



An Effectiveness of High Order Thinking Skills (HOTS) Self-Instructional Manual for Students' Assignment Achievement

Nuraffefa Hamdan^{1*}, Tze Kiong Tee², Mei Heong Yee³, Saiful Hadi Masran⁴, Jailani Md Yunos⁵, Mimi Mohaffyza Mohamad⁶, Nurulwahida Azid⁷, **Widad Othman⁸**, Zaliza Hanapi⁹, Mohamed Nor Azhari Azman¹⁰, Mohd Hairol Mizzam Haris¹¹, & Suzana Shafei¹²

^{1,2,3,4,5,6}Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia, 86400, Parit Raja, Batu Pahat, Johor, MALAYSIA

⁷School of Education and Modern Languages, Universiti Utara Malaysia, 06010, Sintok, Kedah, MALAYSIA

⁸Faculty of Education and Linguistic, Open University Malaysia, 50480, Kuala Lumpur, MALAYSIA

^{9,10}Faculty of Technical and Vocational, Universiti Pendidikan Sultan Idris, 35900, Tanjung Malim, Perak, MALAYSIA

^{11,12}Politeknik Sultan Abdul Halim Muadzam Shah, 06000 Jitra, Kedah, MALAYSIA

DOI: <https://doi.org/10.30880/jtet.2019.11.01.008>

Received 06th September 2018; Accepted 30th October 2018; Available online 31st March 2019

Abstract: High Order Thinking Skills (HOTS) is an important aspect of teaching and learning. An individual's thinking can affect learning ability, learning speed and effectiveness of learning. The weakness in implementing HOTS is one of the reasons for a student not being creative in solving all the problems that arise. The purpose of this study was to evaluate the effectiveness of HOTS's Self-Instructional Manual (SIM) in teaching and learning for assignment achievement among polytechnic students. This study uses a quantitative approach and the Quasi Experimental design - "Pretest-Posttest Non-equivalent Comparison Group Design" consisting of one Treatment Group (TG) and one Control Group (CG) involving 78 students at Polytechnic of Sultan Abdul Halim Muadzam Shah. The assignment evaluation rubric was modified to assess the level of students' assignment achievement. The findings showed that most of the students for TG and CG achieved good result in the individual pre-assignment. Additionally, there is a significant difference mean scores of individual post assignment between TG and CG. Students for TG achieved excellent result in the individual post assignments. However, students for CG only achieved good result in the individual post assignments. This means that HOTS Self-Instructional Manual has a significant impact on the student assignments achievement. Therefore, we encourage all students of higher education institutions to use Self-Instructional Manual in teaching and learning in order to score better achievement especially in the course work.

Keywords: Self-instructional manual, high order thinking skills, assignment achievement

*Corresponding author: nuraffefa90@gmail.com

1. Introduction

Education can create creativity and build up an innovation that complement the younger generation with the skills needed to compete in the industry and become the catalyst for economic growth. Technical and Vocational Education and Training (TVET) is an integral part of general education which is intended for preparation individuals into the field of occupation for effective participation in the world of work. TVET have equally central roles to play in the development of employability skills. In other words, TVET emphasising application of knowledge, attitudes and manipulative skills for specific occupational fields.

Institutions of Higher Learning play an important role in producing a young generation with the skills required to be competitive in the industry and to be a source of economic growth. Polytechnics is a pre-employment education and training institution that needs to equip students with academic skills, generic skills and technical skills. In addition, students also need to master Higher Order Thinking Skills (HOTS) and have the capability of research to use technology. With the power of HOTS, the country has the talent that is capable of producing something innovative.

Thinking skill (TS) in terms of conceptualising, problem solving, or decision making is crucial in the daily life and career of future students (Chew & Nadaraja, 2014). Students who master in thinking skills such as critical, creative and innovative are able to compete globally (Ismail, Sidek & Mahbib, 2015). In resolving the issue, the use of TS needs to be used so that the student can think creatively in solving problems especially in complex issue that need the high order thinking skills. In addition to making decisions and solving problems, thinking is also a process of using the mind to find meaning and understanding of something, exploring various possible ideas or creations and making judgments, and thus making reflection and meta cognitive on the processes experienced (Yee, Md Yunos, Othman, Hassan & Tee, 2010).

HOTS is defined as the ability to apply knowledge, skills and values in making a reflection to solve problems, make decisions, innovate and strive to create something (Lembaga Peperiksaan, 2014). HOTS also refer to the ability to use knowledge, skills and assessment in reasoning, reflection, problem solving, decision making, innovation and creating something new (Ministry of Education, 2013). The use of HOTS in teaching and learning (T&L) can introduce HOTS in learning and continue to improve student achievement in academics and skills (Sulaiman, Muniyan, Madhyan, Hasan, Syrene & Rahim, 2017).

In an effort to help students to contribute of their knowledge that is not just some ordinary users, teachers should play an important role in creating activity or teaching and learning environment which allows applications of HOTS. In respect of it, the process of teaching and learning need to be taught how to execute HOTS to improve student's thought. The use of HOTS in teaching and learning can introduce HOTS in learning and continue to improve student performance in academic and skills (Sulaiman et al., 2017). An alternative that could be used in an HOTS deployment in the process of teaching and learning is the Self-Instructional Manual. It is also supported by studies undertaken by Yee, Md. Yunos, Hassan & Mohamad (2013), the use of independent learning manual provides an opportunity for students to learn various methods of learning is effective and how to use HOTS in a complete learning cycle.

1.1 Problem HOTS in Polytechnics

Students as future human capital should equip themselves with critical thinking and problem-solving skills to meet the employer's desire to find new employees (Rodzalan & Saat, 2015). TVET is an important path for vocational education and skills development. Through the Economic Transformation Program (ETP) (2013), Malaysia needs to increase 2.5 times the TVET enrolment by 2025. However, the offer of TVET employees is insufficient in 10 of the 12 National Key Economic Areas (NKEAs). The employer reported that some graduates lacked in TS critical knowledge (Ministry of Education, 2015). This is supported by Ramlan's (2012) study, stating that skilled manpower and k-workers are able to identify the problems caused by weakness in solving problems and these problems cause graduates to be difficult to get a job.

In institutions of higher learning including Polytechnics, lecturers are encouraged to implement the approach of learning based students using learning approaches such as problem-solving skills. The study was conducted by Yee et al. (2016) was carried out over 60 lecturer's polytechnics and findings showed a total of 61.7% lecturer considers students having difficulty in solving problems in teaching and learning (T&L). The study also shows that 60% of lecturers agree that lack of using TS in their teaching and learning will cause the difficulties in solving problems among students. Although the TS in the curriculum have been practiced, students still have low intellectual levels and weak in thinking. This is because the emphasis on thinking skills is poor and less of thinking skills in teaching for all students in the learning session.

A study conducted by Yee, Md.Yunos, Othman, Hassan, Tee & Mohamad (2012) on 242 people academic staff Universiti Tun Hussein Onn Malaysia (UTHM) sums up a total of 68% of academic staff agreed with an opinion that TS learned by students in the modules is insufficient and no detail. This is because students are often exposed to the fact, that emphasises technical content but less taught of the used of knowledge learned in creative and practical (Mohd & Hassan, 2015). This has resulted in an effective learning TS is not accessible. Thus, students have difficulty to learn TS due to less exposure. Employers report that most graduates lack are critical thinking and communication skills (KPM, 2015). The study of Ismail (2012) found that among the nine main marketability features, the most marketability feature of the graduates among the graduates was decision making and problem solving, followed by thinking skills.

The report from the Kestrel Education Consultant from England and the 21st Century School of the United States in 2011 stated that high-level thinking among teachers and students in Malaysia was still low (Ministry of Education, 2012). Weaknesses in applying HOTS in learning cause a student not creative in resolving problems arising (Yee, 2015). A study conducted by Yee, Md Yunos, Othman, Hassan, Tee, & Mohamad (2015) on 375 students in technical university Malaysia found that students only mastered 4 HOTS Marzano with modest domination. Meanwhile, 9 HOTS are still low.

Generally, teachers know that HOTS need to be practiced through the lessons to improve student achievement (Sulaiman et al., 2017). Some studies conducted by Nor Puteh Ghazali, Tamyis & Ali (2012) have shown that lecturers have a consciousness of the importance of HOTS in teaching and learning, but they lack knowledge and lack of skills to apply HOTS in teaching and learning. The emphasis on examinations has led the teacher to less attention to the TS students instead of focusing on efforts to complete the syllabus and also the mastery of the technique to answer the exam questions (Ismail & Mahamod, 2016).

Results analysis study by Yee, Hamdan, Tee & Mohamad (2016) shows the most problems faced by Polytechnic students while completing coursework tasks is the student having difficulty in solving the problem. HOTS is the cause of weaknesses result in applying a student to be creative in solving all problems arising (Yee, 2015). The mastery and use of HOTS within a student can help them to solve a problem effectively (Rajendran, 2008). Thus, the purpose of this study was to examine the impact of skills thought in the teaching and learning process.

2. Research Methodology

This study deployed a quasi-experimental, with Pretest-Posttest Non-equivalent Comparison Group Design. Treatment Group (TG) and Control Group (CG) using individual pre-post assignment. The selection of the design of this study is seeks to assess the effectiveness of HOTS self-instructional manual in the process of teaching and learning. The TG was using the self-instructional manual of HOTS Marzano (XT) then the CG group did not use any self-instructional manual and only followed the traditional teaching (XC). The duration to study self-instructional manual for TG is one month. After completing a one-month learning period for TG, the assignment are distributed to students. A month-long learning period for self-instructional manual of HOTS was obtained through a test run on the use of self-instructional manual of HOTS.

Table 1 shows the design of individual pre and assignments for Treatment Group (TG) and Control Group (CG). Through this design, Treatment Group (TG) O1 occupies the individual pre assignment course before treatment is given to Treatment Group (TG).

Table 1 - The design of individual pre and assignments for Treatment Group (TG) and Control Group (CG)

Group	Individual Pre Assignment	Treatment	Individual Post Assignment
TG	O1	X1	O2
CG	O3		O4

O1 = O3 – Individual Pre Assignment

O2 = O4 – Individual Post Assignment

X1 – Self-instructional Manual of HOTS Marzano

2.1 Population and Sample

In this study, the target population for this study consisted of all Diploma in Electrical and Electronic Engineering students, Civil Engineering students, and Mechanical Engineering students at Polytechnic of Sultan Abdul Halim Muad'zam Shah. The samples consist of 78 students in mechanical engineering that have studied the topic of Mechanical Plastics. A total of two classes consisting of 30 to 35 students randomly selected clusters to be into TG and CG. Number of student in TG consist of 37 students and for CG consist of 41 students. There were two justifications of choosing the Diploma Mechanical Plastic Program, Existing educational approach used in problem based learning and same topic was used for all the classes during learning process.

2.2 Research Instrument

This study was conducted using HOTS self-instructional manual, pre assignment and post assignment, and a rubric of assignment to obtain the information or data needed to answer the research questions. This work assignment includes two sets of questions to get students' achievement results on the topic of Mechanical Plastics. Questions for the work assignment which has elements of problem solving and designed based on the syllabus of polytechnics. Individual pre and post assignment evaluation's rubric comprises five main criteria, such as, Introduction and Conclusion, Creative/Innovative Thinking, Problem Solving, Seeing Thing in The Mind Eye and References. This pilot study was conducted on 30 polytechnic students who have the same characteristics as the population to be tested. Reliability values for pre and post assignment achievements were obtained using alpha tests. The value of reliability individual pre and post assignment is .81 and .83.

2.3 Score Range and Level of Achievement of Individual Assignment

Achievement of individual assignment was used to show the effectiveness of HOTS on student academic achievement. Table 2 shows the range of scores and the level of completion of individual assignments.

Table 2 - Score range and level of achievement of individual assignment

Score Range	Level of Achievement
0.00 - 25.00	Poor
25.01 - 50.00	Satisfactory
50.01 - 75.00	Good
75.01 – 100.00	Excellent

The assessment of individual work assignments consists of five criteria, namely 'Introduction and Conclusion', 'Creative / Innovative Thinking', 'Problem Solving', 'Seeing thing in the mind eye' and 'References'. Weightage of scores for score range of level achievement for these five criteria are the same. Table 3 shows score range and level of five criteria achievement.

Table 3 - Score range and level of five criteria achievement

Score Range	Level of Achievement
0.00 - 5.00	Poor
5.01 - 10.00	Satisfactory
10.01 - 15.00	Good
15.01 - 20.00	Excellent

2.4 Data Analysis

In this study, descriptive statistics and inference statistics will be used. Descriptive statistics are used to summarise a set of data when inference statistics are used to generalise the population based on data from the population sample (Idris, 2013). Descriptive statistics using Mean Score and Frequency when inference statistics using ANCOVA, MANCOVA and MANOVA.

3. Result and Discussion

In conducting this study, a total of 78 individual pre and post assignment were distributed to two groups comprising treatment groups (TG) and control groups (CG). Data analysis was done using SPSS 22.0 for Window. With the use of SPSS, results of the analysis were presented in terms of frequency, percentage and differences.

3.1 The achievement of individual pre assignment among polytechnic student

Table 4 shows the achievement of the individual pre assignment for TG and CG. Overall, the achievement of the individual assignment for both groups is at a good and satisfactory level. This is because both groups are in the same environmental factor in polytechnics. The factor of environment or polytechnic climate is also important in influencing student achievement. According to Mok (2013), the conducive physical environment of a conducive study is an important factor in improving the effectiveness of teaching and learning within a place of study. Physical factors in the study includes physical atmosphere within the study area and the surrounding area. The teaching approach used by a lecturer is an important component for the teaching and learning sessions. Learning approaches used are student-centred learning. According to the Department of Polytechnic Education (DPE) (2011), student-centred learning is the main approach to the implementation of learning and teaching (T&L) to achieve the goals and outcomes of the program of polytechnic education. Hence, teaching methods in the course of technical areas between these two groups is the same. Indirectly, it affects student achievement is the same between TG and CG.

Table 4 - Achievement of pre work assignment

Group	Excellent		Good		Satisfactory		Poor		Total	
	f	%	f	%	f	%	f	%	f	%
TG	0	0%	35	94.6%	2	5.4 %	0	0%	37	100%
CG	0	0%	38	92.7%	3	7.3%	0	0%	41	100%

3.2 The difference in mean score of individual post assignment between TG and CG

Table 5 showed the ANCOVA analysis test the difference in the mean of the individual post assignment between TG and CG. The results of the ANCOVA test data analysis showed that there were significant differences in the mean score of individual post assignment between TG and CG as a whole ($p < .05$). The results of this analysis show that treatment has a positive impact on student achievement in the course work after controlling the scores of individual pre assignment.

Table 5- Mean of the individual post assignment between TG and CG (ANCOVA)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5876.480 ^a	2	2938.240	121.188	.000
Intercept	3624.699	1	3624.699	149.502	.000
T_PRA	8.602	1	8.602	.355	.553
GROUP	5674.063	1	5674.063	234.028	*.000

The result of the analysis also found that the mean individual post assignment mean score for TG was higher than CG that is TG (80.54%) and CG (63.17%). On the other hand, the level of completion of individual post assignment for TG is at an excellent level, while CG is at a good level (Table 6). This shows that the use of HOTS self-instructional manual in the individual assignment is very effective compared to the CG which is a traditional learning that do not use the HOTS self-instructional manual.

The findings show that students who have been able to acquire mastery level HOTS grade achievement good individual assignment and vice versa after receiving treatment. This is because students who enhance HOTS themselves will have better academic achievement and skills (Sulaiman et al., 2017). Teaching and learning has been able to increase the achievement HOTS and proved through studies conducted by Yee (2015); Perkins (2011); Keller & Carellas (2011); and Hu (2011). This case clearly shows of the thinking skills will enable students to complete work assignment problems in certain circumstances from a different perspective, especially to resolve high-level a critical problem. Through this awareness, students can improve their performance in the task. Students can complete the tasks and shown them self that they are capable in dealing with the mind effectively. Based on the results of the findings, then it is logical that the increase for TG is high compared with CG.

Table 6 - Mean score and level of achievement of individual post assignment between TG and CG

Group	N	Individual Post-Work Assessment		Sig.
		Mean Score	Level of Achievement	
TG	37	80.54	Excellent	*.000
CG	41	63.17	Good	

* Significant differences in $p < .05$

3.3 The difference in mean score of five evaluation criteria for individual post assignment between TG and CG?

Table 7 showed MANCOVA analysis test the difference in a mean score of five evaluation criteria for individual assignment between the TG and CG. There is a significant difference in a mean score of five evaluation criteria for individual assignment between the TG and CG namely 'Introduction and Conclusion', 'Creative / Innovative Thinking', 'Problem Solving', 'Seeing thing in the mind eye' and 'References'. The results of the analysis show that treatment had a positive impact on the achievement of five criteria in the individual assignment.

Based on homogeneity analysis of subset, Treatment Group>Control Group for five criteria namely 'Introduction and Conclusion', 'Creative / Innovative Thinking', 'Problem Solving', 'Seeing Thing in The Mind Eye' and 'References'. Results of the findings analysis also found that the mean of the individual post assignment for TG was higher than the CG for each evaluation criteria (Table 8). Additionally, the level of individual post assignment for the TG / CG 'Creative / Innovative thinking' and Problem-Solving criteria at the top level. For reference 'Reference' and 'Introduction and Conclusion', TG and CG are at a good level. For the 'Seeing Thing in The Mind Eye' criteria for TG is higher than CG.

In addition, there are significant differences between the five criteria of 'Introduction and Conclusion', 'Creative / Innovative Thinking', 'Problem Solving', 'Seeing thing in the mind eye' and 'References' in TG. This is because each TG learns the HOTS, which is the component needed in solving the problem (Othman & Rahman, 2011). HOTS has an indispensable advantage in solving the problem, which combines the common elements to form an interconnected as a restructuring of the elements to the new structure (Anderson & Krathwohl, 2001). However, for CG there is no significant difference for the five criteria. This suggests that HOTS is the highest level in Bloom's taxonomy (Bloom, 1956) which emphasises on students how to receive and process information through their experience (Mohamed, 2006). Therefore, the teaching and learning process using HOTS self-instructional manual can help students in facing difficulty solving problems as well as enhancing their competence. With this, it can be concluded that HOTS 's learning has had a significant impact on the achievement of coursework assessment compared to traditional learning.

Table 7 - MANCOVA analysis test the difference in a mean score of five evaluation criteria for individual assignment between the TG and CG

Source	Dependent Variable	Mean Square	F	Sig.
Corrected Model	Introduction and Conclusion	77.670	25.227	.000
	Creative /Innovative Thinking	28.354	3.556	.004
	Problem Solving	43.383	7.846	.000
	Seeing Thing In The Mind Eye	30.286	4.362	.001
	References	48.028	9.798	.000
Intercept	Introduction and Conclusion	143.875	46.730	.000
	Creative/Innovative Thinking	254.991	31.981	.000
	Problem Solving	211.156	38.188	.000
	Seeing Thing In The Mind Eye	93.408	13.453	.000
	References	48.959	9.987	.002
GROUP	Introduction And Conclusion	354.064	114.999	*.000
	Creative/Innovative Thinking	128.636	16.134	*.000
	Problem Solving	196.731	35.579	*.000
	Seeing Thing In The Mind Eye	84.907	12.229	*.001
	References	230.818	47.086	*.000

Significant differences in $p < .05$ **Table 8 - Mean score and level of achievement of five evaluation criteria for individual post assignment of between TG and CG**

Criteria	Group	Mean Score	Level of Achievement	Sig.
'Introduction and Conclusion'	TG	14.86	Good	*.000
	CG	10.00	Good	
'Creative/ Innovative Thinking'	TG	18.78	Excellent	*.000
	CG	16.10	Excellent	
'Problem Solving'	TG	17.84	Excellent	*.000
	CG	14.27	Excellent	
'Seeing thing in the mind eye'	TG	16.49	Excellent	*.001
	CG	13.78	Good	
'References'	TG	12.57	Good	*.000
	CG	9.02	Good	

* Significant differences in $p < .05$

3.4 The difference in mean score between pre and post assignment for TG and CG?

The analysis of mean score difference between individual pre and post assignments for both groups is carried out. Table 9 shows the MANOVA Test analysis shows that there is a mean difference between the individual pre and post assignments for TG and CG as a whole. There was a significant difference mean score between the individual pre and post assignment in TG ($p < 0.5$). While for CG, there is no significant mean score of individual pre and post assignment.

Table 9 - MANOVA Test analysis the difference in mean score between the individual pre and post assignments for TG and CG as a whole

Source	Measure	Mean Square	F	Sig
PRE POST	KR	11772.973	178.301	.000
	KK	97.297	2.057	.160
Error (PRAPOS)	KR	66.029		
	KK	47.297		

The study found that there was an increase in the mean score between individual pre assignment and individual post assignment. For CG, there was a high increase that is 17.84% from 62.70% to 80.54%. This was followed by TG, there was a low increase in the mean score between the individual pre assignment and individual post assignment, which was

1.62%. In addition, there is an increase one level achievement in the individual pre assignment and individual post assignment, from the good level to the excellent level of TG. Meanwhile, CG has no increase and is at the same level (Table 10). This is because TG learned HOTS, which is the component needed in solving problems (Othman & Rahmat, 2011). HOTS has an indispensable advantage in solving the problem, which combines the common elements to form an interconnected as a restructuring of the elements to the new structure. The use of HOTS among students helps students to manipulate information and translate the information to the easy-to-understand form (Ea, Chang & Tan. 2005). Therefore, HOTS is an indispensable skill for every individual in any educational settings (Tan & Halili, 2015).

Table 10 - Overall mean score and level of achievement between pre and post assignment for TG and CG

Groups	N	Mean score of individual work				Sig.
		Pre		Post		
		Mean	Level of achievement	Mean	Level of achievement	
TG	37	62.70	Good	80.54	Excellent	*.000
CG	37	61.62	Good	63.24	Good	

* Significant differences in $p < .05$

3.5 The difference mean score of five evaluation criteria between pre and post assignment for TG and CG

The MANOVA test analysis shows the mean difference between individual pre assignment and individual post assignment for TG and CG for five evaluation criteria (Table 11). There is a significant difference between the individual pre and post assignments for TG and CG for the five criteria namely 'Introduction and Conclusion', 'Creative / Innovative Thinking', 'Problem Solving', 'Seeing thing in the mind eye', and 'References'.

Table 11 - MANOVA analysis test the difference in a mean score of five evaluation criteria for individual pre assignment and individual post assignment between the TG and CG

Source	Measure	Mean Square	F	Sig.
PRA	Kr_Introduction	357.432	17.932	.000
POS	Kr_Creative	925.000	66.600	.000
	Kr_Probelm	568.243	36.743	.000
	Kr_Seeing	297.973	32.802	.000
	Kr_Reference	327.027	18.898	.000
	PRA	Kk_Introduction	6.081	1.000
POS	Kk_Creative	2.703	.130	.720
	Kk_Problem	.676	.042	.838
	Kk_Seeing	16.892	1.090	.304
	Kk_Reference	2.703	.280	.600

The findings of the study showed that there was an increase of mean score between individual pre and post assignments for TG which was 3.1%, 5.00%, 3.92%, 2.84% and 2.98% (Table 12). Each value represents the 'Introduction and Conclusion', 'Creative / Innovative Thinking', 'Problem Solving', 'seeing thing in the mind eye' and 'References'. In addition, there is an increase in the level achievement of individual pre and post assignments, from Good to Excellence level for TG representing 'Creative / Innovative Thinking', 'Problem Solving', 'Seeing thing in the mind eye'. Criteria for 'References' also has a level of improvement from satisfactory to good. However, criteria for the 'Introduction and Conclusion' and 'reference' there is no increase in the level of achievement of individual pre and post assignment

Among the five criteria, criteria "Creative / Innovative Thinking" showed the highest achievement. According to Chinedu & Kamin (2015), HOTS is a major component of creative and critical thinking. Creative thinking can help students develop more innovative ideas, perspective ideas for imaginative ideas. Rajendran & Idris (2008), students who have been taught how to develop creative views to solve problems are more appropriate to solve more complex problems than those who are not taught in creative thinking. In addition, the "Problem Solving" criteria also shows an increase. HOTS is an important aspect of the teaching and learning process, as one of the main goals of the lesson is to ensure that students can think and solve problems critically (Chinedu & Kamin, 2015). Obviously, students need to learn and apply HOTS in the teaching and learning process. Mastery of HOTS in learning enables students to solve various types of tasks or problems whether in academic or in real-life situations. By classifying HOTS, students are able to complete tasks on different TS levels either at low or high levels. Hence, students need to study HOTS for the purpose of achieving excellent academic achievement.

Table 12 - Mean score and level of achievement of five evaluation criteria between individual pre and post assignment for TG and CG

Criteria	Group	Mean Score Individual Assignment				Sig.
		Pre		Post		
		Mean	Level of achievement	Mean	Level of achievement	
Introduction	TG	11.76	Good	14.86	Good	*.000
	CG	9.59	Satisfactory	10.00	Satisfactory	
Creative	TG	13.78	Good	18.78	Excellent	*.000
	CG	15.95	Excellent	16.22	Excellent	
Problem Solving	TG	13.92	Good	17.84	Excellent	*.000
	CG	14.32	Good	14.46	Good	
Seeing	TG	13.65	Good	16.49	Excellent	*.000
	CG	12.97	Good	13.65	Good	
References	TG	9.59	Satisfactory	12.57	Good	*.000
	CG	8.78	Satisfactory	9.05	Satisfactory	

* Significant differences in $p < .05$

4. Conclusion

HOTS should be an important aspect of the teaching and learning process, as one of the main goals of teaching is to ensure students can think and solve problems critically especially related to TVET. Learning on HOTS has an impact on the improvement of the achievement of pre and post coursework assessment. While traditional learning alone cannot have a significant effect on the increase of HOTS. It is clear, therefore, that meta cognitive knowledge, the application of HOTS in the course work of the course plays an important role in enhancing the level of people's thinking skills. Mastery of cognitive knowledge alone, traditionally learning is not enough for a student to improve the HOTS level.

In the context of student academic achievement, HOTS Self-Instructional Manual was able to provide students with a clear learning experience on the form of questions based on the HOTS level and the right form of answer by referring to learning notes. Furthermore, the use of HOTS Self-Instructional Manual allows students to compare, contrast, organise, classify and identify the causes and consequences according to their own views and opinions in completing the assignment. It can be concluded that HOTS Self-Instructional Manual is very important for students. Implication, learning on HOTS Self-Instructional Manual can improve the HOTS level and academic achievement of students.

By mastering eight HOTS in learning, students learn how to use a variety of learning strategies or techniques that enable the accomplishment of accomplishing tasks based on high-level thinking skills. Lecturers can provide high-level problem-solving questions that can challenge students' minds and stagger high-level questions to encourage students to give insights and to conduct research and exploration in a structured manner.

5. Implication and Recommendation

Awareness of the importance of mastering HOTS can assist the lecturers in polytechnics and training students in solving tasks that require thinking skills. The results of this study have further implicated on the teaching and learning as it is evidence that the lecturers should train students to applying HOTS and increase teaching and learning activities based on HOTS to students so that the HOTS level can be enhanced. With this HOTS Self-instructional manual, students can learn and apply the problem-solving skills according to their ability.

The following recommendations was obtained in this study, there are several positive suggestions that can be guided by certain parties to enhance and strengthen students' thinking skills.

- Student

Students can improve academic performance by having high knowledge in HOTS. Indirectly, students will enhance their potential by using various learning strategies for effective learning. The use of HOTS materials such as high-level questions can encourage students to think more deeply, draw conclusions and reflections, and then apply the knowledge in real situation. Students also can apply questions based on HOTS in everyday life to test the mind and problem solving.

- Teacher

Teacher need to teach students to keep track of their thinking, engaging in a purposive and conscious evaluation of thinking is in itself a higher level of thinking. Teacher can use student-centred learning strategies in the teaching and learning process as this strategy is most effective in improving student development. Instructional teaching method such as problem based learning to engage student in high order thinking very suitable in student centred learning. Teacher also can provide high-level problem solving questions that can challenge students' minds.

Acknowledgement

The authors would like to thank to the Ministry of Education, Malaysia for supporting this research under the VOT number V010 for the Graduating Teacher Programme (PPG). In addition, the authors also wish to thank the Mechanical Engineering Department who have given their full cooperation to ensure the success of this study.

References

- Anderson, L. W. & Krathwohl, D. R. (Eds.) (2011). *A taxonomy for learning teaching and assessing: A revision of Bloom's Taxonomy of Educational Objective*. New York: Addison Wesley Longman.
- Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive Domain*. New York: David McKay Company, Inc.
- Chinedu., C.C. & Kamin, Y. (2015). Strategies for improving higher order thinking skills in teaching and learning of design and technology education. *Journal of Technical Education and Training (JTET)*, 7(2) ISSN 2229-8932
- Department of Polytechnic Education [DPE]. (2011). *Dasar dan prinsip perancangan dan penyampaian kurikulum program pengajian Planning principles and policy, and program curriculum delivery*.
- Ea, J.; Chang, A. & Tan, O. S. (2005). *Thinking about thinking: What educators need to know*. Singapore: National Institute of Education, Nanyang Technological University, McGraw Hill Education. Pg 72.
- Hu, W. P. (2011). Effects of “Learn To Think” intervention program on primary schools students. *Proc. of the 15th International Conference on Thinking (ICOT15)*. Northern Ireland: Queen’s University Belfast. ms. 88-94.
- Idris, N. (2013). *Penyelidikan dalam pendidikan*. Malaysia: Mc Draw Hill (Malaysia) Sdn. Bhd
- Ismail, M.H. (2012). Kajian Mengenai kebolehpasaran siswazah di Malaysia: *Tinjauan dari Perspektif Majikan. Prosiding PERKEM VII, Jilid 2 (2012) 906-913. ISSN: 2231- 962X*. Universiti Kebangsaan Malaysia.
- Ismail, N., & Mahamod, Z. (2016). Sikap dan kesediaan pelajar sekolah menengah terhadap kemahiran berfikir aras tinggi dalam pembelajaran komsas bahasa melayu (Attitude and Readiness Secondary School Students on Higher Order Thinking Skill in Malay Language Literature Component), *Jurnal Pendidikan Bahasa Melayu – JPBM (Malay Language Education Journal – MyLEJ)*, ISSN: 2180-4842. Vol. 6, Bil. 2 (Nov. 2016): 59-67
- Kim, Y. (2005). Cultivating reflective thinking: *The effects of a reflective thinking tool on learners' learning performance and metacognitive awareness in the context of on-line learning*. (Ph.D dissertation, The Pennsylvania State University). Dicapai pada 10 Oktober 206 dari <http://search.proquest.com/docview/305419245?accountid=28930>
- Keller, K. & Carellas, T. (2011). Developing a culture of thinking at Golden Grove High School. *Proc. of the 15th International Conference on Thinking (ICOT15)*. Northern Ireland: Queen’s University Belfast. ms. 42-56.
- Kementerian Pendidikan Malaysia, (2013) *Pelan pembangunan pendidikan malaysia (PPPM) 2013 – 2025 (Pendidikan prasekolah hingga lepas menengah)*. Putrajaya; Kementerian Pendidikan Malaysia
- Kementerian Pendidikan Malaysia (2015). *Ringkasan eksekutif pelan pembangunan pendidikan malaysia 2015-2025 (Pendidikan Tinggi)* Di akses pada 10 December 2017 dari www.ptsb.edu.my.
- Lembaga Peperiksaan (2014). *Pentaksiran kemahiran berfikir aras tinggi*. Kementerian Pendidikan Malaysia, Kuala Lumpur.
- Mohamed, S. Z. (2006). *Kesan pendekatan penyebatian kemahiran berfikir kreatif dalam pengajaran karangan deskriptif dan karangan imaginatif dalam kalangan pelajar tingkatan IV*. Disertasi Ph.D. Universiti Sains Malaysia
- Mohd Yusof, N. (2007). Penggabung jalinan dan penyerapan dalam pengajaran dan pembelajaran pensyarah untuk melahirkan modal insan di IPTA. *Persidangan Pengajaran dan Pembelajaran Di Peringkat Pengajian Tinggi 2007*. Kuala Lumpur: Universiti Putra Malaysia. 33-40
- Mohd A. & Hassan, A. (2005). *Pemikiran reka cipta: Kaedah mengajar dan bahan latihan untuk guru dan jurulatih*. Pahang: PTC Publications & Distributors Sdn. Bhd. Universiti Sains Malaysia: Tesis PhD.
- Mohd. A. & Hassan, A. (2006). *Belajar Berfikir*. Kuala Lumpur: Percetakan Zafar Sdn. Bhd.
- Mok, S. S. (2013). *Psikologi pendidikan untuk pengajaran dan Pembelajaran*. 2nd ed. Selangor: Penerbitan Multimedia Sdn. Bhd.
- Nor Puteh, S., Ghazali, N. A., Tamyis, M. M., & Ali, A., (2012). Keprihatinan guru Bahasa Melayu dalam melaksanakan kemahiran berfikir secara kritis dan kreatif. *Jurnal Pendidikan Bahasa Melayu*, 2 (1): 19- 31.

- Othman, F. & Rahman, S. (2011). Kepentingan Penyebatian Kemahiran Berfikir secara Kritis dan Kreatif (KBKK) Dalam Proses Pengajaran dan Pembelajaran. *Pembentangan Seminar Serantau ke 5/2011*. Indonesia: Riau.
- Othman, W., Selamat, K. & Hashim, R. (2010). *Teaching methods in technical and vocational education*. Selangor: Open University Malaysia
- Peirce, W. (2006). Designing rubrics for accessing higher order thinking. *Proc. of AFACCT*. Columbia: Howard Community College. ms. 1-14
- Perkins, D. (2011). Visible thinking - Stories from around the globe. *Proc. Of the 15th International Conference on Thinking (ICOT15)*. Northern Ireland: Queen's University Belfast. ms. 110-121
- Philips, J. A. (1997). *Pengajaran kemahiran berfikir: Teori dan amalan*. Kuala Lumpur: Utusan Publication.
- Poh, A. S. H. (2009). Teaching thinking. *Proc. of the 14 International Conference on Thinking (ICOT14)*. Kuala Lumpur: Universiti Putra Malaysia. 134-145.
- Rajendran, N. S. (2001). *Pengajaran kemahiran berfikir aras tinggi: Persediaan guru mengendalikan proses pengajaran pembelajaran*. Seminar/PameranProjek KBKK: Warisan-Pendidikan-Wawasan. Kementerian Pendidikan Malaysia: Pusat Perkembangan Kurikulum.
- Rajendran, N. S. (2008). *Teaching & acquiring higher-order thinking skills: Theory & Practice*. Tanjong Malim: Penerbit Universiti Pendidikan Sultan Idris.
- Rajendran, N. S. (2009). Reconstructing the teaching of higher-order thinking. *Proc. of International Conference on Teaching and Learning in Higher Education 2009 (ICTLHE 2009)*. Tanjong Malim: Universiti Pendidikan Sultan Idris Malaysia.
- Rhoades, E. B., Ricketts, J. & Friedel, C. (2009). Cognitive potential: How different are agriculture students? *Journal of Agricultural Education*, 50(2), 43-55.
- Subramaniam, S. R. (2009). Metacognition in teaching. *Proc. of the 14th International Conference on Thinking (ICOT14)*. Kuala Lumpur: Universiti Putra Malaysia. ms. 23-35.
- Sulaiman, T., Muniyan, V., Madhvan, D., Hasan, R., Syrene, S., & Rahim, A. (2017). *Implementation of higher order thinking skills in teaching of science : A Case Study in Malaysia*, 1(1), 1-3.
- Tan, S. Y., & Halili, S.H (2015). Effective teaching of higher-order thinking (HOT) in education. *The Online Journal of Distance Education and e-Learning*, April 2015 3(2).
- Yee, M. H., Md Yunos, J., Othman, W., Hassan, R. & Tee, T. K. (2010). Penggunaan kemahiran berfikir aras tinggi Marzano dalam penjana idea. *Prosiding Seminar Majlis Dekan Pendidikan IPTA 2010*, Shah Alam: Universiti Teknologi Mara. ms. 60-73
- Yee, M. H., Othman, W. B., Md Yunos, J., Tee, T. K., Hassan, R., Mohaffyza, M., & Mohamad, B. (2011). The level of Marzano higher order thinking skills among technical education students. *International Journal of Social Science and Humanity*, 1(July), 121-125. <http://doi.org/10.7763/IJSSH.2011.V1.20>
- Yee, M. H., Md Yunos, J., Othman, W., Hassan, R., Tee, T. K. & Mohamad, M. M. (2012). The needs analysis of learning higher order thinking skills among technical students. *Proc. of the 3rd International Conference on Education and Educational Psychology (ICEEPSY 2012)*. Turkey: Istanbul.
- Yee, M. H., Md. Yunos, J., Y., Hassan, R. & Mohamad, M. M. (2013). Penilaian kualiti manual pembelajaran sendiri pengintegrasian gaya pembelajaran Kolb dan kemahiran berfikir aras tinggi Marzano. *Proceeding of the International Conference on Social Science Research, ICSSR 2013*. 4-5 June 2013, Penang, Malaysia.
- Yee, M. H (2015). *Kesan manual pengintegrasian strategi pembelajaran dan kemahiran berfikir terhadap penjana idea dalam kalangan pelajar teknikal*. Universiti Tun Hussein Onn Malaysia: Thesis Ph.D
- Yee, M. H., Md. Yunos, J., Othman, W., Hassan, R., Tee, T. K. & Mohamad, M. M. (2015). Disparity of learning styles and higher order thinking skills among technical students. *4th World Congress on Technical and Vocational Education and Training (WoCTVET)*, 5th-6th November 2014, Malaysia. *Procedia - Social and Behavioral Sciences* 204 (2015) 143 - 152
- Yee, M. H, Hamdan, N., Tee, T. K., & Mohaffyza, M. (2016). Analisis keperluan gaya pembelajaran dan kemahiran berfikir aras tinggi dalam pembelajaran berasaskan masalah. *NCTVET 1st National Conference on TVET 2016 : Faculty of Technical and Vocational Education*
- Yusof, R., Othman, N. & Karim, F. (2005). Strategi pembelajaran pengalaman berasaskan model kolb dalam pendidikan perakaunan. *Jurnal Pendidikan*, 30, 113-128.