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Integration of Learning Styles and Higher Order Thinking Skills among Technical Students

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Abstract: Learning styles and Higher Order Thinking Skills (HOTS) play an important role in higher education learning. They represent different individual preferences and strengths in learning and can be a stimuli for developing new ways of learning. This is because KBAT can increase an individual's ability to observe and process new information while learning style is a method of observation and process the information that occurs in the individual. The purpose of this research was to identify the pattern of Kolb Learning Styles among the technical students based on demographic factors and identify the patterns of Marzano HOTS usage based on Kolb learning styles. The design of this study was descriptive with a quantitative approach. A total of 163 technical students from Faculty of Civil and Environmental Engineering at University Tun Hussein Onn Malaysia (UTHM) were random cluster selected as samples. The Kolb Learning Styles Inventory and assessment rubric were used as research instruments. The findings indicated that the most dominant learning style among technical students is Doer and followed by Feeler, Thinker and Watcher. The patterns of learning styles based on demographic factors are the same. The findings showed that the most widely used Marzano HOTS by all four types of Kolb Learning Styles are comparison and induction. Besides that, the findings revealed that there is no statistically significant difference in Kolb Learning Styles on the usage of Marzano HOTS. Therefore, the differences in learning styles do not affect the usage of HOTS. The implication of the integration of Kolb's learning styles and HOTS Marzano have the potential to bring two simultaneous benefits to students in terms of achievement of ideas generation.

Keywords: Integration, Kolb learning styles, Higher Order Thinking Skills

1. Introduction

The fast-paced developments in sciences and technology greatly affect the particular structural elements in education (Maria, 2013). The process of learning is a fundamental and very important process in determining the quality of education as it determines the main reason for the existence and function of education. To be an effective self-regulated

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learner, students actively have to influence and adjust all learning processes of the cognitive, metacognitive, and motivational dimension (Thomas & Dirk, 2012).

Each individual has his or her own style of learning (Abdul Wahab, 2015). Learning style preferences are influential in learning and academic achievement and may explain how students learn (Yazici, 2016). Student learning styles vary from one style to another according to student's tendency (Nor et al., 2014). This is due to the differences in personality between individuals and the uniqueness of students' values to acquire knowledge (Adnan et al., 2013). It is also seen as an individual way of thinking and learning in a variety of ways and is best understood (Willingham et al., 2015) because the learning method applied is specific to an individual (Ahmad et al., 2014).

Kolb Learning Style Theory is one of the well-known educational theories in higher education (Kolb, 1984). Kolb learning style has gained attention from various fields of study, particularly studies that require practical training such as science, life skills (Othman & Othman, 2004), engineering (Harb et al., 1995), medicine, entrepreneurship (Norasmah, 2002) and accounting (Jonick, 1998). This learning style allows students to do activities during class or in the lab. It can help students to remember previous learning through experience by doing something. The Kolb inventory classifies learners along two dimensions: a preferred mode of perception (concrete or abstract) and a preferred mode of processing (active experimentation or reflective observation) (Gogus & Gunes, 2011; Zacharis, 2011; Pashler et al., 2009).

Kolb Learning Styles was identified into four dominant types of learning styles by combining four stages of learning cycle, namely Doer (a combination of Active Exercise and Concrete Experience), Watcher (a combination of Reflective Observation and Concrete Experience), Thinker (a combination of Reflective Observation and Abstract Concepts) and Feeler (a combination of Active Experiments and Abstract Concepts). Learning styles describe the unique way individuals navigate through learning cycles based on their priorities for four different modes of learning (Kolb & Kolb, 2013). Each type of Kolb Learning Style has its own strength and tendency in the learning activities.

Human thinking skills can be classified into two major groups; low-order thinking skills (LOTS), and higher order thinking skills (HOTS) (Tanujaya, Mumu & Margono, 2017). Definition to HOTS, according to MOE (2015), is the ability to apply knowledge, skills and values in making sense and reflect to solve problems, make decisions, innovate and create something. The use of HOTS in teaching and learning (PDP) may introduce HOTS in learning and enhance student achievement in academic and skills (Sulaiman et al., 2017).

Marzano (1992) identified eight HOTS in the framework of the Dimension to Enhance and Improve the Knowledge contained in the Marzano Learning Dimension Model (1992). It comprises eight types of thinking skills which are comparing, classifying, induction, deduction, error analysis, constructing support, abstracting and analysing a perspective. Based on these eight thinking skills, it showed that the Marzano HOTS is able to supply a complex picture of how an individual learns and thinks. It was developed and published by the Association of Supervisory Development and Curriculum aimed at improving learning and thinking in all contexts. In other words, the development of thinking skills is one of the most effective ways to improve performance, both in answering test and completing assignments.

2. Problem Statement

Thinking skills are needed to open and give way for generating ideas (Othman & Rahman, 2011). With the skill of thinking in a particular field, an individual can build and implement his/her plans effectively. To achieve effective learning objectives, the wisdom of selecting one's learning style needs to be taken care of. Learning styles play a significant role in the lives of learners (Hawkar, 2014). Studies in learning styles are still lacking in Malaysia, especially among technical students. Failure to identify student learning styles will have an impact on the effectiveness of the teaching and learning process. (Yee, 2015). This is because there are some students who are still struggling to adapt their learning styles to suit their abilities (Raai, 2014). The most important reason for determining the learning style is to create a proper teaching strategy.

According to Meor Ibrahim and Assaadah (2011), learning styles are very important for every student as they have a strong influence on academic achievement and provide a learning mechanism that can challenge students and provide proper feedback on their academic pursuits. Some students face difficulties in applying strategic learning styles that fit the learning process (Jasmi & Sulaiman, 2018). As a result, students are making poor results in academic achievement. This is due to the poor application of learning styles in their learning process. Through the learning process, students need to be helped to identify their learning style so that the learning objectives can be achieved well. Iberahim (2014), explains that the reason for student achievement is declining because students cannot adapt their learning with the teaching techniques used by teachers as well as not using appropriate learning styles. Adnan et al., (2013) point out that although individuals have different learning styles with different learning processes, with the same level of understanding of achievement they differ due to the variety of learning styles practiced.

Furthermore, students were lacking understanding of the learning styles causing them to have problems to apply appropriate and effective learning styles in their study (Rashid, 2008). For example, the factor of diversity in capabilities among students are often ignored in the teaching of engineering courses (Shafie & Alias, 2007). As a result, students do not achieve the desired academic results. (Rashid, 2008). This problem exists because most lecturers like to carry teacher-centered learning sessions that cause students to be less involved in learning activities and processes. Hargadon (2010) found that teaches must pay attention to learning differences of students and because of these differences, teachers must use different methods of teaching in order their students gains better performances.

By this implication, student academic achievements are affected. Hence, the objectives of this study are to identify the pattern of Kolb Learning Strategy among technical students based on demographic factors, the pattern of Marzano HOTS usage based on Kolb Learning Strategies and the differences in Kolb Learning Styles on the usage of Marzano HOTS. Specially, the objectives of this study are to identify:

i. The pattern of Kolb Learning Styles among technical students based on demographic factors.
ii. The pattern of Marzano HOTS usage based on Kolb Learning Styles.
iii. The differences in Kolb Learning Styles on the usage of Marzano HOTS.

3. Research Methodology

Researchers use quantitative methods to carry out this study. This is survey research where data can be collected directly from respondents (Wiersma, 2005). The population of this research was all the technical students in Malaysia The researchers chose the university located in the south of Malaysia as the location of research because of this university has the most number of technical students compared with other technical universities in Malaysia. The sample of this research consisted of 163 students from Faculty Civil and Environmental Engineering who were randomly selected.

The research instruments consist of Kolb Learning Styles Inventory, individual assignment and eight types of Marzano HOTS graphic organisers. The Kolb Learning Style Inventory (2000) 18 items is used to identify student learning styles. However, the individual assignment and eight types of Marzano HOTS graphic organisers are used to determine the pattern of Marzano HOTS usage based on Kolb Learning Styles. Eight types of Marzano HOTS graphic organisers which namely comparing, classifying, induction, deduction, error analysis, constructing support, abstracting and analysing perspective were provided to the students and students need to use the graphic organisers to complete their individual assignment. The quantity of graphic organisers usage depends on creativity and initiative students.

The content of all research instruments was verified by seven field experts of instrument design, thinking skills, technical and language. The reliability value of Kolb Learning Style Inventory obtained through Cramer's V correlation test is .90 on all items. The reliability value of individual assignment obtained through alpha test is .81. To analyse this research's questions, the researcher manually checked and reviewed the data by using SPSS. The data was analysed by using a descriptive and inferential quantitative method. Descriptive statistics are used to summarise a set of data, while inference statistics are used to draw conclusions of a population based on the sample data of that population (Idris, 2013).

4. Result and Discussion

4.1 The Pattern of Kolb Learning Styles among Technical Students Based on Demographic Factors

The Kolb Learning Styles has four types, namely Doer, Feeler, Thinker and Watcher. Table 1 shows the pattern of Kolb Learning Styles based on technical students' demographic. Overall, the most popular types of learning styles by technical students is Doer, which is 64 (39.26%) students, and followed by Feeler 34 (20.86%) students, thinker 33 (20.25%) students and Watcher 32 (19.63%) students. Technical students have a descending order for the learning styles from Doer, Feeler, and Thinker to Watcher.

The findings of this research were also supported by research Demirkan & Demirbas (2010) which showed that the factors of gender (Chang, Wen & Chen, 2011; Othman & Othman, 2004) and academic achievement (Shams Esfandabad & Emamipour, 2008) had no significant relation with the learning styles. Overall, the findings showed that there are no different tendency in learning styles for gender, academic achievement and SES. However, there is still a slight difference for the second dominant learning styles between male and female students that was Feeler and Thinker. This is because the male students can receive concrete information, process and abstract information actively and reflectively. While female students are able to receive the information in concrete and abstract forms in which they are more likely to process information actively but not reflectively.

In addition, the second dominant learning styles which favoured by students who obtained CGPA 3.00-3.69 (Watcher) and 2.70-2.99 (Feeler and Thinker) were different. This was due to the learning contents in engineering course for second year students are still at introductory level. It also shows that the method of receiving information concretely is more important than receiving the abstract information by thinking, analysing and evaluating. Besides that, in order to excel academically, learning by experience is still more important if compared with learning through theory. Thus, students are encouraged to engage directly in doing experiments in laboratory and learning at fieldwork rather than thinking logically to produce theories for problem solving and decision making (Kolb & Kolb, 2005).

Moreover, there also is a difference between poor and moderate poor students in second dominant learning styles which was Thinker and Watcher respectively. This is because poor students are able to be flexible in their learning styles and adapt easily in different learning styles. Thus, poor students are able to receive concrete and abstract information while being reflective and active towards the newly received, information. Poor students have the strength to understand the vastly information and summarise them in formulas and produce theories (Kolb & Kolb, 2005; Kolb 1984). However,

moderate poor students has the strength in innovation and imagination and can see the situation from different perspectives (Kolb & Kolb, 2005; Kolb, 1984).

Table 1 - Pattern of Kolb learning styles based on technical students' demographic factors.

Students' Demographic		Kolb Learning Styles								Total	
		Doer		Feeler		Thinker		Watcher			
		f	%	f	%	f	%	f	%	f	%
Gender	Male	32	19.6	19	11.7	11	6.8	14	8.6	76	46.6
	Female	32	19.6	15	9.2	22	13.5	18	11.1	87	53.4
	Total	64	39.3	34	20.9	33	20.3	32	19.6	163	100.0
Academic achievement	CGPA≥3.70	9	5.5	5	3.0	2	1.1	4	2.5	20	12.1
	3.00≤CGPA≤3.69	**30**	**18.4**	12	7.4	13	8.0	**19**	**11.6**	74	45.4
	2.70≤CGPA≤2.99	20	12.3	**13**	**8.0**	**17**	**10.5**	8	4.9	58	35.7
	2.00≤CGPA≤2.69	5	3.1	4	2.5	1	0.6	1	0.6	11	6.8
	CGPA≤1.99	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	64	39.3	34	20.9	33	20.3	32	19.6	163	100.0
Socio-Economic Status	Poor	**29**	**17.8**	**15**	**9.3**	**18**	**11.0**	**18**	**11.0**	80	49.1
	Moderate Poor	9	5.5	5	3.1	6	3.7	9	5.5	29	17.8
	No Poor	26	16.0	14	8.6	9	5.5	5	3.0	54	33.1
	Total	64	39.3	34	20.9	33	20.3	32	19.5	163	100.0

4.1 The Pattern of HOTS Marzano Usage based on Kolb Learning Styles

Table 2 (Appendix A) shows the pattern of HOTS Marzano usage based on Kolb Learning Styles and Learning Cycles. The results of the data analysis indicate that among the eight types of HOTS Marzano, comparison and induction are the most widely used of the four types of learning styles. Only Feeler and Thinker student used eight types of HOTS Marzano to generate ideas.

This is because comparison of HOTS allow the students to find the similarities and differences between the objects or things based on certain aspects (Sulaiman et al., 2011; Hj. Nor & Mohd Ramli, 1998) to gain more information and more idea through the divergent thinking (Marzano et al., 1997). In addition, learning activities in technical courses involve many training and assignments, experiments, research and writing reports (Othman & Johari, 2007). Indirectly, induction was often used by technical students to conclude or construct a concept from experimental or research results. Induction allows the students to collect and interpret tiny and specific information, then summarise it and generating it into common ideas (Mok, 2010). Hence, most of the technical students are more likely to use comparison and induction to generate ideas.

The third highest usage of HOTS Marzano by Doer and Feeler students is classification. This is because both types of learning strategy tend to process information actively by trial, experimental and persistent training. Doer students like to challenge new experiences, find ideas and use the ideas before others know it by trial. While, Feeler students like to look and know the information about how the things work (Kolb, 1984).

However, the third highest usage of HOTS Marzano by thinker and watcher students is error analysis. This is because Thinker and Watcher students are more likely to process information in a reflective manner by observing and seeing the implications of a thing from different perspectives based on self-experience and expert views. Thus, the students like to use error analysis to analyse and evaluate the errors that may occur in the observations. As a result, students can use an accurate and clear information to generate ideas without being influenced by people, things and other situations.

4.2 The Differences in Kolb Learning Styles on the Usage of Marzano HOTS

Table 3 shows the difference of mean scores in Kolb Learning Styles on the usage of Marzano HOTS. The results of data analysis for ANOVA showed that there were no significant differences of mean score in Kolb Learning Styles ($p < .05$). This is because technical students are low in mastery and application of HOTS (Yee et al., 2011). Technical students rarely use difference type of Marzano HOTS in processing information even they are in difference type of learning style (Table 2). Most of the technical students have same type of Marzano HOTS usage which are comparison and induction in completing their individual assignment.

Table 3 - The difference of mean score in Kolb learning styles on the usage of Marzano HOTS.

Learning Style	Mean	Standard Deviation	Sig.
Doer	.3544	.19297	0.24

Feeler	.4033	.30574
Thinker	.3214	.12199
Watcher	.2157	.05855

*Significant differences in p<.05

5. Conclusion

The most dominant learning styles for technical students is Doer and followed by Feeler, Thinker and Watcher. This research shows that technical students have the same tendency of learning styles with a different background. Additionally, this research also clearly shows that the same learning features, no matter receiving and processing information were the factors for technical students to choose the type of HOTS Marzano to generate ideas. This is because the process of learning cycles involve the different methods of receiving and processing different information by relating to the brain function process (Zull, 2002; Dunn, 1986; Price, 1982). In addition, HOTS is an effective learning strategy for students (Othman & Rahman, 2011). In other words, the existence of compatibility between the uses of HOTS in students learning styles. Thus, the integration of learning styles and HOTS is very important for students. The implication of the integration of Kolb's learning styles and HOTS Marzano have the potential to bring two simultaneous benefits to students in terms of achievement of ideas generation.

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Appendix A - The pattern of HOTS Marzano use based on Kolb learning styles and learning cycles.

Kolb Learning Styles	Kolb Learning Cycles	Order	HOTS Marzano	*f*
Doer	Concrete Experiment		Comparison	8
			Classification	3
			Induction	3
			Analysis Error	2
			Abstract	2
	Active Examination	↓	Comparison	7
			Induction	3
			Abstract	3
			Classification	2
			Analysis Error	1
			Support Construction	1
	Reflective Observation		Comparison	7
			Induction	3
			Abstract	3
			Classification	2
			Analysis Error	1
			Support Construction	1
	Abstract concepts		Comparison	6
			Classification	2
			Induction	2
			Abstract	2
Feeler	Abstract concepts		Comparison	5
			Induction	4
			Classification	1
			Deduction	1
			Analysis Error	1
			Support Construction	1
			Abstract	1
			Perspective Analyzing	1
	Active Examination	↓	Comparison	5
			Induction	4
			Classification	1
			Deduction	1
			Analysis Error	1
			Support Construction	1
			Abstract	1
			Perspective Analyzing	1
	Reflective Observation		Comparison	4
			Induction	3
			Classification	1
			Deduction	1
			Analysis Error	1
			Abstract	1
			Perspective Analyzing	1
	Concrete Experiment		Comparison	5
			Induction	4
			Classification	2
			Deduction	2
			Analysis Error	2
			Support Construction	2
			Abstract	2
			Perspective Analyzing	2

Appendix A - (Continue)

Kolb Learning Styles	Kolb Learning Cycles	Order	HOTS Marzano	*f*
Thinker	Reflective Observation		Comparison	5
			Induction	3
			Analysis Error	3
			Deduction	2
			Abstract	2
			Classification	1
			Support Construction	1
			Perspective Analyzing	1
	Abstract concepts		Comparison	5
			Induction	3
			Analysis Error	3
			Deduction	2
			Abstract	2
			Classification	1
			Support Construction	1
			Perspective Analyzing	1
	Concrete Experiment		Comparison	4
			Induction	2
			Analysis Error	2
			Abstract	2
			Classification	1
			Deduction	1
			Support Construction	1
			Perspective Analyzing	1
	Active Examination		Comparison	4
			Induction	2
			Analysis Error	2
			Abstract	2
			Classification	1
			Deduction	1
			Support Construction	1
			Perspective Analyzing	1
Watcher	Concrete Experiment		Comparison	2
			Analysis Error	2
			Induction	1
			Perspective Analyzing	1
	Reflective Observation		Comparison	2
			Analysis Error	2
			Induction	1
			Perspective Analyzing	1
	Abstract concepts		Comparison	2
			Analysis Error	2
			Induction	1
			Perspective Analyzing	1
	Active Examination		Comparison	5
			Induction	4
			Analysis Error	2
			Perspective Analyzing	1