

THE PATTERNS OF MARZANO HIGHER ORDER THINKING SKILLS BASED ON DIMENSION OF EXTEND AND REFINE KNOWLEDGE AMONG TECHNICAL EDUCATION STUDENTS

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Abstract

Higher Order Thinking Skills (HOTS) play an important role in higher education learning. Students will not become good thinkers if they are not trained with activities towards produce good thinking. Hence, the purpose of this research was to identify the pattern of Marzano HOTS based on the Dimension of Extend and Refine Knowledge among students in Technical Education Faculty, Universiti Tun Hussein Onn Malaysia. There are 8 skills in this dimension, namely *comparing, classifying, abstracting, inductive reasoning, deductive reasoning, constructing support, analyzing errors, and analyzing perspectives*. Descriptive analysis with quantitative approach was used to collect data by distributing a set of questionnaire comprising 25 items based on the 8 skills with 4 points scale response. Data obtained was analyzed by using mean, Eta and ANOVA methods. The findings of this research indicated that *comparing, deducing, constructing support and inducing* are at medium level. However, *error analyzing, abstracting, analyzing perspectives and classifying* are at low level. The Eta analysis indicates that there was a very low positive significant relationship between the level of *comparing, classifying, deducing, analyzing perspective* and year of study, students' intake and socio-economic status. Besides that, the findings also showed that there was a significant difference in gender, and academic achievement on level of Marzano HOTS.

Keywords: Marzano Higher Order Thinking Skills, Dimension of Extend and Refine Knowledge, Technical Education

Introduction

Higher order thinking skills (HOTS) is one component of the creative thinking skills and critical thinking. Generating creative ideas influenced by the environment of an individual. According to Walberg *et al.* (1981), parents need to give freedom to their children to involve with any fields that their children interested.

In Malaysia, the skills of critical and creative thinking has been emphasized since the drafting of the Integrated Curriculum for Secondary Schools (ICSS) in 1988 (Sulaiman, 2000). According to Poh (2000), creative thinking can develop individual to be more innovative, have good creativity, ideal, imaginative and high humanistic elements. While critical thinking is important elements to form a nation are able to use their minds to face of many challenges, pressures and changes.

When students know how to use both of these skills, it means that students have applied high order thinking skills. These skills can be learned through stimulus and the training so that students can apply it

in their daily learning process. Therefore, the optimal learning will be occurring in the process of teaching and learning.

The Malaysian Government has begun on various efforts to develop and expand the creativity of the people in various fields including business and education. The establishment of the Corridor Multimedia under Eighth Malaysian Plan and smart schools is one example of the government's efforts in developing the creativity of its people (Palaniappan, 2005).

Therefore, the emphasis on thinking skills in the national education system is a wise step to produce first class minds citizen. This is the main purpose of education to strengthen a person's thinking to the maximum level so individual will become innovative, creative and imaginative (Willen *et al.*, 1994).

Problem Background

Exam-oriented learning still practice in school or at higher educational level. Teaching and learning process more emphasize low level cognitive activities like memorizing, remembering and understanding (Mohd Ali & Shaharom, 2003). Students learn to rote memorization as preparation to pass in the examination. Thus, students' ability is measured by performance in examination.

Moreover, Niar (2007) found that teachers in secondary schools are still using traditional methods in teaching and learning which limit the critical and creative thinking skills among students. Most of the implementation of teaching and learning at the school is teacher-centered teaching practices. This situation causes students to become passive and does not use the mind to think otherwise just hear when the teacher is teaching. As consequence, the graduates' ability to apply knowledge in the workplace becomes an issue to be debated.

As a result of this, graduates are increasingly expected not only to employ the knowledge and skills they have acquired during the process of growing up and schooling, but more important is to be able to find new ways and means to solve their daily problems and make appropriate decisions (Rajendran, 2008).

According to research Yee *et al.* (2010), technical education students have perception on mastering higher order thinking skills level (mean = 2.49) and application of higher order thinking skills (mean = 2.48) at low level. Besides that, technical education students also have perception on facing difficulty completing higher order thinking skills based tasks (mean = 3.14), and generating ideas (mean = 3.24). Based on these background problems, researchers want to study the patterns of Marzano Higher Order Thinking Skills among technical education students on Extend and Refine Knowledge Dimension. In addition, researchers also want to identify relationships and differences between the Marzano Higher Order Thinking Skills with gender, achievement, student recruitment, year of study and socio-economic status.

Specifically, the objectives of this study are:

- i. To identify the patterns of Marzano HOTS among technical education students for eight types of HOTS namely comparing, classifying, inducing, deducing, analyzing error, constructing support, abstracting and analyzing perspective.
- ii. To identify the relationship between Marzano HOTS and gender, academic achievement, intake of student, year of study and socio-economic status.
- iii. To identify the difference between Marzano HOTS and gender, academic achievement, intake of student, year of study and socio-economic status.

Methodology

The design of this study was survey. Chua (2006) defines survey research as a method to collect data directly from a subject. Most of the survey describes the characteristics of the population through the distribution of frequencies and percentages. This research is focused on the analysis of the perceptions of students on mastering the level of HOTS in technical education subjects.

1. *Population and Sample*

Population is a group of people who have similar characteristics. Population should be identified appropriately based on the research to be done. In this research, the population were all the technical education students in higher education institute. A total of 158 questionnaires were distributed to the students which are taking the course in Technical and Vocational Education (BBV) at Faculty of Technical Education, UTHM. The sampling procedure used for the study was stratified random sampling. The stratification has been done on the years of study and intake. The samples were randomly selected in a specified layer is to reduce sampling error factors such as the size of a large variance of sample estimates (Mohd Majid, 2003). Table 1 shows the sample of students by year of study and intake.

Table 1: Sample of students by years and intake

Years of Study	Sample of students	
	Matriculation	Diploma
Years 2	24	42
Years 3	21	55
Years 4	16	
Total	61	97

2. *Instrument of research*

This research was conducted through a survey using questionnaire. This set of questionnaire was modified from Marzano HOTS rubric that comprising 25 items based on the 8 skills with 4 points scale response. Johari (2004) stated that questionnaires can use to collect detailed data, structured and standard. Responses obtained are more consistent when compared to the observations. In the construction items, things that need to be addressed by researchers are the questionnaire item used were easily understood by respondents. Questionnaire method is a collection of research data from a number of units or individuals in a given time. Using questionnaire, researchers can identify the patterns of Marzano HOTS among technical education students. Before the actual research done, a pilot test was conducted to determine the validity and reliability of the instrument. For this study, the reliability value is .7217. Therefore, set this questionnaire has high reliability and can used in actual research. Questionnaire prepared by the researchers consists of a four point scale.

3. *Data analysis*

This was a quantitative approach research and the gathered data were analyzed using Statistical Package for Social Science (SPSS) software. The selection method of data analysis in this study

was based on the research questions (Table 2). The findings are presented in the tables with calculation of mean score. Interpretation of mean scores or the tendencies are shown in Table 3.

Table 2: Method for data analysis

Research Question	Type of Statistics	Analysis Method
Q 1	Descriptive	Frequency, mean
Q2	Inference	ETA Test (Mean score)
Q3	Inference	ANOVA Test (Mean score)

Table 3: Interpretation means scores of statistic descriptive

Mean Score	Interpretation Level
1.00 – 2.00	Low
2.01 – 3.00	Medium
3.01 – 4.00	High

(Source: Adaptation from Wiersma, 2000)

Results and Discussion

1. *The patterns of Marzano HOTS among technical education students*

The findings from the study show that none of thinking skills was rated as high. There were only four thinking skills rated as medium which are comparing, inducing, deducing and constructing supporting. While *classifying*, *error analysis*, *analyzing perspectives* and *abstracting* were rated as low (Table 4).

Table 4: Level of students engage in the thinking skills

Thinking Skills	Mean	SD	Skill Level
<i>Comparing</i>	2.15	0.76	Medium
<i>Classifying</i>	1.76	0.59	Low
<i>Inducing</i>	2.04	0.73	Medium
<i>Deducing</i>	2.13	0.64	Medium
<i>Error Analysis</i>	1.96	0.67	Low
<i>Constructing Supporting</i>	2.08	0.55	Medium
<i>Analyzing Perspectives</i>	1.84	0.73	Low
<i>Abstracting</i>	1.96	0.71	Low

Classifying level is low because in extending and refine knowledge, these skills are challenging process. Many students can assign classifying tasks when define the categories. However, they failed to use these skills when required to create their own categories and explain what the characteristic of their grouping.

Error analysis is low because students do not have a good skill to detect even subtle or skillfully crafted errors in reasoning. Many students accept or believe any content information in their academic without identified any errors especially information from someone that have authority likes lecturer. Sometimes, student identified errors with influenced by their emotion. These situation caused analyzing error skills are low among the students.

Analyzing perspectives involved our feeling and emotion about something. This is caused this skills are not mastered by students. Failure of student to control their emotion can influence their observation about something or topic. Analyzing perspectives need student to examining the reason or logic behind each task. For examining the reason, student should have good knowledge about the topic. In this situation, this skills level are low because many students have lack of information, knowledge and not preferred to give any opinion in a class or group discussion.

Abstracting is process of finding and explaining general patterns in specific information or situation. In practice, students most of the time are copying and modifying the information that they searched but not summarize it to specific and important points. Due to lack of abstracting skill, students are always facing difficulty on completing higher order thinking skills based tasks. Therefore, students cannot score a higher mark in their course work or assignments.

2. Relationship between Marzano HOTS and gender, academic achievement, intake of student, year of study and socio-economic status.

Using Eta Test at $\alpha = .05$, it was found that there was no statistical significant relationship between Marzano HOTS and gender and academic achievement. However, there was a very low positive significant relationship between *classifying* (Eta=.175, $p=.028$), *analyzing perspective* (Eta=.215, $p=.007$) and year of study, *deducing* (Eta=.286, $p=.010$) and intake of students, *comparing* (Eta=.215, $p=.026$), *classifying* (Eta=.226, $p=.017$), *analyzing perspective* (Eta=.230, $p=.015$) and socio-economic status (Table 5).

Table 5: Relationship between the level of Marzano HOTS and gender, academic achievement, intake of student, year of study and socio-economic status

Thinking Skills	Gender		Academic Achievement		Year of study		Intake of student		Socio-economic status	
	Eta	p	Eta	p	Eta	p	Eta	p	Eta	p
<i>Comparing</i>	.50	.532	.111	.590	.035	.664	.085	.893	.215	.026*
<i>Classifying</i>	.072	.369	.201	.096	.175	.028*	.129	.629	.226	.017*
<i>Inducing</i>	.96	.229	.172	.198	.002	.977	.101	.813	.128	.279
<i>Deducing</i>	.113	.156	.182	.159	.001	.994	.286	.010*	.089	.541
<i>Analyzing error</i>	.126	.114	.201	.094	.135	.091	.096	.842	.137	.229
<i>Constructing support</i>	.67	.405	.128	.467	.077	.336	.095	.845	.114	.360

<i>Abstracting</i>	.4	.615	.177	.180	.063	.435	.055	.976	.101	.449
<i>Analyzing Perspectives</i>	.54	.499	.172	.198	.215	.007*	.134	.595	.230	.015*

*Correlation is significant at the .05 level.

3. *Difference in gender, academic achievement, intake of student, year of study and socio-economic status on the level of Marzano HOTS*

Table 6 shows that there was a significant difference in gender between female and male on the level of *inducing* ($p=.034$). However, there was no significant difference in gender between female and male on the level of *comparing, classifying, deducing, analyzing error, constructing support, abstracting and analyzing perspective*. Therefore, all the technical education students whether male or female have same level of thinking skills, except the level of *inducing*.

Table 6: *Difference in genders on the level of Marzano HOTS*

Thinking Skills	Female		Male		<i>p</i>
	Mean	SD	Mean	SD	
<i>Comparing</i>	2.86	0.78	2.78	0.74	.132
<i>Classifying</i>	2.42	0.61	2.33	0.54	.519
<i>Inducing</i>	2.65	0.69	2.59	0.61	.034*
<i>Deducing</i>	2.79	0.59	2.71	0.51	.680
<i>Analyzing error</i>	2.58	0.78	2.49	0.62	.981
<i>Constructing support</i>	2.74	0.77	2.90	0.64	.600
<i>Abstracting</i>	2.82	0.68	2.66	0.54	.670
<i>Analyzing Perspectives</i>	2.72	0.69	2.52	0.74	.290

*Difference is significant at the .05 level.

The findings also show that there was a significant difference in academic achievement on the level of *analyzing perspective* ($p=.015$). However, there was no significant difference in gender between female and male on the level of *comparing, classifying, inducing, deducing, analyzing error, constructing support, and abstracting* (Table 7). Hence, there is no difference in the level of thinking skills between excellent, moderate and weak students except the level of *analyzing perspective*.

Table 7: *Difference in academic achievements on the level of Marzano HOTS*

Thinking Skills	CGPA \geq 3.70		3.00 \leq CGPA \leq 3.69		2.70 \leq CGPA \leq 2.99		2.00 \leq CGPA \leq 2.69		CGPA \leq 1.99		<i>p</i>
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
<i>Comparing</i>	3.00	0.88	2.82	0.75	3.67	-	2.67	-	-	-	.906
<i>Classifying</i>	2.00	0.50	2.43	0.59	2.25	-	2.50	-	-	-	.650

<i>Inducing</i>	3.15	0.65	2.76	0.74	2.00	-	3.00	-	-	-	.257
<i>Deducing</i>	2.54	0.55	2.80	0.65	3.67	-	2.00	-	-	-	.616
<i>Analyzing error</i>	2.28	0.59	2.67	0.67	2.67	-	2.00	-	-	-	.253
<i>Constructing support</i>	2.54	0.59	2.78	0.55	3.00	-	2.67	-	-	-	.181
<i>Abstracting</i>	2.36	0.87	2.69	0.69	2.33	-	1.33	-	-	-	.296
<i>Analyzing Perspectives</i>	2.17	0.63	2.59	0.73	2.00	3.00	-	-	-	-	.015*

*Difference is significant at the .05 level.

Table 8 shows that there was no significant difference in intake of student between matriculation and diploma on the level of Marzano HOTS. Students' intakes have no influence on the level of thinking skills.

Table 8: *Difference in intakes of student on the level of Marzano HOTS*

Thinking Skills	Matriculation		Diploma		p
	Mean	SD	Mean	SD	
<i>Comparing</i>	2.87	0.78	2.81	0.75	.760
<i>Classifying</i>	2.26	0.58	2.47	0.58	.744
<i>Inducing</i>	2.78	0.66	2.79	0.78	.955
<i>Deducing</i>	2.77	0.67	2.77	0.63	.895
<i>Analyzing error</i>	2.68	0.67	2.60	0.67	.501
<i>Constructing support</i>	2.71	0.56	2.80	0.54	.559
<i>Abstracting</i>	2.54	0.72	2.73	0.69	.659
<i>Analyzing Perspectives</i>	2.36	0.68	2.68	0.74	.925

*Difference is significant at the .05 level.

Table 9 shows that there was no significant difference in year of study on the level of Marzano HOTS. All technical education students whether junior or senior students have same level of thinking skills.

Table 9: *Difference in years of study on the level of Marzano HOTS*

Thinking Skills	Year 2		Year 3		Year 4		p
	Mean	SD	Mean	SD	Mean	SD	
<i>Comparing</i>	2.65	0.82	2.95	0.70	3.06	0.66	.891
<i>Classifying</i>	2.29	0.46	2.53	0.67	2.17	0.55	.953
<i>Inducing</i>	2.85	0.68	2.80	0.81	2.52	0.53	.651

<i>Deducing</i>	2.75	0.59	2.82	0.69	2.63	0.67	.887
<i>Analyzing error</i>	2.56	0.55	2.66	0.77	2.77	0.58	.621
<i>Constructing support</i>	2.70	0.59	2.83	0.54	2.71	0.42	.913
<i>Abstracting</i>	2.62	0.71	2.74	0.71	2.422	0.68	.498
<i>Analyzing Perspectives</i>	2.45	0.67	2.71	0.75	2.21	0.73	.545

*Difference is significant at the .05 level.

Table 10 shows that there was no significant difference in socio-economic status on the level of Marzano HOTS. The status of socio-economic is not the factor on the level of thinking skills among technical education students.

Table 10: *Difference in socio-economic statuses on the level of Marzano HOTS*

Thinking Skills	≤RM1500		≥RM1501- RM2500		≥RM2501- RM3500		≥RM3501- RM4500		≥RM4501		p
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
<i>Comparing</i>	2.78	0.80	2.90	0.70	2.81	0.94	2.80	0.71	2.97	0.63	.118
<i>Classifying</i>	2.44	0.56	2.34	0.62	2.33	0.59	2.60	0.57	2.27	0.71	.177
<i>Inducing</i>	2.86	0.74	2.77	0.78	2.63	0.70	2.73	0.75	2.76	0.58	.799
<i>Deducing</i>	2.96	0.56	2.60	0.71	2.76	0.66	2.83	0.39	2.39	0.66	.279
<i>Analyzing error</i>	2.64	0.70	2.66	0.68	2.54	0.71	2.63	0.55	2.61	0.51	.993
<i>Constructing support</i>	2.77	0.53	2.80	0.56	2.78	0.52	2.63	0.76	2.64	0.50	.924
<i>Abstracting</i>	2.68	0.75	2.71	0.72	2.56	0.63	2.60	0.81	2.48	0.47	.738
<i>Analyzing Perspectives</i>	2.57	0.69	2.47	0.78	2.48	0.57	2.86	0.80	2.64	0.91	.804

*Difference is significant at the .05 level.

Conclusion

As the conclusion, this study shows that technical education students have medium and even low level of Marzano HOTS in their academic and daily life. The study findings also indicated that there was almost no significant relationship between the level of Marzano HOTS and relationship between the level of Marzano HOTS and gender, academic achievement, intake of student, year of study and socio-economic status. There was only a few of Marzano HOTS have a very low significant relationship with gender, academic achievement, intake of student, year of study and socio-economic status. In addition, there was no significant difference in intake of student, year of study and socio-economic status on the level of Marzano HOTS. However, there was only a significant difference in gender and academic achievement on the level of *inducing* and *analyzing perspective*. Therefore, students should learn thinking skills, especially higher-order thinking skills to help them solve problems in learning and enhance their academic results. The further research may be conducted to determine the pattern of Marzano higher-order thinking skills among students based on dimension knowledge meaningfully.

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