Index of Learning Styles of Engineering and Architecture Students for SY 2011-2012

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ABSTRACT

Purpose:
The study is concerned with finding out the index of learning styles of engineering and architecture students for SY 2011-2012.

Methodology:
The study employed descriptive research design. Quantitative data was collected and presented. The proponents of this study used a standard survey questionnaire developed by Felder and Silverman to determine the index of learning styles.

Findings:
The results showed that the student-respondents were active, sensory, visual and sequential learners.

Conclusion:
The majority of the student-respondents were active, sensory, visual and sequential learners.

Keywords:
Learning styles, engineering and architecture education, teaching styles

INTRODUCTION

Learning may be defined as attaining or acquiring new or modifying existing knowledge, behaviours, skills, values or preferences. This may involve processing and synthesising different types of information. Human learning may occur as part of education or personal development.

Students learn in different ways. They can learn lessons by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorising and visualising and drawing analogies and building mathematical models; steadily, or in fits and starts. Teaching methods also vary. Some instructors lecture, others

demonstrate or discuss; some focus on principles and others on applications; some emphasise memory and others understanding (Felder and Silverman, 1988).

Is there effective learning in the process? For many years it was observed that many engineering and architecture students failed in mathematics and professional subjects. There may be mismatches existing between common learning styles of engineering and architecture students and traditional teaching styles of their professors. Learning styles of these students and teaching styles of most engineering and architecture professors are incompatible in several dimensions.

This study will serve as a venue to determine the learning style index and learning difficulties of the engineering and architecture students, and this will be used as a basis for instructional policies and intervention in the future. The proponents will be using the *Index of Learning Styles* instrument developed by Richard M. Felder (North Carolina State University) and Linda K. Silverman (Institute for the Study of Advanced Development). The *Index of Learning Styles* is an instrument used to assess preferences on four dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) of a learner.

Objectives of the Study

The main objective of the study is to determine the index of learning styles and learning difficulties of the engineering and architecture students for SY 2011-2012. Specifically, the study is aimed to determine:

(1) The profile of the student respondents in terms of:
    1.1 Sex
    1.2 Program/Course
    1.3 Year Level
(2) The index of learning styles of the student respondents in terms of:
    2.1 Processing (Active – Reflective)
    2.2 Perception (Sensory – Intuitive)
    2.3 Input (Visual – Auditory)
    2.4 Understanding (Sequential – Global)
(3) The index of learning styles of the students when grouped according to:
    3.1 Sex
    3.2 Program/Course
    3.3 Year Level

METHODOLGY

Research Design

This study employed descriptive research design. This determines the current status of the engineering and architecture students on their learning styles. Quantitative data were collected and presented.

Respondents

This study involved all engineering and architecture students enrolled during the second semester of SY 2011-2012 from the School of Engineering and Architecture. The eight academic programs of the school were included: civil engineering, chemical engineering, mechanical engineering, industrial engineering, electronic and communication engineering, electrical engineering, computer engineering and architecture programs. The study was conducted from January to February 2012.

Research Procedure

The following is the procedure used by the proponents:
(1) Gathering of information;
(2) Administration of survey questionnaire;
(3) Tabulation, analysis and interpretation of data.

The data gathered were tabulated, analysed and interpreted using applicable statistical tools. Only the completely answered questionnaires/instruments were included. Table 1 interprets the index of learning styles.

Table 1: Verbal description of learning styles percentage range

Learners' Percentage in the Dominant Learning Style	Verbal Description
Up to 60.00%	Balanced / Mild
60.01% to 80.00%	Moderate
80.01% to 100.00%	Very Strong

Statistical Treatment

The following statistical treatments were used to analyse and interpret data:

(1) Frequency Count. This was used to determine the number of learners falling on each learning preference per dimension.
(2) Percentage. This was used to establish the percentage for learning preferences in each dimension.

RESULTS AND DISCUSSION

Profile of the Students

There were 771 student-respondents involved in this study. They were enrolled in the School of Engineering and Architecture for the second semester of SY 2011-2012. Figure 2 shows the percentage of male and female students. There were 498 males (64.59%) and 273 females (35.41%).

There were 223 architecture students (ARCHI) – 28.92%, 105 civil engineering students (CE) – 13.62%, 74 chemical engineering students (CHE) – 9.60%, 40 computer engineering students (CPE) – 5.19%, 94 electronic and communications engineering students (ECE) – 12.19%, 42 electrical engineering students (EE) – 5.45%, 96 industrial engineering students (IE) – 12.45%, and 97 mechanical engineering students (ME) – 12.58%.

There were 261 first year students (33.85%), 153 second year students (19.84%), 154 third year students (19.97%), 87 fourth year students (11.28%) and 116 fifth year students (15.05%).

Overall Index of Learning Styles

In the processing dimension, 447 of all respondents were classified as active learners (57.98%) while 324 respondents were classified as reflective learners. This means that the majority of students are active learners. Active learners prefer to manipulate objects, do physical experiments and learn by trying. They enjoy working in groups to figure out problems. They prefer team activities. Reflective learners, on the other hand, prefer to think things through, to evaluate options and learn by analysis. They enjoy figuring out a problem on their own. They learn better if they work alone.

Among the 447 active learners, there were 266 balanced active learners (59.51%), 150 moderate active learners (33.56%) and 31 very strong active learners (6.94%). Balanced active learners can easily shift to reflective learning style if conditions permit.

Among the 324 reflective learners, there were 236 balanced reflective learners (73.84%), 77 moderate reflective learners (23.77%) and 11 very strong reflective learners (3.40%). Balanced reflective learners can easily shift to active learning style in some circumstances.

In the perception dimension, 578 of all respondents were classified as sensory learners (74.97%) while 193 respondents were classified as intuitive learners. Figure 8 includes the percentage of sensory and intuitive learners. The majority of respondents are sensory learners. Sensory learners prefer concrete, practical and procedural information. They look for the facts. They learn fast if there are step-by-step facts. Intuitive learners prefer conceptual, innovative and theoretical information. They look for the meaning. They also prefer to see the reason behind the information.

Among the 578 sensory learners, there were 253 balanced sensory learners (43.77%), 244 moderate sensory learners (42.21%) and 81 very strong sensory learners (14.01%). Balanced sensory learners can easily shift to intuitive learning style.

Among the 193 intuitive learners, there were 127 balanced intuitive learners (65.80%), 51 moderate intuitive learners (26.42%) and 15 very strong sensory

learners (7.77%). Balanced intuitive learners can easily shift to sensory learning style.

In the input dimension, 684 were visual learners (88.72%) while 87 were auditory learners (11.28%). The overwhelming majority were visual learners. Visual learners prefer graphs, pictures and diagrams. They look for visual representations of information and can easily learn if they are presented with data in a visual way. Auditory (or verbal) learners, on the other hand, prefer to hear or read information. They look for the meaning of the words.

Among the 684 visual learners, there were 186 balanced visual learners (27.19%), 291 moderate visual learners (42.54%) and 207 very strong visual learners (30.26%). A greater percentage of moderate and very strong visual learners was observed. This means that there is a strong indication that the respondents learn visually.

Among the 87 auditory learners, there were 62 balanced auditory learners (71.26%), 23 moderate auditory learners (26.44%) and 2 very strong auditory learners (2.30%). The majority of the auditory learners were balanced auditory learners.

In the understanding dimension, 537 of all respondents were classified as sequential learners (69.65%), while 234 respondents were classified as global learners (30.35%). The majority of the respondents are sequential learners. Sequential learners prefer to have information presented linearly and in an orderly manner. They put the details together in order to understand the big picture that emerges. They learn fast if they are presented information in a step-by-step way. By contrast, global learners prefer a holistic and systematic approach. They see the big picture first and then fill in the details. They learn easily if they are informed first of the whole idea before the details.

Among the 537 sequential learners, there were 318 balanced sequential learners (59.22%), 191 moderate sequential learners (35.57%), and 28 very strong sequential learners (5.21%). The majority of the sequential learners were balanced sequential learners.

Among the 234 global learners, there were 181 balanced global learners (77.35%), 45 moderate global learners (19.23%), and 8 very strong global learners (3.42%). The overwhelming majority of the global learners were balanced global learners.

In summary, Table 2 includes percentages of dominant learning styles. The active, sensory, visual and sequential learners are the dominant ones. The visual learning style has the higher percentage and is interpreted as "very strong." Sensory and sequential learning styles are described as "moderate", while the active learning style is described as "balanced". This means that the engineering and architecture students learn very strongly in the visual style and moderately in sensory and sequential learning styles.

Table 2: Percentage of dominant learning styles

Dimension	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description
Processing	57.98%	Active	Balanced
Perception	74.97%	Sensory	Moderate
Input	88.72%	Visual	Very Strong
Understanding	69.65%	Sequential	Moderate

Index of Learning Styles when Grouped by Sex

The male active learners accounted for 295 respondents (59.24%), while the male reflective learners had 203 respondents (40.76%). The female active learners accounted for 152 respondents or 55.68%) while the female reflective learners had 121 respondents (44.32%).

Of the 498 males, there were 360 male sensory learners (72.29%) while 138 were intuitive learners (27.71%). Of the 273 females, there were 218 female sensory learners (79.85%) while 55 were intuitive learners (20.15%). Figure 20 describes the percentage of female sensory and intuitive learners. The overwhelming majority were sensory learners.

There were 447 male visual learners (89.76%) and 51 auditory learners (10.24%). A very high percentage of visual learners among male respondents was observed. There were 237 female visual learners (86.81%) and 36 auditory learners (13.19%). A very high percentage of visual learners among female respondents was observed.

There were 340 male sequential learners (68.27%) and 158 global learners (31.73%). The majority of male respondents were sequential learners. There were 197 female sequential learners (72.16%) and 76 global learners (27.84%). The majority of female respondents were sequential learners.

In summary, Table 3 describes the percentage of dominant learning styles of male and female respondents in four learning dimensions – processing, perception, input and understanding. There were 59.24% male active learners and 55.68% female active learners. All were in balanced description.

There were 72.29% male sensory learners and 79.85% female sensory learners. All were in moderate description.

There were 89.76% male visual learners and 86.81% female visual learners. All were in very strong description.

There were 68.27% male sequential learners and 72.16% female sequential learners. All were in moderate description.

Index of Learning Styles when Grouped by Program

Among the architecture students, there were 58.74% active learners and 42.47% reflective learners. Among the civil engineering students, 60.95% were active learners while 39.05% were reflective learners.

Among the chemical engineering students, there were 60.81% active learners and 39.19% reflective learners. Among the computer engineering students, there were 50% active and 50% reflective learners.

Table 3: Percentage of dominant learning styles in males and females

Sex	Processing			Perception			Input			Understanding		
	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description
Male	59.24%	Active	Balanced	72.29%	Sensory	Moderate	89.76%	Visual	Very Strong	68.27%	Sequential	Moderate
Female	55.68%	Active	Balanced	79.85%	Sensory	Moderate	86.81%	Visual	Very Strong	72.16%	Sequential	Moderate

Among the electronic and communication engineering students, there were 56.38% active learners and 43.62% reflective learners. Among the electrical engineering students, there were 57.14% active learners and 4.86% reflective learners. Among the industrial engineering students, there were 56.25% active learners and 43.75% reflective learners. Among the mechanical engineering students, there were 57.73% active learners and 42.27% reflective learners.

The top three programs with the highest percentage of active learners are civil engineering, chemical engineering and architecture. The highest percentage of reflective learners is in the computer engineering program.

Active learners are those who feel more comfortable with, or are better at, active experimentation than reflective observation, and the converse is true for a reflective learner. There are indications that engineers are more likely to be active than reflective learners (Dunn & Carbo, 1981). The civil engineering, chemical engineering and architecture students, as observed, learn by doing. They can make designs after the facts have been presented. The computer engineering students can work independently. They tend to think first before designing in order to create algorithms. They tend to use their imaginations.

Among the architecture students, there were 65.02% sensory learners and 34.98% intuitive learners. Among the civil engineering students, 75.24% were sensory learners while 24.76% were intuitive learners. Among the chemical engineering students, there were 77.03% sensory learners and 22.97% intuitive learners.

Computer engineering program had 72.50% sensory learners and 27.50% intuitive learners. Electronic and communication engineering program had 84.04% sensory learners and 15.96% intuitive learners. Among the electrical engineering students, there were 69.05% sensory learners and 30.95% intuitive learners. Industrial engineering program had 80.21% sensory learners and 19.79% intuitive learners. Mechanical engineering program had 85.57% sensory learners and 14.43% intuitive learners.

The top three programs with the highest percentage of sensory learners are mechanical engineering, electronic and communication engineering and industrial engineering. The architecture program has the highest percentage of intuitive learners.

According to Felder and Silverman (2002), sensory learners prefer concrete, practical and procedural information. They look for the facts. It was evident that mechanical engineering students learn fast if they are given practical and procedural examples in the lessons. Intuitive learners, like architecture students, prefer conceptual, innovative and theoretical information.

Among the architecture students, there were 90.13% visual learners and 9.87% auditory learners. Among the civil engineering students, 88.57% were visual learners while 11.43% were auditory learners. Among the chemical engineering students, there were 82.43% visual learners and 17.57% auditory learners. Computer engineering program had 92.50% visual learners and 7.50% auditory learners. Electronic and communication engineering program had 88.30% visual learners and 11.70% auditory learners. Among the electrical engineering students, there were 83.33% visual learners and 16.67% auditory learners. Industrial engineering program had 88.54% visual learners and 11.46% auditory learners. Mechanical engineering program had 91.75% visual learners and 8.25% auditory learners.

The top three programs with the highest percentage of visual learners are computer engineering, mechanical engineering and architecture. The chemical engineering program had the highest percentage of auditory learners.

According to Felder and Silverman (2002), visual learners prefer graphs, pictures and diagrams. They look for visual representations of information. Auditory learners, on the other hand, prefer to hear or read information. They look for explanations with words.

Among the architecture students, there were 66.82% sequential learners and 33.18% global learners. Among the civil engineering students, 65.71% were sequential learners while 34.29% were global learners. Among the chemical engineering students, there were 68.92% sequential learners and 31.08% global learners. Computer engineering program had 75.00% sequential learners and 25.00% global learners. Electronic and communication engineering program had 75.53% sequential learners and 24.47% global learners. Among the electrical engineering students, there were 73.81% sequential learners and 26.19% global

learners. Industrial engineering program had 67.71% sequential learners and 32.39% global learners. Mechanical engineering program had 73.20% sequential learners and 26.80% global learners.

The top three programs with the highest percentage of sequential learners are electronic and communication engineering, computer engineering and electrical engineering. The civil engineering program had the highest percentage of global learners.

Sequential learners understand new information in linear steps where each step follows logically from the previous one. Global learners tend to learn in large jumps by absorbing material in a random order without necessarily seeing any connections until they have grasped the whole concept (http://www.jcu.edu.au/tldinfo/learningskills/learningst/sequential.html).

In summary, Table 4 describes the percentage of dominant learning styles of respondents by program in four learning dimensions – processing, perception, input and understanding. It is observed that the majority of the respondents by program possess active, sensory, visual and sequential learning styles.

Table 4: Percentage of dominant learning styles by program

Program	Processing			Perception			Input			Understanding		
	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description
Architecture	58.74%	Active	Balanced	65.02%	Sensory	Moderate	90.13%	Visual	Very Strong	66.82%	Sequential	Moderate
Civil Engineering	60.95%	Active	Moderate	75.24%	Sensory	Moderate	88.57%	Visual	Very Strong	65.71%	Sequential	Moderate
Chemical Engineering	60.81%	Active	Moderate	77.03%	Sensory	Moderate	82.43%	Visual	Very Strong	68.92%	Sequential	Moderate
Computer Engineering	50.00%	Active	Balanced	72.50%	Sensory	Moderate	92.50%	Visual	Very Strong	75.00%	Sequential	Moderate
Electronic & Com. Engineerin	56.38%	Active	Balanced	84.04%	Sensory	Very Strong	88.30%	Visual	Very Strong	75.53%	Sequential	Moderate
Electrical Engineering	57.14%	Active	Balanced	69.05%	Sensory	Moderate	83.30%	Visual	Very Strong	73.81%	Sequential	Moderate
Industrial Engineering	56.25%	Active	Balanced	80.21%	Sensory	Very Strong	88.54%	Visual	Very Strong	67.71%	Sequential	Moderate
Mechanical Engineering	57.73%	Active	Balanced	85.57%	Sensory	Very Strong	91.75%	Visual	Very Strong	73.20%	Sequential	Moderate

Index of Learning Styles when Grouped by Year Level

Among the first year students, there were 61.69% active learners and 38.31% reflective learners. In the second year level, there were 58.82% active learners and 41.18% reflective learners. In the third year level, there were 57.14% active learners and 42.86% reflective learners. In the fourth year level, there were 50.57% active learners and 49.86% reflective learners. In the fifth year, there were 55.17% active learners and 44.83% reflective learners. This indicates that the majority of the students by year level possessed active learning styles.

Among the first year students, there were 77.78% sensory learners and 22.22% intuitive learners. In the second year level, there were 72.55% sensory learners and 27.45% intuitive learners. In the third year level, there were 74.68% sensory learners and 25.32% intuitive learners. In the fourth year level, there were 73.56%

sensory learners and 26.44% intuitive learners. In the fifth year, there were 73.28% sensory learners and 26.72% intuitive learners. This indicates that the overwhelming majority of the students by year level possessed sensory learning styles.

Among the first year students, there were 88.12% visual learners and 11.88% auditory learners. In the second year level, there were 86.27% visual learners and 13.73% auditory learners. In the third year level, there were 87.66% visual learners and 12.34% auditory learners. In the fourth year level, there were 93.10% visual learners and 5.90% auditory learners. In the fifth year, there were 91.38% visual learners and 8.62% auditory learners. This indicates that the overwhelming majority of the respondents by year level possessed visual learning styles.

Among the first year students, there were 72.03% sequential learners and 27.97% global learners. In the second year level, there were 73.20% sequential learners and 26.80% global learners. In the third year level, there were 67.53% sequential learners and 32.47% global learners. In the fourth year level, there were 67.82% sequential learners and 32.18% global learners. In the fifth year, there were 63.79% sequential learners and 36.21% global learners. This indicates that the overwhelming majority of the respondents by year level possessed sequential learning styles.

In summary, Table 5 shows the percentage of dominant learning styles of respondents by year level in four learning dimensions – processing, perception, input and understanding. It can be observed that the most of the respondents possess active, sensory, visual and sequential learning styles.

Table 5: Percentage of dominant learning styles by year level

Year Level	Processing			Perception			Input			Understanding		
	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description	Percent of Dominant Learning Style	Dominant Learning Style	Verbal Description
First Year	61.69%	Active	Moderate	77.78%	Sensory	Moderate	88.12%	Visual	Very Strong	72.03%	Sequential	Moderate
Second Year	58.82%	Active	Balanced	72.55%	Sensory	Moderate	86.27%	Visual	Very Strong	73.20%	Sequential	Moderate
Third Year	57.14%	Active	Balanced	74.68%	Sensory	Moderate	87.66%	Visual	Very Strong	67.53%	Sequential	Moderate
Fourth Year	50.57%	Active	Balanced	73.56%	Sensory	Moderate	93.10%	Visual	Very Strong	67.82%	Sequential	Moderate
Fifth Year	55.17%	Active	Balanced	73.28%	Sensory	Moderate	91.38%	Visual	Very Strong	63.79%	Sequential	Moderate

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were obtained from the analysis and findings of this study:

(1) Most of the respondents were males, architecture students and in the first year.

(2) The majority of the student–respondents were active, sensory, visual and sequential learners.
(3) When grouped by sex, program and year level, the majority of the student–respondents were active, sensory, visual and sequential learners.

It is respectfully recommended that:

(1) A study on the teaching styles of the engineering and architecture faculty be conducted.
(2) A cross-reference study and analysis regarding students who failed in their subjects/courses be conducted and trending patterns established.
(3) A questionnaire or instrument to determine the learning style index be developed to be utilised in the admission and interview process of incoming engineering and architecture students and also to determine their appropriate career path.
(4) A phenomenological study be conducted in order to recognise the mathematics learning experiences and views of the engineering and architecture students.

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