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THE PERCEPTION OF THE LEVEL OF HIGHER ORDER THINKING SKILLS AMONG TECHNICAL EDUCATION STUDENTS

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Abstract—**Higher order thinking skills is an important aspect in teaching and learning especially at higher education institutions. Higher order thinking skills is a useful tool to help students in learning, improving their performance and reducing their weaknesses. Students will become good thinkers if they are trained with activities towards produce good thinking. Hence, the purpose of this research was to identify the perception of the level of Marzano Higher Order Thinking Skills among technical education students in Faculty of Technical Education (FPTek), Universiti Tun Hussein Onn Malaysia. A total of 158 students of FPTek were randomly selected as sample. A set of adapted questionnaire from Marzano Rubrics for Specific Task or Situations (1993) was used as research instrument. This is a quantitative research and the gathered data were analyzed using Statistical Package for Social Science (SPSS) software. The findings indicate that students perceived they have moderate level for *investigation, experimental inquiry* and *invention*. However, *decision making and problem solving* are at low level. The Eta analysis indicates that there is a very low positive relationship between the level of Marzano Higher Order Thinking Skills and gender, academic result as well as socio economic status. Besides that, the findings also show that there is no statistically significant difference in gender, academic result and socio economic status on the level of Marzano Higher Order Thinking Skills. However, there is significant difference in socio economic status on the level of decision making.**

Keywords- Marzano Higher Order Thinking Skills, Technical Education.

I. INTRODUCTION

All students are capable to think, but most of them need to be encouraged taught and assisted to the higher order thinking processes. These higher order thinking skills are teachable and learnable. All students have the right to learn and apply thinking skills, just like other disciplines of knowledge. Higher order thinking is defined as the expanded use of the mind to meet new challenges [1]. It requires someone to apply new information or prior knowledge and manipulate the information to reach possible answer in new situation [2].

A question to be answered or a problem to be solved cannot be done through routine application of previously acquired knowledge [3]. But it can be solved only when expanded use of mind occurred that a person must interpret, analyze or manipulate information. This is because higher order thinking is characterized as nonalgorithmic, complex, self regulative, meaningful, effortful and providing multiple solutions, nuanced judgments, multiple criteria and uncertainty [4].

Higher order thinking skills is an important aspect in teaching and learning. Thinking skills are fundamental in educational process. A person thought can affect the ability of learning, speed and effectiveness of learning. Therefore, thinking skills is associated with learning process. Students who are trained to think demonstrate a positive impact on the development of their education. The findings of Resnick's studies have reported an improvement in reading comprehension and the average grades, therefore and an

increase in the settlement of problems of Mathematics and Science which have undergone a training program to think [4]. This has shown that thinking skill is important for a student to solve problems in their learning, process fostering a competitive student's thought, developing students' intellectual and helping to avoid errors in thinking.

II. MARZANO HIGHER ORDER THINKING SKILLS

Marzano's research on thinking skills is important to students and educators in higher education institution primarily. Marzano identifies eight higher order thinking skills, namely *decision making, investigation, problem solving, experimental inquiry,* and *invention* which work within the Dimensions of Learning (1992) framework. The Dimensions of Learning model assumes that the process of learning involves the interaction of the following five types of thinking:

(i) positive attitudes and perception about learning
(ii) thinking involved in acquiring and integrating knowledge
(iii) thinking involved in extending and refining knowledge
(iv) thinking involved in using knowledge meaningfully
(v) productive habits of mind

Marzano's Dimensions of Learning is a comprehensive model that uses what researchers and theorists know about learning to define the learning process. Dimensions of Learning offer a way of thinking about the extremely complex process of learning so that study can be attended to each aspect and gain insights into how they interact. The five types of thinking are premised as five dimensions of learning that are essential to successful learning [5]. The Dimensions framework will help us to

- maintain a focus on learning;
- study the learning process; and
- plan curriculum, instruction, and assessment that takes into account the five critical aspects of learning.

These five higher order thinking skills are identified in Dimension 4 which will help students use knowledge meaningfully. The most effective learning occurs when we use knowledge to perform meaningful task.

TABLE I. THE DEFINITION OF FIVE MARZANO HIGHER ORDER THINKING SKILLS

Higher Order Thinking Skills	Definition
decision making	Generating and applying criteria to select from among seemingly equal alternative.
investigation	Identifying and resolving issues about which there are confusions or contradictions.
problem solving	Overcoming constraints or limiting conditions that are in the way of pursuing goals.
experimental inquiry	Generating and testing explanations of observed phenomena.
invention	Developing unique products or processes that fulfill perceived need..

III. PURPOSE OF STUDY

The purpose of this study is to analyse the perception of the level of Marzano higher order thinking skills among technical education students in FPTek. The perception of the level of Marzano higher order thinking skills was identified by using adapted questionnaire. Specifically, the objectives for this study are:

(i) To identify the perception of the level of Marzano higher order thinking skills among technical education students.

(ii) To identify the relationship between the level of Marzano higher order thinking skills and gender, academic result and socio economic status.

(iii) To identify the difference between students' gender, academic result and socio economic status on the level of Marzano higher order thinking skills.

IV. METHODOLOGY

This is a survey study. Through survey research, data can be collected directly from respondents [6]. Most of the survey describes the characteristics of the population through the distribution of frequencies and percentages.

A. 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 [7]. In this study, the target population was technical education students in higher education institution. A total of 158 questionnaires were distributed to the students taking the Technical and Vocational Education course (BBV) at Faculty of Technical Education, Universiti Tun Hussein Onn Malaysia. The sampling procedure used for this study was stratified random sampling. The stratification has been done to the years of study and intakes of student. The samples were randomly selected in a specified layer to reduce sampling error such as the size of a large variance of sample estimates [8]. Table 2 shows the sample of students by year of study and intake.

TABLE II. SAMPLE OF STUDENTS BY YEARS AND INTAKE

Years of Study	Intakes of student	
	Matriculation	***Diploma***
Years 2	24	42
Years 3	21	55
Years 4	16	
Total	**61**	**97**

B. *Instrument of Research*

In order to collect detailed data, structured and standard, a set of questionnaire was used in this study. Reponses obtained are more consistent when compared to the observations [9]. This set of the questionnaire was adapted from Rubrics for Specific Task or Situation (1992). It comprises 25 items based on the eight higher order thinking skills with 4 points scale response. Before the actual research done, a pilot test was conducted to determine the reliability of the instrument and to achieve the desired objective of this study. For this study, the reliability value is .7030.

C. *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 3). The findings are presented in the tables with calculation of mean score.

TABLE III. SUMMARY OF RESEARCH QUESTIONS AND STATISTICAL TECHNIQUES USED IN THE STUDY

No	Research Questions (RQ)	Statistical Techniques
RQ1	What are the perception of the level of higher order thinking skills among technical education students?	Percentages and frequencies
RG2	Is there any significant relationship between the level of higher order thinking skills and gender, academic result and socio economic status?	ETA
RQ3	Are there any significant differences in gender, academic result and socio economic status on the level of higher order thinking skills?	ANOVA

V. RESULTS AND DISCUSSION

Research findings used both descriptive and inferential statistics as analytical tools. Parametric statistical techniques were used in the inferential statistics.

TABLE IV. MEAN SCORE AND CATEGORIZATION OF HIGHER ORDER THINKING SKILLS

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

A. *The perception of the level of Marzano Higher Order Thinking Skills Among Technical Education Students*

The findings from the study showed that none of student perceived their thinking skills' levels are at high level. There are only three thinking skills rated as moderate level which are *investigation, experimental inquiry* and *invention*. While *decision making* and *problem solving* were rated as low level (Table 5).

TABLE V. THE PATTERNS OF MARZANO HIGHER ORDER THINKING SKILLS

Thinking Skills	Mean	SD	Skill Level
decision making	1.55	0.38	Low
investigation	2.01	0.62	Moderate
problem solving	1.59	0.27	Low
experimental inquiry	2.16	0.53	Moderate
invention	2.17	0.48	Moderate

B. *Relationship Between The Level of Marzano Higher Order Thinking Skills and Gender, Academic Result and Socio Economic Status*

Using Eta Test, it was found that there was a very low positive relationship between the level of Marzano higher order thinking skills and gender, academic result and socio economic status (Table 6). The findings show that gender, academic achievement, student intake and socioeconomic status do not affect the students' thinking skills. This finding related with research that have been conducted by experts of psychology. Their findings show that humans only use general guidelines that come from personal experience when they make decisions [10].

TABLE VI. THE RELATIONSHIP BETWEEN THE LEVEL OF MARZANO HIGHER ORDER THINKING SKILLS AND GENDER, ACADEMIC RESULT AND SOCIO ECONOMIC STATUS

Thinking Skills	Gender	Academic Result	Socio Economic Status
decision making	0.104	0.082	0.144
investigation	0.051	0.129	0.026
problem solving	0.075	0.126	0.051
experimental inquiry	0.131	0.067	0.052
invention	0.036	0.101	0.077

C. *Differences In gender, academic result and socio economic status on The Level of Marzano Higher Order Thinking Skills*

Table 7 shows that there was no significant difference in student's gender on the level of Marzano higher order thinking skills. All technical education students whether female or male have same level of thinking skills.

TABLE VII. THE DIFFERENCES BETWEEN IN GENDER ON THE LEVEL OF MARZANO HIGHER ORDER THINKING SKILLS

Thinking Skills	Female		Male		*p*
	Mean	***SP***	***Mean***	***SP***	
decision making	1.52	0.34	1.60	0.45	.189
investigation	1.99	0.66	2.06	0.54	.909
problem solving	1.58	0.27	1.62	0.27	.717

experimental inquiry	2.20	0.51	2.06	0.54	.851
invention	2.16	0.47	2.20	0.49	.849

*Difference is significant at the .05 level.

Table 8 shows that there was no significant difference in student's academic result on the level of Marzano higher order thinking skills. Students' academic result has no influence on the level of thinking skills. Students have good academic achievement does not necessarily have a high level in higher order thinking skills compared to students with low academic achievement [10].

TABLE VIII. THE DIFFERENCES BETWEEN IN ACADEMIC RESULT ON THE LEVEL OF MARZANO HIGHER ORDER THINKING SKILLS

Thinking Skills	**CGPA ≥ 3.70**		**3.00 ≤CGPA ≥ 3.69**		**2.70≤ CGPA ≥ 2.99**		**2.00 CGPA ≥ 2.69**		***P***
	Mean	**SP**	**Mean**	**SP**	**Mean**	**SP**	**Mean**	**SP**	
decision making	1.48	0.39	1.55	0.38	1.50	0.35	1.25	-	.464
investigation	2.06	0.68	2.00	0.62	2.00	0.00	3.00	-	.139
problem solving	1.48	0.26	1.60	0.27	1.62	0.18	1.75	-	.301
experimental inquiry	2.11	0.42	2.16	0.54	1.88	0.18	2.25	-	.650
invention	2.05	0.66	2.18	0.47	2.38	0.18	2.50	-	.904

*Difference is significant at the .05 level.

Table 9 shows that there was no significant difference in socio economic stats on the level of Marzano higher order thinking skills except *decision making*. Students' family background has no influence on the level of *investigation, problem solving, experimental inquiry* and *invention*. However, students from low socio economic status are better in decision making compared to students from high socio economic status.

TABLE IX. THE DIFFERENCES BETWEEN IN SOCIO ECONOMIC STATUS ON THE LEVEL OF MARZANO HIGHER ORDER THINKING SKILLS

Thinking Skills	**≥1501≤2500**		**≥ 2501≤3500**		**≥3501≤4500**		**≥4501**		***P***
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	
decision making	1.42	0.35	1.60	0.29	1.63	0.46	1.61	0.44	**.034**
investigation	2.00	0.58	1.82	0.62	2.21	0.55	2.07	0.78	.538
problem solving	1.60	0.25	1.60	0.25	1.60	0.30	1.56	0.30	.702
experimental inquiry	2.10	0.55	2.17	0.48	1.81	0.41	2.28	0.44	.533
invention	2.14	0.54	2.07	0.40	2.23	0.61	2.14	0.28	.056

Difference is significant at the .05 level.

VI. SUGGESTION

When we ask higher-order questions or select powerful content to activate students' thinking, only a minority of pupils being involved in the discussion [11]. Hence, a Self-Instructional Manual is important to help every single student to study on their own pace [12]. The Outline Perspective Plan, which was tabled and approved in Parliament in April 2001, required the Education System to be reviewed in order to ensure that Malaysian students are taught explicitly to acquire and use several thinking skills [1]. The research findings support the teaching and learning of thinking skills because thinking skills instruction enable students to be aware of their thinking skills when they performed tasks. Through this awareness,
students can improve their performance on those tasks [13].

Models, strategies, techniques, and activities are model lesson plans showing how thinking skills that could be taught together with subject matter using infusion approach were been implemented in the school system in Malaysia since 1993 [1]. But, using self-instructional manual can be an alternative approach, thus can make significant contributions. Moreover, the manual is self-paced and it can cater to more extendable individual differences of learner's abilities, interest and degrees of application. Manual is a largely self-instructional that requires specific basic study programme that can be run either as a pre-requisites as part of a total structure programme of technical and vocational education [14]. Therefore, we proposed a new approach by using instructional manual for individualized learning to deliver the thinking skills learning task due to limitations on teachers and schools.

VII. CONCLUSION

As a conclusion, this study shows that technical education students perceived that they have moderate and even low level of Marzano higher order thinking skills in their academic and daily life. The findings of the study also indicated that there was a very low positive relationship between the level of Marzano higher order thinking skills and gender, academic result and socio economic status. Besides that, there was no significant difference in gender, academic result and socio economic status on the level of Marzano higher order thinking skills. Therefore, students should learn 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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