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The Difference between Polytechnic Students' Learning Styles and Their Higher Order Thinking Skills Level

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ABSTRACT

In order to help students learn thinking skills more effectively and improve their academic performance, learning styles preferred by students must be identified. The research purpose of this work was to analyse the difference between polytechnic students' learning styles and the level of their higher order thinking skills (HOTS). A descriptive quantitative methodology study was conducted among 368 diploma students studying in three polytechnics in Malaysia. The students' learning styles were identified through the Kolb Learning Styles Inventory while their HOTS level was identified through a set of questionnaires adapted from the Marzano Rubrics for Specific Tasks or Situations. The results indicated that 'Doer' is the most dominant learning style among polytechnic students. The results also showed that polytechnic students perceived their HOTS level to be moderate. The Cramer V analysis showed that there was no relationship between students' learning styles and eight Marzano HOTS levels. There was also no significant difference between the Kolb Learning Styles and the Marzano HOTS levels. This indicated that regardless of the learning style possessed by the technical students i.e. Doer, Watcher, Thinker or Feeler, the level of HOTS of all the students was the same. This suggests that each student has a different learning style but that all of them possess equal opportunity and capability to learn and master HOTS.

Keywords: Difference, higher order thinking skills (HOTS), learning styles, polytechnic students, relationship

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INTRODUCTION

The higher education system in Malaysia has been improved over the decades. In the past 10 years, there has been an increase in student enrolment in higher education institutions around the country, increasing global recognition for local publications, research and patents and a rise in the quality of these institutions, as well as an explosive growth in the number of international students in local institutions have also been apparent (Ministry of Education, 2015). Hence, the need for the transformation of higher education is crucial as these large numbers of youth need to be adequately prepared to face the challenges of the future.

The Malaysian Education Ministry launched the Education Development Plan 2015-2025 (Higher Education) or PPPM-PT on 7 April, 2015 as a guideline for confronting the challenges faced by the higher education system. PPPM-PT outlines 10 thrusts to achieve the aspirations of students and the nation. The first four thrusts stress that successful people have to focus on higher education, which can be accessed through academic studies, technical and vocational education and training, being involved with the academic community and lifelong learning. The other six thrusts focus on the ecosystem variables of higher education, fund financing, governance, innovation, online learning, internationalization and delivery.

Successful Technical and Vocational Education and Training (TVET) students must show these features: holistic development, entrepreneurial character, balanced attitude and commitment to excellence and lifelong learning. The National Education Philosophy expects graduates to be disciplined, practise morality and adopt the appropriate mind-set and behaviour to develop themselves in ways that would enable them to contribute to the harmony and progress of family, community and the national and global communities. This quality is highlighted through six key attributes: ethics and spirituality, leadership skills, national identity, language skills, thinking skills and knowledge.

Optimal use of thinking skills involves using higher order thinking skills (HOTS) as skills for analysis, synthesis, evaluation and creation (Anderson et al., 2001). HOTS refers to the continued use of the mind when dealing with new challenges (Rajendran, 2009). HOTS allows students to make comparison, evaluation, justification and inferences (Sykes, Floden, & Wheeler, 1997). The HOTS transformation process happens when students combine facts and ideas through the ability to synthesise, generalise, explain, hypothesise or produce conclusions and interpretations (Tee, 2012). The process of manipulating information and ideas will enable students to solve problems, find understanding and gain new insights in learning (Anderson et al., 2001). The application of HOTS can enhance a student's next observation to process new information to publish various alternatives, ideas, actions and design solutions to solve a problem (Yee, 2015).

According to Mohd and Hassan (2005), two main processes in learning thinking

skills are level of perception and level of processing. However, the ability and propensity of individuals to organise and process information is different from one another (Abd. Razak & Azman, 2012). This is because some people more easily understand concrete information while others more easily understand the abstract (Yee, 2015). In the learning environment, Rogers (2009) defined learning style as the tendency to see concrete and abstract information.

Learning style refers to the method people collect, organise and transform data and information into useful information (Kolb, 1984). According to Dunn and Dunn (1994), learning styles are defined as the unique methods or ways used by an individual to learn and scan information. Gremli (1996) stated that learning style involves aspects of personality, information processing, social interaction, the use of guidelines and the focus of attention on something new and unique. Learning style also explains the behaviour of a person in performing a learning task (Rassool & Rawaf, 2007).

According to Yee (2015), cognitive learning style and learning strategies are two fundamental aspects of behaviour and learning style. Cognitive learning style is one's way of thinking, while learning strategies are the demonstration of the process of conducting the learning activities. In other words, individual learning style is a strategy the individual uses to deal with environmental and educational materials. Therefore, we may define learning style as students' tendency in thinking, communicating with others and performing classroom activities (Rogers, 2009).

Since learning style is closely related to thinking skills, the proper application of learning styles among students is crucial (Yee, 2015) as it helps them develop their potential and achieve better academic performance (Abd. Razak & Azman, 2012; Cano-Garcia & Hughes, 2000; Habib & Azizan, 1997). In order to help students practise the application of HOTS and improve their academic achievement, their learning styles should first be identified (Othman & Rahman, 2011).

TVET is an important route for vocational education and skills development. To fulfil the needs of Malaysia's Economic Transformation Programme (ETP), the country must increase its TVET enrolment by 2.5 times by the year 2025 (Ministry of Education, 2015). However, the human resources to meet this demand is insufficient at the moment. In addition, TVET is considered less attractive than conventional university education. This has led to a shortage of TVET students, especially highly qualified ones. Therefore, Malaysia needs to shift from the widely accepted belief that conventional university education is the only career path for Malaysian youth, and also emphasise TVET as a legitimate option for higher education.

The fourth thrust in PPM-PT outlines the Ministry of Education's intention to produce quality TVET graduates by 2020. In the working world, quality is as important to employers as quantity of work. According

to Husain et al. (2010), the requirement for knowledge workers or K-Workers is a top priority among employers for business and economic growth. Employers have reported that most graduates lack critical thinking skills and communication (Ministry of Education, 2015).

According to Ariffin et al. (2008), critical thinking skills, which is an element of HOTS, is an important skill for any profession. Thus, the application of HOTS among students in institutions of higher learning is necessary as preparation for working life in the future. In fact, failure to apply HOTS causes lack of creativity among students in solving problems (Yee, 2015). HOTS is indispensable among students for the generation of creative ideas (Othman & Rahman, 2011). Thinking skills help students to build and execute plans effectively.

Findings by Yee et al. (2010) obtained from a study that was conducted among 131 students from the Faculty of Technical Education in the University of Tun Hussein Onn Malaysia (UTHM) concluded that the students rarely used HOTS. The respondents also perceived that the level of HOTS application among them was low. Another study conducted by Yee et al. (2011) among 375 students from four technical universities in Malaysia found that the students only applied four Marzano HOTS levels at moderate level and nine Marzano HOTS levels at low level.

HOTS should be applied by technical and vocational students (McCaslin & Parks, 2002). Technical and vocational education provides real-world cognitive development. In addition, career needs are increasingly dependent on cognitive ability (Tee, 2012). For students to apply HOTS, educators should be wise in choosing strategies for delivering knowledge in the teaching and learning process. These strategies should be based on the learning styles identified (Claxton & Murrell, 1987) so that learning objectives can be achieved.

Failure to identify students' learning styles will impact on the effectiveness of the teaching and learning process (Yee, 2015). Furthermore, lack of understanding of learning styles could cause a problem in applying the appropriate and effective learning styles among students (Ikhasan & Sapar, 2007). As a result, academic performance will be affected (Rashid, 2007). Unfortunately, most educators conduct teacher-centred learning sessions that cause fewer students to be involved in the learning process and activities (Yee, 2015).

Therefore, learning style is an important matter for students' success. Learning style can ensure a student learns well (Kamaruddin & Mohammad, 2011). Students need to identify their learning style so that they can tap into their potential and expand their cognitive skills. Educators also need to help students identify their learning styles by providing a task or using teaching methods that involve a variety of teaching styles (Abu et al., 2007).

Consequently, learning styles and HOTS should be identified among students so that they acquire an effective learning environment (Tapsir et al., 2012). In the

technical field, students need to master skills besides understanding the related theory (Felder & Spurlin, 2005) to ensure that graduates are able to apply the learning content in the working environment. However, it is difficult for students to master skills if the learning process is not effective. Most students have problems improving their performance because their learning style does not fit their learning process (Rashid, 2007). Therefore, this study was undertaken to identify patterns of student learning style and their HOTS level. Specifically, the objective of this study was to identify:

1) The pattern of Kolb Learning Styles based on the student demographics,
2) The students' Marzano HOTS level,
3) The relationship between students' learning styles and their HOTS level, and
4) The difference between students' learning styles and their HOTS level.

METHODOLOGY

The study design was a survey using the quantitative approach. All data were collected directly from the respondents. Commonly, in survey research, the population characteristics can be described through the distribution of frequencies, percentages and mean score.

Population and Sample

The population for this study was a group of individuals who met the criteria that were set that would allow the researcher to generalise the findings (Idris, 2013). The target population was the students of Year 1, 2 and 3 of the Diploma of Civil Engineering, Mechanical Engineering and Electric and Electronic Engineering programmes of three polytechnics in Malaysia.

The sampling method used was simple random sampling, which is the best way to get a sample from a population of large size (Idris, 2013). Every member of the population was given equal opportunity of being selected for inclusion in the sample. Based on the Table Sampling by Krejcie and Morgan (1970), the number of samples in this study was 368 students, all of whom were currently enrolled in the diploma course for each semester. The distribution of the sample size is shown in Table 1. However, only 307 sets of data were successfully collected by the researcher.

Table 1
Population and sample number of technical students in three Polytechnics in Malaysia

Polytechnic	Population	Sample
Port Dickson Polytechnic	3959	167
Melaka Polytechnic	1206	51
Merlimau Polytechnic	3551	150
Total	8716	368

Research Instrument

One set of questionnaires was used as the research instrument. The questionnaire consisted of three parts: Part A comprised five items, Part B comprised 18 items consisting of two-choice answers, 'Yes' and 'No', and Part C comprised 25 items based on the eight Marzano HOTS levels, with a 4-point scale for responses (Table 2). Prior to the actual research, a pilot test was conducted to determine the reliability of the instrument and to achieve the desired objectives of this study. The reliability of the Kolb Learning Styles Inventory was above 0.90 in all cases. However, the reliability of the questionnaires adapted from the Marzano Rubrics for Specific Tasks or Situations was 0.75.

Table 2
Number of items in three parts of the questionnaire

Part	Item	Number of Items
A	Demographic factors including gender, hometown, parents' gross income, semester of study and academic achievement	5
B	Kolb Learning Styles Inventory (2000)	18
C	Questionnaire adapted from Marzano Rubrics for Specific Tasks or Situations (1993)	25

DATA ANALYSIS

All collected data were analysed using the Statistical Package for Social Sciences (SPSS) software. The statistics selected for data analysis were based on the research questions recorded in Table 3. The Kolb Learning Styles used in Research Question 1 was data nominal. In order to analyse data nominal trends, a descriptive statistic was best for presenting data in frequencies and percentages.

Table 3
Summary of research questions and statistical techniques used in the study

No	Research Questions (RQ)	Statistical Techniques
RQ1	What is the pattern of the Kolb Learning Styles based on the student demographics?	Frequencies and Percentages
RQ2	What is the students' Marzano HOTS level?	Mean scores
RQ3	Is there any significant relationship between the Kolb Learning Styles and the Marzano HOTS levels?	Cramer V
RQ4	Is there any significant difference in the Kolb Learning Styles and the Marzano HOTS levels?	MANOVA

For Research Question 2, the Marzano HOTS level was data interval, which was analysed as the mean of the average score for a given set of data. According to Sternberg (2008), mean scores are the most appropriate value representing a data set. Interpretation of the range of the mean for the Marzano HOTS level was adapted from Wiersma and Jurs (2005) as shown in Table 4.

Table 4
Interpretation of the range of the mean for the Marzano HOTS levels

Range of the Mean	HOTS Level
1.00-2.00	Low
2.01-3.00	Moderate
3.01-4.00	High

For assessing the relationship between two variables, the Kolb Learning Styles and Marzano HOTS levels, in Research Question 3, the Cramer V Correlation Test was used. In this case, the non-parametric test was used because both variables were on the nominal scale. The findings suggested that the students had one dominating Kolb Learning Style out of the four (Doer, Watcher, Thinker and Feeler) and applied each Marzano HOTS level in one of three levels (low, moderate and high). To analyse the data collected to answer Research Question 3, strength of correlation were used (Table 5).

Table 5
Strength of the correlation coefficient

Correlation Coefficient	Correlation Strength
0.91 sehingga 1.0	Very Strong
0.71 sehingga 0.90	Strong
0.51 sehingga 0.70	Medium
0.31 sehingga 0.50	Low
0.01 sehingga 0.30	Very Low
0.00	No Correlation

The MANOVA analysis test was used for Research Question 4 to assess whether the means of eight dependent variables (eight Marzano HOTS) were significantly different in four groups of the Kolb Learning Styles (independent variable). In this case, the means of eight Marzano HOTS levels were used as the interval scale.

RESULTS AND DISCUSSION

Both descriptive and inferential statistics were used as analytical tools. Non-parametric and parametric statistical techniques were used with the inferential statistics in Research Questions 3 and 4.

The Pattern of Kolb Learning Styles Based on Student Demographics

Descriptive analysis was used to determine the students' learning styles. The results showed that the majority of the technical students (45.3%) had the dominant learning style of Doer (Table 6). This was followed by Feeler (20.5%), Thinker (18.6%) and

Watcher (15.6%). This pattern seems appropriate for technical courses, which emphasise applying knowledge or skills to solve a practical problem. The method of processing information actively via trial and exercise in the practical application of new ideas (Kolb & Kolb, 2005; Grochow, 1973; Stabell, 1973) by Doer and Feeler students is commensurate with their respective fields. This finding is consistent with the Kolb Learning Styles pattern, which explains that students who practise the Doer and Feeler learning styles are suited to the professions of educator, technician and engineer and have a background in education, technical studies and engineering (Kolb & Kolb, 2005).

Table 6
Pattern of Kolb learning styles

Student Demographics		Kolb Learning Styles								Total	
		Doer		Watcher		Thinker		Feeler			
		f	%	f	%	f	%	f	%	f	%
Gender	Male	74	24.1	29	9.4	23	7.5	32	10.4	158	51.5
	Female	65	21.2	28	9.1	25	8.1	31	10.1	149	48.5
	Total	139	45.3	57	18.6	48	15.6	63	20.5	307	100
Academic Achievement	CGPA≥3.70	3	1.0	0	0.0	0	0.0	1	0.3	4	1.3
	3.00≤CGPA≤3.69	43	14.0	14	4.6	14	4.6	18	5.9	89	29.0
	2.70≤CGPA≤2.99	40	13.0	18	5.9	14	4.6	24	7.8	96	31.3
	2.00≤CGPA≤2.69	47	15.3	23	7.5	19	6.2	19	6.2	108	35.2
	CGPA≤1.99	6	2.0	2	0.7	1	0.3	1	0.3	10	3.3
	Total	139	45.3	57	18.6	48	15.6	63	20.5	307	100
	Poor	51	16.6	20	6.5	15	4.9	23	7.5	109	35.5
	Moderate Poor	19	6.2	8	2.6	10	3.3	15	4.9	52	16.9
	Not Poor	69	22.5	29	9.4	23	7.5	25	8.1	146	47.6
	Total	139	45.3	57	18.6	48	15.6	63	20.5	307	100

Students' HOTS Level

The findings from the study revealed that none of the students perceived their thinking skill levels to be high. Only three Marzano HOTS levels were rated moderate, while five Marzano HOTS levels were rated low namely, classifying, analysing errors, constructing support, abstracting and analysing perspectives (see Table 7). Technical courses involve practical exercises and tasks, experiments, research and the writing of reports (Othman & Johari, 2007). Technical students usually need to make comparisons between objects to find similarities and differences (Sulaiman, Aziz, & Mok, 2011; Nor & Mohd Ramli, 1998) as this information is needed in their work. Induction is also required when writing

reports and articles, providing criticism, doing research and making medical diagnoses (Mohd & Hassan, 2006) in order to make interpretations and conclusions or constructing concepts for an experiment or study. Therefore, these HOTS are used more often than others by technical students, and they should master them.

Table 7
The level of Marzano HOTS levels

Marzano HOTS	Mean	HOTS Level
Comparing	2.92	Moderate
Classifying	2.86	Moderate
Inductive Reasoning	2.79	Moderate
Deductive Reasoning	2.95	Moderate
Analysing Errors	2.63	Moderate
Constructing Support	2.86	Moderate
Abstracting	2.72	Moderate
Analysing Perspectives	2.77	Moderate

Relationship between Kolb Learning Styles and Marzano HOTS Levels

Using the Cramer V Correlation Test, it was found that there was no relationship between the Kolb Learning Styles and the eight Marzano HOTS levels (see Table 8). This finding is also consistent with the findings of Sabtu et al. (2011), who found that there was no correlation between four Kolb Learning Styles and four Sternberg Thinking Styles.

Table 8
Relationship between Kolb learning styles and Marzano HOTS levels

Relationship	X^2	*p*	Cramer V	Correlation Strength
Comparing vs. Kolb Learning Styles	4.60	0.60	0.09	Very Low
Classifying vs. Kolb Learning Styles	5.14	0.53	0.09	Very Low
Inductive Reasoning vs. Kolb Learning Styles	2.32	0.89	0.09	Very Low
Deductive Reasoning vs. Kolb Learning Styles	3.75	0.71	0.08	Very Low
Analysing Errors vs. Kolb Learning Styles	9.42	0.15	0.12	Very Low
Constructing Support vs. Kolb Learning Styles	5.65	0.46	0.10	Very Low
Abstracting vs. Kolb Learning Styles	1.16	0.98	0.04	Very Low
Analysing Perspectives vs. Kolb Learning Styles	8.59	0.20	0.12	Very Low

The MANOVA analysis test showed that there was no significant difference between the Kolb Learning Styles and the eight Marzano HOTS levels (Table 10). These findings also prove that there is no one specific learning style that can ensure that HOTS can be managed well by a student and that learning styles should be appropriate to students' field of work. Each student has a different learning style and equal opportunity to learn and master HOTS, and this ensures fair and healthy competition among students.

Difference Between Kolb Learning Styles and Marzano HOTS Levels

Table 9 shows the descriptive statistics for Kolb Learning Styles and Marzano HOTS levels.

Table 9
Descriptive statistics for Kolb learning styles and the Marzano HOTS levels

Marzano HOTS	Kolb Learning Styles	Mean	Std. Deviation	N
Mean (Comparing)	Doer	2.9041	0.68483	139
	Watcher	2.9942	0.63149	57
	Thinker	2.8750	0.72322	48
	Feeler	3.0317	0.63278	63
	Total	2.9425	0.67043	307
Mean (Classifying)	Doer	2.8363	0.63182	139
	Watcher	2.9123	0.57378	57
	Thinker	2.9167	0.54170	48
	Feeler	2.8413	0.65731	63
	Total	2.8640	0.61173	307
Mean (Inductive Reasoning)	Doer	2.7746	0.76478	139
	Watcher	2.9064	0.66594	57
	Thinker	2.7708	0.80529	48
	Feeler	2.7196	0.78564	63
	Total	2.7872	0.75717	307
Mean (Deductive Reasoning)	Doer	2.8873	0.70717	139
	Watcher	3.0292	0.60841	57
	Thinker	2.9583	0.60191	48
	Feeler	2.9894	0.61629	63
	Total	2.9457	0.65509	307
Mean (Analysing Errors)	Doer	2.5971	0.70365	139
	Watcher	2.5965	0.89028	57
	Thinker	2.6667	0.74058	48
	Feeler	2.7090	0.72708	63
	Total	2.6308	0.74960	307

Table 9 *(continue)*

Mean (Constructing Support)	Doer	2.8129	0.65952	139
	Watcher	2.9708	0.59188	57
	Thinker	2.9167	0.58951	48
	Feeler	2.8360	0.61017	63
	Total	2.8632	0.62689	307
Mean (Abstracting)	Doer	2.7050	0.71004	139
	Watcher	2.6784	0.72365	57
	Thinker	2.7361	0.64121	48
	Feeler	2.7619	0.67316	63
	Total	2.7166	0.69208	307
Mean (Analysing Perspectives)	Doer	2.7170	0.76762	139
	Watcher	2.9357	0.73311	57
	Thinker	2.6319	0.68499	48
	Feeler	2.8254	0.75931	63
	Total	2.7666	0.75032	307

The MANOVA analysis test showed that there was no significant difference between the Kolb Learning Styles and the eight Marzano HOTS levels (Table 10). These findings also prove that there is no one specific learning style that can ensure that HOTS can be managed well by a student and that learning styles should be appropriate to students' field of work. Each student has a different learning style and equal opportunity to learn and master HOTS, and this ensures fair and healthy competition among students.

Table 10
Difference between the Kolb learning styles and the Marzano HOTS levels

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Kolb Learning Styles	Comparing	1.078	3	0.359	0.798	0.496
	Classifying	0.405	3	0.135	0.358	0.783
	Inductive Reasoning	1.133	3	0.378	0.657	0.579
	Deductive Reasoning	1.000	3	0.333	0.775	0.509
	Analysing Errors	0.672	3	0.224	0.396	0.756
	Constructing Support	1.194	3	0.398	1.013	0.387
	Abstracting	0.250	3	0.083	0.172	0.915
	Analysing Perspectives	3.059	3	1.020	1.826	0.142

*Difference is significant at the 0.05 level

CONCLUSION

This study revealed that the most dominant learning style among technical students in polytechnics is Doer, followed by Feeler, Thinker and Watcher, in that order. Also, the findings illustrated that the students perceived that their practice of eight Marzano HOTS was at moderate level. There was no relationship or difference between the Kolb Learning Styles and the Marzano HOTS levels. Nevertheless, learning style is a factor that can influence the level of HOTS among technical students. The results of this study suggest that future studies should be conducted to examine other factors related to the practice of HOTS among technical students because this study could not identify a change of more than 90% in the independent variables.

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