

Perception of Mechanical Engineering Students According to A Subject on Felder Silverman Learning Styles

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Abstract

Learning style is not just an ability but the preferred way of one's abilities. Every individual or learners has their own or unique way of doing things as they differ in their styles of retaining new information and skills. In the field of education, the concept of learning styles was very much introduced at least in the midst of 1970s. Subsequently, several researches are continuously conducted in search of the importance of the learning styles that integrates a successful teaching and learning process. Hereby, a study was conducted at premier polytechnics in Malaysia as to determine the learning styles of mechanical engineering students. Felder Silverman learning style was used as it consists of four dimensions which are processing, perception, input, and understanding. It is important to know the learning styles among students, since each of them have different learning styles in their studies. The present study articulates a quantitative research methodology where premier polytechnic mechanical engineering students participated in this survey. The results obtained achieves the objective that identifies the different learning styles among mechanical engineering students. IBM statistical package for social sciences version 23 for windows (SPSS) was used to analyse the data via mean descriptive analysis. Each student has their own style of learning to achieve success in their studies. Henceforth, an understanding of students' learning style is vital as to enhance learning.

Keywords: Felder Silverman Learning Style, Premier Polytechnic, Mechanical Engineering Students

Introduction

Education is the key driver for growth, economic prosperity, and the advancement of both developed and developing countries. An effective teaching results in meaningful learning experiences. A balanced teaching and learning produces externalized performance of the student in the sense of knowledge and beliefs. The knowledge and beliefs are references to the life we live, so living and learning cannot be separated from each other. Not only by

turning away from the physical impure world which is our senses to the world of ideas, pondered by the mind's eye, can we hope to gain true knowledge (Hergenhahn and Olson, 2005). Similarly, Aristotle believed that knowledge comes through the senses. In short, Plato's "rationalism" can be seen in Gestalt and cognitive psychology and Aristotle's "empiricism" is particularly evident in early behavioral psychology.

Hilgard and Bower (1966) had reviewed eleven learning theories and noted that learning theories fall into two main families which are stimulus-response theories and cognitive theories. Knowles (1984) uses Reese and Overton's (1970) organization, in which learning theories are grouped according to two different worldviews: mechanistic and organismic. Gredler (1997) demonstrates the difficulties in deciding which "contemporary perspectives" are actual learning theories. She discusses seven perspectives of learning theories of Skinner's operant conditioning, Gagne's conditions of learning, cognitive learning principles, Piaget's cognitive-development theory, Vygotsky's socio-historical theory, Bandura's social-cognitive theory, and Weiner's theory of motivation. However, three of these theories which are Piaget, Vygotsky, and Weiner technically not categorized as learning theories but they have important implications for classroom practice.

The common attribute from the evolved theories stated only certain cognitive and affective characteristics of an individual are integrated into their system. However, it reduces the scope of validity of the given approach. Thus, it is obvious that neither theory is capable of typifying all the learning characteristics of the individual in the proper way and in proper detail (Tóth, 2012). The existing 60 to 70 theories can be classified into five categories, according to which learning style is biologically determined. Hereby, Felder prevail that learner with a strong preference for a specific learning style may have difficulties in learning if the teaching style does not match with their desired way of learning (Felder and Silverman, 1988; Felder and Spurlin, 2005). The aim of this study is to analyse data based on Felder-Silverman learning style model (FSLSM) to provide a more detailed description of its learning styles.

Therefore, it is important to identify the characteristics of each four dimensions of FSLSM in order to be able to make a more gradual distinction within the learning style facets among students. The first dimension distinguishes between an active and a reflective way of processing information. As for the second dimension covers sensing versus intuitive learning which is on perception. Input dimension is the third dimension where information obtained via visual and verbal. In the fourth dimension, the learners are characterized according to their understanding of which there are sequential and global learners. Thus, the depth analysis of FSLSM is based on the data gained that provides a more comprehensive information for a better application of learning styles in technology enhanced environments.

Literature Review

Brief Summary of Learning

Based on Carroll (1963), learning achievement is influenced by individual's prior knowledge and their learning abilities that is the ability of self-regulated learning. Not only that, the degree of understanding towards a subject knowledge such as their general intelligence, verbal skills and several environmental factors correlates in learning achievement. The quality

of instruction such as the selection of appropriate methods and materials, organization of the curriculum as well as affective and cognitive dispositions (e.g. interest, motivation, level of standards, self-image) is vital. Learning achievement is best articulated as the pace which is the speed of comprehending the knowledge delivered as well as the quality of learning and the durability of knowledge that is the ability to recall. The effectiveness of learning is expressed by a ratio of the time allocated to learning and divided by time needed for acquisition. The former encompasses the time planned by the teacher of the syllabus-based which is the content delivered in classroom or the learning time of the student at home, while the latter comprises the quality of instruction and the time needed by the students to comprehend the knowledge. Nevertheless, the learning processes vary from person to person due to the presence of biological and psychological differences.

Several investigations were conducted until 1950s had derived that learning was a change of behaviour by psychologists. As Hill, 2002 noted that what is learnt does not have to be correct or adaptive. In the process of learning we adapt bad habits as well as good. Moreover, the change does not have to be conscious or deliberate. Also, it need not involve any overt act that is shown clearly. Attitudes and emotions can be learned just like knowledge and skills. Coaching a skill makes us aware of the mistakes we have unconsciously learned and being adaptive to the changes. The notion of change, however, still underlies most definitions of learning. Despite, it has been modified to include the potential for change and the idea that having an experience of some sorts, rather than learning as a function of maturation, is important. Thus, a reasonable definition of learning would be a process that brings together cognitive, emotional, and environmental influences and experiences for acquiring, enhancing, or making changes in one's knowledge, skills, values, and worldviews (Illeris, 2007).

Learning problems are often influenced by the type and level of cognitive processes involved in learning the material and not to the difficulty of the subject matter. The case becomes severe when students come from a diverse educational experiences with different cultural backgrounds (Abidin, Rezaee, Abdullah, and Singh, 2011). Learning as a process focuses on what happens when the learning takes place. In addition, the availability of various media, students are able to learn in different ways based on their preferred learning styles. Learning styles include cognitive, affective and psychological behaviors which are indicators on how learners perceive, respond and interact to learning environments (Triantafillou et al., 2003). A balanced teaching and learning produces externalized performance of the student in the sense of knowledge and beliefs. The knowledge and beliefs are references to the life we live, so living and learning cannot be separated from each other.

Learning Styles

Learning styles affect learners' learning behaviours. Learners with different learning styles would behave differently in the way they perceive, interact, and respond to the learning environment. It is important for teachers to examine learners' different preferences to certain learning styles. This is because the variations in their students learning styles can help teachers become more sensitive towards the way they learn in the classroom (Felder and Spurlin 2005). In brief, learning style has been defined by various scholars mostly as a signal for individual differences.

Felder and Spurlin (2005) claims that environmental factors and an individual's prior learning experience will aid in the formation of learning styles. Even there are papers of Felder and co-workers mentioned most engineering students having active, sensing, visual and sequential learning styles. As known every student has his or her own learning style. Felder-Silverman learning style model (FSLSM) proposes a learning style model which uses technology in an enhanced learning but at the same time it is designed for traditional learning. As for Kolb (1984) and Honey and Mumford (1992) described learning style as an individual preferred or habitual ways of processing and transforming knowledge. Besides, Dunn *et al.*, (2001) prevailed that every individual utilizes their own ways of specific learning styles in order to effectively work on their mental processes, internalization and retain of new and difficult information.

Each student and their experiences will be unique but, by developing activities which help students to integrate into the academic and social framework at their institution and through developing resources and support to help students cope with the demands of the course, more students will share a good first year experience. Watson (2006) argues for a "consultative, research-based, approach to what students really want and need" and this guide aims to provide support for considering how teaching and learning strategies within departments may help to provide the best possible experience for students in their first year and hence increase the likelihood that they will go on to successfully complete their degree.

Some proponents argue that learning environments and instructional methods should be 'meshed' (Pashler *et al.*, 2008), or 'modified' (Kratzig and Arbuthnott, 2006) to an individual's learning style for optimal learning. Moreover, student's gender, intelligence, and personal characteristics influence the learning style (Erden and Altun, 2006). This leads critics such as Willingham (2008) to debunk the notion of learning styles, stating that "we don't need to adjust our teaching to individual learning styles". Apart from that, a third group argue that the way in which we teach matters and that learning environments need to be balanced and scaffold to enhance learning (Felder and Brent, 2005).

Therefore, learning styles play a pivotal role in education where students learn and process new information in different ways. It is definitely not a difficult task to appreciate and identify learner's learning styles. This is because studying with knowledge of the learning style helps an individual to reach his or her goals quickly besides integrating the process of learning to be easy, fast, and successful.

Research Design

In this research, quantitative research method is used as the research design. The research is conducted via questionnaire based on Felder-Silverman learning style model (FSLSM). Distributed questionnaire is divided into two parts where the first part consists of demographic data, while second part of the questionnaire is on the learning style determined according to a subject in mechanical engineering department. The research focuses on premier polytechnic students whereby the sample chosen is from mechanical engineering faculty.

The research is done in three different locations which are in Perak, Selangor, and Johor according to the premier polytechnics in Malaysia. These polytechnics are chosen because of

the programmes offered are similar whereby all these three polytechnics have mechanical engineering course. Sample is from three different polytechnics as mentioned that are premier and certain duration given to answer the questionnaires. Data obtained is based on Likert Scale. The data is analyzed using IBM Statistical Package for Social Sciences version 23 for Windows (SPSS).

Population and Sample

As known the population of students in this research are from premier polytechnics involving 2600 students from mechanical department. Students at premier polytechnic malaysia are selected upon the merit qualification. These students need to have at least five subjects with grade c and the required passed subjects for the course applied. Therefore, stratified random sampling is used for the research since the subgroup within the population is determined specifically according to the engineering departments provided in each polytechnic. Total number of sample taken is 765 based on the (Research Advisors, 2007). The following table of stratified sampling is adapted from previous research on usage of mobile learning among mechanical engineering students at premier polytechnics malaysia (Che Ghani *et al.*, 2017).

Table 1

Stratified sampling on premier polytechnics

Polytechnic	Department	Population	Sample
Polytechnic Ungku Omar (PUO)	Mechanical	1200	291
Polytechnic Sultan Salahuddin Abdul Aziz Shah (PSA)	Mechanical	400	196
Polytechnic Ibrahim Sultan (PIS)	Mechanical	1000	278
Total		2600	765

Source: Che Ghani *et al.*, (2017)

Validity and Reliability

The use of validity and reliability are common in quantitative research. There are four kinds of validity which are given important that are statistical conclusion validity, internal validity, construct validity and external validity. Trochim (2006) states that construct validity refers to how well a concept, idea, or behaviour is translated or transformed into a functioning and operating reality, the operationalisation. Construct validity involves accumulating evidence in six validity types which are face validity, content validity, concurrent and predictive validity, and convergent and discriminant validity. Therefore, face validity and construct validity that is in category translation validity (Trochim, 2006) is used to measure the instruments. As to check on the items in the instrument to be relevant, reasonable, unambiguous and clear validity is to be conducted. It is achieved by having experts in the field of study to rate the suitability of the measuring instrument for its intended use.

In reliability, there are three kinds of reliability in educational research which is stability, equivalence and internal consistency. Internal consistency is chosen since it demands that the instrument or test to be administered once on the intended group of respondents and their

scores collated for analysis using the appropriate statistical tools. Bowling (2009) defines it as the extent to which the items relating to a particular dimension in an instrument tap only this dimension and no other. The statistical tools placed on internal consistency are by using split-half, item-total correlations, Kuder-Richardson-20 and 21 and Cronbach alpha. The value obtained in Cronbach alpha was more than 0.7 that shows the reliability is sufficiently high and acceptable.

Results and Discussion

Learning Styles among Mechanical Engineering Students at Premier Polytechnics Malaysia

The distributed questionnaires among respondents from Polytechnic Ungku Omar (PUO), Polytechnic Sultan Salahuddin Abdul Aziz Shah (PSA), and Polytechnic Ibrahim Sultan (PIS) have given fruitful information for researcher to achieve a good result during the analysis of data. Findings were analyzed using descriptive analysis via looking upon the frequency and percentage. Therefore, the objectives and research questions have been answered via the findings obtained. Majority students were male dominant with around 80% and the rest were female students in mechanical engineering at premier polytechnics Malaysia.

Table 2 illustrates the types of learning style among mechanical engineering students at premier polytechnics. Based on the items in the questionnaire, they are separated into four dimensions of learning styles according to Felder-Silverman learning style model (FSLSM) consist of processing, perception, input and understanding. The highly scored percentages of respondents prefer processing dimension where they have the active and reflective learning styles. Besides that, in perception dimension one of the items had stated the highest percentage but as for input dimension having visual and verbal learning styles shows the next highly scored percentages of item among respondents too. The least percentage scored in learning style is understanding dimension. Henceforth, if the same study is conducted among the students for coming semesters there might be differences in their learning styles. This is because there will be other possible variables such as different learning environment and content which might change students' learning styles (Williams, Brown and Etherington, 2013).

Table 2

Frequency of Learning Style

Learning Style Dimension	Description of Item	Frequency	Percentage (%)
Processing (Active/Reflective)	I was satisfied with my practical learning period in lab.	287	46.9
	My practical learning period helped me to improve my learning achievement.	328	53.6
	I received sufficient guidance in this subject.	301	49.2
	Group work sessions helped my learning.	306	50.0

Learning Style Dimension	Description of Item	Frequency	Percentage (%)
Perception (Sensing/Intuitive)	The objective of this subject has been explained clearly.	301	49.2
	I prefer to memorize facts while studying.	173	28.3
	I am able to use the basic engineering principles and concepts in this subject.	340	55.6
	I am able to formulate a range of solutions to an engineering problem based on the formulas given.	283	46.2
Input (Visual/Verbal)	Videos and images has been a valuable feature for this subject.	326	53.3
	There has been plenty of opportunity to ask questions and discuss ideas among each other.	298	48.7
	It has been easy to obtain assistance when necessary for this subject via internet.	264	43.1
	I got enough supportive feedback from the lecturer.	297	48.5
Understanding (Sequential/Global)	I feel that I have understood this subject.	278	45.4
	This subject has been run in a well-organized manner.	301	49.2
	The pace in this subject has been so rapid that I had trouble keeping up.	212	34.6
	I could see the relevance of this subject to my future career.	256	41.8

Preferred Learning Styles among Mechanical Engineering Students at Premier Polytechnics Malaysia

Based on the results obtained among mechanical engineering students at premier polytechnics Malaysia all four dimensions of Felder-Silverman learning styles model (FSLSM) are seen being used. As stated Felder and Spurlin (2005), mentioned most engineering students are active, sensing, visual and sequential learners. The high score of percentages are found in processing dimension. It is the first dimension in FSLSM as mentioned earlier. Students prefer both active and reflective learning styles since there was no vast differences found in the percentages score of the items stated in Table 2. Active learners learn best by working actively with the learning material by applying the material and trying things out.

They tend to be more interested in communication with others and prefer to learn by working in groups where they can discuss about the learned material. As for reflective learners, they prefer to think about and reflect on the material. Regarding communication, they prefer to work alone or maybe in a small group of which they only work with one of their good friend. Therefore, mechanical engineering students in premier polytechnics here found to be active and reflective learners.

On the other hand, as revealed in many research papers that most engineering students prefer visual and verbal learning styles which is under input dimension of FSLSM. For instance, study conducted at Penn State University stated that engineering students tend to be highly visual learners by (Thomas *et al.*, 2005). The same goes in this research where majority of mechanical engineering department students prefer visual and verbal learning styles. They are the kind of learners who get more out of textual representations through pictures, diagrams or flow-charts, regardless of the fact whether they are written or spoken. Yet, in both perception (sensing/intuitive learning styles) and understanding (sequential/global learning styles) dimensions there are items scored high percentages at par with processing and input dimensions. Learners who prefer a sensing learning style like to learn facts and concrete learning material. They like to solve problems with standard approaches and also tend to be more patient with details. Furthermore, sensing learners are considered as more realistic and sensible as they are more practical than intuitive learners. This is because they like to relate the learned material to the real world. In contrast, intuitive learners prefer to learn abstract learning materials such as theories and the underlying meanings. They like to discover possibilities and relationships and tend to be more likely an out of the box thinkers who evolves innovative and creativity than sensing learners.

Learners are characterized according to their understanding of which there are several kinds of them. Sequential learners learn in small incremental steps and therefore have a linear learning progress. They tend to follow logical stepwise paths in finding solutions. Else like, global learners use a holistic thinking process and learn in large leaps. They tend to absorb learning material in almost randomly without seeing connections but after they have learned enough material they will get the whole picture of what it was concerned. Thereafter, they are able to solve complex problems, find connections between different areas and put things together as a whole. However, they have difficulties in explaining how they accomplished it because the whole picture is important for global learners. They often are inclined to be more interested in overviews and a broad knowledge compared to sequential learners who are more interested in details. According to Watson (2006), to provide the best possible experience for students in their first year it is important to know what students really want and need in achieving a complete successful study.

Conclusion

As an overall, identifying students' learning styles is vital as to enhance the teaching and learning process. The research conducted has shown that all four dimensions of learning styles are coherent with Felder-Silverman model. The findings describe that students are inclined towards active and reflective learning styles under dimension of processing. Followed by input dimension with visual and verbal learning styles among mechanical engineering students. Perception and understanding dimensions are equally important as seen in the

results obtained. Henceforth, learning styles integrates a successful learning for students to achieve the objectives of a lesson. Even Kratzig and Arbuthnott, 2006 stated that learning environments and instructional methods should be 'modified'. Thus, the depth analysis of FSLSM is based on the data gained from the questionnaire survey that provides a more comprehensive information for a better application of learning styles in technology enhanced environments.

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