Results of analytical thinking skills training through students in system analysis and design course

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ABSTRACT

This research is aimed at studying the results of analytic thinking skills training of students in the Systems Analysis and Design course. The sample of 14 third year students at Muban Chom Bueng Rajabhat University in the first semester of the 2010 academic year was selected by purposive sampling. The instruments used for this research were the process of analytic thinking skills training and student questionnaires. The instruments of analytic thinking skills training consisted of brain storm chart creation step, concept chart creation step, and Hierarchy chart creation step. The results revealed that 1) students' analytic thinking skills related to academic performance 2) students' analytic thinking skills and academic performance were higher 3) students have a good attitude towards the process of analytic thinking skills training. Therefore, analytic thinking skills training will be beneficial for students in the System Analysis and Design course.

Keywords: *Analytic thinking skills, Process of analytic thinking skills training, System Analysis and Design*

BACKGROUND AND RATIONALE

Learning, for the purpose of this study encompasses two kinds of meaning. It means to perform the procedure or the various methodologies. This helps the individual person learn in terms of the learning process. In terms of the learning outcome, it includes knowing and understanding the variety of content, the ability to act, using various processes and skills, as well as the feelings or attitudes occurring as a result of the students' learning process. (Khammanee, T., & Team, 2001). As the world population grows rapidly, social and economic conditions have also been altered. Whereas before we had learning by teaching, it has been changed to learn by instruction. This enhances learners ability to apply several different methods in learning. John Dewy (1934) supported the concept of teaching and learning that is a process of learning by doing. Although there has been vast world change from the past until now, the process of instruction of Thai

teachers is still traditional. Thitsana Khamanee commented that most teachers are basically acquainted with the teacher-centered method and there is not sufficient encouragement to motivate the teachers to follow and practice new concepts. They have been obsessed with the teacher-centered form of instruction till now. In the past, the Thai educational system emphasis was on sharing information and data, but not on thinking. Most people perceived that information is knowledge because they could neither think analytically nor classify what reliable data was. Recently, however all educational organizations started to realize the significance of these problems. They tried brainstorming solutions to the problems and defined significant policies and rules. From the educational quality assessment of the Office of Certified Standard and Guaranteed Quality in 2005 and 2007, it was found that the educational quality, in terms of the standard of analytical thinking ability, still needed to be improved. It also showed that there would be an effect on the undergraduate learner level. If the learners had low competency when they were young, it would be difficult to have self improvement when they become adults. The fact that Thai students have lower analytical thinking skills was revealed by the National Institute of Educational Testing Service. It was shown by the assessment of the Ordinary National Education Test (ONET) in the academic year 2008. P.6 students got the average scores in Thai and mathematics less than 50%. In addition M. 3 and M. 6 students achieved average scores in 5 subjects (Thai, English, social science, science and mathematics) less than 50%. Furthermore, M. 6 students have had those scores continually for 4 years. This was not good because they did the tests accidentally. As well, the tests focused on analytical thinking where the learning-teaching process focused on learners accustomed to multiple-choice tests or multiple-choice test answers and were not familiar with analytical thinking. (Education column, 2009).

For the above reasons, Board of Education Policy Reform in Decades performed the action plan for education reform in decade 2, starting within the academic year 2010, by considering indicators of success or the main focus of education reform in decade 2. That super-indicators will lead the changes through learning-teaching management and the development of educational organizations in that time with 4 indicators, they are: 1) Top Thai Education on the world stage will be better than the top over 40 which is obviously determined how the ranking will be moved up to 2) Thai children seek more knowledge and learning 3) Thai children eager to have good mental, moral and ethics. 4) Thai children have to be able to think analytically. (Education column, 2010)

The problem of high school students in Thailand is they have had lower analytical thinking skills than the standard criteria for years. At the same time, the number of students studying in higher education at Rajabhat University, which has 44 nationwide locations and doesn't have an entrance examination system, means that these students can study in whichever field they want to learn.

As a result of the reasons mentioned above, we are aware of the problems found during the learning-teaching process. This is especially evident in teaching the

Systems Analysis and Design course. This course requires students to use thinking skills of analysis through information technology systems and analyzing systems through out graphic symbols such as context diagram, data flow diagram, process hierarchical chart, flow chart, etc. Therefore, methods or procedures for practicing analytical thinking skills should be necessarily fundamental to develop students and will be beneficial for learning in Systems Analysis and Design course.

REVIEW OF LITERATURE

Analytical Thinking

Analytical thinking is the abstract separation of a whole into its constituent parts in order to study the parts and their relations (Farex, 2010). Furthermore, Bloom Taxonomy defined the Analytical thinking in the words as follows : analyze, arrange, connect, divide, separate, classify, compare, contrast, explain, select, order, breakdown, correlate, diagram, discriminate, focus, discriminate, illustrate, infer, outline, prioritize, subdivide and points out.(Larry J., and Annette L, 2010)

Analysis means delineating elements of something into the parts to find what it is made from, how it is to be assembled, and how to link the relative components.. Moreover, analytical thinking can be defined by the ability to discriminate various elements of something or any matter and determine the reasonable relationships between those elements to find the real cause of what happened (Chareonwongsak, C., 1999)

In conclusion, analytical thinking means thinking events separately into sub-issues divided by reasons, principles, function, the ability to link relationships between issues, the ability to order issues respectively and arrange issues to be prior.

Metacognition Strategy.

Metacognition is an understanding of cognitive process. It is being aware of what you are thinking, how you are thinking and making sure to monitor your own thoughts. Many studies show that using metacognitive learning techniques can help learners succeed in learning as well. This popular method uses the relationships of semantic mapping. It is a strategy designed to display data based on graphics to sub-classify with the main concept of the story. In other words, it is a classification of the relationships through diagrams or charts to help them understand the obvious (Phoowipadawan, S., 1999) and also give students the strategies for summarizing ideas what they have learned. (Pilunthananon, N., 1998)

Learning with graphic images will enhance the learning level of students (Cheryl, L. Wills, Susan, L. Mietschin. 2005) and there are research results that show that

graphic image techniques will enable learners to effectly apply these techniques as follows : 1) make abstract ideas visible and concrete 2) conceptualize prior knowledge and new concepts 3) provide structure for thinking, writing, discussing, planning and reporting 4) focus thoughts and ideas that lead to understanding and interpretation. (IARE, 2003).

Teaching Thinking Skills

Any identified thinking skills or processes can be taught directly as the following steps (Phillips, 1997):

1. Introduce the skill.
2. Explain the skill.
3. Demonstrate the skill.
4. Apply the skill.
5. Reflect on the skill

IMMCIP PROCESS OF KMUTT

There are 16 processes of the Interactive Multimedia Computer Instruction Package process (IMMCTP) which was developed within the Faculty of Industrail in Education and Technology of King Mongkut's University of Technology Thonburi (KMUTT). The charts are brain storm chart creation, concept chart creation and hierarchy chart creation. (Teeranathanakul & Kaittikomol, 1999)

Brain storm chart creation is a brainstorming technique applied to capture the subjects which should be to receive many subjects. Those may be repeated or not relevant to what you want. The steps start from writing a story to analyze in the middle and then raise the subject organized by lines linked from the main subject and to ensure the integrity of what they need to be repeated approximately around 3-5 times.

Concept chart creation of the subject is a group derived from brainstorming, as a group or category related by bringing the brainstorm chart to study the accuracy, compliance with the theories, principles, reasons, relationships and continuity of the subject in detail. It may be cut or added to a subject according to the reasons or the appropriateness. To ensure the integrity, it should be repeated approximately 2-3 times.

Hierarchy chart creation is bringing the subject group arranged at concept chart creation step to be organized in a hierarchy of importance of the structural hierarchy from top to bottom to see an overview of the system.

Process of analytical thinking skills practice

The process of analytical thinking skills practice for computer programming writing can be done according to the following steps. (Montaku, S., 2010)

1. Identifying problems
2. Brain storm chart creation
3. Concept chart creation
4. Flow chart creation
5. Assessment

Dimension of Learning

Practice in analytical thinking skills will support the learning process of students which will be based on the concept of dimensions of learning : 1) providing students with a good attitude and acceptance of the practice to improve analytical thinking skills 2) practice in analytical thinking skills to help the students learn and to analyze and integrate different knowledge to the same content 3) practice in analytical thinking skills to develop students understanding of the content they learned deeply 4) practice in analytical thinking skills to support and encourage students to apply knowledge meaningfully such as using knowledge to make decisions, solve problems and analyze systems 5) practice in analytical thinking skills has to be able to help students with creativity, promote self discipline and patience in various skills training. (Marzano & Pickering, 1997)

Diagrams and Symbols of System Analysis

After students find the theories and principles of analysis, the roles of the learners become system analysts, information technology system analysts, through possible education, interviews, data collection by questionnaires and observation of the agency working conditions.

The systems analyst needs to make use of the conceptual freedom afforded by data flow diagrams (DFD), which graphically characterizes data processes and flow in a business system. System analysts attempt to understand the conceptualization of how data moves through the organization, the processes or transformation that the data undergoes, and what the outputs are. A visual depiction can crystallize this information in a useful way.

The four basic symbols used in data flow diagram, their meaning, and example as shown in figure 1.

Developing data flow diagrams are:

1. Creating the Context diagram as shown in figure 2

2. Creating the Process Hierarchical diagram as shown in figure 3
3. Creating the Data flow diagram level 0. as shown in figure 4
4. Creating the child Data flow diagram (more detail level such as DFD level 1, DFD level 2) as shown in figure 5.

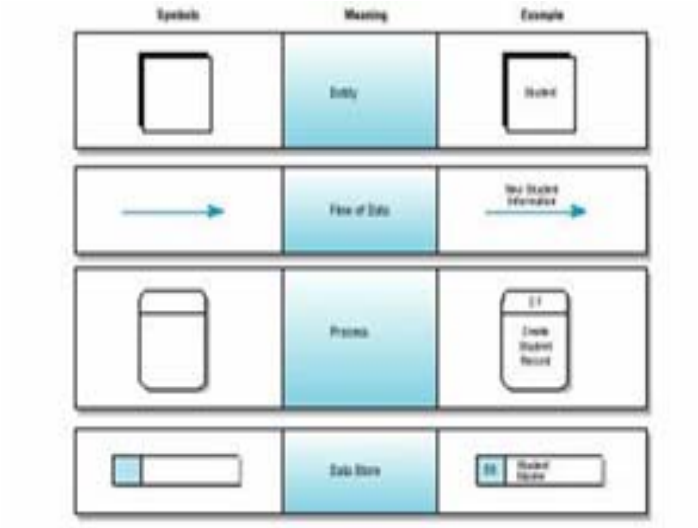


Figure 1: Basic symbols.
(From http://ww2.cis.temple.edu/barampublic/images/A&D-notes.htm

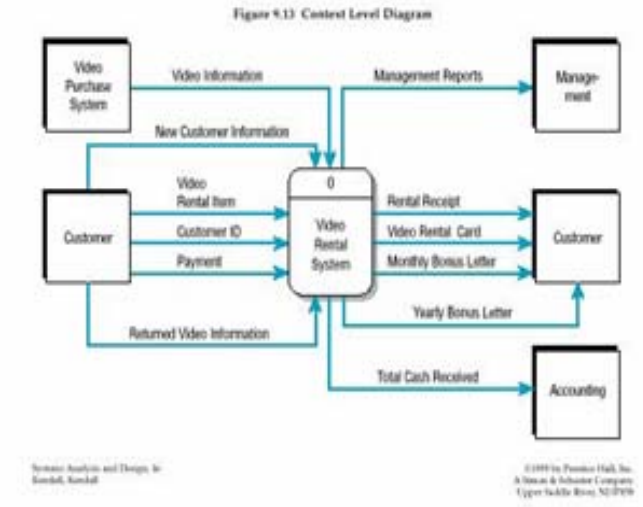


Figure 2: Context diagram.
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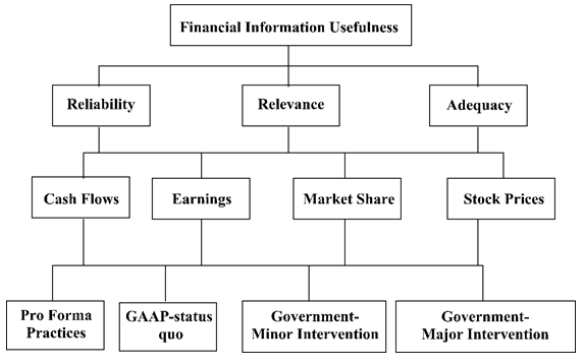


Figure 3: Process Hierarchical diagram.
(From http://www.emeraldinsight.com/fig/2850060201001.png)

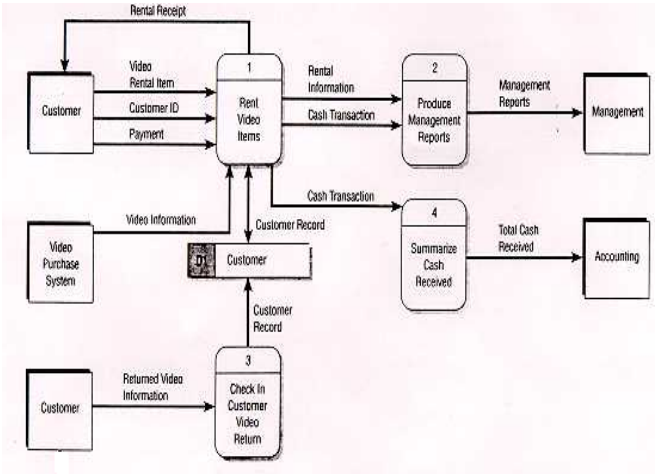


Figure 4: Data flow diagram level 1.
From http://ww2.cis.temple.edu/barampublic/images/A&D-notes.htm

Research Objective

The objective of this research is aimed to study the results of analytical thinking skills training through learning in System Analysis and Design course.

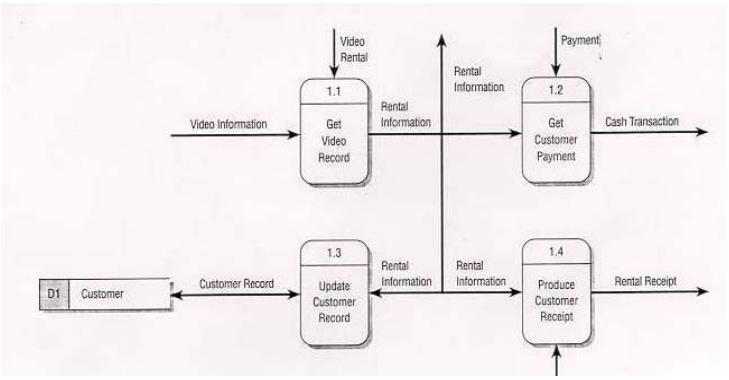


Figure 5: Data flow diagram level 2.
(From http://ww2.cis.temple.edu/barampublic/images/A&D-notes.htm)

Expected Outcome

Expected results from this research are that the process of analytical thinking skills training would be beneficial to enhance learning in the System Analysis and Design course

Research Scope

1. The population was 2,800 undergraduate students of Muban Chom Bueng Rajabhat University in the 2010 academic year
2. The sample was the 14 third year students at a branch of Information Technology from Science and Technology faculty of Muban Chom Bueng Rajabhat University in the first semester of the 2010 academic year was selected by purposive sampling.

Research Tools

The tools used in this research were as follows:

1. The process of analytical thinking skills training
2. Student questionnaires

Research Assumption

1. Pre-tests and mid-term tests in the System Analysis and Design courses are the same tests. Their content is about the system analysis only.
2. Pre-tests and mid-term tests in analytical thinking are the same tests.

3. The result of the tests is the scores during the mid-term examination in the first semester of the 2010 academic year.

Research Limitations

The limitation of this study was that the practice of analytical thinking skills was about computer systems only.

Research Methodology

1. Analysis phase

The processes of analysis were as follows:

1.1 Study on analytical thinking.
1.2 Methacognition strategy
1.3 Study on IMMCIP process of KMUTT.
1.4 Study on dimentions of learning.
1.5 Study on teaching thinking skills.
1.6 Study on diagram and symbols of system analysis.
1.7 Interview computer instructors of 4 Rajabhat Universities (Suan Sunandha Rajabhat University, Suan Dusit Rajabhat University, Udon Thanee Rajabhat University and Chiang Mai Rajabhat University) about the concept to improve analytical thinking for learning of programming writing.

2. Design phase

2.1 Synthesize theories and concepts of analytical thinking skills.
2.2 Make up the model of analytical thinking skills training.
2.3 Four experts from Muban Chom Bueng Rajabhat University, Petchaburi Rajabhat University and Nakhon Pathom Rajabhat University check the possibility, the appropriateness, and receive the suggestion of the model of analytical thinking skills training. Then, the researcher collects it.
2.4 The results were a process of analytical thinking skills training for students learning in System Analysis and Design course.

They were as follows:

1) Identifying problems
2) Brain storm chart creation
3) Concept chart creation
4) Hierarchy chart creation
5) Assessment

Effects of brain storm chart creation , concept chart creation and hierarchy chart creation was shown below.

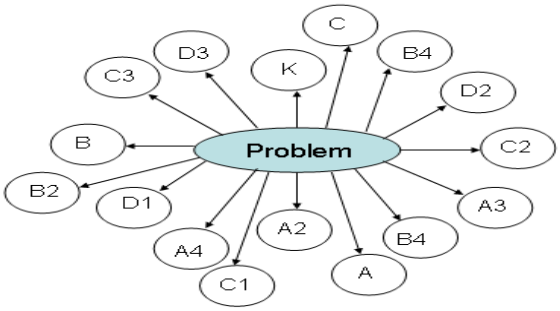


Figure 6: Brain storm chart

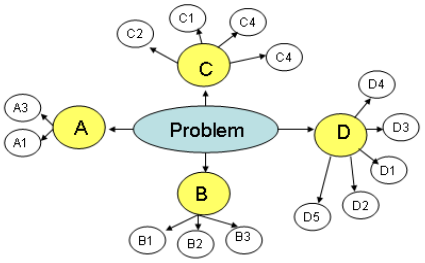


Figure 7: Brain storm chart.

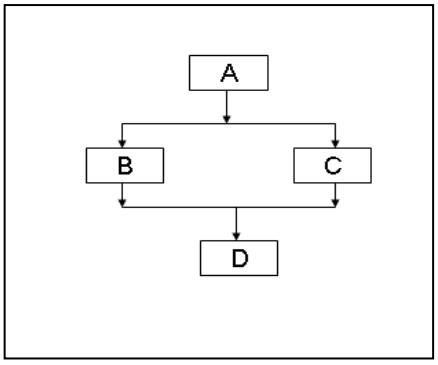


Figure 8: Hierarchy chart.

2.5 Make up 4 items of analytical thinking tests. Each item has 10 points, so the totals are 40.

2.6 Make up 4 items of system analysis tests. Each item has 10 points, so the totals are 40.

Data collection

The process of analytical thinking skills training was used to prepare 14 third year students at a branch of Information Technology from Science and Technology faculty of Muban Chom Bueng Rajabhat University in the first semester of the 2010 academic year before they study System Analysis and Design course for 5 weeks prior to each course.

Research Result

1. The relationship between analytical thinking skills and academic performance of students. The correlation coefficient of the relationships between analytical thinking skills and academic performance of the students was 0.78 indicating that the relationship was statistically significant at 0.01.

2. Results of analytical thinking skills and academic performance of student.

2.1 Based on the comparison of the total scores of analytical thinking skills improvement shows that the mean of pre-test was 1.28 and post-test was 32.28. When testing the differences of significance between the pre-test and post-test, scores of the process of analytical thinking skills training by finding the statistical t-test (Paired Sample t - test) showed that the process of analytical thinking skills provided students with effective analytical thinking increased. The differences were statistically significant at 0.05 as shown in table 1

Table 1: Comparison of the mean scores on the Analytical thinking skill of the experimental group before and after the treatment.

Analytical thinking skill scores	$\bar{x}$	S.D.	T	p-value
Pre-test	1.28	1.54	-22.042	.000**
Post-test	32.28	5.96		

2.2 Based on the comparisons of average total of system analysis, it appears that the mean of the pre test was 4.64 and the mean of the post test was 34.07. When testing the differences of significance between the pre test and post test, scores of the system analysis by finding the statistical t – test (Paired Sample t – test) indicating that the process of analytical thinking skills, combined with teaching process, provided students with effective academic performance increased. The differences were statistically significant at 0.05 as shown in table 2

Table 2: Comparison of the mean scores on the Analytical thinking skill of the experimental group before and after the treatment.

Analytic thinking skill scores	$\bar{X}$	S.D.	T	p-value
Pre-test	4.64	3.65	-28.113	.000**
Post-test	34.07	3.89		

3. The results of the students' interviews, with the process of analytical thinking skills, were concluded as the follows:

3.1 The students' assessment that the process of brainstorming was a benefit to the students way of thinking varies. There is more information required or more issues used as a guideline for the next step to be more perfect, reduce errors, uncover new issues and add more perspective to future studies.

3.2 The students think that the process of concept helps the students to think together, look overall, and link the relationship? the new subject , increase or decrease the content can be more prefect , reduce errors , and create new guidelines.

3.3 The students think that the use of the hierarchy chart process makes them look at the overall picture better and highlight for them the relationship of hierarchy systems.

Summary

The process of analytical thinking skills is the development of activities directly through the process of thinking. Students have the opportunity to practice thinking by themselves and display ideas in a graphic chart. The findings were as follows:

1. Instructors should develop the process of analytical thinking skills and the content of fundamental tests to improve all students.
2. Instructors lead the process of analytical thinking skills in System Analysis and Design course to develop a set of skills as an E – learning methodology to be used widely.
3. Instructors should make the process of analytical thinking skills in learning cover all the content in System Analysis Design course by providing ongoing training through out the semester.

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