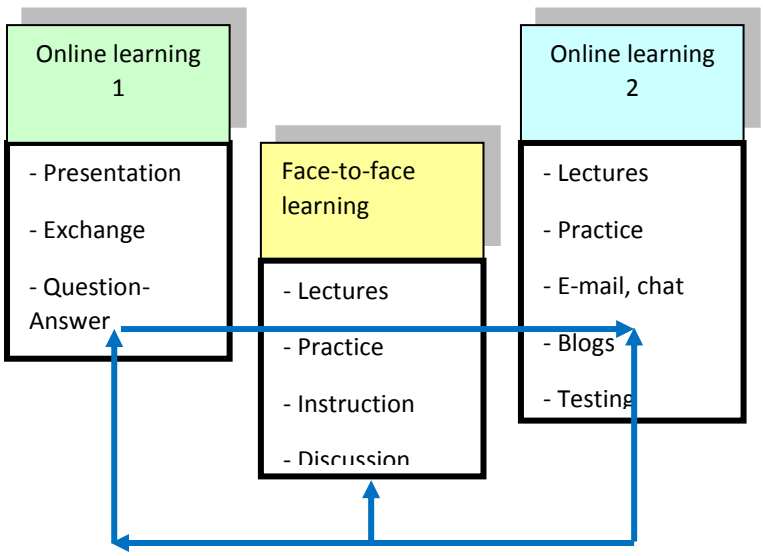

Figure 4: Method 7-3.

With this method, there is more time for online learning, time for offline is spent on students' material research and assignments given by teachers. Teachers have to be online through forums, boxchat, or videos. In the teaching process, online time is for the interaction between teachers and students and during that time, only student/ student group work. Thus, with this method, teachers can apply project-based learning for student/ student groups. The table below illustrates project-based learning with method 7-3.

Table 2: Teaching towards the steps of project-based learning.

Steps	Tasks	Stage 1: online (outside class)		Stage 2: face-to-face (in class)		Stage 3: online (outside class)	
		Teachers	Std/ group	Teachers	Std/ group	Teachers	Std/ group
Step1: Topic identification	Organizing learning groups, identifying topics, constructing supporting system, preparing the lab	Constructing online system e-learning lectures, videos, topics for practice, practice exercises, giving tasks to groups/students discussion, instructing if necessary	Receiving tasks, setting up groups, studying theories and solutions to exercises relating practice topics through videos or e-learning lectures,	Recalling the topics, checking the groups/ students' learning process at home, reviewing the objectives of practice lessons, introducing ways of assessment of practice products	Fulfilling teachers' requirements, checking computers, reviewing theorectical knowledge, satisfying teachers' requirements	- surveying students'needs, investigating learning styles, preparing plans for next practice lessons, instructing	Performing the survey
Step 2: Making performance plans	Setting up a plan for project implementation	Constructing a practice process, making videos, word files, instructional lectures	Setting up a plan for solving practice exercises, discussing and selecting a proper solution	Instructing the process, monitoring to give timely instructions on related algorithms, design analysis, revising groups/ students'solutions	Reviewing plans set at home, analyzing feasibilty of the solutions, algorithms and requirements of practice exercises	Giving answers and supports through the internet (email, forum, chat room)	Using LMS to exchange with each other and teachers make performance plans for the project and other further projects
Step 3: Performance	Implementing the project	Checking project progress, giving instructions if necessary,	Doing exercises of the project, creating a part of necessary products required by teachers	Assist students in creating products in the Lab, receiving preliminary results, explaining and demonstrating if necessary	- creating products in the Lab, (if necessary) Working with other members to comlete the products and hand in them to teachers	Monitoring, supporting, assessing students	- Creating a product expressing groups/ students' result- - self assessment of the product
Step 4 Assessment	Assessment of students' products	Preliminary assessment and giving grades to groups/ students	Handing the products required (solutions, algorithms, analysis and design	Assessment of students' products based on the set criteria	Presenting the products, assessing them	Assessing students' products and giving grades to groups. Giving solutions to students' dificulty and questions, finishing the project	Handing in the final products to teachers via the internet and exchanging, discussing, giving feedback to teachers

Method 3: ***Online and offline combination according to the ratio*** **5-5 (50% online and 50% offline)** ***and learning style k.***

With this method, online time is equal to offline time. This method is superior to the above methods in terms of time, which enables teachers to be active in applying online learning and face-to-face learning. Teachers can rotate between online learning and face-to-face learning. The advantage of this method is that the modules contain time for both theory and assignments or practice. Then, teachers can apply the teaching method based on David Kolb's learning styles (1984) as the cycle below:

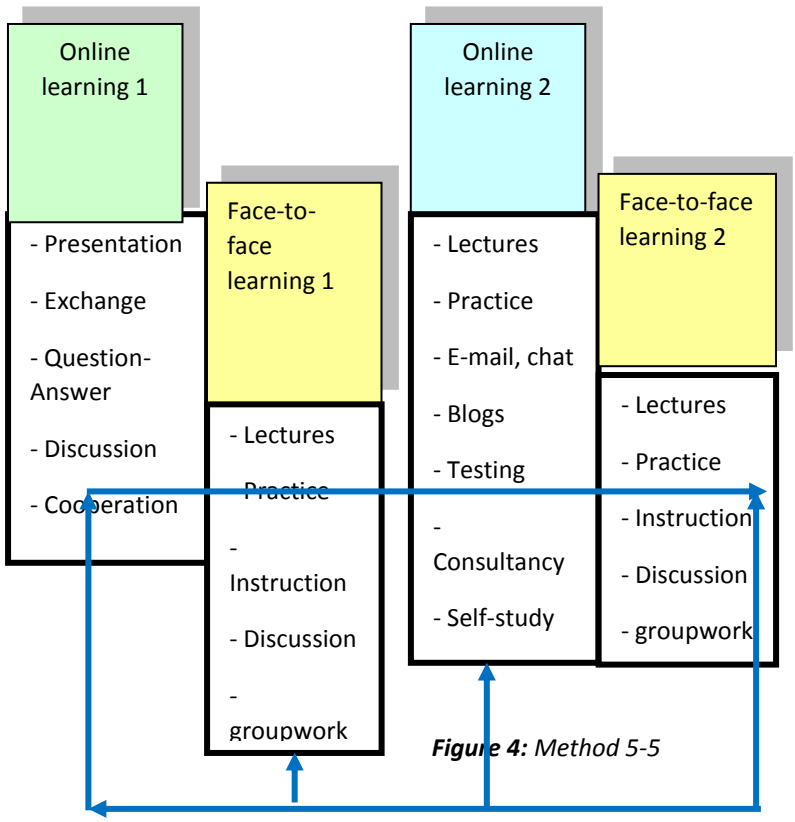

Figure 5: Method 5-5.

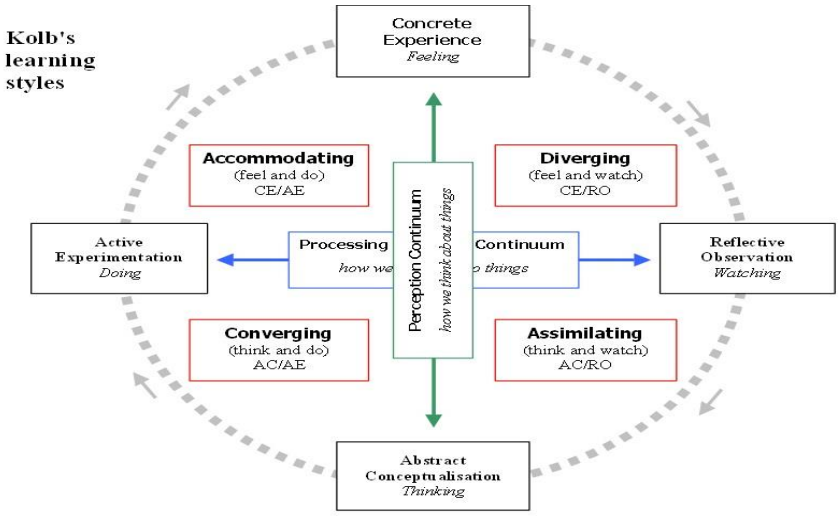

Figure 6: The cycle of David Kolb's learning styles.

From the three methods mentioned above with any student's learning style k, and depending on students, teachers, training facilities in different areas, the teaching system, method and strategy are designed in a way that is suitable for each module.

1. ASSESSMENT IN LEARNING STYLE-BASED BLENDED LEARNING

Testing- assessment is an important stage in the process of teaching. The feature of learning style-based blended learning is the combination of face-to-face learning and online learning based on learning style *k*, thus the assessment also combines these two forms based on the ways chosen by students, of which formative assessment is a core criterion.

For example: For a credit-based training institution M, the module assessment is equal to middle-term result with m% (Score of part 1, Score of part 2, middle term score) and final term result with *n%* (Score of part 1, Score of part 2, end-of term score). A formula is introduced as follows.

Middle - term result (m%) = [(Score of part 1)* coefficient + (Score of part 2)* coefficient + (middle-term score)* coefficient] * (x% face – to – face) + [(Score of part 1)* coefficient + (Score of part 2)* coefficient + (middle-term score)* coefficient] * (y% online)

End-of-term result (n%) = [(Score of part 1)* coefficient + (Score of part 2)* coefficient + (end-of-term score)* coefficient] * (x% face – to – face) + [(Score of part 1)* coefficient + (Score of part 2)* coefficient + (end-of-term score)* coefficient] * (y% online)

Final result =

= (Middle - term result)* m% +(End-of-term result)* n%= 100%

Accordingly, it can be summarized as in the diagram as follows:

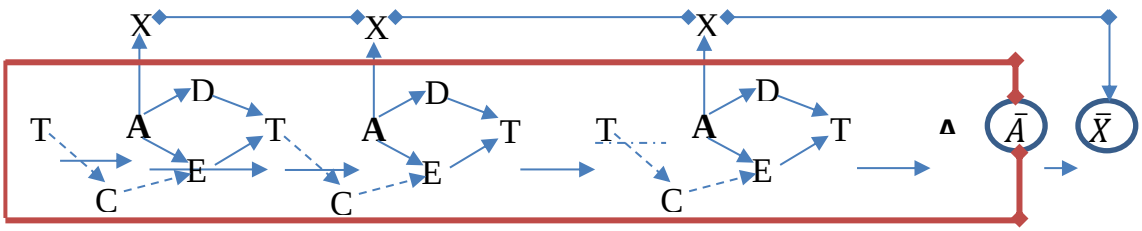

Figure 7: The correlation between teaching and assessment.

Of which: T – Teaching; A- Formative assessment;

X- Grading; C- elements affecting the teaching process

E- Evaluation of the efficiency of the teaching process

D- (Diagnostic appraisal) survey on the need, strengths and weaknesses based on learning styles

$\bar{X}$- Average score/ranking (aggregate of scores in Face to Face and online learning based on learning style *k*)

$\bar{A}$- (Summative assessment) Average assessment of Face to Face and online learning based on learning style *k*

CONCLUSION

The application of theories on learning styles is highly feasible. This is an optimal direction to help teachers both ensure that the teaching requirements are in line with

the psychological characteristics of individuals and activate learners' activities in the digital age. The combination of Face to Face and online learning is suitable for the current teaching process, especially based on students' learning styles.

Blended learning courses result in students' improved performance and cost savings in many countries around the world, especially developed countries in the West. However, the implementation of the models and methods designed in this paper depends on lots of elements to be successful. A training institution has to create necessary policies, strategies, resources, schedules, classroom arrangements, and supporting systems to ensure the success of learning style- based blended learning.

Course schedules of higher education institutions have been challenging and well considered, requiring a clear and specific schedule format for blended learning courses, which helps reduce study time in class and increase flexibility for students. As the methods and strategies laid out, support for students and faculty members is an important component of blended learning, technology training and the support should be available to students and teachers.

In order for a theory to be realized, it needs to be made to become a specific model, which means that blended learning should be carried out. A theoretical framework is transformed into a teaching model. Simultaneously, there must be a flexible way of combination and application in reality.

Learning style –based blended learning shall follow the theory model reflecting the structure and functions of an institution, including basic elements:

1. Teaching philosophy in training;
2. Setting up and explaining teaching goals;
3. Teaching principles;
4. Contents and organization, structure of academic contents;
5. Methods, strategies and teaching techniques;
6. Learning materials, teaching aids;
7. Viewpoints and techniques for evaluating learning outcomes.

Does the model help shape the design and implementation of blended learning (macro level), design and organization of a specific subject/lesson (micro level) towards the expected outcomes set in training currently? It depends on the elements: an institution's policies, leaders, thinking, time, technology, training…

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Developing Capacity Framework and Criteria Set to Evaluate Learners Capacity in Vocational Education in Vietnam

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ABSTRACT

In order to meet the requirements of fundamental reform, comprehensive education in Vietnam nowadays is a very necessary and urgent task. In particular, vocational education plays a very important role. Developing curricula, implementing capacity-based training in occupational education is a new trend that has been developing in Vietnam; but the examination and evaluation of learners' outcomes according to capacity approach in professional education does not have any standard for making scientific arguments. Therefore, developing capacity framework and criteria set to evaluate competencies in vocational education in Vietnam are new, essential and high scientific value.

***Keywords**: examination, evaluation, capacity approach, vocational education, capacity framework, evaluation criteria*

INTRODUCTION

Teaching methods in the direction of academic theory are familiar traditional teaching methods that have been passed down from generation to generation and preserved, maintained and developed through generations. The core of this method is that the teacher is the center of the training process, the subject of the teaching-learning process. The traditional teaching method, known as the "knowledge delivery system" for learners, is the process of transferring knowledge from teacher to learner in the form of compressed information. To implement this teaching method, the teacher is the "living knowledge store", the "encyclopedias", students who listen, record, remember and think according to the teachers' interpretation.

Nguyen Huu Lam, Boyatzis et al. (1995) summarized common shortcomings of the current practical system and education and training programs as follows: 1/ Too

heavy on analysis, not practical direction and action; 2/ lack and weakness in the development of interpersonal skills; 3/ Shortsighted, narrow, no comprehensive complete approach in its values and thinking; 4/ Not helping learners work well in groups and teams [2], [9].

And Rausch, Sherman, and Washbush (2001) agreed with the summary of Boyatzis and his colleagues have stated: "Carefully design education-training programs and focus on outcomes and based on capacity can be considered as a natural solution to solve most, if not all, of these shortcomings." [10]

Examination and evaluation are very important parts, inseparable of the teaching process. Examination and evaluation are intended to provide information to compare and contrast the knowledge, skills and attitudes achieved in learners with the expected results identified in the teaching objectives; to understand and diagnose before and during the teaching-learning process or after a learning process to evaluate the quality and effectiveness of teaching and learning process.

Examination and evaluation learning outcomes of learners is to check and determine the unit of study fully integrating the knowledge, skills and capacities required for the learners' career; Units of study are regularly updated, adjusted and revised to suit the requirements of the world employment.

Forms of examination and evaluation of students' learning outcomes towards the content approach in teaching activities tend to focus on the type of assessment of consciousness, mainly examining and evaluating the ability to memorize and reproduce the knowledge of old lessons has been exposed to many limitations in enhancing the learning positive and the ability to apply flexible knowledge, creative attitudes, knowledge and skills of students in real situations. [2]

In fact, a long time ago, examination and evaluation in education only focused on evaluating learning outcomes to mark and grade learners, not responding to the learners why the learning outcomes were assessed and so such score. Instructors do not explain to the students why the test is true/false; how it is right/wrong. Some instructors mark with feedback but not enough, negative feedback, non-constructive, makes students shame, loses confidence, disbelief, no motivation to correct mistakes, make students depressed, hurt, ... affect the psychology and learning process. [2]

1. Training, Examining, and Evaluating According to the Capacity Approach in Professional Education

Capacity is the ability to carry out responsible and effective actions, addressing tasks and issues in different situations in the professional, social or personal areas on the basis of understanding, skills and experiences as well as willingness to act.

Based-capacity training is a systematic process aimed at fostering the accumulation of knowledge, skills, rules, behaviors or attitudes that lead to better match between learners' characteristics and job requirements. [9]

Based-capacity training is geared towards very specific goals and achieving those goals is always the desire of schools and society.

Examination and evaluation are inseparable parts of the teaching process; it can be said that examining and evaluating learning outcomes of learners in terms of capacity approach is the driving force to promote innovation of the teaching and learning process.

Through the examination and evaluation according to capacity approach, instructors will know the acquisition of knowledge, skills of each learner against the set objectives; Understanding the causes that affect the student's learning situation helps instructors have appropriate pedagogic measures to improve the quality of the lectures and to help students progress. Therefore, examination and evaluation are indispensable parts of the teaching process [6].

Examination and evaluation according to capacity approach helps instructors have a practical basis to evaluate the learning outcomes of learners and detect weaknesses timely, shortcomings in knowledge, skills to fix, add. By examining and evaluating learners' learning outcomes based on the capacity approach, instructors will evaluate their teaching work; realize the advantages and disadvantages of teaching to draw on their own experiences and pedagogical experience [2].

Examining and evaluating students' learning outcomes in the capacity approach will provide instructors with "backwards interaction" information that helps instructors adjust instructional activities. The examination and evaluation, combined with regular monitoring, facilitates the instructors to clearly and precisely define the capacity and proficiency of each student in the class and from which measures are taken to help each individual appropriately, contributing to improving the quality of learning of each student.

Examining and evaluating students' learning outcomes in the capacity approach is an important and effective tool with high efficiency when and only if the instructor explicitly determines the purpose, significance of the test and assessment, the feasibility of each type of test, assessment, planning, examining and evaluating process, select or design appropriate testing and evaluation tools, meet the requirements, design and measurement characteristics. At the same time, instructors must know how to process, analyze, use correct assessment results, know how to feedback to and advise parents and students [3].

2. The Purpose, Function and Content of the Examination and Evaluation According to the Student Capacity Development Approach in Vocational Education

Examining and evaluating students' learning outcomes by capacity approach in education with the common goal of providing information to make decisions about teaching and education. There are three levels of subjects using this information: level of direct teaching and learning; level of teaching and learning support and policy-making level.

The primary purpose of examining and evaluating learners' learning outcomes by capacity approach is to determine the quantity and quality of education and learning in order to motivate instructors to be productive and students independent proactive to achieve good results in learning as expected [4].

Examining and evaluating learners' learning outcomes in a capacity approach has three important functions that help learners reach optimal capabilities [4]:

- Comparative function: In the middle of the stated purpose of achieving results, if there is no testing and evaluation based on capacity approach, there is no valid data or authentication data to compare the results obtained with target requested;

- Feedback function: From the information obtained in examining and evaluating in terms of capacity approach, students self-correct the shortcomings, promote strengths, fill their learning gaps in the learning process, instructors improve teaching methods to suit students better, and gradually adjust the process of teaching to the optimum based on the capacity approach;

- Predictive function: Through the results of the examining and evaluating according to capacity approach helps instructors to predict the performance of student's learning outcomes in the near future.

Training towards a learner capacity approach has been and continues to be an indispensable and universal trend in education around the world. The examination and evaluation in the direction of the capacity development approach, is the assessment of the student's ability to apply the attitudes, knowledge, and skills learned in solving practical situations in everyday life, that is action capacity. Action capacity-based assessment is also referred to as practical capacity assessment [6].

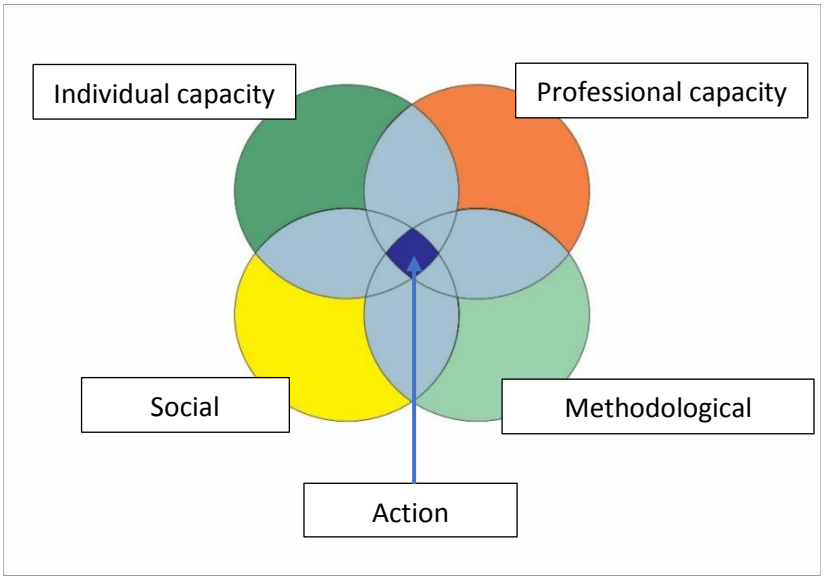

Figure 1: Model of action capacity.

Examining and evaluating the learning outcomes of learners by capacity approach i.e. instructors implement tests and assessments based on the student's action capacity model, i.e. instructors test, assess individual capacity, professional capacity, methodological capacity, and social capacity of students (Figure 1).

Examine and evaluate individual capacity is to assess characteristics, personality as a subject matter in terms of psychology, health, mobility, education, understanding society, …;

Examination and evaluation of professional capacity is the assessment of knowledge and ability, skills to perform professional activities and areas related to professional occupational work such as acquisition, finding, collect, synthesize and apply the knowledge and skills to perform professional tasks, the ability to comment, evaluate and counsel activities in occupational labor,… [2].

Examination and evaluation of methodological capacity is to examine and evaluate the possibilities of selection, application, development of methods, and methods of operation for the most effective implementation of activities in the environment and determined conditions according to the standards required.

Examination and evaluation of social capacity is to examine and assess human knowledge and abilities as a member of a society capable of integrating into and

adapting to rapid changes in society life,… knowledge, sense of responsibility, social responsibility, and ability to communicate and collaborate… [2]

Examination and evaluation of action capacity can be concretized in different professional fields and occupations. The action capacity is well suited to the four pillars of education under UNESCO: Professional capacity - Learning to know; Methodological capacity - Learning to work; Social capacity - Learning to live together and Individual capacity - Learning to be (Figure 2).

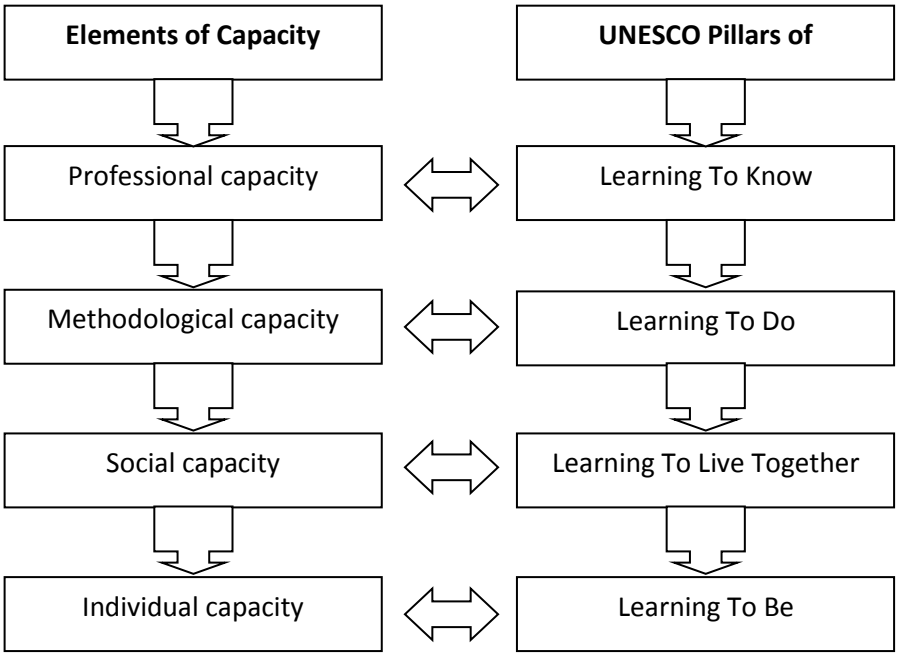

Figure 2: UNESCO's action capacity and educational philosophy.

It can be concluded that examining and evaluating learning outcomes of learners in the capacity approach does not only examine and assess the development of professional capacity including the knowledge, skills and attitudes that it also examines, assesses methodological capacity, social capacity and individual capacity. Examination and evaluation of these capacities are not separated from each other but have a close relationship. Examination and evaluation of the action capacity is formed on the basis of a combination of examination and evaluation of these capacities.

3. Develop Capacity Framework and Criteria Set for Assessing Students' Capacity in Professional Education

3.1. Develop capacity model and capacity framework for students in professional education

Student capacity is defined by American or British schools; Capacity in American schools: Capacity is any element of individual psychology that can help quickly accomplish a task or action effectively; Capacity in British schools: Capacity is limited by three factors: knowledge, skills and attitudes.

Human capacity is like two parts of the iceberg consisting of the floating and the submerged; the floating section accounts for 10% to 20%. This section can be seen through the form of assessment, interview, follow-up, ... The submerged section from 80% to 90%, this is the potential part to detect, promote and develop [8].

Capacity model is a description of the combination of knowledge, skills and attitudes (personal characteristics) needed to well accomplish a role or job. The most commonly used capacity model today - the model of training and personal capacity development. Benjamin Bloom (1956) was the developer of this model and set career standards for job titles based on three main categories of attitudes, skills and knowledge [2].

In particular, knowledge is understood as data collection capabilities, capacity to understand issues, application capacity, analytical capacity, synergy and evaluation capacity. These are the basic capacities an individual needs to acquire when he or she receives a job. The more complex the job, the higher the required level of these capabilities. These capacities will be specified according to the characteristics of each job.

Quality skill is the ability to perform tasks, turn knowledge into action. Often the skills are usually divided into the main levels, such as imitation (observation and stereotype behavior), application (doing some action by following the instructions), manipulation (more accurately with each circumstance) and creativity (becoming a natural reflex).

Attitudes often include elements of the receiving world and respond to realities, valuations, priorities. Qualities and behaviors reflect the individual's attitude to the job, the motivation, and the qualities required to ensure a job well done.

Capacity framework or Capacity profile: Each job will require a set of competencies in the knowledge, skills and personal characteristics required to successfully complete a role/job. The capacity framework is an integrated method to support the work positively for learners. Capabilities in the capacity framework can be used as criteria for assessing students; the capacity framework also gives instructors a comprehensive picture of the job requirements [12], [13]

Capacity framework structure consists of four main groups: Capacity according to role, core capacity, professional capacity and behavioral capacity. However, these capacity groups are not separate but overlapping and interfering in the overall structure of the capacity framework [12]

Develop and implement the capacity framework

The capacity framework is developed in five steps and is implemented as follows:

Step 1: Determine the right purpose

To build the capacity framework for students, first determine what the true purpose of capacity building is. Responding to different purposes will choose different tasks.

Step 2: Standardize tasks / jobs

Capacity framework developing process needs to build the work that corresponds to each capacity and attach it to a task or action. When the task / job is not clear, it will not determine what capacity is needed.

Step 3: Determine the required capacities

Determining the required capacities is important and is very costly time and effort. We need to reference some of the widespread and well-used capacities. The thing to do is to identify the capacities needed, to divide the behavior into different levels from low to high in a logical and scientific way. The methodology used in the available education capacity framework in the world applies to each specific case and adjusted to suit the specificity of the work.

Step 4: Organize the capacity for each position

Placement of capacity for each position must be linked to the goals and the learning outcomes of each subject / curriculum, so the capacity to be assured when selected will be truly relevant and contribute to enhance the effect of jobs.

Step 5: Evaluation

In order for the capacity framework to be put into service, it is necessary to develop individual capacity assessment tools, identifying the capacity gaps required based on competency standards.

3.2. The Criteria Set for Evaluating Students' Learning Outcomes by Capacity Approach in Professional Education

Assessing students' learning outcomes in the capacity approach must be conducted in an environment similar to a realistic environment that meets the expectations of employers and the world of work. The criteria set for evaluating students' learning outcomes should be based on the following competencies [1]:

- Perceptual capacity: the ability to observe and identify the characteristics, features, relationships, processes of things, phenomena in nature, society and production-service activities, …

- Auditory capacity: the ability to receive and process audio, voice ... in the natural environment, learning, social communication - life and work.

- Thinking capacity: the ability to analyze, synthesize, logical reasoning; calculate, generalization, systematize, ... issues, views, events, phenomena, ...

- Language capacity; Communication: the ability to use language as the second signaling system in communication, expression, reasoning; presentations, essays, persuasiveness, listening, empathy, expressing emotions,…

- Adaptive capacity: sensitivity, flexible handling of situations, transfer of skills to carry out new activities, sharing, transformation; coordination, teamwork, …

- Action capacity - solve problems: the ability to perform manipulations, movements, using proficiency tools, means, solve problems, perform tasks, action procedure, create product; assess,…

The criteria set for evaluating the learners' capacity in vocational education.

Table 1: Criteria set for assessing core learning capacity.

Capacity	Expressions of capacity / Evaluation criteria
Sense of humor	The ability to receive signal system from the surrounding world, in the observation and identification of specific characteristics such as shape, size, structure, color, properties, relationships, processes of things, phenomena in society, nature and engineering-technology activities. Specific criteria (level/grade) Criterion 1: Identification, description of objects, images, processes of things, phenomena in nature, society and in activities, engineering-technology process Criterion 2: Analysis, comparison of characteristics, features, basic relationships of objects, things and phenomena in nature, society and engineering-technology activities. Criterion 3: Evaluating, synthesizing and systematizing objects, things, phenomena in nature, life and engineering-technology field. Criterion 4: Creation of new appearances of things, discoveries, new phenomena, propositions or improvements, finishing new processes in engineering-technology.
Audition	Ability to receive and process audio sources, voice, sound in the natural environment, study, social-life and occupational Specific criteria Criteria 1: Receive (or hear) normal sound signals, individual: speech, sound from audio sources, noise from common technical devices and instruments in life and technique. Criteria 2: Distinguish and compare (processing) the types of sounds from different sources: people, nature, sound equipment, machines ... Know how to diagnose techniques from audio sources gathered from the common machinery and technical equipment.

	Criteria 3: Evaluate and synthesize various types of sounds from different sources, hear strange and complex sounds (polyphonic, synthesized,…). Criteria 4: Creation of new appearances of audios, sounds
Thinking/Perception, problem solving	Ability to analyze, synthesize, logical inference; computation, generalization, systematization,… in awareness and solving problems, views, events, phenomena,… Specific criteria Criterion 1: Perform common thinking tasks in perception and identification, problem identification, events, phenomena, in nature, in life and in technology. Criterion 2: Analyze, distinguish, explain, prove, calculate, logical inference,… in perceiving and problem solving, events, phenomena, in nature, in life and in technology. Criterion 3: Synthesis and systematization, generalization, abstraction in perception and problem solving, events, phenomena, … in nature, in life and in technology. (higher-order thinking) Criteria 4: Providing ways of thinking (hypotheses, reasoning, etc.) and new ways of doing things (solutions, processes ...) in perceiving and resolving problems, events, phenomena, etc. in nature, in technical life (creative thinking)
Language; Communicative /emotional	Ability to use language as the second signaling system in communication, expression, and reasoning; presentations, essays, persuasiveness, listening, empathy, expressing emotions,… Specific criteria: Criterion 1: Identify and correctly describe the terms and concepts, basic symbols, common in the field of general technology-engineering (voltage, power, resonance, acceleration, material symbols,…) Criterion 2: Select and use correct technical terms (English and Vietnamese) in documents, general technology–engineering documents; expressing, arguing, presenting closely, logical, persuasive ... in the activities of communication technology–engineering content.

	Criteria 3: Analyze, select, compare different ways, and ways of using communication and express common technical documents and documents. Detect, assess common errors in the use of technical language. Criterion 4: Use innovative terms, common technology-engineering symbols.
Adaptation	Sensitivity, flexible handling of situations, transfer of skills to carry out new activities, sharing, transformation; Coordination, teamwork,… Specific criteria: Criterion 1: Recognizing common technical problems and incidents; adapting to changing jobs and a diverse working environment. Criterion 2: Analysis, explanation, comparison of scenarios, technical problems (tools, equipment, technical processes). Proposing measures to prevent, treat and overcome incidents, unexpected technical situations. Criteria 3: Evaluate, compare measures and effectiveness of implementation. Criteria 4: Have creative ideas and solutions for new situations, new jobs, and new working environment.
Action/Technical Practice/Teamwork	Ability to follow the standards of manipulations, movements,… proficient use of tools and vehicles; problem solving; carry out the work, process of action, create products; experiments, assessments,… Showing the spirit of responsibility, self-consciousness; enthusiasm in the implementation of tasks, jobs, processes, product creation,… Specific criteria: Criteria 1: Implementation, assignment, coordination of work to be done or problem to be solved. Presentation, description of how to perform manipulation, process of work; technical task. To indicate the utility, characteristics and features of technical tools and equipment; The technical and art requirements of the product. Criteria 2: Collect and process necessary information; Selecting the right tools, equipment, technical means necessary, perform and coordinate the operations and movements in accordance with the technical process to

	perform the job or to solve technical problems according to the requirements/standard work (time, speed, accuracy level,…) Criterion 3: Analysis, measurement, evaluation, diagnosis,… general processes, phenomena, situations, and technical problems. Criteria 4: Proposing new ideas, new ways of doing things more effectively in the process of performing work or solving practical technical problems. These capacities at different levels according to the criteria can be assessed through types of exercises, questions.

Examination and evaluation will be put into the teaching process and be carried out regularly with two functions, namely the examination and evaluation function of the training process and the examination and evaluation function of the whole.

The training examination and evaluation function is a learning aid function that is carried out throughout the training process by measuring and evaluating student progress. The summarizing examination and evaluating function is a result recognition function that allows the assessment of the capacity of the student obtained at the end of the training process.

Forms of examination and evaluation of schools must be designed with tool templates to enable the teaching staff and experts of the business to become acquainted with the new assessment methods. The appropriate curricular review and adaptation of the curriculum aims to maintain and develop the adequacy of the program against the world demand for quality employment as well as the reduction/increasing in the number of students required to ensure the balance of labor supply and demand. [2]

Testing, assessing knowledge to assess learning outcomes according to knowledge objectives. Currently, in the capacity-based training, Bloom's educational goal classification is commonly used, in which the cognitive domain has six levels from low to high:

Criteria for assessment of knowledge are elaborated as follows:

Table 2: Assessment criteria according to the level of knowledge acquisition.

Level/Criteria	Definition	Implementation	Note
1. Remember	Recall facts and basic concepts	- It is possible to recall a law, say it again, describing the attributes, properties of a thing, a phenomenon.	
2. Understand	Explain ideas or concepts	- It is possible to compare, contrast, perform formula calculations	
3. Apply	Use information in new situations	- Calculate by formula. - Read the drawing. - Explain the phenomenon, know the cause. - Select, find relationships.	
4. Analyze	Draw connections among ideas	- Circuit analysis / schematic diagram / Structural diagram / process diagram - Analyze the characteristics of a material / Machine details / device / phenomenon - Systematize and classify materials	
5. Evaluate	Justify a stand or decision	- Evaluate the quality of materials and products - Assessment of the rationality of activities, processes, methods,…	
6. Create	Produce new or original work	- Propose new ideas, new ways of doing, new expressions, ...	

The purpose of the skill assessment is to determine what the learner has done and to what extent he or she has learned. Basic skills include: thinking skills; action skills; communication skills; management skills, The level of requirements for learners to do is also from the simplest is imitation to do right, accurate then fast and proficient, automated (skill).

These skills are formed and developed through training process and practical work. In the process of training, learning is a process of cognitive and behavioral learning in order to acquire new knowledge, form and develop intellectual and action skills in a specific field (science-technology, social or occupational) contributes to the

formation and development of personality, creating the right attitudes and values in the lives and occupational work of each individual in society. [1]

At present, in the capacity-based training, the use of the Harrow's Psychomotor Domain classification system is used, consisting of five levels from low to high.

The examination and evaluation of skills depends on the specific objectives to be achieved in different aspects: work process, product, time of performance (productivity), safety, relevance attitude,… Typically, people evaluate skills through testing, evaluating process performance, testing product reviews, or both. It is important to choose the right assessment tool that effectively measures the performance of that skill. [2]

Skills assessment criteria are developed as follows:

Table 3: Criteria for assessing the level of skill formation.

Level/Criteria	Speciality	Ability to perform	Note
1. Imitation	Observes a skill and attempts to repeat it.	- Perform actions as template operations - Passive, low self-confidence	
2.Manipulation	Performs skill according to instruction rather than observation	- Autonomy, self-confidence when manipulating, performing skills. - Perform basic skills, not complicated - No relationship, coordination between skills	
3. Precision	Reproduces a skill with accuracy, proportion and exactness	- Manipulation, standard action, precision - Create continuity when doing work	
4. Articulation	Combines more than one skill in sequence with harmony and consistency	- Ensure speed of work - Standard manipulation and movement	

		- Flexible handling situations - Combination of many types of skills	
5.Naturalization	Completes one or more skills with ease and becomes automatic with limited physical or mental exertion	- Doing work without constant control of consciousness (automation) - Be creative	

The determination of attitudinal evaluation criteria was also studied and implemented based on Bloom, with five levels in a positive direction.

Examining and evaluating learners' attitudes is the most difficult and complicated one. There are even more inconsistent behaviors in the same learner. It is very complex to quantify the attitude training objective as well as to identify the evidence to judge attitudes, very relative. That requires a set of criteria for monitoring and evaluating attitudes through communication, observation, assignment, monitoring, and at various times.

Criteria for attitudinal evaluation are formulated as follows:

Table 4: Criteria for assessing the level of attitude formation.

Level/Criteria	Speciality	Ability to perform	Note
1. Receive	Desire to participate in activities but not clearly expressed own opinion, passive	- Attention listening to lectures; Listen to other people's opinions, do not argue, etc. - Not speaking in group discussions.	
2. Response	- Expressing political views, but there is no persuasive argument. - Compliance	- Responsible for the work; Participate in debates, etc. - Show interest attention, willing to exchange ideas when the situation is appropriate.	

3. Evaluation	Expressing persuasive opinion. Have solid faith in situations where he or she is not compelled to act or obey.	- Be aware, trust and protect the right, etc. - Self-discipline in observing the laboratory rules without a laboratory manager.	
4.Organizational awareness	Set up system values; Organize, attract others. Commit to a kind of spiritual value, expressed by a steady attitude.	- Balancing values; Coordinate activities in movements,…	
5. Characteristic / Character manifestations	Characteristic, personal identity. All manner of behavior is consistent with values that have become intrinsic.	- Have sustainable values; Self-consciousness and high responsibility.	

The combination of capacities required (or capacity framework) of each position in vocational education and training will show learners the strategies of the school and the teacher about expectations students achieve goals and work optimally, helping them work more effectively and gaining employment in the world of work.

Developing a set of criteria for assessing learners' academic performance as well as assessing their knowledge, skills and competency in professional education is a new and feasible step. The combination of capacity framework and assessment criteria is the standard for evaluating student learning outcomes in the capacity approach to professional education.

From the scientific point of view, we set up a suitable scale for each capacity framework, each criterion of capacity for explicit use in examining and evaluating the learner's results in terms of capacity approach.

4. CONCLUSION

Developing capacity framework and criteria set for assessing students' competencies in vocational education as a measure of student learning outcomes in

terms of capacity approach is a new scientific argument in occupational education in Vietnam.

This scientific argument plays a very important role in improving the quality of training and teaching in schools. The results of the examining and evaluating are the basis, points to adjust the teaching activity of the teacher, the learner's behavior and the educational management method of the school.

The criteria set for assessing students' ability in vocational education is a standard for examining and evaluating learners' learning outcomes in a practical way. In this method, the trainer has developed a plan to test the learner's performance on the basis of a review of the component assessments: professional capacity, methodological capacity, social capacity and individual capacity assessment as the scientific evidence for the assessment according to capacity approach assessment.

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Learning Method and Application in Integrated Teaching Approach to the Subject Experience in Industrial Maintenance Management

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ABSTRACT

Integrated teaching is a modern method of teaching, and teaching in accordance to the learner's learning style is one of the various approaches. We have built a teaching system based on the understanding of the theoretical models of learning style, thus designed teaching activities suitable for each learner's learning style. This teaching method has been put into practice on the subject of industrial Maintenance Management. The initial results in the process of teaching showed that the teacher must look into and care about the learner 's specific learning style in order to fully promote the learner 's special abilities and help them overcome their own limitations. In other words, teaching to suit the learning style of each learner.

***Keywords**: Learning style; Integrated teaching; Experiential learning and teaching; Maintenance.*

1. SET THE PROBLEM

In the labor market revolution 4.0, labor market will be seriously challenged between the quality of labor supply and demand as well as the labor structure. When automation replaces people in many areas of the economy, workers must adapt quickly to changes in production that otherwise would be redundant or out of work. The change of production and labor force structure in the future poses many problems for vocational education (GDNN). The change of training activities, especially the method and method of training, is one of the problems that the vocational education establishments must innovate strongly.

The training of new teaching method (DH) at present, it is necessary to create people actively take control of knowledge, actively control their learning activities. Knowing the style of the learner (NH) will help the teacher (ND) flexibility in designing activities that promote the unique strengths of individual learners.

2. SOME OF THE ISSUES OF INTEGRATED TEACHING APPROACH IN THE FIELD OF INDUSTRIAL MAINTENANCE MANAGEMENT

2.1 Integrated Teaching

TEACHING is an orientation for Teaching to help students develop the ability to mobilize knowledge and skills... in various fields to effectively solve problems in learning and in life to perform immediately in the process of knowledge acquisition and skill training, develop the necessary capacity, especially the problem solving capacity. Relevance refers to the mobilization, incorporation, and interrelation of related factors in many areas to effectively address a problem and achieve multiple goals.

2.2 Integrated Teaching with the Experience Approach

TEACHING is integrated in the experiential learning model, Teaching is organized according to the process of actual experience until the formation of capacity at the learner meeting the requirements of practical in production

If the built-in Teaching does not specify the capacity-building process at learner, then "TEACHING integrates in an empirical model" demonstrates that the path of specific capacity is represented by four stages. In order to solve each stage, learners will have to integrate knowledge, skills, experiences and attitudes to solve the problem, the instructor creates an environment conducive for learners to interact through combining the learning methods of the learners. Competency components are integrated into one another: learning method, experience, knowledge, skills to reach capacity building.

2.3 Management of Industrial Maintenance

At present, the subject of industrial maintenance management is teaching the mechanical equipment maintenance with vocational college degree in accordance with Circular No. 06/2011/TT-BLDTBXH On Mar 30, 2011 of the Ministry labor, war invalids and social affairs; MH 20 - organization management and maintenance, training time is 45h and training institutions training content, specifically at vocational colleges in HCMC, including 05 programs as follows: Chapter 1: overview of the business; Chapter 2: Overview of organization management and maintenance, Chapter 3: Organizational Systems Management, Maintenance, and Implementation of Maintenance Management Systems, Chapter 4: Reliability and Availability, Maintenance Total Productivity, Chapter 5: Life Cycle Costs and Maintenance.

2.4 Learning Method

Learning method (PCHT) is the way that learners acquire process and display information during learning. In 1984, David Kolb published his research on the model of postulates. D. Kolb's learning theory offers four different learning methods (learning modes) based on a four-stage learning cycle (experience, perception, conceptualization). Active experiment (applied). Specific Experience (Feeling) [CE]: Concrete Experience (Feeling) [RO] Reflective Observation (Watching); (AC): Abstract Conceptualization (Thinking); Active Experiment (AC): Active Experimentation (Doing).

2.5 Principles of Applying Learning Method in Teaching

When preparing for classes, pay attention to the traits and characteristics of the trainees. The following principles should be followed: ensuring a quiet, convenient and assessable teaching and learning environment. Develop student-student and learner-student relationships, give students more responsibility for mastering their learning, making decisions and assessing their own performance, Focus on a learner-centered approach: maintain a positive participant in the learning process, use meaningful and relevant learning materials for learners, Use old knowledge, skills and experience of the trainees during the learning process, ensuring the amount of time for practical activities, also try and reflect, use group effects in learning situations, create a learning environment that motivates learners to achieve quality [1].

2.6 The Relationship between Learning Experience and the Role of Learning Method

David A. Kolb emphasizes attention to the inner cognitive process of learners. According to him, learning is the process by which knowledge is introduced through the transformation of experience and the transformation of it". In order to gain experience, learners have different learning methods: self-taught and self-taught;

Self-study or random learning in the workplace (see how others do it, explore it themselves ...), learn at anytime, anywhere in the workplace. Active learning is only effective when the need to learn in the learner is resolved in order to resolve the conflict of knowledge, skills and attitudes.

Thus, the learning method plays an important role in creating interesting, active and creative learners in resolving conflicts of knowledge, skills and attitudes which are displayed in the superior position. Their learning method during the learning experience.

3. APPLYING LEARNING METHOD TO THE INTEGRATED TEACHING PROCESS AS STANDARD, THE JOB OF MANAGING AND MAINTAINING THE INDUSTRY

Applying the knowledge about the model of strategic planning, the principle of applying the strategy in teaching, IT in the process of integrated teaching we build the process of teaching the subject of management of industrial maintenance including 04 phases: 1) learning method group; 2) learner and Teacher preparation for promotion of integrated learning according learning method; 3) organizing lecture on applying learning method in the process of Integrated Teaching as standard; 4) evaluate and apply.

To illustrate this process, we take the example of designing a specific activity: "Reliability and Availability" (Chapter 3 - Pham Ngoc Tuan's Industrial Maintenance Management Book).

*** Stage 1: Grouping learning method of learner**

Prior to study, Teacher organized for the learner test in the view of classifying the learning method of Kolb item 2.5, shown by the following survey:

STUDY SURVEY

Lesson: **Day month year**

Lecturers:

Full name of surveyor: age:

Phone: e-mail:

Class: Occupation: Level:

Please answer the question by ticking (x) in the box provided. Your information is very valuable for studying the lecturer's work.

Would you please tell me:

Your learning method is: (Please tick 01 of the 04 learning methods you like)

I like to read books, documents to understand more deeply (1)	I like to split the data or object to understand things more deeply (2)	I like to answer questions or solve problems to understand things deeper (3)	I like to apply the new theory to learn in practice to understand things more deeply (4)	Other learning methods (5)

(1) If you are learning other styles, please indicate your other learning method:

.....

Note: (Explain in detail each learning method)

(1) ***I like to read books, documents to understand more deeply***: is learning method how to acquire knowledge through abstract concepts and transform their experiences through experiments. There is a tendency to always explore the relevance or "what" of the situation.

(2) ***I like to split the data or object to understand things more deeply:*** is learning method that captures knowledge through specific methods and transforms my experience based on reflection. Tend to explore the relevance or "why" of the situation.

(3) ***I like to answer questions or solve problems to understand things deeper:*** is learning method through abstract conceptualization and empirical transformation through reflective observation. Tend to answer the question "what do I need to know?"

(4) ***I like to apply the new theory to learn in practice to understand things more deeply:*** is learning method from experiences through experience and change experience through active experiment. The tendency to adjust the experience is motivated by the question "What if I do this"

Sincerely thank you.

After the learner completed the test, teacher group 04 groups of learning method were named: - The **"I"** team consisted of learners with the learning method having the **"what"** factor of the situation; The **"II"** group consists of learners with the learning method having the **"why"** factor of the situation; The **"III"** group consists of learners with the learning method having the **"what do I need to know"** factor of the situation; The **"IV"** group consists of learners with the learning method having the **"what if I do this"** factor of the situation.

***Stage 2: Preparation of post course to apply learning method in the process of Integrated Teaching as standard.**

a- Learners: Go to the tutor's website to view the information plan, notes about the material that needs to be previewed, preparation of learning conditions, online materials to deal with classroom situations.

b- Teachers:

- Step 1: Identify goals: For knowledge, you should:

+ Describe the process of maintenance, analysis of the process steps, draw out the action plan to overcome the situation + apply knowledge, skills: + Forgive teamwork skills, Observation of knowledge acquisition, drawing, reading comprehension text; + Develop the capacity of thinking analysis, comparing general, attitude: positive attitude, active interest in learning.

- Step 2: Designing teaching-learning activities to apply learning method in the process of integrated teaching

+ Teaching content definition: This helps the learner know the reliability index, the readiness index of the device, the application of analytical calculations, and then draw up an action plan.

+ Determine the method and organizational form of teaching: Select the method and form of organization for each model of learner. Among them, the method and form of Teaching organization is Teaching in small group.

+ Selection of teaching way and environment: arranging tables and chairs in groups by group, 4 types of groups, number of groups depends on learner group size and number of learner under different plans (about 5-7 people per group). Then there will be groups I1, I2, I3, etc. II1, II2, II3, etc. III1, III2, III3, etc. IV1, IV2,

IV3, etc. prepare computer, projector A0 paper pen, sticky tape. Prepare the academic questionnaire: study survey, study survey #1 for the "I", learning method group, study survey #2 for the "II", learning method group study survey #3 for the "III", learning method group study survey #4 for the "IV" learning method group. These forms are designed as follows:

*** Stage 3: Organize the lessons to promote learning method in the process of Integrated Teaching as standard**

- Step 1: assignment of learning tasks (1 minute): After identifying the individual plan, each student will randomly divide the learner into groups according to the plan. Assignment of team leader and secretary (or self-elected team leader and secretary). There will be groups named I1, I2, etc. II1, II2, etc. III1, III2, etc. IV1, IV2, etc. Teacher assign tasks for each group and individual learner, specifically:

+ Individual tasks: Study contents according to study cards, rely on reference documents related to learning content, apply existing experience to contribute ideas to the group.

+ group tasks: after individual study, conduct group work as required in the study card.

+ full class discussion: After the discussion groups have finished, discuss the whole class with the participant's report and debate on the content of the lesson.

- Step 2. Individual study: Individuals conduct research on the contents of the questionnaire.

- Step 3. Group discussion: The leader team conducts the activity according to the request form. The clerk discusses the discussion and finalizes the product of the discussion group (the attached questionnaire) and is conducted in the order of the learning cycle (CE - RO - AC - AE)

- Step 4. Class discussion: After the groups have completed the task, the team organizes the group presentation, controls the discussion process, in group order "I", group "III", group "II", group "IV".

- Step 5. Conclusion:

Time for maintenance support, maintenance time

Results: scaling and analysis

From the above results, find out the causes of productivity losses due to the maintenance and management which will be the basis for the action plan to deal with the causes of the above losses.

*** Stage 4: Evaluate, apply**

- Step 6 a- Teacher together with the learner to evaluate the presentation of 04 groups and suggested banks to apply for specific work with the following contents:

Surveying and evaluating equipment maintenance procedures for key equipment in the unit from which the action plan is proposed to reduce losses and waste in production activities of the unit. This product is informed you back to Teacher after 07 days from the end of the course.

b- Make a scientific assessment, methods and style of teacher, the parts of the learners, from which the teacher has information to design for more effective.

4. CONCLUSION:

Applying the learning method in the integrated teaching process to the experience of industrial maintenance management work, the learners themselves is a subject that works on the basis of applying the knowledge or experience have to deal with a new situation and arrange new knowledge into the existing knowledge system and only if the learner has created an organic connection between the new knowledge and the old, arranged into the system knowledge is available then the new knowledge will have application value.

Therefore, Teacher must have a living capital, professional experience, flexible ability to apply flexible learning method To step in the teaching process, must transform the scientific knowledge into teaching knowledge with the construction set up teaching situations that contain the knowledge that needs to be understood, and create a social environment for learners to build their knowledge experienced industrial maintenance managers can train creative workers who contribute to improving the quality of vocational education.

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Solutions to Enhance Enrollment Quality in Vocational Educational Institutions in the New Context

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ABSTRACT

Admission is the first step in the training process, the quality of the input is good, the quality of training, training effectiveness will be guaranteed, meeting the process of training human resources. The article introduces a number of solutions to improve the quality of enrollment to help institutions in the professional development of sustainable development.

1. STATEMENT OF PROBLEM:

Resolution no. 76/NQ-CP dated on 3rd September, 2016 about unifying state administrative department in terms of vocational education creating new opportunities for many vocational schools before the context of educational renovation in Vietnam. Therefore, it is important to enhance the quality of human resource training at vocational educational institutions.

Admission in vocational educational institution gained a number of achievements in many years ago such as the annual increase in the number of students, the improvement of the quality of student input, the diversity of learners and so on; which showed the effort of state administrative departments and vocational schools. However, to enhance the quality of vocational educational institutions, it is essential to renovate the quality of student enrollment. This article refers to the following context: market economy based on socialist orientation, international integration, comprehensive innovation, industrial revolution 4.0; as a result, school administration needs renovating with the aim of meeting the innovative process of vocational education in the new context and improving the quality of enrollment in vocational educational institutions.

Looking for effective solutions to enhance the quality of enrollment in vocational educational institutions depends on the practical awareness dating back to many years ago, opinions of the Government and the Party in the process of

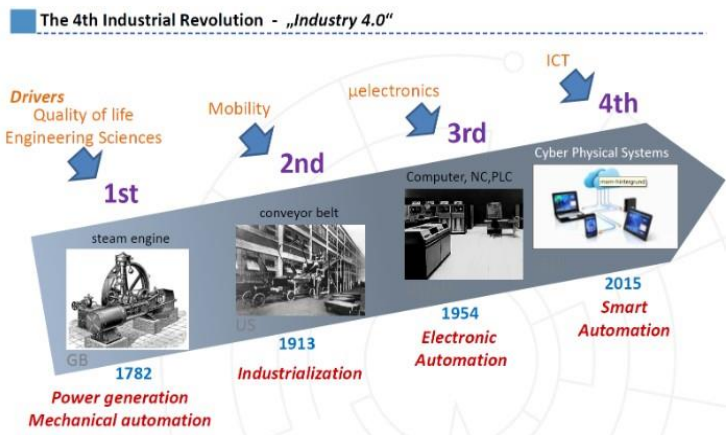
industrialization and modernization, current state of economy and society and developmental orientation of the field of vocational education in the new context.

The article suggests some possible solutions about enhancing the quality of enrollment in vocational educational institutions, which aims at meeting the requirement of labor markets in the renovation in training and developing human resources.

2. CONTENT:

1. New Context:

1. Market economy based on socialist orientation: Nowadays, Vietnam is on the way to transfer from economy of centralized planning, bureaucracy, subsidies to the market economy based on socialist orientation run by law of value, law of supply and demand and law of competition.
2. International integration: Vietnam is in the process of intensive integration. Therefore, it has formed a cross-border education, which creates a serious competition in educating human resources.
3. Comprehensive innovation
4. Industrial revolution 4.0



1. Common Assessments about Admission in Vocational Educational Institutions:

1. Advantages:

1. Vocational educational institutions have been invested modern equipment and facilities and guaranteed learners' abilities after graduated.
2. Companies tend to recruit high-skilled workers (one of the advantages of vocational schools).
3. Unifying state administrative departments in terms of vocational education.
4. Government and Party's concerns about training high-qualified human resources.
5. Being active and flexible in admission such as: providing more students' enrolling periods each year and diversifying different kinds of training.

2. Disadvantages:

1. Thinking "not to be a worker" of some students and their parents.
2. Confronting with tough competition from other universities.
3. Still existing several universities training vocational education.
4. A huge number of universities and colleges.
5. Students solely pay attention to vocational training after failing universities.
6. Lack of vocational encouragement policies from the Government via mass media.
7. Enrollment online is unpopular to remote areas due to low – level of computer skills among students.
   - Unthoroughness of vocational division
8. Communication with learners is still limited, inconsistent and unsynchronized.

3. SOLUTIONS:

Solution 1: Using marketing strategies in vocational education.

1. Defined as an activity to promote the reputation of institutions of vocational education with products from training services, along with benefits for users.

Solution 2: Training quality

2. The quality of human resources trained does not meet job requirements, which significantly decreases the quantity of student input, students' learning motivation and attitudes.

Solution 3: Implementing commitments with enterprises about training quality

3. Implementing commitments with enterprises about training quality shows self-responsibility, brand of trained products from institutions of vocational education, which plays a pivotal role in the existence of educational institutions in the context of human resource training.

Solution 4: Planning and developing training fields according to the social needs.

4. Effective planning and developing training fields according to the social needs aims to define the demand of society in order not to result in unemployment and waste time of learners as well.

Solution 5: Learners' services

5. Nowadays, Vietnam consists of approximately 1989 institutions of vocational education, and admission for them are encountering a lot of difficulties. In fact, learners are not fully aware of the role of vocational education. Hence, it is vital to guarantee the spreading and every learners' services needed, to consider learners as potential customers before and after the students' enrolling time, to ensure learners' satisfaction during studying time at vocational educational institutions.

Solution 6: Deployment of vocational guidance education at institutions of vocational education.

6. Vocational guidance education at institutions of vocational education gives students opportunities to choose certain jobs that suit the available ones at these institutions. Hence, the main feature of vocational educational guidance is job suitability. Due to the fact that job suitability only appears when students start to attend vocational training, being formed and developed during studying and training period in vocational schools or enterprises.

4. CONCLUSION:

In these days and ages, vocational training has been oriented to the structure of market economy since economy of subsidies is no longer suitable. Therefore, it is important to enhance the quality of enrollment and to innovate training methods of the institutions of vocational education. Law of supply and demand of market and the training have to ensure the high quality and meet customers' needs, which directly affects the development and existence of vocational educational institutions. As a consequence, these institutions need to have synchronous deployment in some solutions such as: using marketing strategies in vocational education, training quality, implementing commitments with enterprises about training quality, planning and developing training sectors according to social needs, learners' services, deploying vocational guidance education at the institutions of

vocational education with the purpose of enhancing training quality, effectiveness, sustainable development of vocational educational institutions in the new context.

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Solutions for Managing Institutions of Vocational Education in the Direction of Self-Reliance

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ABSTRACT

To improve the training quality, meet the human resource needs of the labor market in the context of international integration, the region. Vocational education institutions need to innovate in organizing and managing training activities in the direction of self-reliance and self-responsibility to meet new requirements in human resource training.

1. STATEMENT OF PROBLEM

In the context of Vietnam, which is step by step, transferring from the economy of centralized planning, bureaucracy, subsidies to the market economy of socialist orientation and the promotion of industrializing and modernizing country. Added to this is to develop the knowledge economy, international integration along with the industrial innovation 4.0 and new requirements for human resource training in vocational training.

Resolution No.29/NQ-TW about fundamental and comprehensive innovation in education and training, has put a significant question that requires serious answers: "How career education could be fundamentally and comprehensively innovated?". Innovation in Vocational Education in general and school administration structure in particular is an urgent need, a consecutive process and it is required to fit the worldwide trend. In order to promote the proactive, creative characteristics and to exploit the strong points of each field among the schools, thinking in schools' administration must be modified. That is to change from the model of administrative department with solely one head – officer to another type with the collaboration of each individual and the team.

Item 1 – Article 25 of Career Educational Law states: "Career educational agency could be self-controlled in fields of their organization, personnel, finance and asset, training and technology, international cooperation, training quality assurance". Therefore, innovation in school administration is an indispensable way to achieve the enhancement of the training quality as well as the outcomes. This paper not only aims to introduce some solutions dealing with the administration of career educational agencies currently implementing self-reliance, self-responsibility but

also to provide other schools with theoretical basis about the mission of training human resources meeting the needs of labor market.

5. GENERAL ASSESSMENT ON CONDUCTING OPERATIONAL STRUCTURE AT CAREER EDUCATIONAL INSTITUTIONS.

1. Advantages

- Self-reliance at the institutions of vocational education and University education is enabled to gain the attention from the Party and Governments.
- Already having the policy for self-reliance structure at colleges and universities.
- Having the institutions for vocational education and higher education to implement the self-reliance structure.
- Law of supply and demand has been built up in human resource training.
- National educational system has formed and unified all of the training levels.

2. Disadvantages

- This type of structure is still fresh to some of the Ministry and local administrators, who are seen to misunderstand about the nature of self-reliance at vocational education institution. Hence, the implementation as well as the operation might meet difficulties in deploying.
- The definition of "self-reliance" is cutting off all the activities such as: finance; other activities, which have been appearing in the thinking of local and Ministries' administrators.

3. SOLUTIONS:

- Solution 1: Raising awareness

Innovation of the operational structure in vocational educational institutions may provide new opportunities in training, science research and technology transfer: training based on government's requirements, enterprises; approved invested projects with piecework operational structure; working and receiving wages based on their competency; encouraging applications and transfers of science research's results close to labor market and social needs. Hence, making agreements among institutions of vocational educations plays an indispensable role in the process.

- ***Solution 2:*** **Spreading brand and enrollment.**

Institution of vocational educations need to define its core value: "the training quality is a school's honor and brand". Therefore, raising the quality of service and training towards students is a critical role of school administrators. Furthermore, to advertise schools' brand and enroll students effectively, it is necessary to build up

the connection among high schools, vocational institutions, enterprises and labor supply organizations.

- ***Solution 3:*** **Perfecting training program linked to social needs.**

It is urgent and essential that when starting self- reliance, administrators need to define the training program meeting students' needs and high-skilled labor recruiting demands.

- ***Solution 4: Strengthening science research and technology transfer.***

When conducting self-reliance, schools has to be fully aware that science research and technology transfer are two vital factors directly affecting the training quality of any institutions. As a result, school administrators need to disseminate them comprehensively among students.

- ***Solution 5:*** **Training association between school and enterprise.**

When a school gets self-reliance, the problem of "training association between school and enterprise" becomes its existence in conjunction with its slogan is "school and enterprise are two pivotal elements of labor market".

- ***Solution 6:*** **Making commitments between school and learners.**

Schools' administrators make commitments with not only learners and make sure that get information about self-reliance, but also enterprises and labor recruiting units about training quality. Moreover, they need to guarantee with students about suggesting employment opportunities after graduated or publicize job positions at companies related to their educated majors.

- ***Solution 7:*** **Perfecting policy structure and consolidating system.**

Policy structure in process of deploying self-reliance is the crucial legal corridor. While carrying out self-reliance, policy structure has to guarantee real benefits for stakeholders. To be more specific, they will work and receive wages based on their competency. In addition, elimination need to be applied in egalitarianism along with creating motivation, pressure for operator, official and staff to gain expected results in general.

Arranging and consolidating system is the extremely vital mission when administrating institutions of vocational education in direction of self-reliance, shortening system, choosing the best group of school administrators to assure the effectiveness of every tasks and not to result in system separation or ineffectiveness.

4. CONCLUSION

In the context of educational innovation in general and vocational education in particular, changing the thinking in schools administration is indeed necessary to promote every source of vocational training units and to comprehensively improve the training quality, training effectiveness according to the law of supply and demand; heading to the self-reliance in institutions and acknowledging it as the core mission in the innovation of school administration. Therefore, to fully developed and sustainably exploited all the sources at vocational educational institutions, schools might need to have synchronous deployment of the solutions proposed by the writer.

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Middle Leadership in Vietnamese Universities and Challenges for Vietnamese Higher Education System

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INTRODUCTION

This paper aims to draft an overview of middle leadership in Vietnamese universities and colleges and work out some significant concerned issues that Vietnamese higher education may have faced. To support the key objective, the paper will give answers to the questions of leadership and middle leadership in particular. In addition, Vietnamese context, especially the decentralisation-oriented reform of higher education system will be analysed to portray the detailed background for the implementation of the middle leadership. Based on leadership and team building theories and practical statistics on Vietnamese higher education, three middle leadership issues related to human resource, financial budget and time management will be figured out. Some further recommendations will be also mentioned at the later part of the paper.

Leadership

The term '*leadership*' has generated various excitement and interest across a wide range of disciplines since ancient time with the images of powerful dynamic individuals. Up to now, there has been no universal definition of leadership because in different areas, 'leadership' requires different definitions with different points of view. However, in general, 'leadership' is identified as the influencing process of leaders and followers to achieve organizational objectives through change (Lussier & Achua, 2010). In addition, it is considered as the principle input for every team process and teamwork performance (Day, Gronn, & Salas, 2004).

In education, leadership seems to be more complex because the essence of leadership in school is "capacity building" and "school development" (Dimmock, 2011). In the educational environment, leader is likely to be considered as a/ an innovator, developer and linker. Because, educational leadership is to develop and optimize the human, physical and financial resources to lead the school to target vision (Dimmock, 2011); also to act as a 'bridge' between staff and staff, between teachers and ideas, and between researchers and materials and resources (Johnson, 2003).

Distributed Leadership and Middle Leadership

For the past decade, ambitious educational policy reform initiatives have put influence on schools and identified several difficulties that a school leader need to face to and deal with to drive school toward committed missions (Heng & Marsh, 2009). In this contemporary pace, *distributed or shared leadership* has recently become into vogue (Harris, 2004). It has been used increasingly in numerous discourses on and discussions about leadership and leadership in educational organization in particular, and received much attention from a wide range of educator as well as educational policy makers (Bennett, Wise, Woods, & Harvey, 2003; Harris, 2004). Categorized as one of effective leadership modules in education, distributed leadership is defined as a shared leadership, in which every individuals participate into the decision making process (Day et al., 2004). In distributed leadership, the focus is put on individual influence within a team and member behaviour, rather than the formal title leader (Fitzgerald, 2009).

Linked to distributed leadership, *middle leadership* seems to be a popular leadership occurring at schools and educational organisations. Middle leadership is generally defined as the combination of roles related to both teaching and management (Fitzgerald, 2009). Conceptually, middle leadership is connected to distributed leadership, but narrower because its focus is the leadership functions of the middle leaders in schools only, not all leaders in the educational hierarchy system (Heng & Marsh, 2009). In addition, middle leadership is also conceptually narrower than teacher leadership, as it discusses issues related to middle management and subject leadership, rather than the broad capabilities of teachers (Harris, 2004). In hierarchical terms, middle leaders are basically faculty dean, head of department, and subject headers who are not responsible for the overall school development but a specific group of staff performance (Busher & Harris, 1999). At a middle level, head teachers are those who take responsibilities of their academic tasks related to pedagogy and research, and also administrative functions (Fitzgerald, 2009).

THE VIETNAMESE CONTEXT

Decentralization-Oriented Reform in Vietnamese Higher Education Management

Before 1975, Vietnam was divided into the North and the South. During the wartime throughout the 20th century, Vietnamese society in general has experienced a long period of self-sustaining (Can, 1991). The educational system, therefore, at that time was controlled by the two separate governances. After Vietnam's independence and deliberation in 1975, the two existing higher education systems have been emerged into one unique unified system (Huong & Fry, 2002). During the first eleven years of post-war-reconstruction, the higher education system seemed to work smoothly in accordance with the Government's guidelines on the national education. Prior to 1987, Vietnamese higher education was organised and controlled by centralised

policies, in which, universities and colleges would take responsibilities of training human resource to fulfil the national requirements and missions authorized by the government (Can, 1991). However, this traditional centralised management was likely to be not appropriate to sustain and develop the higher education system to catch up with Vietnam's increasingly changing economy. Through the dramatic socioeconomic "renovation" launched in 1987, Vietnam changed its economy from centralised planning economy into mixed economy including both socialist and marketised sectors in order to decentralise the state administration to satisfy the needs of globalization (Can, 1991). To keep pace with this national renovation, beside efforts to increase training quality, Vietnamese higher education had to change accordingly.

Since 1986, education has considered as one of national priorities, and prior to 2000, the higher education system in particular has experienced three significant changes in 1986, 1991 and 1996 (Hayden & Thiep, 2007). The principle focus of these three changes is to innovate the curriculum so that the knowledge taught at universities would become more practical and friendly to the industrialization (Can, 1991). However, these changes to higher education have been revealed to be unsuccessfully because of inadequate social attention, insufficient educational professor and the national economic difficulties (Huong & Fry, 2002). During that time, Vietnamese higher education system has witnessed numerous problems, including the limitation of entrance, declining of training quality, declining teachers' standard of living, difficulties of placing graduates (Huong & Fry, 2002). Until 2005, by the release of Resolution 14/2005/NQ-CP on November 2nd 2005, all the above issues has been pointed out as reasonable consequences of an inappropriate top-down management. By this resolution, weakness of the Vietnamese higher education related to financial control, curriculum design and development, teaching pedagogy have figured out as results from centralised management policies that might actually be not consistent with the socialist and marketisation-oriented economy and the fast pace of globalisation (Khai, 2005). Consequently, the resolution asserted that one of major actions is to give universities and colleges the right of autonomy, including the autonomy in curriculum development, personnel, enrolment quota and finance (Khai, 2005). This transfer of institutional autonomy to school level could be seen as the decentralization that is defined as "the transfer of decision-making authority, responsibility, and tasks from higher to lower organizational levels or between organizations" (Hanson, 1998).

The Rise of Middle Leadership in Vietnamese Universities and Colleges

In schools in general, the formal leader(s) may face tensions and dilemmas between exercising formal authority versus desire for collegiality, the need to maintain control and hierarchy versus equal contribution for members, and empowering others versus responsibility for decisions made (Cranston & Ehrich, 2009). To deal with increasing requirements and tensions, *distributed leadership* is recommended

as the best module of educational leadership by many authors because it allows members to participate in leadership process, which creates a capacity for versatility and adaptability (Johnson, 2003; Day et al., 2004; Dimmock, 2011). The same situation has happened in Vietnam's universities and colleges when the school leaders have been authorised to take responsibilities of their own schools' curriculum design, personnel, enrolment quota and finance instead of implementing goals determined by the Government with the mediation of the Ministry of Education and Training (MoET). In the national pace of decentralization-oriented higher educational reform, to deal with the greater authority in controlling schools, shared leadership, especially middle leadership would be seen as an effective management mechanism. Because with the module of middle leadership, school leaders could rely on their middle leaders, who are faculty deans or subject headers, to make their own staffing decisions, gather their own potential students, evaluate and develop their own curriculum, implement their own research plan and control financial budget (Hayden & Thiep, 2007). At a middle level, head teachers are those who take responsibilities of their academic tasks related to pedagogy and research, and also administrative functions (Fitzgerald, 2009). Middle leaders' perception and expectations may play a major role in school construction and development. Because as a teacher, they are those who have deep understanding on curriculum design and development, on teaching methods, on recent research activities and on students' needs (Heng & Marsh, 2009). But, like teaching, leading a team does not come easily nor follow a specific recipe; moreover, taking simultaneous responsibilities of not only their academic subject areas but also administrative tasks in schools may result in the fact that the teachers may have a little time for both teaching and administrative tasks – one of continuing challenges of educational organizations (Fitzgerald, 2009).

MIDDLE LEADERSHIP AND ITS ISSUES IN THE CONTEXT OF VIETNAMESE UNIVERSITIES AND COLLEGES

One of the most significant characteristics of middle leadership is that with the experience of a school teacher and researcher, middle leaders take responsibilities of overseeing and developing working performance of their staffs to contribute to school development and produce qualified outcomes (Busher & Harris, 1999). To satisfy the requirements of a middle leader, the head teachers in Vietnamese universities and colleges in particular may get involved into a complex matrix of roles. Not only academic teaching tasks but the head teachers also take charges of numerous complicated administrative tasks related to staff management, financial control, and training plan. However, as mentioned before, leading a team is not easy or follows a specific recipe, but requires a combination of skills and experiences that not every teacher can satisfy. As a result, the module of middle leadership in the Vietnamese context of decentralization-oriented higher educational reform and the socialist and markettisation-oriented economy may face several practical issues related to human resource, financial control and time management.

Human Resource Issues

Before the release of the Resolution 14, the Vietnamese higher education system in general took the responsibilities determined by the Government and had no right to make own decision (Can, 1991). To control the performance of the higher education system, the Government has an official consultant that is MoET. On behalf of the Government, the MoET control and manage all universities and colleges' performance. Accompanying with the Ministry of Planning and Investment, the MoET consults the Government in approving decisions on enrolment quotas for each school, financial budget and staffs in accordance with the enrolment students and framework for each training programme (Hayden & Thiep, 2007). It could be seen that, by this centralised governance, school leaders and middle leaders would follow the MoET's guidelines to organise the task implementation at their own schools and report the performance to the MoET, recommend improvements but have no right to make their own decision. With the approving of Resolution 14 to give universities and colleges the right of autonomy, the school leaders, in contrary, would take the charge of self-controlling their school development. Accordingly, the leaders at middle level get more responsibilities to not only manage their group performance, but also develop and innovate the groups for school renovation. However, the *quality of the middle leaders* at Vietnamese universities and colleges should be taken into consideration. According to the National report on higher education system in 2009, the number of lecturers in Vietnamese universities and colleges climbed up to 61,190 (increased three times in comparison to that number of ten years before), in which the number of doctorates accounted about 10 percent and the percentage of both professor and associate professor was 3.7 percent (MoET, 2009). Based on such indicators, the quality of Vietnamases teaching staff in particular and the training activities of universities and colleges in general has been evaluated to have higher ranking than that of only Laos and Cambodia in the Asian region (Vallely & Wilkinson, 2008). Vallely and Wilkinson (2008) also pointed out that inadequate quality of staff could be incapable of consulting school leaders in solving school issues related to both training programme and administrative activities. In addition, beside the quality of staff, the number of staff having management skills and experience is also a concerned problem. Up to 2009, most of human resource training policies for higher education have focused on academic qualification only, and only 252 school leaders and head teachers have been selected by the MoET and trained on school leadership and management (MoET, 2009). Consequently, in term of hierarchy system, it seem to be not easy for Vietnamese school headers to promote qualified middle leaders who have both adequate academic qualification and management contributes to help them in developing school missions.

Financial Issues

Traditionally, most of expenditures to maintain school performance have been based on tuition fees and partly on national budget (Hayden & Thiep, 2010). Before

2006, with the consultancy of the MoET and Ministry of Planning and Investment, the Government decided exactly how much a staff receive per month and how much student may pay for tuition fees, depends on training programme of science and technology or social studies or economics and business (Hayden & Thiep, 2007). By this financial management, faced to the fast changing economy and the increasing inflation, the standard of living of teachers was said to be declining gradually year by year and lower than that of staffs in other non-education sectors (Huong & Fry, 2002). Insufficient budget funding for staff and the management activities in general has been considered as one of the principle causes leading to Vietnamese higher education crisis in recent years (Vallely & Wilkinson, 2008). Up to now, by giving institutions the right of autonomy including the autonomy in financial management, the Government has not determined the detailed school expenditure any longer, but still keep control on it. Instead of giving exactly number of tuition fees and each budget percentage for each expenditure, the Government now has decided the minimum and maximum tuition fee and the limitation for each expenditure including the expenditure for staffing and school management (Hayden & Thiep, 2007). This could be understood that, although institutions are said to have autonomy in financial management, they do not have total freedom to decide how much students may pay for tuition, how much their staff would receive per month, how much spent for management activities and how much the middle leadership could get for extra administrative tasks. As a result, despite of the fact that expenditures for human resource training, staffing and management have been increased, this increase has not been significant and sufficient with the increasing school requirements in steps of school development (Hayden & Thiep, 2010).

Timing Issues

Recently, the number of student at universities and colleges has increased by 13 times from 133.136 in 1987, when the first educational reform was activated, to 1.719.499 in 2009 (MoET, 2009). With this fast grooming of enrolment students, the number of teachers, as mentioned before to be 61.190 (MoET, 2009), seems to be inadequate. The estimated average ratio of lecturer over student is about 1:30 (Hayden & Thiep, 2010). With this ratio, lecturer in general might be expected to spend most of their time to prepare curriculum, implement academic teaching tasks, assess student learning and solve issues related to their academic responsibilities. Furthermore, it is said to be the fact that most of teachers in Vietnam have to take an extra job due to burdens related to financial problems (Vallely & Wilkinson, 2008). As mentioned before, the standard of living of Vietnamese teacher in general is rather low, not according to the fast developing economy (Can, 1991; Vallely & Wilkinson, 2008). Therefore, dealing with a huge tasks of academic teaching and extra jobs, the head teacher at middle level seem to have a very little time for administrative responsibilities.

Having a little time for administrative tasks is likely to be the reasonable consequence of taking simultaneous responsibilities of both academic teaching and

management activities not only in Vietnamese higher education, but also in every other educational context of other countries. For example, by conducting three middle leadership project at New Zealand schools, (Fitzgerald, 2009) pointed out one of continuing challenges for these New Zealand schools is that leaders at the middle level in schools have a very few time or even no time for leadership because teaching activities dominate most of their work. The same situation has happened in Singapore educational organisations, middle leaders have faced difficulties in participating in school decision-making process because of inadequate time for management and leadership requirements (Heng & Marsh, 2009).

DISCUSSION AND CONCLUSION

One of significant characteristics of middle leadership is that it focuses much on leader behaviour rather than the roles of leadership (Briggs, 2001). Being a teacher and directly working inside classrooms as all other teaching colleagues, leaders at the middle level in schools might be expected to bring their academic knowledge into their group performance management, and based on that, consult school header to have innovative decision to develop the training programme and the school performance in general. Has been implemented in many context of other countries, middle leadership is considered as one effective narrower model of the distributed leadership (Heng & Marsh, 2009). In Vietnam, middle leadership also has proved its roles in school management leadership in this current context of decentralisation-oriented reform of higher education system and the fast increase of enrolment students. However, because of the increasingly changing economy and being at the very first steps of implementing institutional autonomy, Vietnamese universities and colleges are likely to have faced several middle leadership issues. These issues related to quantity and quality of human resource, financial budget and time management may need to be addressed not only by the middle leaders themselves, but also the Vietnamese government and all school staffs. As discussed before, the three given issues may be mostly resulted from inappropriate government's policies in training human resource, allocating budget and managing school expenditure. Therefore, it would be necessary to have more flexible educational policies that allow school headers to have greater right in deciding their management mechanism, and give middle leaders more opportunities to take part in the roles of leadership. For the leaders at the middle level, they need to rely on their own academic knowledge and interpersonal skill rather than formal authority to implement their administrative tasks (Bennett, 2003). Furthermore, it is suggested that, to fulfil the middle leadership responsibilities, the middle leader themselves should learn by participating in shared decision-making process and learn to understand people and context as well. Besides, to improve the roles of leadership, strengthening the followership among staffs plays an essential part (Lussier & Achua, 2010). Especially, middle leadership is conceptually connected to distributed leadership, in which all members consider themselves to be leaders and change agents and distribute tasks and roles accordingly (Johnson, 2003).

Therefore, it would be supportive when staffs get more involved in the leadership activities and consider themselves as part of decision-making process.

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Student Learning Experiences During an International Study Tour

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ABSTRACT

In this era of globalisation, the importance of students being given an opportunity to gain knowledge and work experience in multiple countries using various local teaching and experiential learning practices is eminent and advantageous. This paper discusses student learning experiences during an international study tour which involves, the advantages, disadvantages and possible solutions to the issues involved. The report is based on a bachelor unit, SET 404-engineering design-international study tour being offered at school of engineering during Trimester 3 every year. Each trimester is of 11 weeks duration at Deakin University. The author was a tour leader for one of the study tours to India taken place in trimester 3, 2015. The host university chosen for this study tour was- IIT Hyderabad, India. The student enrolled in the unit had an option to choose between countries-Malaysia, China and India. The student cohort size involving students from various disciplines such as Civil, Electrical and Mechanical engineering was 21. The various learning practises adopted on this tour based on the project requirements are work integrated learning, design based learning and project based learning. The

feedback received from the students and on field experience by the author during the study tour has been used as the context of this report. The paper concludes by expressing some interesting observations such as study tour was a good opportunity for a student to move away from the comfort zone and realise their potential towards independent project management, experience the local culture and achieve a balance between academic and social life.

Keywords: *Work Integrated Learning-WIL, International study tour, Global education, Learning outcomes.*

INTRODUCTION

With the rise of globalisation in the higher education sector, the learning process has changed and adapted the varied country wise learning and teaching techniques of education delivery-tools and systems. The demand for exposure to international work culture, gaining knowledge and skills required at global level and opportunity to get a hands on experience of global practices has been a value addition to the students skill set. There are various ways to meet the demand using work integrated learning such as exchange programs, internships and study tours. The purpose of conducting short term international study tours as part of work integrated learning has been helpful as a means to achieve the required skills. This paper is a review on the role of international study tours in work integrated learning environment. The context of the paper revolves around evaluating the student learning by identifying the bottlenecks and suggest solutions for improving the learning process. The different stages involved in the planning and execution of the study tours-preparation, on-field and reflection is described in this paper. This paper is also an attempt to align and better utilise the fundamentals of work integrated learning in order to achieve the learning outcomes.

WORK INTEGRATED LEARNING (WIL)

International study tours are one of the best means to achieve the learning outcomes in a course where the curriculum has been designed based on the principles of Work Integrated Learning (WIL).Work Integrated Learning (from now on referred as WIL) is one of the learning and teaching approaches in engineering education involved in successful transfer and implementation of the theoretical knowledge from the lecture in order to bring out an open ended, sustainable and timely solution to a given engineering problem in a project/study tour/industry [11, 12]. WIL is the learning and teaching approach described and associated with this paper in the form of international study tours. The success of WIL is mainly based on the student ability to learn, interpret and transform the theory in order to develop the practical skills as required by the industry/project. WIL is an industry based learning and teaching approach where the skill coordination with the industry is essential in order to establish a proper connect between the skills achieved in a class and implemented

in the industry. The advantage with the WIL program is the graduate employability as on completion of the course, students are well versed in pragmatics, working order and project management in an industrial environment.

As said by Denise Jackson, WIL is a means to equip potential graduates with the necessary employability skills to function effectively in the work environment [12]. International study tours, study abroad and global student exchange programs are some of WIL supported initiatives at a global level. To star, plan and conduct a WIL program depends on factors such as university-industry coordination, student interest and abilities, curriculum design, infrastructure design, time frame/schedule, implementation and assessment. Assessment is a tough ask in WIL as most of the course coordinator opt for reflective report at the end of the report. According to the research work conducted on reflective assessment in WIL by bonnie et. al., there are few limitations with the assessment technique due to the misalignment in the assessment and reflective practice, which can be corrected by providing a balanced structured and unstructured assessment tasks [13].

This paper discusses student learning experiences during an international study tour which involves, the advantages, disadvantages and possible solutions to the issues involved. The report is based on a bachelor unit, SET 404-engineering design-international study tour being offered at school of engineering during Trimester 3 every year. Each trimester is of 11 weeks duration at Deakin University. The author was a tour leader for one of the study tours to India taken place in trimester 3, 2015. The host university chosen for this study tour was- IIT Hyderabad, India. The student enrolled in the unit had an option to choose between countries-Malaysia, China and India. The student cohort size involving students from various disciplines such as Civil, Electrical and Mechanical engineering was 21. The various learning practises adopted on this tour based on the project requirements are work integrated learning, design based learning and project based learning. The feedback received from the students and on field experience by the author during the study tour has been used as the context of this report. The paper concludes by expressing some interesting observations such as study tour was a good opportunity for a student to move away from the comfort zone and realise their potential towards independent project management, experience the local culture and achieve a balance between academic and social life.

INTERNATIONAL STUDY TOURS

Study tour can be visualised as an opportunity for students to learn and enhance their technical knowledge and gain work experience by visiting foreign universities/industries for a short period of time [1, 2]. Study tours are best known for the successful use of theoretical skills learned in class rooms in order to do conduct a case study, analyse a problem in industry and basically, put his skills to practice [3]. There are two major terms being discussed to define a study tour, “theory” and “practice” which is also a similar way to define Work Integrated

Learning (WIL) [4]. Work Integrated learning is generating industry ready graduates [5].

The set up involved in study tour consists of three stages [2]:

1. Problem definition/project proposal at parent university with assistance from unit chair, tour guide and project supervisors. The time allotted for this stage is 3-4 weeks from the start of the trimester before the student leaves on the study tour.

2. The students start his project work at the host university under the supervision of local academic. The time allotted for this stage of the study tour is two weeks. Within the two weeks, the student needs to put his theoretical skills into practise under the guidance from host supervisors and bring a feasible solution to the problem defined at the start of the project. This stage also involves students visiting the local industry and trying to understand industrial management, production technology, safety and ethics, work culture and to gain hands on work experience by practically working on an allotted task.

3. At this third and final stage, the student is back at the parent university and is involved in completion of the project and report writing. The students reflects on his time at the host university and writes a report which is later submitted as part of his assessment for the unit.

The different stages of the international study is described in the figure 1.

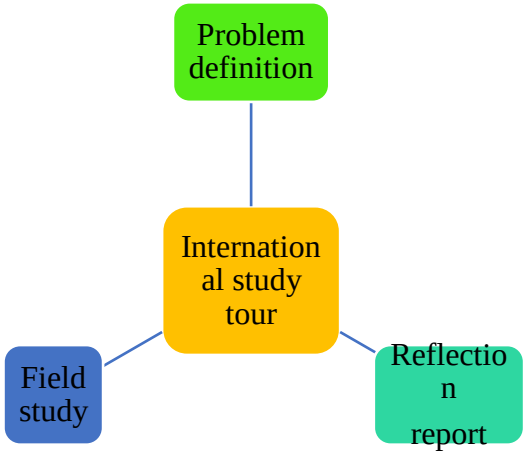

Figure 1: Stages involved in International study tour.

METHODOLOGY

The data considered and analysed was obtained from the survey conducted at the end of the semester/study after students completing this unit/subject. The data type involved was both quantitative and qualitative. The quantitative data obtained from the survey is shown in the form of graphs as shown in figure 2. The data helps to analyse the alignment between WIL and international study tour leading to better and trouble free pathways to achieve the learning outcome.

RESULTS AND DISCUSSION

The feedback data is essential and valuable for the conduct of the unit as it suggests the areas for improvement and tune/cut short the unpopular areas of the unit in order to make the unit effective leading to more students achieving the learning outcome. The qualitative data obtained was in the form of individual feedback given by the students. Figure 2 outlines the bar graph in % of overall satisfaction of students in the 5-point Likert Scale from Strongly Disagree to Strongly Agree.

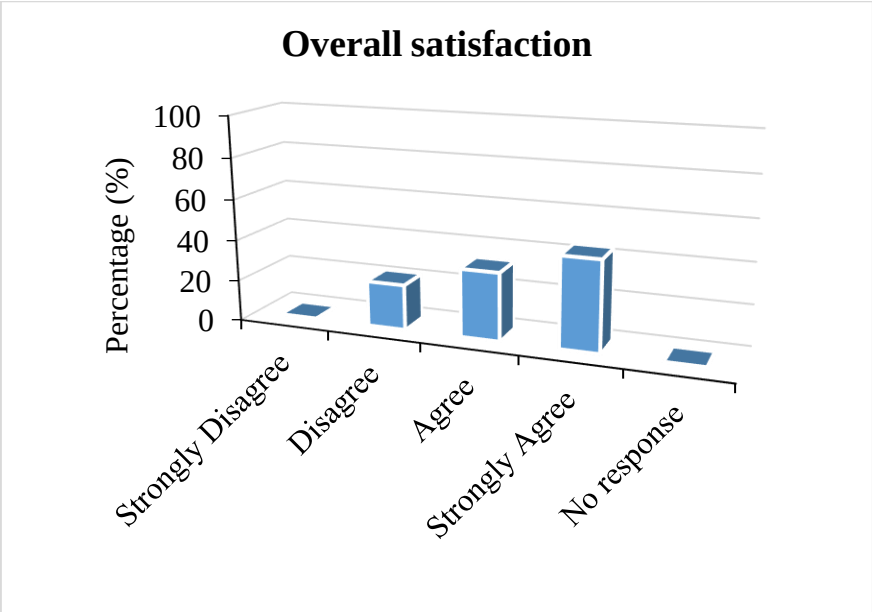

Figure 2: Quantitative feedback.

Qualitative Feedback

The study also reveals some of the interesting qualitative feedback data from students. After analysing the qualitative feedback provided by the students on the most helpful aspects of the unit and suggestions to improve the unit. Some of the qualitative comments are listed as below.

1. *Constant support and motivation is vital for the students especially in foreign environments to express their abilities, think out of box and develop independent working style.*
2. *Good communication between the student and the teacher is essential to avoid any misunderstanding and clearly understand the requirements of the unit.*
3. *Excellent organising (logistics/infrastructure) and set up at home and host universities is essential for easy and trouble free conduct of the unit.*
4. *Study tour is a great opportunity to interact with pioneers/experts in the respective engineering discipline at a global level.*
5. *Study tour helps students to develop project management skills of scoping, planning and executing with their own initiatives.*
6. *Study tour help student understand and adapt the unknown dimension of global work ethics, tradition and culture.*
7. *The student had a happy learning experience especially to balance their work and social commitments.*
8. *Assessment tasks and criteria need to be re designed to reflect the experiential learning involved in the unit.*
9. *Infrastructure (work station, internet and other logistics) provided at the host universities should be ensured and tested before the student arrival.*
10. *On time feedback on assignment will be helpful for the students to improve the performance*
11. *The study tour duration should be increased by a week as two weeks where not enough to cover the field study and get a valuable work experience.*

Overall, the students expresses satisfaction for providing an opportunity to be away from their usual work environments and to bring in the best of their abilities by adopting out of box thinking and balancing social-work commitments.

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Integrating Engineering Education with Workplace Training

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ABSTRACT

The purpose of this paper is to explore the requirement of engineering students getting well equipped to perform various engineering jobs which can be achieved through clustering formal Engineering Education at all stages with workplace training and informal learning. In this research paper, the inputs from various workplaces will be analysed. The disadvantage of lack of workplace training and the reasons behind the non-existence of efficient workplace training will be discussed. The research techniques such as surveys, industry and academic institution consultations will be employed and the feedback will be analysed. The integration of on the job training to Engineering Education curriculum will be proposed. Engineering education must go through a revolution in the learning and application processes. Technology has generated many successful advances in engineering education and higher education. But in reality, current Engineering Education structure cannot meet rapidly accelerating changes in the global environment. For maximum productivity and a successful career for engineers, the formal Engineering Education must be sandwiched with judicial mixture of informal education and workplace learning. To meet the industrial skill requirements, engineering students must be very familiar with the workplaces during formal education. Hence the integration of on the job training to Engineering Education curriculum is extremely necessary. The integration must be extended throughout their career in the form of workplace training.

Keywords: *Workplace training, On the job training, Engineering Education, Workplace skills*

INTRODUCTION

In the past two decades research in engineering highlighted the fact that engineers were being educated in a manner that would probably be no longer applicable by the time they exit school (Fortenberry, 2006). Hence there was a reported need for

innovative approaches to educating engineers aimed at developing adaptive people and organizations tasked with designing learning experiences to leverage students' strengths and experiences (Haghighi & Smith, 2008).The aim of this paper is an analysis of the importance of workplace learning and the requirements of integration of engineering education with workplace training.

In most of the workplaces, the application of engineering knowledge is below the expected standards. The knowledge of engineering staff at all levels may not be appropriate for the job they are supposed to perform. Even though the knowledge gained through academic education is of high standards, it may not be effectively applied in their workplace to gain the required output. There is a requirement of research with focus on the techniques to maximise the gain and application of engineering knowledge and skills in the workplace through effective workplace training. Engineering students must get an opportunity to get trained in a few companies according to their major studies to get familiar with the industrial application of what they study in the academic education. They may join with the on the job trainees or there may be a separate system of workplace training for engineering students.

Workplace training is common in large as well as small organizations. It is usually carried out informally, with an experienced colleague or mentor monitoring or guiding the trainee. It may be conducted on the plant floor, in a classroom or in any other place where work is being performed. Workplace training is ideally inexpensive since it is task based and requires only the existing equipments. It is also much less disruptive than other forms of training, because employees aren't removed from their duties, but are instead trained for their work while doing it (Gabriele, 2005). Supervisor gives immediate feedback, and trainees learn and improve their skills quickly which will escalate their confidence. Employees also feel more confident about their job performance when they are being coached by supervisors, and on-the-job training is a good way for new employees to build relationships with their comrades.

PAST RESEARCHES AND REPORTS

Workplace learning in industry has a powerful influence on the engineering students' identity development. There is a vast developmental differences observed among the students during workplace learning. To find explanations for these differences, one study was on students to identity development during workplace learning using a self-guiding and mentoring model. (Dehing, Jochems & Baartman, 2013). Research questions explored were:

(1) To what extent do bachelor engineering students develop their engineering identity during workplace learning?

(2) What are students' developmental models?

(3) Can different effects of these models on student identity development be found?

The study was conducted on 256 third-year bachelor student engineers in Netherlands. Two written questionnaires were used to collect the data, one before and one after workplace learning. The outcome was a significant incline and decline on the two aspects of identity development which are the clarity and identification. Combined achievement on the two aspects showed a sort out into four different development groups. Students entering workplace learning with a low identity score proved to catch up, while those entering with a high score slowed down and developed less. This indicates an insufficient preparation for workplace learning. The recommendation was that students' professional identity must be developed and included in the course design. Hence during the preparation, during workplace learning, and in the final year, it gets greater and explicates attention. For this purpose a system of career conversations could be used (Dehing, Jochems & Baartman, 2013).

Another research study was to identify the gaps in the engineering education and set out to accomplish the following high-level agenda:

a. Provide evidence for the existence of compound problems and their attributes,

b. Research the problem-solving processes of engineers while engaged in compound problem solving in the workplace, and

c. Recognize a new class of skills (compound problem solving), which extends existing models of expertise and expertise development in problem solving.

(Strobel1 & Pan, 2011)

The research suggests that expertise is highly domain specific. But, if attributes of expertise apply unequivocally to compound problem solving is unclear. The role of strategies play for solving different problems and how experts activate and switch between strategies also is unclear. No studies reveal expertise in compound problem solving. Since different types of problems intertwine with one another within compound problems, experts may utilize unique strategies to move between various kinds of problems. It necessitates further research to investigate whether existing knowledge in expertise could explain performance in compound problem solving.

The importance of work and problem solving efficiency in the workplace has been validated for years. For instance, the report by Sheppard et al. (2008) stated that job efficiency and problem solving is an essential thinking skill for engineers. To solve workplace problems, professionals in any field are hired, retained, and rewarded for their abilities. It is a challenge to prepare engineering students to solve real-world problems. Problem-based learning (PBL), project based teaching, or service learning (Savery, 2006) have been utilized by several instructional and educational strategies. The aspiration to integrate real-world workplace problems into the curriculum is evident from these approaches. It gives opportunities to face the same challenges of staying abreast with transforming roles of engineers in the workplace. Understanding and solving the problems in the workplace is essential to effectively

design problems for classrooms, support structures for, and effectiveness research on students' performance and conceptual development (Strobel1 & Pan, 2011).

In the paper published in January 1993, "Engineering Education: Innovation Through Integration", certain changes in engineering education has been suggested. It offers a new paradigm calling for a holistic baccalaureate education for engineers. The investigating theme about engineering education can be stated as "Engineering is an integrative process and thus engineering education, particularly at the baccalaureate level, should be designed towards that end" (Engineering Education: Innovation Through Integration, 1993)

PROBLEM DEFINITION

The engineering knowledge and skills have not been properly applied in the workplaces due to various reasons. Some of the reasons are as follows:

1. Absence of academic education integrated with workplace training.
2. Lack of proper knowledge and skills held by engineering graduates.
3. Inadequate workplace learning system.

The reason behind the difficulty in filling crucial positions experienced by most of the employers is that candidates lack essential skills, especially in engineering and skilled trades. The core problem is that engineering education and training is usually irrelevant to available jobs. Some employers have concerns with workplace training due to the following disadvantages and hence they do not entertain workplace training in their companies (Snell & Scott, 2015).

1. Low Productivity

The learners are taken at the actual work station for training since they are in the skills learning process. As a result, the productivity of the organisation will be lower.

2. Errors on Production

There may be the chances of errors on production since the trainees are not skilled in workplace activities. The output by learners may not meet quality standards.

3. Costly

On the job training is expensive since the production process will be disturbed by the trainees. The products will be of low quality or even get damaged due to unskilled trainees which increase due to the production cost.

4. Disturbance

The experienced employees and supervisors will get disturbed due to the interference of trainees since they will consult with them as part of learning process.

5. Possibility of Accidents

The inadequate skills and practical experience of the trainees can cause workplace accidents. Non-supervised use of tools and equipments by the trainees are hazardous.

Disadvantages of Lack of Training' in the Workplace

The success of the company is relying on the skilled and dedicated employees who perform in compliance with the industry standards. Focussed on the job training is being considered as unwanted expense by some of the companies. Some management decides that the new employees should learn from senior employees and supervisors which is an inefficient training system (Latta & Terry, 2008; Tina, 2017).

Unhappy Employees

The engineering employees must be dedicated and prideful in doing their job which will advance the company as well as allow them to climb up the career ladder. Lack of training will cause the employees remain unskilled which will cause demotivation among employees and decline in the company's progress. The loss in morale will result in employee turnover which cause the skilled applicants not to prefer working in such companies.

Low Production

The underperformance of the trainees will reduce the production rate. In their learning process the trainees will take considerable time which will slow down the production process. The trainee supervision requirements will reduce the supervisor's and experienced employees' productive time

Unsafe Work Environment

The Occupational Safety and Health Administration reported that the unskilled employees are more prone to injuries. The reason is that the untrained staffs are not familiar with the safe operation of tools and equipments. The hazard is more in companies with heavy duty machineries and hazardous materials.

Increased Expenses

The untrained employees will cause increased expenses such as first aid and medical costs due to the increased accident possibilities while using tools and equipments. The expenses will be more if there are compensation requirements and lawsuits.

Loss of Customers

The low quality products and inefficient services can cause decline in the quality which will cause loss of customers. Sales of the company will be reduced and the customers will approach competitors who are making better products and providing proper services.

Further considerations

The supervisors and senior staff may not have sufficient skills and knowledge to train the new employees. Even if they are skilled, they may not be proficient trainers or mentors. They will not have time available to train the new employees since they have their own job responsibilities. The trainees will need study resources and the supervisors will have to prepare learning resources and assessments tasks. There must be supervised practical tasks for the trainees to develop practical skills. The terms and concepts required for workplace will be different from the theoretical and practical learning at universities. The supervisors and senior staff will have to teach the new employees the terms and concepts practiced in industries. Unless there is time allocated for them for training, the informal training will not be adequate.

Knowledge, skill and attitude are the three primary components of Engineering education. Knowledge implies the Engineering Education facts and concepts. Skill is management and application of engineers' knowledge in problem solving is. Attitude is the way engineers use their skill and knowledge to achieve professional goal, in conformance with personal values, concerns, preferences and biases. Our aim is to develop a knowledgeable workforce with industry-ready knowledge, skill and attitude above the traditional engineering curriculum. The engineering education and training focus should advance from knowledge presentation to the concept of knowledge integration (Jesiek, Newswander & Borrego, 2009; Mastin, 2008)

RESEARCH METHODOLOGIES AND APPROACH

The following research techniques can be proposed to explore the possibilities for the integration of engineering education with workplace learning which can be customised according to students and institute requirements and work situations.

1. Conduct surveys at various workplaces using questionnaire and discussions with the staff at different levels.

2. Study and analyse the knowledge and skill requirements for workplaces and design a standard method in consultation with the industry.

3. Collaborate with Universities, TAFEs, Registered Training Organisations (RTOs) and government agencies to design education and mentoring programs, as well as apprenticeships and internships.

The research must progress embedding the following factors which will develop the knowledge and skills of the employees in the workplace.

Suggested workplace training techniques

One or more of the following four techniques can be employed in the research (Polley-Berte, 2014)

4. **Coaching:**

   This is a prescriptive and corrective method which involves one-on-one interaction by a supervisor or external experienced coach. The trainees will understand their strengths, weakness, and areas of improvement. This method may be adopted until the learners become proficient.

5. **Mentoring:**

   This technique investigates the trainees' strengths, weaknesses, and areas of improvement. This is conducted ongoing basis on-on-one by a well experienced company professional or supervisor. The trainees receive feedback, guidance, and they can identify the areas that may have been overlooked.

6. **Job Rotation:**

   Job rotation technique allows the learners to practice and achieve proficiency in various work aspects and different job roles. The learners get opportunities to try out different functions and exposed to different work areas

   Job rotation is beneficial to the company since the worker skill sets in critical areas gets diversifies. It also will help the company to get alerts about vacations, flu epidemics, and catastrophes etc. Employees recognise each other's job responsibilities since job rotation promotes organization-wide goal and objective sharing.

7. **Job Instruction Techniques:** These techniques help the trainers to plan, prepare, present, trial, implement and follow-up workplace learning. The plan includes a written work and the training objectives breakdown. The plan will be presented to the learners in the trail stage. During the process trainees will try out with regular follow up. Depending upon the business case and the proposed tasks, this method can be streamlined or made more complex.

Proposed workplace learning methods

In this research, effective learning transfer at workplace can use the following methods at the three stages which are preparation, action and evaluation (Cree & Macaulay, 2000; Alton, 2017).

1. Learning goals and outcomes identification

Review the requirement of the training and recognise the learning goals and outcomes clearly, before starting the workplace training. It will allow the training team to focus the training visualising the big picture in mind. It gives the trainees a clear idea of the aim of training, its importance and expected outcome.

2. Including real world examples

The more real life examples and situational experiences are used during the training of engineering students and trainees, the more exposure they will extract from the training. The real world examples prepare the trainees in facing the challenges they will face in the industries.

3. Provide post-training support

The post-training debriefing will help the trainees to identify, plan and discuss the correct application of skilled learned and guide them to meet their goals. It is very important to provide the trainees with ongoing support. It can be consultation

arrangements or ongoing onsite training facilities. This method will help them to rectify any concern they have during the application of what they learned during the training.

The ultimate success of workplace learning programs is the quality of learning transfer between the training team and trainees. The long-term success of future engineers depends upon the quality and amount of attention given to learning transfer.

Engineering students'/trainees' role in this research

During this research on workplace training, there are some responsibilities the engineering students/trainees have to focus on to acquire competence in the workplace. The trainees will have to employ the following techniques to enhance the knowledge and skills (Gilbert, 1978).

1. Expand knowledge for competence

The trainees will have to focus on acquiring comprehensive knowledge which consists of factual, conceptual, procedural or strategic knowledge. The trainees will become successful engineers when they acquire highly developed situational and strategic knowledge which will help them to approach different situations through different strategies.

2. Acquire and master the skills

Trainees must acquire skills through observing, doing, feeling and thinking in the workplace environment. To master the skills, trainees will have to practice more and build confidence

3. Differentiate the self with abilities

The trainees must understand the equation: ABILITIES = KNOWLEDGE + SKILLS

Engineering ability is the sum of Engineering Knowledge and Skill. To differentiate the self in terms of abilities, the learners need to make sure that they properly integrate knowledge and skills. While learning a new skill, trainees have to acquire comprehensive knowledge in the skill set.

4. Develop a winning attitude

There will be many engineers with same amount of knowledge and skills. Engineers with a winning attitude will excel at work. The trainees will have to develop their own method or technique to keep them high in quality. They will have to apply and test the techniques in certain situations to gain confidence to handle unforeseen situations.

5. Demonstrating competence

The equation for competence in work place is COMPETENCE = ABILITIES + ATTITUDE

Through experience, the trainees must recognize more situational elements, organize the situation and concentrate on important elements. A competent engineer is able to assess the situation, set the goal and choose a best strategy. In the workplace, acquiring competence in the workplace implies that the trainees might be ready to perform real-life situation.

In conclusions, to be a successful engineer with leadership qualities, learners have to integrate their knowledge and skills in a way people can see it as abilities and then they need to use a winning attitude that transforms these abilities into a visible competence everyone can develop confidence upon.

OUTCOME

The expected outcome of this proposed research is to redesign engineering education to meet the requirements of engineering in industries which is an integrative process. Incremental changes in course content and or rearrangement and adjustment of traditional isolated areas cannot achieve this outcome in engineering education. The engineering education curriculum needs to be changed structurally and culturally in the broad sense. The experience obtained from industries proves that engineering education should emphasis advance from course content focus to a more comprehensive learning.

The development of human resources must be the focus of future engineering education. The curriculum must also connect and integrate the individual parts of broad educational experience. Our discussions and analysed reports assure the research requirements to achieve the required engineering education outcome for industries.

A concurrent change is required from the predominant engineering academic culture which is based on compartmentalization of knowledge and individual specialization. Engineering education needs to be changed to a culture that values integration with workplace learning. It should focus on job specialised training, dedicated skills achievement, leadership qualities, teamwork and cross disciplinary expertise. Although the responsibility of the quality of engineering education is

directly on the students, faculty and the campus administration, the ultimate responsibility is on the appropriate curriculum and qualified and talented faculty.

The revised engineering education will require changes in the theory and practical application we teach as well as the methods and tools used to teach. The technical content cannot be isolated from industrial application. The engineering faculty is responsible only for the technical theory. Students must learn the practical application and nontechnical context through workplace training as part of their education as engineers. Engineering education must focus on workplace learning approaches that will enhance effective learning and students learning from professional engineers. We need to focus our research on student-faculty interaction which is more structured with active workplace learning. The engineering faculty and professional engineers must be the guide for student learning.

CONCLUSION

For effective engineering education there must be a comprehensive change in the curriculum which integrates on campus theory and practical learning with workplace training. The focus of engineering education must not be restricted to education in universities or engineering colleges. The entire curriculum must be restructured by including workplace learning modules at various phases of academic education which will benefit engineering education. The goal is well educated, highly skilled, technically competent and professionally contributing graduates. The post university engineers must be fully capable and confident with the job being performed justifying the time and efforts spent for engineering education. The engineering companies must be celebrating the profession with their talent pool and not just tolerating incompetent engineers.

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Compuphilia: The Burgeoning Sociocultural Addiction to Computechnology

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ABSTRACT/INTRODUCTION

If there is a defining condition of the modern age, it is undoubtedly the unbridled faith we have in the power of technology to provide a panacea for virtually all our problems, be they technological problems or not. Western culture's unreserved commitment to the importance of what we shall call 'sociocultural computechnology" represents one facet of this almost religious-like faith in technology. In this paper, we shall argue that the ever burgeoning cultural preoccupation with computers has become so socially entrenched that it represents a syndrome in its own right, which Laura has elsewhere) unaffectionately dubbed, "Compuphilia" (Laura,R.S. et al, 2008). The term 'Compuphilia' is intended to convey the sense of an individual's infatuation or obsession with computers that is so extreme and addictive that the justification for its habitual use has become perilously uncritical and dangerously mesmerizing. The burden of this piece is to show that this mindless obsession with computechnology has blinded the western world to the depersonalization impacts upon human relationships which have resulted from compuphilia. In particular, one paradoxical outcome is that society has so fervently adopted computechnology outside and inside such a wide array of institutions that it has now become commonplace to anthropomorphise (i.e.. ascribe human attributes to our computers) while at the same time unabashedly and progressively treating humans as if they were machines. The implications of this conceptual shift have momentous pedagogic and sociocultural consequences which have largely gone unnoticed. For example, many people now 'christen' their computer with the name of a person such as '*James*' or '*Janet', and* thus by construing it in human terms, feel comfortable in excusing its aberrant behavior and

mechanistic breakdowns with anthropomorphized descriptions of compassionate concern. When a computer is slow in booting up, or exhibiting aberrations of mechanical functionality, it is not unusual for users to say that the computer is '*exhausted*,'' or '*suffering from Monday morning blues', 'temperamental', 'depressed', or* even *'on strike"*, to name only a few. *At the same* time when a person is not working effectively in the workplace, or misunderstands a supervisory directive, it is not unusual for the employee or student to be reprimanded with ascriptions of mechanistic metaphors such as, '*come on, get with the program', 'get plugged in', 'boot up'*, or even, '*get connected before it is too late*'. Similarly, it is not uncommon for people to express their adulation for an especially diligent worker with a compliment such as,'*he works like a machine*'. Some people even use other mechanistically-inspired phrases of praise such as '*you are a Machine*' to simulate a mechanistic attribution of personal identity to a human being. In essence, technologically advanced societies have come to sympathetically treat the **mechanistic** failings of our computers as **human** shortcomings, while paradoxically and aggressively chastising those people who naturally exhibit **human** shortcomings by directly suggesting that such people need to learn to work with '*machine-like efficiency,' especially* if they want to keep their employment. Moreover, when the performance outcome of employees is outstanding , many employers have no hesitation at all in passionately praising them by describing him/her as if they were a 'machine', often using mechanistic phrases such as, '*You work like a Machine'* and straightforwardly, *'You are a Machine*', though they are in fact humans.in In the last analysis, we have created a discourse within which we anthropomorphise an array of our machines such as restored cars in human descriptions like , '*The Ole Girl has had a Resurrection*', along with the ascription of human names to our computers, I pads, Laptops and even our mobile phones. In so doing, we make ourselves more connected to the very machines which disconnect us from our personal face-to-face interchanges with other humans, while simultaneously making it easier to be' forgiving of them' when they display their mechanistic dysfunctions. Similarly, we create a discourse within which we dehumanise employees by criticising them for not being able to work like machines, just as we expect employees to define their own level of efficiency as judged by the efficiency of the computers at which they work. So we select mechanistic phrases as discussed earlier such as ' get connected' and ' get plugged in' which imply that the pulse of our efficiency should be determined by the computechnological devices upon which we rely.

THE TECHNOLOGICAL CONNECTION: CAN SCHOOLS BE TOO PLUGGED IN?

Given the increasing awareness of the pedagogic importance of the depth of bonding between students and teachers, there is a mordant irony in the fact that so little critical reflection exists which questions whether computer-based learning is systematically depersonalising the school environment. To understand the source of this irony we first need to comprehend why western culture is far too quick to

applaud the success of technology, while at the same time , reluctantly slow to recant its indiscretions. Because technology is now a defining characteristic of the modern age, so to say, we are as a culture more inclined to embrace new technologies unreflectively than to assess them critically. One plausible explanation for this discrepancy is that technology has itself come to function as the standard measure of progress and thus as the primary means of resolving our problems, whether they be technological or not.

This being so, it is perhaps unsurprising that computechnology has been assimilated into the school curriculum more as matter of idle ritual, than as a consequence of critically rational assessment and philosophical discussion. Within the culture of Laura's construction of compuphilia (Laura, R.S. 2017) the trust we put in computer-based education may not so much have been earned, as it has been inherited as part of our socio-cultural commitment to, and ethos of a technological worldview. Is it not possible that we have become so bedazzled by the power of technology to let us walk upon the earth as giants that we have failed in educational and other institutional contexts to discern that we come to walk the earth as 'blinded technological giants' who have lost our sense of purpose? Stoll states, “a poor substitute it is this virtual realty where frustration is legion and where- in the holy name of Education and progress-important aspects of human interaction are relentlessly devalued” (Stoll, 1995:4).

Technological power does not in itself bequeath philosophical vision, but without that vision we have only a shadow of a picture of what it is that gives education its value and in turn confirms that the educational goals we seek are actually worth pursuing. In a study conducted by Warschauer et al. (2004) on computer use in American schools, for example, he concluded that placing computers and internet connections, especially in low-SES schools in and of itself “does little to address the serious educational challenges faced by these schools” (Warschauer et al, 2004:585).Thus, even when it is so admirably perceived that the bonds between students and teachers represent an integral constituent of effective pedagogy, the suspicion that computer–based education could possibly serve as an impediment to such bonding rarely occurs.

THEOLOGIZING TECHNOLOGY

The concept of technology is admittedly multifaceted, and it is no part of our purpose here to get mired in the semantic morass of definitional demarcation which surrounds it. Suffice to say, there exists a subtle but monumental difference between the sense of technology as it refers to the specific machines, tools or devices we use to direct or facilitate our interactions within the world around us, on the one hand, and the sense of technology as a Weltbild or conceptual scheme within which we actually view the impacts of computechnological depersonalisation throughout the world, on the other. The point of important distinction we am endeavouring to bring

to bold relief here is that we no longer simply use technology; we live it, and we imbibe it. This being so, technology is ascribed and revered as an authority and priority in our lives that is tantamount to theologizing it. We literally experience our existence in the midst of our technologies, and we use technology to become co-creators of a technological world. Our lives, our movements, and even our values become technologically textured. In a bizarre sense it could be said that in so doing, we unwittingly 'sacralize' what is in essence 'secular' and we secularize what is in essence sacred. Part of the problem is that we have, as a culture, been seduced into believing that technology, in general, is the panacea or 'cure-all' for all our problems. This being so, we theologize it by idealising it as a form of salvation. It is touted not only as a form of socio-salvation, but as a modality of spiritual salvation, by way of which wholeness, peace and self-completion can be brought to fruition.

Because we are surrounded by and immersed in the technological texturing of our lives, we tend not to notice how profoundly technology has impacted on every aspect of the way we live, including the sacredness, as it were, of our relationships with each other. Indeed what might be called the 'theology of technology' has become so pervasive that educators are seduced into thinking that they cannot live without the materialist catechism it extols. This being so, we are blinded to the growing body of evidence and human experience which strongly suggests that we cannot live without it, when the truth is that Computechnology has become so ubiquitous that it is so addictive that it has become increasingly difficult to live with it. "In an age when the market has replaced the temple as the epicenter of our social landscape…it was, no doubt, naive to imagine that cyberspace could provide a more 'pure' foundation for our dreams" (Wertheim, 2002, 225).

COMPUTECHNOLOGY AND DEPERSONALISATION

We are now in a position to make explicit our main reservations about computer-based education. The persistent claims and promises for the most recent innovations in computer mediated communication are inescapable. This technological 'advance', it is argued, will bring to our lives knowledge, power, pleasure, personal liberation, and unlimited shopping (Brook & Boal, 1995, viii; see also Laura, R.S.& F.D.Hannam, 2017). On this rationale , whatever is lacking in our lives can be provided by way of greater access to new forms of communication, entertainment and information, all of which can be provided by the computer, tablets, and Laptops.

Nonetheless, let us make plain that we have no wish to deny the many benefits which computechnology makes available both inside and outside the classroom. Nor do we wish to contest that in certain contexts computechnology may both encourage and facilitate the cultivation of personal relationships across the continuum of human interchange. The problem to which we are alluding is a different one, and its resolution depends firmly on qualitative considerations, and a spectrum of quantitative ones.

The first consideration to be addressed relates to the fact that while it is happily admitted that appropriate contexts exist for the use of computechnology, we have as a culture, partly as a consequence of vested political and economic interests, generalized the specific cases of its acceptable use in such a way that the application of virtually any specific form of technology in question becomes universal. For example, it has been only a decade or more since it was acknowledged that enrolment procedures for students who resided long distances from universities could be facilitated with computechnology. The idea is that computer enrolment procedures made the process more administratively 'efficient' by enrolling students 'on-line'. Shortly thereafter, however, it was legislated that enrolments for all students would have to be organized on-line. From a specifically justified principle for the use of computechnology in one context, an almost imperceptible extrapolation was made which universalised and extrapolated the principle in other contexts in which it has not been justified. This being so, we thereby diminish options for students by standardising procedures which by their very nature discourage face to face interchange. Because provision of on-line courses for distance students may be justified, it clearly does not follow, by parity of reasoning, that any substantive justification has been provided to show that all university courses should be offered on-line and only on-line, though we all know that such degree courses as this already exist.

By embracing the theologized form of secular life within which the technology of electronic communication is embedded, we at one and the same time marginalize and compromise the value of face to face interchange. The more that the use of computers is demanded of us, the more we shall be distracted from the salient value of cultivating truly deep face to face human experiences. From this value presumption, however, it does not follow that people should never spend time at a computer screen. Nor does it mean that if you spend time at a computer, you will never have any deep human experiences. It just means that the burgeoning obsession with computechnology creates its own subculture within which its constituents are covertly encouraged to rely ever more fervently on mechanistic and impersonal interactions which marginalises and rigidifies the regimen of those people seeking to live human lives (Lakoff, 1995: 124). This being so, our reliance upon computechnology and its various modes of communication (eg. Mobile phones, video games,tablets and internet transactions, etc) become ever more embedded, taken for granted, and thus socially ubiquitous, without philosophical reflection as to why this should be so. Should we not be asking whether our resolute commitment to computer-based learning serves unwittingly to devalue the qualitative experience of our children's education by increasingly substituting face to face classroom interchanges with mechanically mediated informational transmissions characterised primarily by the processing of data? Is it not worth considering that the more time we encourage school children to spend in the isolated context of the computer screen, the less time they spend actually interacting with their teachers, and the less time they spend learning how to interact with others to form bonds of trust and loyalty? Should we not be concerned philosophically that the pedagogic goal of computopia may in the end serve inadvertently to propagate contexts of

depersonalization,not only in schools, but in both the workplace and the wider community? (Laura & Chapman, 2009)

The Loss of Face: The Human Face

That computechnology has facilitated and proliferated the forms of communication now available to us in incontestable. It is salutary to remind ourselves, however, that the more forms of mechanistic communication we increasingly institutionalise and embed educationally to expand the culture of computechnology, the increasingly less intimate and more depersonalised become the face to face human interactions that they were designed to promulgate. Simply put, the argument advanced here affirms that the depersonalisation of human relationships and the modalities of dehumanisation which follow from it are an inevitable consequence of universalising the highly mechanised modes of communication which characterise computechnology. The mind set which results from the obsession with computechnological interaction reverts to 'compuphilia' which becomes enshrined to represent a socially legitimated and educationally enshrined syndrome which overtly encourages the love of computers, without adequately understanding the extent to which their universality is by its very nature a threat to the cultivation and preservation of empathetically inspired and loving relationships. The failure to understand the nature of this threat is why, as a culture, we tend unwittingly to anthromophormise our machines, while at the same time dehumanizing each other. Consequently, these contrary dispositions give rise to serious moral antinomies, most of which have been badly neglected. For example, as intimated earlier, humans are now expected by their employers- or we demand it of ourselves- to work at our computers, not only throughout the day ,but sometimes tirelessly into the night. One promise of computopia was to give us all, even school children, more leisure time, but the truth is that when we have more leisure time, we all too often spend it working or ‘playing’ at the computer in virtual isolation. I-Pods, I-Pads, and Tablets are just another symptom of this growing trend towards what Laura has called ‘technological isolationism’(Laura, R.S.2012) It is well worth noting that to date insufficient attention has been paid to the deleterious physical and mental effects of these new forms of social isolation, with regard to loneliness,alienation ,depression,and increasing rates of suicide. It is no longer uncommon to see a group of young people who have decided to go to dinner spending more time engaged on their mobiles than they do interfacing with their friends who are in attendance. Although they ostensibly sit together, much of their time is taken up sitting in isolation with their phones frenetically texting, emailing, phone shopping, game playing, or hunting for dates with the opposite sex, and particularly those in the same vicinity. They may have agreed to come out to be together, but in reality, their union is an idle ritual of voluntary solitude. While they have gathered together, they are disconnected by having voluntarily chosen the purgatory of 'self-isolation' on their mobiles.

In such circumstances they can be described as being together in a group, but paradoxically, their interactions with each other are only minimally exemplified. This bizarre form of disconnection is witnessed by the fact that they are more connected to their mobiles than they are to each other. What has happened almost imperceptibly, Because we have been seduced by these devices, and especially by our mobile phones, we always keep them with us, so that no matter what we are doing, we are obliged to reach out to them in the illusory fear that not being able to do so will rob us of our opportunity to preserve our contact with the world around us. In short, we have unfolded a culture of addiction to our mobile phones, keeping them ever close to us, and becoming acutely disconcerted, should we have lost or left our mobile phone, or I Pad, for that matter, someplace where we are not. Because we spend progressively more time communicating with others in isolation with our phones, I Pads/Tablets, and even our Laptops, we tend not to notice that we are spending less time, and certainly less quality time with each other. Potentially intimate and vital personal relationships are in essence being channeled without much, if any notice on society's part, into impersonal one dimensional, and mechanistically-mediated ones. We have slipped ineluctably into a different state of consciousness, or a simulacrum of human relationship, which structurally encourages the substitution of face to face forms of human interchange with technologically-mediated forms of communication, even when face-to-face communication is available.

If a text or photo comes in, or even an uninvited promo or advertisement for any of a variety of products, it is their mobile that is given priority, not the guests around the table.. This being so, the continuity of connection with friends is jeopardised by being regularly interrupted. As a consequence, the continuity of table discussion becomes compromised and fragmented, making it less likely that participants will return to the same topic, or even to the same person with whom they were conversing. The reason for this that mobile usage at the table is so active that in the intervening time between table conversation and mobile phone conversations and texting, their table interlocutor is likely to have been distracted either by the making or receipt of a text message on their own phone.

CONCLUSION

We have from the outset made clear that our primary objective in this piece has been to explore the sociocultural phenomenon of what Laura has elsewhere identified as 'compuphilia'. Despite the many benefits of computechnological development, we have been slow as a culture of technophiles to recant its indiscretions and reflect critically upon the impact which compuphilia is having, particularly among schoolchildren worldwide, in the pursuit of loneliness through the loss of genuine intimacy of deep rather than cosmetic or sexually utilitarian relationships of convenience. Our conclusion is that we have in essence inadvertently ushered in and are now bearing witness to the birth of a potentially global culture addicted to mobile phones, I Pads, Tablets, and to some extent Laptops. In Doing so, we have

all too often mindlessly relinquished our Face-to-Face communication with the people around us in favour of engaging our computechnological devices whenever they call out to us for attention. We have argued that the personalisation of Face-to-Face communication is of paramount importance to building sacred bonds of loyalty and trust between people. Our communication has been compromised in the transition from personal interfaces with people to electronically-mediated ones. This being so, our addiction to the mobile phone represents a secularisation of many of the things that were once construed as 'sacred', while simultaneously 'sacrilising' many of the things that were once regarded as 'secular'. In so doing, we are turning the world of human relationships on its head. Admittedly, we have only had time to tease out some of the neglected implications of compuphelia, and mobile phone addiction, as they pertain to the new culture of depersonalisation of human relationships and the dehumanisation of human beings as a consequence. It is incontestable that we live in the era of technological giants, and that there are many virtues to justify its priviledge. However, we have endeavoured to bring into bold relief the deeper truth that without serious philosophical reflection on addiction of every kind, we will inevitably become a global culture of ' blinded giants' who have lost our way and the fundamental values of purposive direction. Leadership in education should be designed to emancipate us from the myopia of materialist conceptual schemes within which our intellectual imagination is incarcerated, while the commercial infrastructures that sustain vested interests are theologised as worthy of worthy of worship, though in fact they are not Most of us know that computechnology can empower us and make us very strong, but we need to know also that compuphilia can make us very weak, because obsession is a form of addiction, and addiction is a form of paralysis of imagination, leading to conformity. Conformity leads to promulgating the Status Quo, and we do not make the world a better place by keeping the world as it is. We tend to forget, for example, or prefer not to be reminded that the status of computechnology depends in large part on the corporate vested interests of the companies that produce computer technology which is designed to be obsolete and out of date at the time of its being launched. This being so, the newness of its marketing introduction will soon be superseded by new technologies, ironically already existing and waiting in line to usher in the next wave of sales that sustain the commercial goal of relentless marketability.

Lest we be misunderstood, it has been no part of our purpose to deny that computer technology can serve to facilitate communication with others who are remote from us, or in proximity, depending upon circumstances, and whether the medium of contact is undertaken by way of e-mail, videoconferencing, teleconferencing, on-line banking, home shopping, electronic voting or telecommuting.

Notwithstanding these benefits, we have been concerned to argue here that the potential for integrated well-being and the forming of deep and trusting relationships not only between teachers and students, but between us all is an integral factor in educational outcomes. Our view is that the value of all this is being jeopardised by the increasing reliance on computechnology as the predominant medium within which education is administered and mediated at virtually every level of teaching. A central concern of this piece has been to show that such

electronic technologies can easily become depersonalising and dehumanising when the computehnological relationships they galvanise are regularly substituted for the face to face personal modes of human contact and interchange, which by their very nature have the potential to be intrinsically richer than electronically mediated ones. Stoll states, "a poor substitute it is this virtual reality where frustration is legion and where- in the holy name of Education and progress-important aspects of human interaction are relentlessly devalued" (Stoll, 1995:4). We submit that this is as true in the educational context as it is in society generally. When we sacralise technology, we are at one and the same time marginalising the potential of our humanity, and in the final analysis it is the promulgation of our humanity and the empathy for service to others in need that gives us the best chance of a better world.

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Active Learning Assessment through Inquiry-Based Learning Experiences in a Classroom

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ABSTRACT

The purpose of this research has been to design, manage, and integrate course contents for facilitating inquiry-based learning experiences of 33 third year students from electrical technology education in the Faculty of Industrial Education and Technology, KMUTT (King Mongkut's University of Technology Thonburi). The course contents has covered scientific and engineering practices from the STEM disciplines (Science, Technology, Engineering, and Mathematics). The contents has been designed to provide inquiry-based learning experiences using five stages of an inquiry cycle, namely, to engage, to explore, to explain, to elaborate, and to evaluate. The results of this research has revealed authentic inquiry-based learning through a variety of instructor-led processes, such as, observation and interview, and through students' understanding of scientific skills and methods. This helped the students to adequately apply their knowledge or skills to their selected topics using problem-based learning or project-based learning. The learner-selected topics for inquiry has been based on real life or any authentic situation. This research has confirmed that this project will be producing 21st century learning outcomes which included individual effort, team collaboration, self-regulation, and oral and written communication skills, to name a few.

Keywords: *Active Learning, Inquiry-Based Learning, Inquiry Cycles, Project-Based Learning, Problem-Based Learning, Learning Outcomes, Authentic Assessment*

INTRODUCTION

According to Section 4 of the National Education Act 2542 B.E. with Amendments (The Second National Education Act 2545 B.E.) and Further Amendments (The Third National Education Act 2553 B.E.), "Lifelong education means education resulting from integration of formal, non-formal, and informal education so as to create ability for continuous lifelong development of quality of life." Chapter 4, National Education Guidelines, read: "Education shall be based on the principle that all learners are capable of learning and self-development, and are regarded as being most important. The teaching-learning process shall aim at enabling the learners to develop themselves at their own pace and to the best of their potentiality. Learners are the most important." Moreover, Section 24 elaborates that in organizing the learning process, educational institutions and agencies concerned shall "(1) provide substance and arrange activities in line with the learners' interests and aptitudes…(2) provide training in thinking process, management, how to face various situations and application of knowledge for obviating and solving problems (3) organize activities for learners to draw from authentic experience; drill in practical work for complete master, enable learners to think critically and acquire the reading habit and continuous thirst for knowledge (4) achieve in all subjects a balanced integration of subject matter, integrity, values and desirable attributes…(5) enable instructors to create the ambiance, environment, instructional media and facilities for learners to learn and be all-round persons, able to benefit from research as part of the learning process…" (Office of the National Education Commission, 2010).

The lecturers and researchers in the Department of Electrical Technology Education, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi (hereinafter, KMUTT), have observed that the instructional problems still exist and they fail to achieve the ideal principles as stated in the National Education Act 2542 B.E. with Amendments (The Second Act 2545 B.E.) and Further Amendments (The Third Act 2553 B.E.). Dr. Prasert Palitponkarnpim and Dr. Arun Wittayasuporn have suggested (Rak-amunaykit, 2016) the deconstruction of Thai education in order to develop learners in the 21st century having the following attributes: 1. to focus more on learning than on achieving knowledge and to focus more on problem-solving procedures than arriving to answers (the process should be given more importance than getting an outcome); and 2. to develop learning skills by encouraging critical thinking or promote the ability to think and substantiate with reasons (not just by memorizing things). Also, to develop communication skills or the ability to convey ideas to others and engage in debates and discussions. The learners should possess the skill

of engaging and interacting in social networks and have respect for the ideas of others. To do so, the learners need to develop another skill, which is "creativity", or the ability to use in-depth knowledge to build up learning capacity and IT skills. They also need to learn other living skills such as conflict-resolution etc. All these skills are quite difficult to teach in classrooms. So, they should be taught through seminars or projects wherein the whole process of learning could be more systematical.

To address the above-mentioned issues regarding teaching and learning, it had been decided to conduct a research study to assess the development through active learning. This study included Inquiry-Based Learning Experiences of students from Electrical Technology Education belonging to the Faculty of Industrial Education and Technology at KMUTT. The research findings had been used to develop the instructing methods while conducting classes in the Department of Electrical Technology Education in order to meet the targeted requirements of Education 4.0 of Thailand (Fisk, 2017).These targets are: Diverse time and place; Personalized learning; Free choice; Project based; Field experience; Data interpretation; Exams will change completely; Student ownership; Mentoring will become more important.

Purpose of this Study

The purpose of this study had been:

1. To design, manage, and integrate course contents for inquiry-based learning (5Es) experiences offered to the third year students in electrical technology education in the Faculty of Industrial Education and Technology, KMUTT.

2. To assess the learning outcomes based on a learning sequence of 5Es, STEM, and find out the desired attributes for the 21st century students belonging to the 3rd year of electrical technology education program in the Faculty of Industrial Education and Technology, KMUTT.

The Research Questions

The research questions would be as follows:

1. Could learning outcomes based on a learning sequence of 5Es enhance the desired attributes for the 21st century students studying in the 3rd year of electrical technology education program in the Faculty of Industrial Education and Technology, KMUTT?

2. How could we know that a learning sequence of 5Es would promote the desired attributes for the 21st century students studying in the 3rd year of electrical technology education program in the Faculty of Industrial Education and Technology, KMUTT?

BACKGROUND

This research had been designed in accordance with the principles of active learning through inquiry-based learning experiences as offered to the students from electrical technology education program in the Faculty of Industrial Education and Technology, KMUTT. The principles were based on a learning sequence of 5Es (Bybee, R. et al., 2006) which involved scientific and engineering practices, as well as technology processes, so that learners could achieve desired attributes or expected learning outcomes for the 21st century (Law, N. et al., 2002). These attributes included learning skills, communication skills, life skills, and IT skills, as well as attributes for Education 4.0 which focused on education at any time, at any place which is student centered and the learning outcomes were assessed by authentic assessment tasks.

RESEARCH METHODOLOGY

The methodology used by the researchers while conducting this study is as follows:

Sampling Group

The sampling group consisted of 33 third year students from the electrical power program under the Electrical Technology Education Department of the Faculty of Industrial Education and Technology, KMUTT. This study had been conducted during the second semester of academic year 2016.

Variables

The variables considered for this study were:

1. Independent variables:

    1. 5Es (The five stages of an inquiry cycle, namely, to engage, to explore, to explain, to elaborate, and to evaluate.)

2. STEM (Brown, R. et al., 2011) include scientific and engineering practices as well as technology processes.

2. Dependent variables:

1. The expected learning outcomes as in 21st century characteristics,

2. The authentic assessment (Custer, Rodney L., 1996) using rubrics as follows:

3	equates with	Well organized, demonstrates logical sequencing and sentence structure
2	equates with	Well organized, but demonstrates illogical sequencing or sentence structure
1	equates with	Weakly organized.

2.3 Achievement test included midterm and final

Scope of the Study

The ETE 351 course or Principle of Inquiry-Based Learning for Technical Teaching would be required as the scope of the study for students in the third year electrical power program under the Electrical Technology Education Department, Faculty of Industrial Education and Technology, KMUTT. The study had been conducted during the second semester of academic year 2016.

Data Analysis

To analyse the data, authentic assessment had been done relating to the learning outcome of the learners in tune to 21st century characteristics.

Data Collection

In order to collect the data according to the principle of 5Es, a series of learning activities had been planned for the whole term, i.e., the second term of academic year 2016, during which the classes for ETE 351 course had been conducted. The title of the course is “Principle of Inquiry-Based Learning for Technical Teaching”. The details are as summarized in Table 1.

Table 1: Learning sequence (of 5Es) related with learning activities.

5Es	Learning Activities
1. Engage	1. Thirty-three students from the electrical technology education (hereinafter, ETE) were divided into 11 groups of three each. 2. Problems had been set up according to the current situations related to ETE. 3. tudents in each group were supposed to write a project (mentioning causes and consequences pertaining to the concerned project. For example, a project on "A Car Fired After Filling out Petrol") including a project title, its objectives,

5Es	Learning Activities
	expected outcomes, hypotheses (one hypothesis should be given every student) and references.
2. Explore	4. Hypotheses should be used (including cause and consequence factors such as "A Short Circuit of Battery Causes a Spark in a Car). 5. A project title should be written alongside with one's hypothesis. 6. Data, supposed to be collected in order to examine the factors. This could either be done by making a report or by conducting an experiment or through literature review.
3. Explain	7. The project findings could be presented in various forms such as graph, chart, image or a piece of work such as a circuit. 8. The learners needed to explain the causes and the consequences so as to accept or reject his/her mentioned hypothesis.
4. Elaborate	9. Explain and elaborate the data that had been gathered to meet acceptance or rejection of the mentioned hypothesis. 10. The student should also clearly elaborate the causes and the consequences in order to establish the acceptance or rejection of his/her hypothesis.
1. Evaluate	2. The group had built a body of knowledge from the project. 3. The group had suggested an organization, a user or other concerned factors regarding the body of knowledge.

FINDINGS

The results of this research could be summarized as follows:

According to the students' achievement or students' midterm and final results, it had been found that: 22 or 66.67% scored 'A', 5 or 15.15% scored 'B^+', 3 or 9.09% scored 'B', 2 or 6.06 scored 'C^+', and 1 or 3.03 scored 'C'.

While using rubrics to assess the students' project as specified in Table 1, it had been observed that only two groups or 18.18% of the students' work were well organized and demonstrated logical sequencing and sentence structures. Five groups or 45.45% of the students showed that their work was well organized, but they demonstrated illogical sequencing or sentence structures. The rest of the four groups (or 36.36% students) had been evaluated with a very weakly organized work.

DISCUSSION

According to the research findings pertaining to a learning sequence of 5Es, it had been found that the learning activities (Task 1: Problem Statement; Task 2: Hypothesizing, Data Collection; Task 3: Analysis, Interpreting, Generalizing, Inferring; Task 4: Discussion; and Task 5: Suggestions) complied with STEM or Scientific and Engineering Practices and Technology Process, in the following ways: 1. Observation; 2. Investigation; 3. Testing, Making, Mock-ups; 4. Acceptance, Alteration, Rejection; and 5. Chosen Ideas should promote the expected learning outcomes of the 21st century characteristics such as the student curiosity and imagination; self-regulation, determination; critical thinking; collaboration across networks; and vision for the future.

CONCLUSIONS

After the instructional management followed the 5Es principle, it had been found out that the instruction procedure also promoted STEM and/or Education 4.0 and helped learners to cultivate the attributes, such as Learning Skills, Communication Skill, Life Skill and IT Skill for the 21st century which were in tune to Thailand 4.0.

ACKNOWLEDGEMENT

This research had been financially supported by the grants allotted from the project of teaching and learning on integration. The authors are thankful to the Faculty of Industrial Education and Technology, KMUTT for receiving great assistance to conduct the research.

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MOOCs: Education for all– on Going Development in India

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ABSTRACT

It is evident, that the number of qualified teachers is less but the number of students willing to learn new technologies is increasing tremendously. Therefore, it is desired that alternative methods should be adopted to reduce the gap between the required number of qualified teachers and the actually available. As the technology is evolving rapidly, Massively Open Online Courses (MOOCs) appears to be an imminent concept which allows the students to use the IT infrastructure to learn while sitting at their home or workplace. MOOCs help the students to nurture problem-solving capabilities in them with the help of a plethora of online courses in diverse fields. Learners can choose courses of their interest and acquire a certificate of the same. This paper explores the concept and benefits of MOOCs in today's scenario, its advantages like freedom from geographic boundaries, flexibility, optimal cost, better educational outcomes. Further, this paper highlights challenges and limitations towards implementing MOOCs such as the dearth of infrastructure in developing countries, absence of proper assessment method, invalidity of such courses in conventional degree level programs, lack of practical sessions, and dropout rate. Significant developments in the field of MOOCs are ongoing in India under the banner of Ministry of Human Resource Development's project SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds). Nature Journal survey has shown that India ranked second in the world to access MOOCs services. Indian Institute of Bombay and Indian Institute of Kharagpur started a program called T10KT (Train 10 Thousand (K) Teachers) to conduct large-scale teachers training and E-learning awareness program. This paper wraps up with some other developments implementing MOOCs in India with some pragmatic case studies.

Keywords— *MOOCs, e-contents, Coursera, Udacity, edX, Swayam, India*

INTRODUCTION

Learning is an art of acquiring new skills, knowledge, and behavior which is driven by goals. It is a continuous process and involves different technological tools. With the advancement of technology, E-Learning plays an important role which involves the use of electronic media in learning. According to Bernard Luskin, the “e” of e-learning implies “exciting, energetic, enthusiastic, emotional, extended, excellent, and educational” in addition to "electronic” [1] whereas according to Parks the "e" implies “everything, everyone, engaging, easy” [2]. In E-learning various professional and non-professional courses are being offered by the Universities across the globe through CDs, DVDs, Online or Offline video/audio content. The various online courses provided for E-learning are Coursera, edX, Udacity, Swayam (Indian MOOC platform) etc.

In 2008, two separate persons David Cormier and Bryan Alexander coined the term MOOC (Massive Open Online Courses)[4]. It involves large numbers of course participants who can access information through the internet. It should have open access, open content and open platform. It involves the use of multiple devices from disparate locations to access the course content. MOOC concept not only concerned with providing Information Technology (IT) education but includes other domains also. IT is just an enabler of MOOC. An article published in Nature Journal [3] conducted a survey of courses offered by Coursera up to March 2013 is shown in figure 1.

So, MOOCs are free non-degree online courses with open unlimited global enrollment to anyone who desires to learn, and regardless of their current educational level [4]. Princeton University [15], Stanford University [16], University of Michigan [17], Massachusetts Institute of Technology [18] and Harvard University [19] and top tier universities are offering free and online courses to attract people for higher and quality education. As per the European Commission's Open Education Europa initiative, there were over 3,842 MOOCs worldwide by January 2015. In fact, the popularity of MOOCs courses across the world can be estimated by the fact that the total number of MOOCs grew 201% in 2014. Nevertheless, the aim of this paper is to study MOOCs, its role, and importance in developing countries like India where current Gross Enrollment Ration (GER) in higher education is low in comparing to its counterpart nations. Therefore, the related advantages and challenges of MOOCs are also addressed.

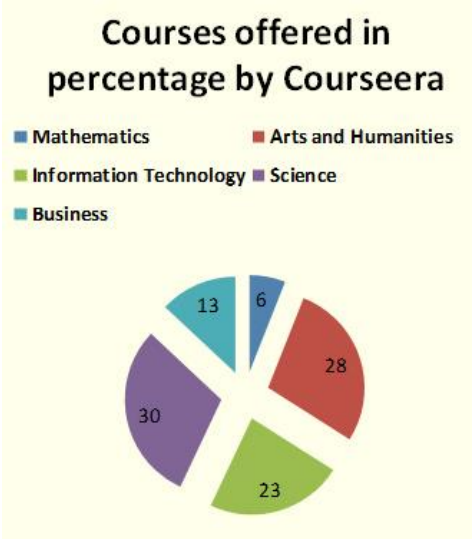

Figure 1: Courses offered by Coursera.

Rest of this paper is organized as follows. In Section II, characteristics of MOOC are listed. The goal behind MOOC, advantages of having MOOC, challenges in the implementation of MOOC, and working of MOOC are briefly discussed in section III and IV. Section V explores the impact of MOOC in India, while section VI discusses a case study. Finally, Section VI gives the concluding remarks.

CHARACTERISTICS OF MOOCS

The characteristics of MOOC are [5]:

Massiveness: It involves large numbers of course participants who can access to the information through the internet.

Openness: It should have open access, open content and open platform. It involves the use of multiple devices from disparate locations to access the course content. It is open with respect to software, registration, curriculum and assessment. It makes use of open source software, anyone can register for the course and the course can change easily. It is open in communication like interaction, collaboration, and sharing. Also it is open in learning environments. The assessment model is also open to change.

Connectivism: The instructor is not only involved in knowledge transfer but also connects with the learners so that the concepts can be easily applied. The role of the instructor is a facilitator so as to motivate the learners for increased learning and interaction.

GOALS AND CONCEPT OF MOOCS

The goals of the institutes providing MOOC services are [5]:

Extending reach and access: It provides a platform for the Institute to be available for the large audience.

Building and maintaining brand: It provides an opportunity for the institute to attract more students and instructors.

Improving economics: It provides facility to reduce costs or increase revenues.

Improving educational outcomes: It facilitates the instructor to think of an effective teaching method and redesign the course accordingly.

Innovation in teaching and learning: It provides effective methods to experiment new teaching methods.

MOOCs are based on web-based platforms for effective teaching and learning. They are not restricted by the geographical boundaries and can cater to a large audience. MOOCs are generally free as compared to the other approaches for online teaching and learning, i.e., the learner or the student is not charged for the course. MOOC courses are synchronous, i.e., they are delivered on a defined schedule. Based on the time zone and the convenience of the student a course can be enrolled and the assignments can be practiced. The lectures recorded are of short duration to allow the students to understand the concept and then apply the concept to practical scenarios. The assignments and assessments conducted are automated.

In MOOC, learning is provided through flipped classroom model. The instructor makes use of the underlying technology to share his/her expertise and then allow the student to attempt hands-on for a proper understanding of the concept(s). The instructor and the students work together on the problems. It provides the students with the option to help each other and work on assignments or assessments.

The activities performed in MOOC are coherent to those in a classroom environment. The sequences of activities performed are as under [8]:

1. Teacher announces an MOOC through a company offering MOOC services. Information regarding the course such as start date, end date, the duration is all announced.

   Online registration is made open for the interested learners. In general, there is no criterion to be satisfied for the admission.

   Learners can access the lectures online using a web browser from any location and through any internet service provider. Recorded lectures, online lectures and other facilities are available for the learners to learn the concepts.

   Assignments and assessments are embedded within these lectures. Generally, the assessment is on weekly basis.

   The final grade is based on continuous assessment and includes the score of weekly assessments. A final test is conducted at the end of the course. And, certificate of accomplishment is delivered online.

MOOCS ADVANTAGES AND CHALLENGES

There are number of advantages of MOOC for learners. Some major benefits are listed below [6, 7]:

1. Through multimedia, the learning can be made more interactive.
2. It is possible for the learners to learn according to their schedule. So, there is no need of instructor all the time.
3. It provides the learners with the freedom to select the desired course by the desired instructor from the desired institute.
4. As the course is available online, a learner can access the content from disparate geographical locations.
5. It is easy for the instructors to share their expertise with a large number of learners without being physically present.
6. It helps in inculcating the habit of self-learning within an individual.
7. There is no time or geography barrier.
8. It can be easily and quickly organized.
9. As it involves group learning so it allows the learners to learn from each other and not from the instructor only.
10. It is open in terms of enrolment.
11. There are no admission or eligibility criteria.

12. Provides an opportunity for lifelong learning.

13. Provides the learner with an insight into the concept.

To make the concept of MOOC successful, there are number of challenges that are to be addressed. Some of the key challenges are described below:

1. *Business Model:* There is no business model to address the issue of financial stability of MOOC. Some of the approaches for providing financial support to the providers, institutions, faculty, students and the society engaged with MOOC are:

    1. Charging the students for the certification of course completion
    2. Sharing the performance data of the students with the employers in search of talented employees.
    3. Using the platform to advertise for the related products or higher certificate courses

2. *Pedagogical Impact:* It is generally observed that the number of drop-outs of the course is high. The issue remains open whether the students are able to understand the concepts and apply their knowledge. Data indicates that most MOOCs have a completion rate of less than 13% [9]. Completion indicates the numbers of students who earned a certificate.

3. *Intellectual Property:* In the case of MOOCs, the intellectual ownership of the course contents is ambiguous i.e., whether institute, faculty, or the course provider will be the owner of the content. Similarly, whether a student who writes the assignment or the instructor who evaluates them will be the owner of the content

4. *Identity and Credit:* There is no mechanism for the employers/colleges or Universities to ensure the learning of the individual. So, proper testing and verification of the learned concepts/technologies are required.

5. *Credit Policy:* MOOCs have a different credit policy and it is required to understand whether MOOC will fit in with the traditional degree programs.

6. *Lack of Infrastructure:* The possibility to enroll for the course and then undergo the learning is based on the availability of Internet. For example, in India, the availability of fast speed internet is not available to all. So, MOOCs are still in their initial stage.

7. *Lack of Awareness:* As the concept is new and evolving so everyone is not aware of the concept and thus hinders its usage.

8. *Lack of Human Interaction:* As compared to classroom environment there is less human interaction in MOOCs environment. Generally, it is desired that the learner should write the doubts, queries in the discussion forum and seek suitable answers.

9. *Lack of Practical Sessions:* For some of the courses it is difficult to arrange practical sessions which are desired for the better learning of the students.

10. *Individual Instruction:* In a classroom method of learning, the instructor can change the style of teaching based on the learners but in MOOC it is difficult for the instructor to change the teaching style based on the individual.

11. *Lack of Proper Assessment:* It is difficult to identify the original work and fraudulent work. So, assessment of the student's performance is difficult.

MOOCs IN INDIAN CONTEXT

Fig 2 indicates the enrollment data of a popular MOOCs provider Coursera, it indicates the interest of Indian students as they ranked second after the USA in accessing MOOCs programs [3]. Inspiring from the facts and demand, significant developments in India towards developing indigenous MOOCs can be seen these days by the motivation of MHRD's project NMEICT (National Mission on Education through ICT) [11]. In October 2014, MHRD announced India's official MOOC platform 'SWAYAM' (Study Webs of Active-Learning for Young Aspiring Minds) started in the academic year 2016 [12]. Under this program, students are able to access certificate based free online courses from IITs, IIMs, NITTTR Chandigarh and other centrally funded Institutions. IIT Bombay has also announced to offer MOOC in some selected areas in collaboration with edX from 2014 onwards. Mr. Anant Agarwal, CEO of edX asserts that every year 1,00,000 to 1,50,000 Indian engineering students register on edX.

Dr. Deepak B. Phatak of IIT-Bombay, flag-bearer of MOOC revolution in India, iterates that current Indian Gross Enrollment Ration in higher education is low in comparison to other countries. India is also facing an acute shortage of skilled and qualified faculty thus has plenty of opportunity for such courses. Therefore, keeping high drop-out rate in mind, Dr. Phatak suggests a blended MOOC approach for India

in which a local teacher will also monitor the progress of MOOC and conduct an evaluation in association with MOOC provider. He also emphasizes that MOOC course grades should be accepted by Indian colleges and universities. And, to achieve it successfully, a local teacher should monitor and evaluate the performance of students. A local teacher may conduct laboratory experiments as well. In order to train local teachers, T10KT (Train 10 Thousand (K) Teachers) program was initiated by IIT Bombay and IIT Kharagpur to conduct the large-scale teachers training program. T10KT aims to train teachers first with online teaching-learning tools and environment [13]. MHRD's National Programme on Technology Enhanced Learning (NPTEL) is an MHRD project involving 7 IITs and IISc. It started on the model of MIT's Open Courseware project. NPTEL now offers an enhanced version of Massive Online Open Courses (MOOCs), called NPTEL Online Courses (NOC). Each NOC includes an in-person, invigilated examination. Successful candidates, therefore, receive a performance verified certificate, which can be authenticated online. More than 1000 candidates have received certificates so far under this project [20]. In the year 2012, MHRD, Govt. of India assigned a mandate of training 20,000 technical teachers in the northern region of India to the NITTTR, Chandigarh Institute. NITTTR, Chandigarh has one of the largest set-up of Education Television Studio in the region with the latest equipment. Thus, the institute decided to exploit the potential of video conferencing to fulfill the mandate of training 20,000 technical teachers [21]. NITTTR, Chandigarh Technology Enabled Learning (NCTEL), is also providing ICT-based courses to remotely located education centers and available globally. Till date, NCTEL has a collection of more than 300 videos and is being enriched with more video lectures on the regular basis [22].

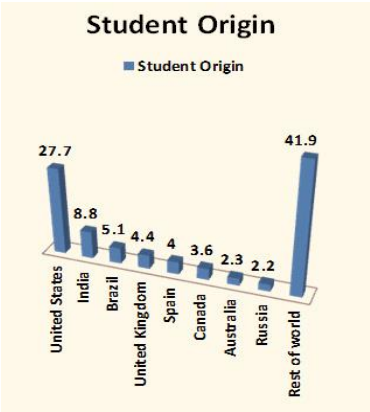

Figure 2: Country wise enrolment in MOOCs.

Recently, reported by Times News Network that Indian School of Business, Hyderabad will be the first Indian B-School to participate in Coursera online courses [23]. And a leading Indian magazine India Today reported in August 2014 that Indian Ministry of Human Resource Development (MHRD) is planning to launch a campus connect a program to make 21000 colleges and universities Wi-Fi

enabled [24]. IIT Kharagpur is also planning to set up National E-Library project to collect, store, and disseminate entire intellectual output of the nation [25]. MHRD also assigned responsibility to University Grant Commission (UGC) to prepare MOOCs for the post graduate level programs. This project is termed as e-PG Pathshala and will be managed by Information and Library Network (INFLIBNET) Centre, Gandhinagar (Gujrat) [26]. Other than the above stated, there are many other initiatives viz. The Sakshat pilot project started in 2006 to felicitates lifelong free learning for anybody wishing to learn [27], National Digital Repository of Indira Gandhi National Open University (IGNOU) termed as E-Gyankosh [28], EDSAT satellite-based Consortium for Educational Commission (CEC) [29]. In fact, similar concerns are being noticed for Indian school education, therefore, Shikshya for CBSE students of 11th and 12th standard, Vidya Vahini for school teachers and students have been proposed [30]. These initiatives aim to provide good quality e-contents to students at primary, secondary and higher education level. Undoubtedly, in the time to come, India will prove its mettle in the area of MOOCs to the global fraternity.

CASE STUDY

An interesting self-experience of an Indian health care professional was published in leading English daily newspaper The Hindu. Her experience reveals that she was among few people who enrolled in the MOOC program when Coursera sensation freshly hit India. The course, she opted was designed for working professional, not for a college student having no knowledge of that area. It was found that initially she was quite fascinated with the wide range of courses offered by MOOC provider. And, swiftly joined many of the courses relevant to career and hobby. But, later on, her professional assignments and responsibility overtook her interest and she could barely finish all those courses on time. Finally, she ends up with a few of certificate of accomplishment and realized that it is very challenging to complete many courses at a time, especially, while continuing with your job-related activities. Therefore, the conclusion of this case study can be summarized as the major problem with MOOCs courses is of dropout rate. Learners, become over excited while going through the catalogs of varied courses and confuse between career goals versus hobbies, science versus arts, refreshing existing skills versus acquiring new skills. This state of confusion ultimately leads to increase in dropout rate [31].

Eric Fredericksen and Mark Zupan, Faculty at the University of Rochester share that these MOOCs or virtual classroom classes are not an alternative to traditional campus experience, while, it just complements the same as of now. They believe that these courses are really helpful for the students residing at geographically distant locations and don't have access to quality education. Nevertheless, lack of proper interaction with the instructor is a big concern as there are thousands of students enrolled in a class and it is not possible for the instructor to interact with them. These courses are good to enrich your knowledge and upgrade your skills but the official validity of such courses is still a grave concern. They add that international students, having English as the second language, can review the

content multiple times to understand accurately, but dropout rate is again a major issue with MOOCs (95% of students who enrolled in EdX, Harvard and MIT's online education platform, dropped out). They said that many people believe that like online shopping, MOOCs also pose a similar threat to the traditional education system. But, both the author advocates the supremacy of university-based teaching that has remained remarkably durable for a millennium [32].

CONCLUDING REMARKS

The success of MOOCs can be seen through the increase in the number of providers, institutions offering courses, instructors involved and the students enrolled in these courses. More and more courses are being added, more faculty members and students are becoming involved. As the teaching and learning process needs to be carefully designed so that crucial issues related to MOOC need to be addressed so that it will benefit all the stakeholders, i.e., students, faculty, institutions, and providers. Nevertheless, the transition from the traditional classroom learning to the MOOC-based online learning will take some time but is expected to be adopted by many in the coming years. Most of the MOOCs are in American or British English ascent, therefore, it is difficult to understand for the students who have English as a second language of communication. Therefore, more focus is required to develop indigenous MOOCs. Evaluation and examination of MOOCs courses under strict supervision is vital. To reduce the drop-out rate, MOOCs providers need to ensure that a user at a time should not enroll in more than a certain number of courses. In developing countries like India, starting of such initiatives is really a laudable step of Government and academia. India's 12th five-year plan targeted to increase its GER in higher education to 30% from current 17.87% [33]. Therefore, India is keen to explore enormous possibilities in MOOCs based e-learning to overcome the deficiency of qualified faculty. But due to lack of proper implementation, accountability, and transparency, most of the projects remained in files only. Moreover, adequacy of computer resources and Internet connectivity is also a major challenge in developing countries like India. Especially, in the rural area of India where its 68% population lives even without very basic amenities of life like.

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ANDRAGOGY AND PEDAGOGY IN TECHNOLOGY EDUCATION

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ABSTRACT

This paper explores how to deal with university students, with some being self-motivated/ self-directed and some being teacher-motivated/ teacher-guided. In this paper, 'andragogy' refers to the art and science to teach self-motivated and self-directed students. 'Pedagogy' refers to the art and science to teach teacher-motivated and teacher-guided students. This paper investigates how learning and teaching can happen effectively that requires teachers to use both the andragogy and pedagogy, particularly for dealing with the information technology students in a first-year first-term subject 'Systems Analysis' in two programs about 'Bachelor of Information Technology'. The subject involves dissimilar students who needed minimal, averaged, or substantial help from the teachers, in order for each teaching member to adequately help the students to achieve their best possible performances. This research adopts a qualitative case study approach. It collected data obtained through observation, survey and documentation. The analysis results show that there are mixtures of both self-motivated and self-directed students, as well as teacher-motivated and teacher-guided students in the classrooms. It is recommended that a teaching approach using both andragogy and pedagogy is a realistic useful approach for any teaching members, whenever a classroom involves students as a mixture of both self-motivated/ self-directed and teacher-motivated/ teacher-guided students. This paper shows the preliminary study results and more future work will take place to enrich the study results.

Keywords: *andragogy, pedagogy, multiple-campus operation, mix-mode studies, technology education.*

INTRODUCTION

Central Queensland University (CQU) is twenty-five years of age, in which experience of multiple-campus operations and distance education abound (Rodan (2016). It has 25 campuses and study locations that spread widely across Australia. Its distance students either reside within Australia, or overseas. This paper examines how to adopt a suitable approach towards teaching a technology subject, specifically 'Systems Analysis', for students in CQU. It examines a subject in which some students were self-motivated/ self-directed and some were teacher-motivated/ teacher-guided. For the subject, a subject coordinator took a lead role of all teaching team members over six different campuses. In addition, the subject coordinator directly taught a small number of information technology students on campus, as well as directly looking after all distance students. On different campuses, lead lecturers and tutors guided their domestic and international students well under the

guidance of the subject coordinator. To investigate how all information technology teaching staff members can appropriately approach their teaching of students with some being self-motivated/ self-directed, and some being teacher-motivated/ teacher-guided, this research adopts the data collection techniques as observation, document and survey.

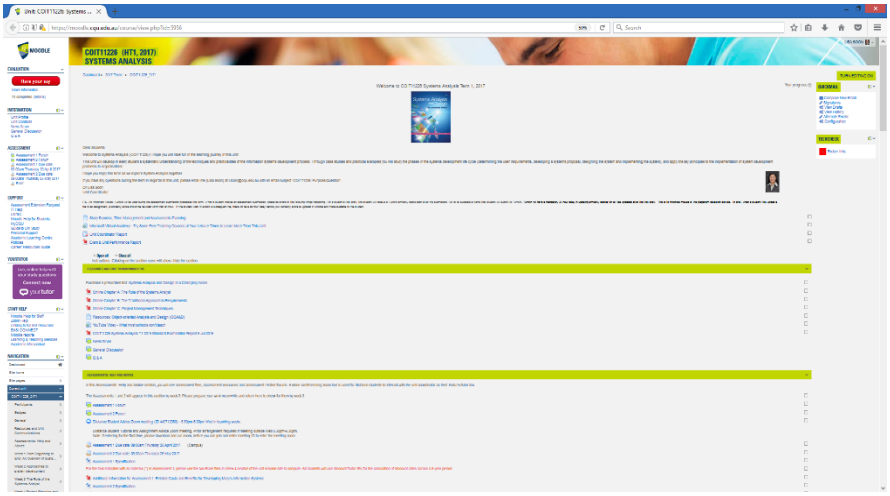


Figure 1: COIT11226 Term 1 2017 Moodle Website

As in Figure 1, a learning management system called Moodle, has been in use within CQU. Moodle allows staff to upload all weekly teaching materials, and students to download them for learning. Moodle also tracks all staff and student activities, activity-related information and communication messages generated from the subject Moodle site. Moodle has advanced communication and interaction tools such as 'compose new mail', 'participants', 'Zoom' (video conferencing software), and 'forum', which tracks the correspondence histories for re-use in different ways. Each campus staff member can use 'compose new mail' for sending direct messages with email trailing recorded on Moodle. Any staff member can use 'Zoom' for video- or audio- conference meetings with one or more students. Further, students can use the forum to obtain feedback from peers or staff during the term. Observation in this research refers to observing the tracked generated messages as communication foot prints using Moodle tools, which will help understand how interaction happened through the communication means for learning and teaching. Documentation refers to the materials recorded on the subject Moodle website, such as materials uploaded in the forms of lecture slides, study guides, tutorials, practice exam papers, external website resources, subject-related videos, and the like. There was also an end-of-term evaluation feedback survey collecting qualitative information, as comments from students about their experience in subject learning.

The analysis results show that on-campus students were largely teacher-directed and teacher-guided students, with a small number of self-directed and self-guided students. On the other hand, the distance students are represented with many self-directed and self-guided students with rich industrial experiences, plus some teacher-directed and teacher-guided students, esp. those who came directly after the senior high school. The research results shed light for the teaching team members

on how to conduct a subject better in the future by more carefully understanding the types of students that they have. It highlights to the teaching staff that there is an importance to identify the characteristics of their types of students enrolled in a subject earlier through evaluating class roll details and monitoring class interaction, in order for them to effectively provide adequate relevant useful instructions, guidelines, materials, advice and activities for the self-directed and self-guided. It also highlights an importance for the teaching staff to sufficiently plan for important instructional advice and more supporting step-by-step learning materials for those students who are teacher-directed and teacher-guided teaching. Some useful guidelines developed in this research that help to enhance learning and teaching include: (1.) Establish students-teachers partnership, (2.) Engage students in a productive learning environment, (3.) Actively improve student learning based on student needs, (4) Provide clear instructions over assessment practices and cultures, and (5.) Use reflective practice to improve subject. The research outcomes will be useful for technology education instructors who teach a diversity of students with distance students geographically far apart, as well as on-campus students in multiple distant venues in a university like CQU. Nevertheless, this research is a preliminary study and the results is based on a case study, more extended future work is needed in order to enrich the study results.

LITERATURE REVIEW

There is a dichotomy of the two terms ‘pedagogy’ and ‘andragogy’. Interestingly, Ozuah (2005) explains that pedagogy is derived from two words meaning “child” and “leader of”, hence literally, it means the art and science of teaching children. Clardy (2006) adds that pedagogy always involves an adult assists a child to become an adult, and there is an element of involuntariness to help the child mature. An important significance brought up to our attention is that the learner is regarded a child or child-minded (Holmes & Abington-Cooper, 2000; Pew, 2007; Saunders, 1991; Yonge, 1985; Yoshimoto, Inenaga & Yamada, 2007). By the same token, the teacher is seen as a leader of a child-minded learner. In other words, a child-minded learner is teacher-guided and teacher-directed, who demonstrates the characteristics of a learner needing frequent teacher advice, directions, assistance and regular guidance of an adult teacher as a leader.

The term pedagogy has been used with a much longer history than the term andragogy, which become popular since Knowles’s work in 1987 (Marshak, 1983; Davenport & Davenport, 1985; Bullen, 2003). Malcolm Knowles (1970) uses the term andragogy to refer to the arts and science of helping adults learn. His work has influenced many educators and there have been many followers of his work (Davenport & Davenport, 1985). According to Mohring (1990), andragogy is widely used around the world as an alternative to pedagogy, esp. when referring to teaching adults. Ekoto and Gaikwad (2015), and Clardy (2006) note that andragogy rose to a significant position among practitioners in the adult education field, like a primary model of adult learning. Handal, Marcovitz, Ritter & Madigan (2017) see the adult learners as those who have control of an instructional task and a positive orientation to learn. Ozuzh (2005) explains that andragogy is premised on several crucial assumptions about the nature and characteristics of adult learners. In

common, the above scholars discuss adult learners undertaking education as being self-guided and self-directed, demonstrating a nature of the adult learners with great self-motivation and self-discipline.

Mohring (1990) cautions us that we should not coin the Greek words[4] to its initial meaning of pedagogy. He cautions that while one uses 'pedagogy', which literally means 'the art and science of teaching children', one may actually use it to mean the art and science of teaching learners with no restrictions on the age or gender of the recipients of the teaching. Researchers like both Davenport and Davenport (1985) and Mohring (1990) similarly agree that educators have different philosophical orientation when using 'pedagogy'. As such, a debate kicks off and goes on as 'pedagogy' can apply to more than children educators to also include adult educators, which works like a ‘chickens and the eggs’ game. Hence, work in Davenport and Davenport (1985) and Mohring (1990) shows a similar standpoint that pedagogy is an art and science of teaching all learners, regardless of their age and gender.

Despite the above, in this paper, ‘andragogy’ strictly refers to the art and science to teach self-motivated and self-directed students. ‘Pedagogy’ clearly refers to the art and science to teach teacher-motivated and teacher-guided students. This research explores how pedagogy with its two spheres as ‘andragogy’ an ‘Pedagogy’ are really different, but useful in teaching both on-campus and distance learners in technology education within a university, specifically in CQU. Having gone through the above discussions, it is noticed that both andragogy for adult learning and self-learning, and pedagogy for children learning and guided learning could co-exist in a learning environment (Holmes & Abington-Cooper, 2000; Pew, 2007; Saunders, 1991; Yonge, 1985; Yoshimoto, Inenaga & Yamada, 2007). It is argued in this paper that human beings are both andragogical and pedagogical oriented. Particularly within a university context, self-learning and guided learning most likely co-exist, where there is no age limit set on student admissions into an Australian higher education institution or Australian university. It is also argued that, in CQU, the use of both andragogy and pedagogy in teaching and learning are most appropriate.

The key questions are who are regarded as child learners and who are regarded as adult learners. Since the age and gender are not tied to pedagogy or andragogy, it was not clear what nature or scope of learning qualify for both child and adult learners. While most common research focus on teaching that adopt either andragogy or pedagogy, there is limited research work that focus on details of teaching that uses both andragogy and pedagogy, and how to implement the use of both andragogy and pedagogy in technology education. To the best of the researcher’s knowledge, there was limited research about mixing both styles of education. This research explores the use of both andragogy and pedagogy in technology education, specifically through a technology subject ‘Systems Analysis’.

[4] Greek words: pedagogy is derived from the Greek words paid [sic], meaning "child," and agogus [sic], meaning "leader")

RESEARCH METHOD

The technology education subject COIT11226 'Systems Analysis' in CQU mainly involves students in two different three-year bachelor programs, i.e. Bachelor of Information Technology (BIT) and Bachelor of Information Technology (co-op) (also known as BIT co-op). The BIT co-op students needs a higher admission entry score like 'OP 6' or better at Queensland standard or similar to enter BIT co-op, as compared to the BIT students into their BITs. 'Systems Analysis' is also open to students from other disciplines, such as business, education, multimedia arts, and aviation, to take up as an elective subject or core subject. As there is a course 'Start University Now' to encourage high student to enroll into a bachelor degree subject, CQU students can be as young as 15. In CQU, there is no maximum age limit imposes on any student during the admission process. CQU students could be of any nationalities, of any cultural backgrounds, with or without prior learning, and from anywhere within Australian or the world.

Qualitative inquirers bring to a study a different lens than that brought by a traditional quantitative study (Creswell, 2009). Yin (2007) recommends a use of case study research method to investigate a contemporary phenomenon in depth within a real-life context, especially when the boundaries between phenomenon and context are not clearly evident. To have a better picture of a new unfamiliar phenomenon (Yin, 2007) about an appropriate use of both andragogy and pedagogy in teaching 'Systems Analysis' to BIT, BIT co-op and intra-faculty students, a qualitative enquiry is warranted. This research adopts qualitative case-study research method to examine the new unfamiliar phenomenon with uncertainties on whether the students are self-motivated/ self-directed learners or teacher-motivated/ teacher-guided learners and how to handle them. It is believed that a qualitative enquiry using case study research method will bring along a variety of lenses, which would allow for multiple facets of the phenomenon to be revealed and understood (Baxter & Jack, 2008). The qualitative case study was instrumented using the data collection techniques 'survey', 'observation' and 'documentations'. This research design is useful to help carefully explore and better understand how pedagogy and andragogy used in teaching can facilitate the subject learning and remove learners' difficulties.

Moodle is a learning management system (LMS) used for teaching and learning within CQU. On the subject Moodle website for 'Systems Analysis', there were a lot of documentations as inputs and outputs from staff and students on Moodle. For examples, there were teaching and learning materials originating from staff such as lecture slides, study guides, tutorials and extra notes. There were documents generated by students such as shared student files on forums, and as online submission files in the different required file-type formats. Using the documentation technique, the input and output documentations were examined for the purposes of the document generations, the meanings of contents in them, what expected knowledge or skills to teach and have learned, why each type of document was used by staff or students, the teaching objectives, and in what ways the learning outcomes were achieved. They were explored to obtain an insightful understanding about what both teaching staff and students accessed and used, and the frequencies/ patterns of activities and usage. The observation technique was used to check and

monitor Moodle generated/recorded messages as interaction and communications between all staff and student members, between any staff or student member, and between anyone and the subject coordinator for analysis. All forum discussions, emails, Zoom video-conference meetings, and the like were followed through with observation notes and recordings. Observation also involved going through all personal email communication messages directly sent from a staff or student email account to the subject coordinator or vice versa for analysis. At the end of the teaching term, a survey questionnaire with open-ended questions that collected student feedback and comments was created. It was placed on the subject Moodle website. It was used to explore student learning experiences and obtain feedback. The use of survey, observation and documentations helped to provide an in-depth understanding on how students were advised, guided or helped by the related teaching staff. By the same token, the techniques were used to also help investigate whether student sought help from their teaching staff member(s) and what level of guidance or help was given to each type of student seeking help.

COIT11226 Systems Analysis was run at six different campus venues in different Australian cities, i.e. Melbourne, Sydney, Brisbane, Rockhampton, Cairns and Townsville since Term 2016, including Term 1 2017. In Term 1 2017, the teaching team consisted of nine lecturing and tutoring staff members. The subject coordinator had a lead role in providing guidance, instructions and help to the teaching team during the term. The subject coordinator also looked after students in Townsville campus as well as all distance students as online learners. There were 2 staff members looking after the students in Sydney, Brisbane, and Rockhampton campuses. There was one teaching staff member each looking after students in Melbourne and Cairns campuses. On the census date, it recorded a total number of 178 students enrolled in 'Systems Analysis'. There were 7 enrolled in BIT co-op, 142 enrolled in BIT and 29 from other intra faculty courses. Amongst these students there were 22 female (F) students and 156 male (M) students. Amongst all of them, 173 were above the age 18, and 5 were below 18.

Table 1: Enrolments in COIT11226 Systems Analysis Term 1 2017

Campus \ Degree	Sydney	Melbourne	Brisbane	Townsville	Rockhampton	Cairns	Distance	Total
Male	36	15	33	4	17	6	45	156
Femal	5	2	5	0	3	1	6	26
Total	41	17	38	4	20	7	51	178

Table 1 show the enrolment numbers of students at all campuses and in distance mode. Amongst the distance students, one was a student at high school age of 15 studying 'Systems Analysis' as a subject in a CQU course 'Start University Now'.

DATA COLLECTION AND ANALYSIS

Data obtained through different campuses from each different source like observation, documentation and survey questionnaire were used to cross-check with data obtained from other sources for consistency and validity checking. Data about difference campuses and in distance mode were used for further comparisons and evaluation. Through careful examinations of all data, the results show that on-campus students who attended classes were able to closely follow the instructions and really obtain direct help and advice of the local lead lecturers and tutors in different campuses. Being well-guided and well-directed, the students progressed in their work in good hands of their teaching staff. By the same token, these students being well teacher-guided and teacher-directed in the presence of any teachers in direct face-to-face classes are regarded as child-learners, where pedagogy is in full use for the greatest class benefits and learning outcomes.

The on-campus teaching staff occasionally reported that some students skipped weekly lectures. When checking through such students' performances, some of these students actually did reasonably well or obtain satisfactory achievement in their work without attending classes. It might also be due to weekly lectures conducted by the subject coordinator was video-recorded and soon made available for all staff and student members, i.e. all students at all campuses and in distance mode. Further, there were general forum, Q&A forum, and specific assignment forums to facilitate different discussions, sharing of ideas and providing advice and help to students throughout the teaching term.

Due to the different designs of the learning environments on Moodle, on-campus international students or domestic students who are self-directed and self-guided learners were able to skip one or more classes and viewed the video lecture at their preferred available times, just like their peer distance-students. It is argued that through appropriate use of Moodle online facilities and tools, e-learning environments can be set up to allow the 'adult-learner' student to self-guide and self-direct in learning. This strategy reflects, to a very large extent, andragogy is in effective use underlying the 'adult-learner' teaching.

Distance students involved different types of learners. There were some who were located at places of small and remote townships, where the CQU campuses were distant away. There were those who lived in popular cities. There were mature students, who had abundant life and work experiences before embarking on their studies, while working part-time or full-time jobs. While most mature students tended to be able to control time schedules, handled their assessment tasks and oriented themselves well in learning, there were some who struggled to cope with assessments and learning.

There were students who started university as fresh senior high school leavers without real-life work experience. They needed to adjust to a new university study system and appeared needing more teacher guidance and help. Among the students who were fresh senior high school leavers, there were a small number who progressed well, being able to manage their work and times on assessment. Their

learning reflecting some 'adult-learner' attributes, e.g. plan well ahead, take self-initiatives, manage times and execute tasks well.

It is found that whenever any learners need help, support and advice, and a teacher intervened quickly to help. With prompt teacher intervention and timely feedback, the students were guided into improving their class work, achieving better assessment task results and performing learning activities well. With teacher advice and guidance, students were put onto the right track for their work and they were able to make good progresses in their studies. Teacher guidance happened through interaction between teachers and learners within classes, over emails/forums/video-conferences or through face-to-face consultations/online chatroom discussions. While some students needed pointer information and took a lot of own actions to progress much more work in learning, some students merely took advice as such and did exactly what a teacher told to do each time in learning. The analysis results show that in this subject, there is a mixture of both self-motivated and self-directed students, as well as teacher-motivated and teacher-guided students in the on-campus and online classrooms, regardless of age. Having said the above, student failures happened to both the on-campus students and distance students.

The analysis results showed that there were students from both the mature students and fresh school leaver students who absent-failed the subjects without attempts for all assessment tasks. When the subject coordinator rang these students some were uncontactable completely, so their reasons for absent failure were unknown. Some who was contacted revealed that they could not find time for their studies due to relocation to a home in a different state, family commitments, work overload, illnesses, family hardships after a QLD cyclone Debbie. Having evaluated the comments and feedback provided by many students from all campuses and in distance mode, it indicated that teacher guidance is very important and helpful. The results show that the students generally prefer to be teacher-guided and teacher-directed with interaction in classrooms, as seen in their feedback remarks from the official unit evaluation survey below:

- 'The class was flexible. The teaching was good';
- 'The lecturer was good. He did his best to engage with the students and cared about …';
- 'Staff involved in subject are very nice and provide a positive and effective educational activity';
- 'Lecturer is very good. He explains in a way that we can easily understand and provide useful ideas of the topic';
- 'Friendly lecturer';
- 'The classes are very informative';
- 'The tutor was very helpful and friendly'; and
- 'Our lecturer gave us examples and comparisons to real life situations that made the materials clearer.'

An on-campus student who preferred teacher-directed teaching commented that 'Please keep the classroom approach instead of taking classes online. As I would

personally feel like that would be much more supportive as you can talk to your lecturer and tutor face to face instead of via online communications like email.'

From more of the distance students and a few from on-campus students, who were given some pointers as help or more specific helpful advice from the subject coordinator (left anonymous as Xxxx), they provided the following remarks.

- 'I found Xxxx very helpful and responsive when asking a question';
- 'This subject was very enjoyable and a massive thanks goes to Xxxx for the continuous effort Xxxx puts into all subject members (both on campus and distance)!';
- 'Xxxx was amazing. Xxxx was extremely helpful and informative in the lectures';

- 'The best aspect of this subject was the forums. It was easy to see …'; and
- 'Xxxx explains any problems and concepts very well when visited/called in person.'

RESULTS AND DISCUSSIONS

The investigation results show that, on-campus and distance students both presented a mixture of the teacher-directed/ teacher-guided and self-directed/self-guided students. It is found that the mature students regardless of their age and gender, would possess great self-motivation and self-discipline in themselves. They were many more of self-directed/self-guided students (as mature students) in the distance mode than those self-directed/self-guided on-campus students. They usually possessed work experience or real-life experience, had the basics of effective time management, could plan ahead and truly executed study tasks as in their planned schedule. For the group of self-directed/self-guided students in the distance mode, clear instructions provided in an effective subject outline, assignment specifications and the additional subject forums as advice, tips, resources and extra assistance, would easily help them. For the group of students in the distance mode who are both teacher-directed/ teacher-guided and self-directed/self-guided and those similar ones on various campuses, the subject coordinator and the on-campus staff members tended to encourage them through forum messages or email directly. The subject coordinator rang students too when necessary.

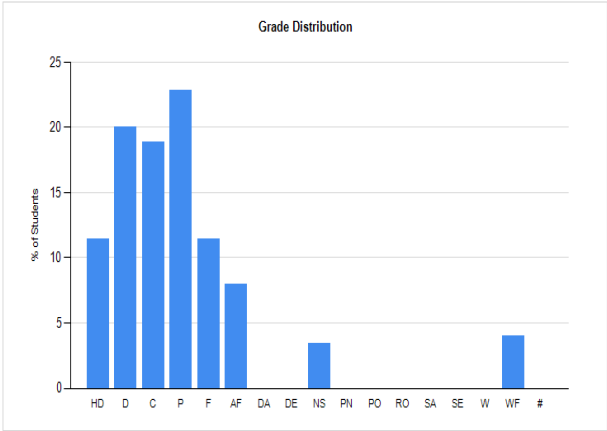
In both Term 1 2017 and Term 1 2016, the subject coordinator also invited all distance students to join in the scheduled Zoom video conferences for help and discussions in relation to all assessment tasks. For some on-campus students who skipped most classes due to their substantial work commitments, they were able to view video-lectures, work out tutorial tasks as well as asking and following forum advice like the distance students. They were also seen as self-directed/ self-guided students. They emailed their immediate lead lecturers and/or tutors whenever they needed help and advice.

For a majority of on-campus students, they preferred to have the presence of the teaching staff members to guide them and help them understand their work. They generally obtained much more help and clearer advice from the teaching staff

members with frequent face-to-face interaction. They demonstrated a need for the teacher presence and an emotional dependence on the teacher, they are therefore regarded as the teacher-directed/teacher-guided students. These students often had more time with teachers in classes to obtain further interactive and detailed explanations or advice.

Table 2 Student Performance in Term 1 2017

Grade	O/A #	O/A %
HD	20	11.43%
D	35	20%
C	33	18.86%
P	40	22.86%
F	20	11.43%
AF	14	8%
DA	0	0%
DE	0	0%
NS	6	3.43%
PN	0	0%
PO	0	0%
RO	0	0%
SA	0	0%
SE	0	0%
W	0	0%
WF	7	4%
#	0	0%
Total:	175	100%



The grades for comparisons are: HD high distinction, D distinction, C credit, P pass, F fail, AF absent fail, DA deferred assessment, DE deferred examination, NS not sat a required exam, PO practicum outstanding, PN Pass where a range of grades is unavailable, RO result outstanding, SA supplementary assessment, W withdrawn and WF withdrawn fail.

Table 3 Student Performance in Term 2 2017

Grade	O/A #	O/A %
HD	13	8.39%
D	20	12.9%
C	29	18.71%
P	32	20.65%
F	18	11.61%
AF	34	21.94%
DA	0	0%
DE	0	0%
NS	0	0%
PN	0	0%
PO	0	0%
RO	0	0%
SA	0	0%
SE	0	0%
W	0	0%
WF	9	5.81%
#	0	0%
Total:	155	100%

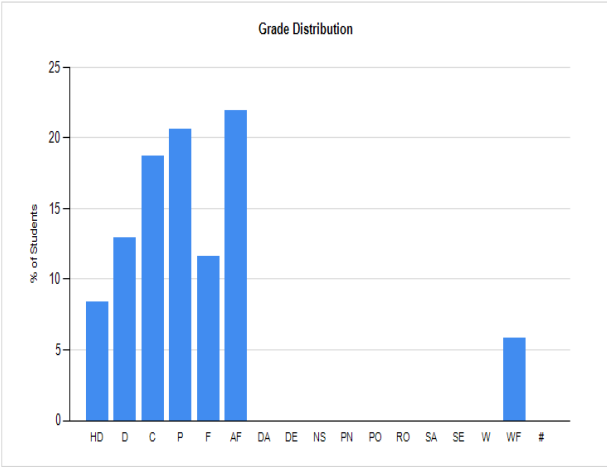


Table 1 shows that the subject in Term 1 2017 recorded a 73% passing rate at the Certification of Grade date as compared to 61% recorded in Term 1 2016 as in Table 2, due to the subject coordinator put in different subject improvements in Term 1 2017. The increase in passing rate for Term 1 2017 was also due to the subject coordinator having implemented effective changes by adopting both andragogy and pedagogy in teaching and learning. This approach effectively handled the mixture of the teacher-directed/ teacher-guided and self-directed/self-guided students in the subject. The approach was able to increase interaction between students and class teachers or between students and online communication tools on Moodle. The implemented effective changes were grounded on using the subject teaching experiences obtained from Term 1 2016, which also run at the same six different campus venues in different Australian cities and in distance education.

Using the insights obtained from this research, some guidelines were develop to improve learning and teaching of a mixture of the teacher-directed/ teacher-guided and self-directed/self-guided students, to achieve better quality student learning experiences and higher level of student successes. The following guidelines (as lessons learned through this research) are useful to all teachers who have a mixture of students both teacher-directed/ teacher-guided and self-directed/self-guided.

Establish students-teachers partnership

- Teachers are open to deliver, share and explain concepts to the students.
- Teachers develop an effective relationship with students to help them learn and succeed.
- Students are willing to ask when in doubts.
- Students take responsibility for activities, tasks and assessments.
- Students discuss class activities and assessment doubts openly as dialogue with effective interaction between teaching staff and peer students.

Engage students in a productive learning environment

- Design assessment tasks that focus students on what they need to learn and the learning activities related to the tasks.
- Make assessment tasks significant learning activity and engage students on the appropriate tasks.

Actively improve student learning based on student needs

- Provide informative and supportive feedback, which would facilitate a positive attitude to future learning.
- Whenever students seek help, teachers provide timely feedback to improve student learning and quality work in learning.
- Encourage students to regularly receive specific information, e.g. frequently check specific assignment-related forums.
- In providing assignment feedback, do not restrict to just marks and grades, but also useful comments about how to improve the quality of their work.

Provide clear instructions over assessment practices and cultures

- Assessment practices are carefully structured within subjects in early stages of courses to ensure students make a successful transition to university study in their chosen field.
- Assessment practices respond to the diverse expectations and experiences of students.

Use reflective practice to improve subject

- Apply reflective practice in subject teaching and its assessment designs.
- Use past teaching and learning experiences to identify problems in classrooms and to improve subject teaching and learning in the next offering.

It is believed that the above useful guidelines will help teachers to effectively handle a classroom with a mixture of students both teacher-directed/ teacher-guided and self-directed/self-guided. As a result, the students will have high quality learning experiences and higher level of study successes.

CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

This qualitative case study research has explored how to deal with university students, with some being self-motivated/ self-directed and some being teacher-motivated/ teacher-guided. Whenever there are presences of self-motivated/ self-directed student, 'andragogy', that provide some lead information, instructions and guidelines and advice, is most helpful for dealing with the students. However, 'pedagogy' is very important whenever teacher-motivated and teacher-guided students are present in a classroom. This paper presented a subject with its learning and teaching to discuss how the teachers, especially the subject coordinator, could effectively use both the andragogy and pedagogy in dealing with the technology students in a first-year first-term subject 'Systems Analysis'. A list of guidelines is developed for teachers to more effectively deal with a class with a mixture of both self-motivated/self-directed students and teacher-motivated/teacher-guided students. It is recommendable for the teaching staff to approach teaching using both andragogy and pedagogy, whenever a classroom involves students who are a mixture of both self-motivated/ self-directed and teacher-motivated/ teacher-guided students.

Nonetheless, this paper presently shows a preliminary study about the use of andragogy and pedagogy in the classroom. The preliminary study results will need more extended work to enrich the study results in the future. Further, this research is currently based on a single case study in technology education framed within an Australian higher education context. More future work for different types of subjects in different technology education set ups and different country contexts are needed to improve the validity and quality of the findings.

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DESIGNING A PRE-MASTERS ENGINEERING PROGRAM FOR INTERNATIONAL STUDENTS: TOMSK POLYTECHNIC UNIVERSITY EXPERIENCE, RUSSIA

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ABSTRACT

This paper evaluates methodological principles that underpin the design of a pre-masters program offered to international students in Tomsk Polytechnic University (TPU) as an essential course leading to the master programs. TPU is a university that mainly provides engineering education. It is the first university in Russia that created a pre-masters program model for international students based on students' competence and on adopting the most appropriate design approach for such programs. The research methods used here include observation and survey as the most suitable data collection techniques. The subjects of this research were international students who held bachelor degrees in those countries where English or other languages is spoken and who wished to progress to TPU master programs in Russia using the Russian language. This paper presents the results of the analysis of the implemented surveys for the graduates of the pre-masters program in TPU during the years 2013, 2014 and 2016 with monitoring and evaluation. It focuses on

the specific features of the pre-masters program. The researchers investigated methods of studying the Russian language in order to achieve specific educational goals within a short period (7-10 months). They also provided a report on how to determine an optimal set of general and specialist courses for the pre-masters program. In addition, the paper presents proposals for further improvements and re-development of the program.

Keywords: *International students, pre-masters program, master programs, educational technology, observation, survey.*

INTRODUCTION

The processes of modernization, internationalization and globalization of the entire higher education system are taking place all over the world and in Russian universities as well. These changes and trends enable students to have new choices and have greater mobility for their continued academic studies in a preferred country. Consequently, this situation results in an increase of the number of international students in Russian universities [1, 2]. Education in Russia has always been popular with international students. The reasons for this are as follows. On the one hand, there is a positive image of Russian engineering education on the international market of educational services, and on the other hand, Russian higher education is relatively low cost compared with European countries and the USA. In addition, there is increasing academic collaboration between Russian and international universities jointly developing double degree programs. This increase, presenting new possibilities of obtaining a diploma from both countries, is another motive for international students to pursue an education in Russia. In each of the past three years, the Russian Federation invited up to 15 thousand foreign nationals, who were awarded Russian scholarships, to study in Russian universities [3]. More than 400 universities are involved in this process. Citizens of 198 countries can apply for various educational programs in Russian universities. All of the above explains the sustained interest of foreign nationals to enroll in engineering programs, not only at the bachelor's level but also at the master's level, particularly in Tomsk Polytechnic University (TPU). TPU is rated second highest among Russian universities in terms of the number of international students, i.e. with 2337 foreign students, according to the statistics given in the issue "Academic mobility of foreign students in Russia" of the national research university Higher School of Economics (Moscow) in the years 2015/2016 [4]. TPU offers engineering master programs [5], which include mechanical engineering, petroleum engineering, information technology, nuclear physics, materials science, electronics, optical engineering, and other highly popular courses. In the rest of this paper, these study programs are referred to as engineering programs for convenience.

In order to study in Russia, a foreign student needs to know the Russian language – a difficult language to learn [6]. About four thousand foreign citizens arriving in the Russian universities do not speak Russian and have to take foundation courses prior

to enrolling in an underground ate degree course. TPU has more than 20 years of experience in preparing foreign citizens for admission to the undergraduate programs in the universities of the Russian Federation. In recent years, the demand for master programs in engineering increased significantly, including those programs that are related to those, which foreign citizens studied at home obtaining bachelor diplomas. The above trends led to the emergence of new challenges for the Russian higher education with the necessity to create a new trajectory of the educational process for a certain group of foreign nationals who have bachelor diplomas from their native countries and wish to continue their master programs education in the Russian language at the universities in the Russian Federation.

RUSSIAN LANGUAGE AND TPU EXPERIENCE IN THE IMPLEMENTATION OF THE PRE-MASTERS PROGRAM

The demand for master programs has led to the need to develop a pre-masters program in the Russian language for TPU's master's engineering program students. In Guzarova et al. article [7], there is a comparative analysis of pre-masters programs delivered in English in a number of countries such as USA, Canada, Germany etc., in which the methodological approaches to the problem similar to that in Russia are discussed. This article outlines the concept of the approach in training foreign nationals as 'how to prepare them for admission to master programs in the Russian language', offering a detailed account. This account reveals the organizational and methodological aspects of the problem, demonstrating the results of the survey of the pre-masters program graduates in 2013 and 2014. Even though Russian universities have developed some experience in training international students for progressive admissions to their chosen master programs over the past five years, the search for better ways to improve the efficiency of the process continues [8-17].

One of the most effective ways to understand whether international students have made adjustments through their pre-masters program is the implementation of feedback collection. Arrangements were made for the students to take part in a survey. They completed their questionnaires in the first year of study of their master engineering programs. Analysis of these surveys provides an understanding of how to make corrective actions not only for the pre-masters program but also for the master programs. Regular observation and monitoring of these students further help suggest possible future adjustments, beneficial in the design of a better pre-masters program. Altogether, it reflects on the trajectory of its realization. In some authors' [8-10] opinion, international students begin to study the Russian language starting with zero knowledge, and within a short timeframe (8-10 months) during the pre-masters course, they have to gain skills in the Russian language on a level that allows them to understand things not only in the educational context but also in their scientific and professional communications. The Russian language should become the language of professional scientific communication for such students. This is

because, after two years of study, they must prepare and defend a master thesis in the Russian language. Consequently, their knowledge of the Russian language must match the level of scientific research in the field of their profession.

In some articles [15, 16], the concept of a professional medical speech was discussed as a specific type of communication. The authors of those articles claim that professional medical speech is a necessary component of the learning content delivered in the Russian language for international students at a medical university. Moreover, we can add that every specialization has its own professional language (e.g. economic and engineering communication). Mastering the genres of a professional speech is critical for international students and is a necessary condition for successfully accessing specialist subjects, passing an educational practice, and speaking with confidence as a professional. Sotova and Kolesova [15] state that the development of the methods of teaching the Russian language to international students using the concept of genre-oriented approach presents a growing interest for researchers who are specialists in the studies of speech genres. New teaching methods on how to teach Russian to international students begin to emerge. Teaching specific speech genres in different fields of professional activities becomes the focus of researchers' efforts. There are problems for non-Russian medical students at all levels linked to mastering professional speech and different aspects of speech culture, which were least methodically worked out in the genre style aspect. Teaching specialist subjects and mastering professional speech should be considered as interconnected and interdependent processes. During the lessons of Russian as a foreign language, special attention is paid to the genre of thematical talk as an obligatory process of forming the skills of professional speech, allowing international students to gain important professional skills. The solutions emerge as communicative tasks involving the completion of exercises grounded on an authentic material, role games envisaging one's readiness for producing monologues and dialogues of various types, the analysis of cases, presentations on a given theme, as well as prepared discussions in organizational forms of mastering speech within a specific sphere of professionalism.

Kupchina and Ragul'skaya [10] focus on the problems of pre-university training of non-Russian students – future master students of economics, with (1) no knowledge of the Russian language, (2) insufficient basic knowledge in economics obtained during a bachelor program in their native country, (3) linguistic features of economic disciplines, in which there are many terms of established clichés, which are difficult to translate. Often, a simple Russian word translated into the native language of a non-Russian student does not lead to an effective understanding of the meaning in the real material containing professional jargon. Moreover, (4) there is a huge volume of educational materials that needs to be delivered during a short period of training. The authors highlight this problem as the most serious problem for non-Russian pre-masters students and teaching staff. They conclude by claiming that there is a need to improve learning and teaching processes using new

technology, as well as developing (in collaboration with the Russian language teachers) a set of new textbooks with selected economic literature for use in language lessons, a complete dictionary of economic terms and computerized economic materials, as well as building the students' professional competencies. Ermakov [17] points out a problem resulting from the need to process a huge volume of educational material provided within a short period of study, also noting that an educator, experienced in the use of different methodological techniques, plays a significant role in helping to solve a student's problem.

The aim of this paper is to indicate a direction for the development of engineering pre-masters programs (PMPs) for international students who have obtained bachelor diplomas from other countries and wish to continue their studies in Russia.

RESEARCH METHOD FOR EXPLORING THE EXPERIENCES OF THE FIRST YEAR MASTER STUDENTS IN TPU

In order to identify and evaluate appropriate methodological principles in the design of pre-masters programs, observation and survey techniques were used. The students involved in a pre-masters program over three academic years were closely observed and monitored for the learning difficulties that they experienced and other issues. The use of both observations and surveys does not only allow the researchers to obtain answers to the questions, but also triangulate the survey results with the observation data in order to gain a better understanding of learning and teaching processes, and grasping the characteristic of each respondent and relevant issues as a result. Students were requested to complete a survey after completing their pre-masters programs and at the start of their master programs. As discussed in the previous section, although the practice of delivering pre-masters programs is not new, in Russia (esp. in TPU), there is a lack of pre-masters programs tailored to students' specific needs, and such programs still need to be specially designed and implemented. The challenge of delivering such a program is due to the fact that the requirements in Russian higher education differ from those in other countries. Figure 1 is developed to explain the processes undertaken in this research.

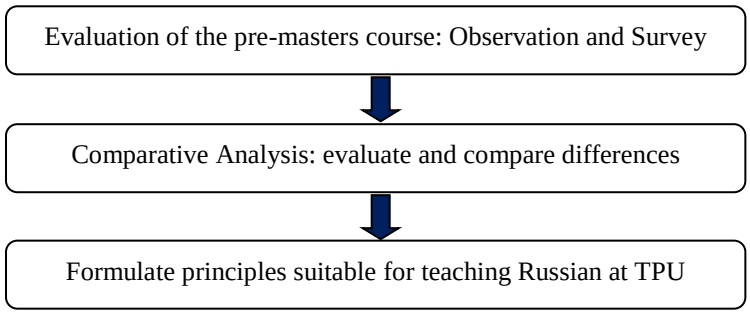

Figure 1. Stages of this research

In Figure 1, the top rectangle shows that observation of related learning and teaching activities took place as part of this research and that a planned survey was used in each academic year to evaluate the effectiveness of the pre-masters program delivered at TPU. In the second rectangle, there is a mention of comparative analysis used in this research based on the triangulation of observation and survey data collected across different years. It is helpful to analyze the data and present the analysis of results across the relevant years. The third rectangle reflects the process of formulating principles appropriate for TPU as a part of Russian higher education, based on the principles and guidelines identified and developed as a result of the comparative analysis carried out in this research. The principles thus identified were used in the development of a curriculum for a new pre-masters program in TPU, which may also be recommended to other universities within the system of Russian higher education.

The three surveys were conducted with the same international students who have successfully completed their pre-masters program in the previous year 2012, 2013 and 2015 and in the first year of a master program in the years 2013, 2014 and 2016. The survey questionnaires aimed to obtain some comparative data collected across the three different years. The results for each year were carefully moderated and confirmed, and the survey results across the three years were carefully compared. The purpose of questioning before and after the pre-masters programs aimed to confirm whether the academic learning difficulties which the students experienced in their pre-masters program, were still the same as what they continued to experience in the first semester of their master programs. In 2015, the graduates of PMP went to other cities of Russia to study for their master programs and only three students were able to meet up in a follow-up event. Therefore, data could not be properly collected from PMP graduates in that year and subsequently when they were in the master programs.

Twelve (12) first-year master program students took part in the survey in 2013, and 11 in 2014. Most of them (9 persons [or 75%] in 2013 and 7 persons [or 64%] in 2014) were trained in master programs such as “Oil & gas”, “Mechanical engineering”, “Optics & Electronics” and so on within the engineering profile. A vast majority (83-91%) of the students were from East Asia’s countries. Out of them all, 84-90% did not know the Russian language at the beginning of PMP, but at the end of PMP, 100% of the graduates received BI and B2 certificates (B1 and B2 are the levels of the Russian language. The same applies to English levels B1and B2). Such result indicates that the pre-masters program graduates (aged 24-26 approximately) had the self-motivation to pursue the intensive training required by the program. They differed in their levels of diligence, but their diligence yielded excellent results overall.

In 2016, 15 students who were trained in master engineering programs took part in a survey. Among them, 66% (10 persons) were from East Asia’s countries. There were 26% (4 persons) from Africa and 8% (1 person) from Latin America. At the

time when the survey was conducted, all of them were first-year master students, who had been trained in a pre-masters engineering program. None of them knew the Russian language at the beginning of PMP, but at the end of PMP, only 87% of the graduates received certificates B1 and B2. Such result indicates that the pre-masters program graduates (aged 22-32 approximately) did not always have the self-motivation to go through the intensive training prescribed by the program. They differed in their levels of diligence and in achieving PMP results.

ANALYZING THE EXPERIENCES OF FIRST-YEAR MASTER STUDENTS AT TPU

When the first-year master students were asked a question "How well do you know Russian after your training in the PMP program?", they provided different answers as in Table 1. The survey results of 2016 where the students were questioned about their academic learning difficulties in the first semester of their master programs, showed significant differences in some items from those in the surveys of 2013-2014.

Table 1. Russian Language Proficiency after the PMP Program

Question: How well do you know Russian after your training in the PMP program?	**Answers of graduate students (%)**		
	2013	**2014**	**2016**
I can communicate freely	20	19	13
I can communicate, but it is difficult to study	20	27	50
I know insufficiently to study	40	27	12
I do not have enough knowledge in core subjects (the higher mathematics, physics …)	20	27	25

There is a decrease in the number of answers about free communication, but in general, a little more than half of the graduates of PMP (62%) revealed that, in their opinion, there were difficulties in the study because of their insufficient knowledge after bachelor program and their weak skills in the Russian language.

RESULTS AND DISCUSSION

The most important aspect of the pre-masters program is training in ‘listening skills’, which would equip the students with the skills to understand a lecture delivered orally by the lecturer. No respondents of the three surveys ever answered

that they "hear nothing and understand nothing about what the lecturer is saying". The number of participants' who answered, "I have very big difficulties" in all subjects decreases from 40% and 45% in 2013 and 2014 respectively, to 34% in 2016. Meanwhile, the answers "I have not very big difficulties" showed an increase from 50% to 62%. Nevertheless, the problem of training in the Russian language for professional and special purposes continues. Therefore, we decided to ask PMP students about difficulties during lectures, practical work (seminars) and in labs.

As shown in Table 2, the greatest difficulties in the lectures are experienced in major subjects and in the Humanities, while there is less difficulty in the core subjects. We discovered some facts that concerned us. On the one hand, the pre-masters curriculum contains some subjects where the study involves the use of special texts in mathematics, physics, and chemistry with a few hours spent on introducing the students to their respective professional fields. On the other hand, the students of different subsets in the engineering profile were grouped together to take part in the same training events and were presented with the same set of significantly varied professional terminologies. Unfortunately, it is not possible to organize different individual groups for different subsets of master program students within the same engineering profile, due to a very small number of students on each subset. As for courses in the humanities, master's students should use a much larger vocabulary exceeding that which they acquired within the framework of the pre-masters program. To improve the students' understanding of lectures, there is a need to develop a dictionary of specialist terms and use such pedagogical techniques in 'advanced training lectures', where students could become acquainted with more new words which they will encounter in future lectures.

Table 2. Difficulties in Lectures

What kind of difficulties are you experiencing in lectures?*	**I can hear familiar words but I do not understand what the lecturer is saying (%)**	**I cannot hearing all words but I understand what the lecturer is saying (%)**
Core subjects (such as math, physics and others)	20	68
Major subjects	43	57
Humanities	50	41

* Not all of the students answered this question.

Table 3 shows that in practical classes, the greatest difficulties arise due to a lack of knowledge on the subject ranging from 40% to 62%, which is probably associated with a significant profile change. For example, a student who enrolled in the master program in optical engineering might hold a bachelor's degree in biochemical technology. To eliminate this difficulty, it is necessary to recommend to the student in the pre-masters program to take extra classes in prerequisite subjects, corresponding to the chosen master program. The second significant difficulty is when a student does not know how to ask the lecturer any question about subject materials (from 25% to 45%). In this case, it is necessary to provide lecturers who know both Russian and the language of the student to improve communication in class during their lectures addressing this as an aspect of educational communication, i.e. pedagogical communication, dialogue and ability to engage and maintain a discussion, etc.

Table 3. Difficulties during Practical work, Seminars, in Labs

What kind of difficulties are you experiencing during practical work, seminars, in labs?	**I cannot complete assignments because I do not understand specialist terms (%)**	**I cannot complete assignments because I do not have enough subject knowledge (%)**	**I cannot complete assignments because I cannot ask question in Russian (%)**
Core subjects (e.g. math, physics)	16	58	45
Major subjects	13	62	25
Humanities	27	40	33

Students generally do not have great difficulties in the study of the Russian language as a subject. Half of them said that they cannot hear all words, but they understand what the lecturer is saying. Others said that they understood the lecturer well.

In order to explore further the reasons for the difficulties that the master's students experienced, two additional questions were asked as well. One of them was "What kind of learning activities did you have in class?" From Table 4, we can see that the time was approximately evenly divided between the monologue speech of the

lecturer, discussion, written assignments, and presentations in the classroom, but very little time was spent on gaming and practical trainings as teaching methods.

Table 4. In-Class Activities

What kind of learning activity did you have in class?	**Lecturer's monologue (%)**	**Conversation, dialog, and discussion (%)**	**Games, trainings (%)**	**Writing exercises, and problems (%)**	**Presentations, and multimedia (%)**
Core subjects (e.g. math, physics)	25	28	0	25	22
Major subjects	30	20	0	31	19
Humanities	19	28	15	14	24

Another question was this: "In your opinion, what is missing from textbooks and workbooks?" Students' responses reveal that the most significant difficulties are associated with the reading of textbooks, especially in major subjects (48%). In their opinion, textbooks and workbooks lack examples of solving problems (30%).

In the years 2013, 2014 and 2016, one of the survey questions entailed a request to explain the types of difficulties that students encountered in the first year of their master program on a 10-point Likert scale. For each group of students, the ratings of a same rated item from all related students were averaged. In 2016, there were three cases in which the responses of two students differed significantly from the average, as shown in Table 5. The comparison of results in the table shows the following implications. In the previous years, none of the master program students indicated any kind of difficulty at 10 points, but in 2016, two students indicated 10 points – they were two Chinese students who found the Russian language particularly difficult to learn. The first item 'knowing insufficient terms in my subjects' indicates that students of the year 2016 had slightly less difficulties in terminologies than students from the years 2013 – 2014 (from 6,5 - 7,6 to 6.0). This fact, however, indicates a rather high level of academic challenge and adaptation for the students through a PMP into a master program, even when different subject teachers tried harder to use special texts in the lessons and to focus the attention of students on contents within the lessons during the terms. Nevertheless, difficulties in speaking increased from 5,6 - 4,6 to 6.0. Comparatively, listening decreased slightly from 5,3 - 4,8 to 4.5. We can explain this by the fact that among the respondents, there were many Chinese students, who find speaking and listening very hard. This suggests that the speaking component should be made compulsory during training. The Russian language serves not only

as a means of communication, but also as a means of learning and cognitive activity. During lectures, students have to assimilate information and react to it in real time, but they are unable to fully understand and analyze the requirements of educational material, despite the fact that they were familiar with most of the terminology. The same was observed in the labs or during the students' self-study when there was the need to read the description and to perform an operation, to obtain and evaluate the result. The students had problems associated mainly with contextual linguistic features, and with a lack of experience in performing this type of tasks. Therefore, in the pre-masters training for international students, it is necessary to use various teaching methods such as lectures, practicals, seminars, labs, and consultations. Many students highly rate manuals (from 2,3 - 2,4 to 0) and electronic resources (from 2,4 - 4,4 -1.0). In 2016, students practically always had access to electronic resources (from 2,2 – 4,4 – 1,0). The difficult climatic conditions of Russia were more dramatic for the last group of respondents, but they do not consider the Russian educational system (from 2,1 - 1,9 to 0,5) as a significant challenge. In our opinion, the latter was due to the fact that the curriculum of the pre-masters program was revised by introducing a new subject "Introduction to a master's program". In the academic year of 2014/15, the textbook for this course was developed by Professor T. Vasilyeva. This textbook consists of two parts. The first part introduces the students to the specifics of the Russian university education system and explains challenges that they need to overcome in order to successfully graduate from engineering-technical programs and the requirements of the learning process for master students. The second part of the textbook prepares students for the writing of separate sections in master's theses grounded on authentic texts as fragments in the master's theses. Learning the textbook material would require 72 hours (2 credits), distributed as follows: 36 contact hours (1 credit) plus 36 hours (1 credit) for self-study. The textbook is designed for pre-masters students speaking Russian at a level close to B1 and, consequently, may be used in the third period of a pre-masters program. Lastly, according to the survey results, the correctly allocated teaching staff was engaged in their specific tasks (from 1,9 – 2,2 to 0).

Table 5. Ratings of Academic Difficulties in 2013, 2015 and 2016

Academic difficulties	**Assessment of difficulties (10-point Likert scale) (1 point – I have no difficulties, 10 point – I have very great difficulties)**		
	2013	**2014**	**2016**
I know insufficient terms in my subjects	6,5	7,6	6.0
Insufficient baccalaureate preparation	6,3	5,6	6,0 (2 person put 10)

It is difficult to speak in Russian	5,6	4,6	6.0 (1 person put 10)
It is difficult to listen and understand a teacher	5,3	4,8	4.5
It is difficult to do written tasks	5,1	6,2	5.6 (1 person put 10)
It is difficult to read textbooks and manuals	4,6	5,0	5.0
Difficult climatic conditions of Russia	3,9	4,8	6.5
The educational system of Russia considerably differs from an education system in the student's native country	3,6	3,7	3.5
Manuals provided at TPU are not helpful	2,3	2,4	0
Not enough electronic resources	2,2	4,4	1.0
Difficulties with the Russian culture	2,0	2,6	2.0
Difficulties with the Russian educational system	2,1	1,9	0.5
Lecturers are not approachable	1,9	2,2	0

CONCLUSION AND RECOMMENDATIONS

This research confirmed the need for the creation of purposefully designed pre-masters programs in conjunction with the master programs. The effectiveness of this approach, as shown in the results of the study, helped us understand and correct the difficulties in the academic teaching of international students. Overall, the survey results have demonstrated a high level of students' adaptation (62%) in the learning environment and the necessary minimum level of language competence to continue education. By the same token, there is still a lack of understanding when major subjects are concerned (i.e. not enough Russian terminology), difficulties in the construction of monologues and dialogical speech, and the ability to maintain a discussion. Therefore, within the pre-masters training framework, teachers must encourage students to practice their skills of producing a monologue with statements based on a list of special vocabularies learned in class within the major subjects, both orally and in writing. Future master students usually find this approach interesting given their extensive subject expertise and high motivation.

Analyzing the survey results obtained in 2016, we find that the increasing difficulties for graduates of a pre-masters program reflect some aspects of the first-year master program in 2016 that require attention for improvements as follows. Firstly, students enrolled in the pre-masters program do not speak Russian. Intensive Russian language course run by the Preparatory Department needs further resources and support during a master's program training period. Further, the curriculum of the first-year master program contains the subject 'Russian as a foreign language' as an elective, which covers an appropriate amount of basic Russian language for the students. From September 2016 onward, this subject was included in the curricula as mandatory. However, the study time was kept to a minimum of 64 hours per semester (4 hours per week). Secondly, in recent years, there are tendencies to intensify the master program curriculum by including very specific major subjects (e.g. basics of safety critical technologies, safety and reliability of technical systems, production management, nuclear physics, business law, pedagogical practice, etc.). The preparation of these courses requires further methodological developments at the stage of a pre-masters program. The problem may be solved by asking members of teaching staff specializing in the major subjects to suggest improvements to the subjects for pre-masters training. Thirdly, students' opinions about academic difficulties, as shown in the surveys, often relate to the gender and ethnicity of the master students who previously completed the pre-masters program. In 2016, the group of pre-masters students recruited in that year almost exclusively consisted of males. Experience shows that young men are more likely inclined to display a more critical attitude to issues that cause difficulties in their learning than young women. In addition, graduates from East Asian countries dominated the students' recruitment in 2016 and language systems in their countries are significantly different from the Russian language. Within 10 months of training, those students could possibly master Russian language only with special diligence and serious engagement in a large amount of additional self-study. Finally, one should note that a student's self-motivation for learning is very important. The students recruited in 2016 were not sufficiently prepared for goal setting and were not motivated to achieve a high level of learning outcomes.

Based on the above discussion, we believe it is necessary to take the following recommended actions for the purposes of both organizational and methodological improvements.

- The subjects' teachers of a pre-masters program will use authentic texts in core subjects for teaching terminological vocabulary and allow a flexibility to allocate classroom time for developing skills of speaking, listening, writing and reading, depending on the national composition of an international student group.
- The master program lecturers will strengthen the terminological dictionaries and thesaurus as digital educational resources and improve their professional competence in teaching major subjects in Russian as a foreign language.

- The teachers of Russian as a foreign language will liaise with subject specialists helping them to focus on the effective teaching of professional vocabulary and lexical and grammatical constructions in the classroom.
- The pre-masters program's organizers will include prerequisite subjects in the curriculum, if a chosen master program differs from the original bachelor diploma.
- International students are encouraged to learn new words before a scheduled lecture during 'advanced training lectures'.
- Before international students are admitted to the pre-masters program, they are advised to visit the website "Russian education", URL https://pushkininstitute.ru/, where there is a possibility to study the Russian language online (general course) before they arrive in Russia. They are also advised to learn the terminology of core subjects (e.g. math, physics, chemistry, and information technology) in order to be better prepared for their study programs.

ACKNOWLEDGEMENT

We would like to express our great appreciation to Tomsk Polytechnic University's project partners from European Universities and organizations within the framework of funds and programs, TEMPUS, TACIS, DAAD, INTAS, Marie Curie Fellowship, FP6 (INCO) etc. The research is funded by Tomsk Polytechnic University Competitiveness Enhancement Program grant.

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