

The Relationship between Teachers' Knowledge Level and Pedagogical Skills of Primary School Teachers with the Implementation of Higher Order Thinking Skills (HOTS) in Design and Technology Subject

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Abstract

Higher Order Thinking Skills (HOTS) encompasses higher intellectual level. In line with the aspiration of the Ministry of Education, which is to create a thinking society, much emphasis is needed to be given to the implementation of HOTS. Thinking skills, especially Higher Order Thinking Skills (HOTS), are the core of the mold of 21st-century education. HOTS can create a lifelong learning spirit in individuals seeking new knowledge and skills in response to global changes. According to the Malaysian Ministry of Education, every student must achieve one of six important attributes: thinking skills. It is for this reason that the Design and Technology RBT subject has been developed to help students innovate in producing products based on technology, so this subject can be a means of applying higher-order thinking skills. Implementation of HOTS within the subject of RBT depends fully on the level of pedagogical knowledge and skills possessed by teachers when conducting teaching and learning processes. Hence, this study is conducted to investigate the level of teachers' knowledge and pedagogical skills concerning the implementation of HOTS in the Design and Technology subject. This study used questionnaires as the main instrument. The research method used in this case applied to quantitative approach. The researcher in this case distributed questionnaires to 160 teachers of Design and Technology, RBT. Descriptive statistics analyzed data obtained during the first instance. The result of this study showed that the level of knowledge of teachers about the implementation of HOTS stood at a mean score of 4.11 (SD = 0.40). The mean score of the pedagogical skills of the teachers was 4.19 (SD = 0.39). The results of the correlation in this study indicated that knowledge levels and pedagogical skills of the teachers were significantly related to the implementation of HOTS in Design and Technology (RBT). In this context, Design and Technology (RBT) teachers possess high knowledge and pedagogical skills. The successful implementation of Higher Order Thinking Skills (HOTS) in the Design and Technology (RBT) subject will also be based on effective feedback from all the stakeholders.

Keywords: Higher Order Thinking Skills (HOTS), Teacher Knowledge, Pedagogical Skills, Design and Technology (RBT)

Introduction

Malaysian education has undergone many changes to meet the needs of today. It was also aligned and reformed to ensure that education within the nation is at par with international standards. The Malaysian government is also determined to ensure that Malaysian education becomes globally competitive through the Malaysian Education Development Plan (PPPM) 2013-2025. Much emphasis has been given to education today, especially in the development of students, in manners that can enable the delivery of a generation of human resources who are modular personalities with world-class and exemplary character. (Mohamad Zuber et al., 2020; Tutuk, 2020).

Malaysian Education Development Plan (PPPM) 2013-2025 will present opportunities to all learners to compete in the global educational landscape in aspects such as knowledge, thinking skills, leadership skills, bilingual proficiency, ethics and spirituality, and national identity. The ability to think more critically, creatively, and innovatively, also known as Higher-Order Thinking Skills (HOTS), will not only provide competent human capital but also equip with relevant skills to face the challenges of the future.

The Design and Technology (RBT) subject was implemented for the reason that each student's potential should be holistically developed in a balanced and integrated manner to enable them to take the initiative by grabbing opportunities wisely and creatively (Kementerian Pendidikan Malaysia, 2015). Moreover, HOTS allows learners in primary schools to become competent individuals and be better prepared for higher education. Teaching and learning process must, therefore, be done in an orderly, making sure that all students receive appropriate state-of-the-art knowledge and exposure to issues on HOTS.

Consequently, RBT teachers should be prepared and equipped with higher-order thinking skills, specifically HOTS, for the learners during the learning process. The knowledge and skills of each teacher play an important role in realizing the aspirations of the Malaysia Education Blueprint or PPPM in developing students with HOTS. This is also elaborated in a study by Rajendren (2017), where he asserts that teachers' roles and the application of HOTS itself are much needed in the development of the minds of students, nurturing intellectual culture, and preparing them for every challenge that might come their way in the future. The other researchers stated that according to Syazwani Roni and Zamri Mahamod in their study of 2015, teachers play a major role in encouraging students to use HOTS during the teaching and learning process in the classroom.

The role of teachers in implementing HOTS in schools is therefore highly imperative. In fact, a study undertaken by Syazwani Roni and Zamri Mahamod (2015), indicated that teachers are very instrumental in encouraging students to engage in the use of HOTS for learning and facilitating teaching and learning processes in the classroom. In addition, teachers also act as a pedagogical implementer and assessor of students in schools. Thus, it is incumbent upon teachers to keep upgrading their knowledge in education continuously to help in bringing an advancement in the quality of education. The teaching and learning processes should be carried out in a systematic way so that students get the opportunity to obtain up-to-date knowledge, exposure to HOTS, and acquire the latest knowledge. Teachers are supposed to develop teaching skills related to the process of student learning in the field of mastering thinking skills, especially HOTS. In fact, this also corroborates the findings of a

study conducted by Gajathiswari, Nurzatulshima, and Suhaida (2016) that to perform better, teachers need to be competent enough in delivering knowledge and creating an innovative environment for learning.

Problem Statement

The aim of education through the National Education Philosophy, (FPK) is to produce balanced, well-rounded, and high-quality individuals through the process of all-round holistic development. This idea was realized when the concept of HOTS was incorporated into the school curriculum.

Teachers in Malaysia must be exposed to fundamental training in the areas of subject content knowledge and teaching skills for them to apply HOTS in every subject. This collaborates the findings from a study conducted by Mohamad Nurul Azmi Mat Nor and Nurzatulshima Kamarudin (2016) which substantiated the fact that HOTS is an important strategy employed by all trainee teachers in Teacher Education Institutes (IPG) that prepare teachers, with a focus on the HOTS-based teaching and learning environment.

One of the factors that is against employing teachers' HOTS in teaching and learning in the classroom is teacher unreadiness. In fact, in the study done by Mohd Syaubari et al. (2017), when the teachers are not ready to do so, even though they aware of and understand the importance of HOTS, the practice of employing HOTS cannot be conducted during teaching. Indeed, Farah Aziana Abdul Aziz and Fadzilah Abd Rahman (2018) in their study found that most teachers are not yet ready for the implementation of HOTS within the teaching process because teachers have been less exposed to how elements of HOTS can be used in the Pdpc process. Thus, the implementation of HOTS in teaching and learning is at a low level (Norlaila and Md.Nasir, 2019).

It is also found that teachers still lack knowledge about HOTS. As Talhah Ajmain and Aderi Che Noh (2016), said, "Concept misunderstanding happens when knowledge is not completely understood." According to Amir Khan, Aderi Che Noh, and Tarmimi Hussein (2016), teachers gave different definitions of HOTS. A study by Mohamad Nurul Azmi, Nurzatulshima, Umi Kalthom, and Mohd Hazwan reveals that RBT teachers are supposed to possess the knowledge and pedagogical skills in HOTS to enhance students' ability in HOTS.

Besides that, the level of teachers' pedagogies in implementing HOTS remains at the level of moderately proficient. Wan Nor Shairah Sharuji and Norazah Mohd Nordin (2017), exposed that teachers are not prepared to apply HOTS elements to the PdPc process due to inadequate knowledge of the teaching methods and pedagogies of HOTS. As a result, this leads educators to like applying the same or previous teaching approaches. (Nooriza, 2015). Nasyimah and Zamri Mahomad (2016), also pointed out that if teaching by the teacher is boring, then students' interest in learning will reduce and students' thinking skill is not insisted by the teacher, then they will suffer after completing their education and seeking employment.

Apart from that, traditional methods of teaching are also one of the challenges in implementing HOTS in the Design and Technology (RBT) teaching and learning process. The study by Jamilah and Zamri (2018), also highlighted how teachers found it challenging to shift

from conventional education to student-centered teaching. According to Syazana and Zamri (2018), traditional teaching is what obstructs students from enhancing their thinking skills.

Research Objectives

- Identify the level of teachers' knowledge about HOTS in Design and Technology
- Identify the level of teachers' pedagogical skills in implementing HOTS in Design and Technology.
- Determine the relationship between the level of knowledge about HOTS and the level of teachers' pedagogical skills in implementing Higher Order Thinking Skills (HOTS) in primary school Design and Technology.

Higher Order Thinking Skills (HOTS)

The underlying theory in the present study is that of Anderson and Krathwohl, done as a revision of Bloom's Taxonomy. In this revision, the cognitive domain has been divided into six components, namely, remembering, understanding, applying, analyzing, evaluating, and creating. These have been ordered hierarchically from lower to higher levels. (Muehleck et al. 2014; Utari 2012). In Bloom's Taxonomy hierarchy, Lower Order Thinking Skills (LOTS) include remembering and understanding, while Higher Order Thinking Skills (HOTS) involve applying, analyzing, evaluating, and creating. The concept of HOTS has been inculcated into curriculum modifications in a bid to generate students who can think outside the box, thus coming up with new ideas and inventions. Moreover, HOTS has several processes involved like defining, classifying, differentiating, reasoning, defending views with strong arguments, and many others (Rosnani Hashim, 2012).

On the other hand, A Rahman Haron et al (2016), explained that HOTS involves intellectual reasoning skills, which encompasses deep and broad thinking in decision-making or problem-solving. Sukiman Saad et al (2012), said that HOTS is one of the skills that can develop a visionary, optimistic, and transformative generation. Moreover, HOTS is also defined as the ability of students to create, solve problems, make decisions, innovate, and use knowledge, skills, and values (Ministry of Education Malaysia, 2013a). For this current research, HOTS is one of the skills that should be employed in a teaching and learning process in Design and Technology (RBT). In this context, it encompasses the three main aspects of curriculum, pedagogy, and knowledge.

Teachers' Knowledge About Hots

Knowledge is the result of curiosity over time through sensory processes, especially in the eyes and ears, about an object. According to Donsu (2017), knowledge is one aspect that has a considerable role in developing open behavior and forming open behavior. Teachers need to know HOTS so that they can transfer it to students so that students can master these skills. Kassim and Zakaria (2015) found that in this research, teachers still vaguely understand what HOTS means. All teachers master the basic knowledge of cognitive levels in Bloom's Taxonomy but do not understand the differences and functions of each level in LOTS and HOTS. The teachers have to draw upon their repertoire of knowledge on HOTS, and devise opportunities to employ HOTS when working with the student during Pdpc to share such skills with the students. According to Shulman (1987), the Pedagogical Reasoning and Action Model and Cycle of Pedagogical Reasoning and Action require a teacher to first have deep understanding of the content that is to be taught in a given subject. It is used to conduct effective teaching

and involves several phases, which are comprehension, transformation, instruction, evaluation, reflection, and new comprehension. While all the phases are important in this process, it is both initiated and completed with the comprehension phase. In the process of acquiring new understanding, teachers and students alike will develop a clearer understanding of the subject content. According to Shulman (1987), teaching that starts with these phases allows the transfer of teachers' content knowledge into effective and understandable teaching forms since Shulman (1987), believed that "to teach is first to understand." Shulman (1987), also mentioned that in teaching every option, teachers must first understand and master each subject they teach. To utilize higher-order thinking skills, teachers need to have sufficient knowledge and skills.

Teachers' Pedagogical Skills

Pedagogy is the art of teaching principles and techniques. Pedagogy simply refers to the techniques of teaching that a teacher uses to teach, particularly in special fields. Instructive teaching and learning sessions can only be assured of being effective when the teacher is good pedagogically. The word pedagogy means that teaching should start with mere instruction which gradually progresses to higher levels of teaching. Teachers should have pedagogical skills for choosing methods of teaching and learning that correspond with reception levels of their students. Pedagogical skills will provide a way for the teachers to plan for daily lessons that are appropriate and easy. Pedagogy is not restricted to teaching skills only. It is more about an art or science in which emotions and values along with human behavior are involved. The presence of an artistic element in pedagogy relates to the technique of teaching for the teacher, in which teachers capture the attention of the students.

Research Methodology

Research Design

The very important aspect in any study is the research design. This is both a descriptive and an inferential study, whereby a quantitative approach is adopted in the survey method. Questionnaires were used to primary school teachers in the Northeast zone of the Penang state. The research design in this study is descriptive while explaining the level of teachers' knowledge and pedagogical skills on HOTS in primary schools. Quantitative research can be referred to as a scientific investigation that is systematic wherein the outcome becomes important, with statistical analysis involved.

In this study, the researcher will investigate two aspects: teachers' levels of knowledge and teachers' pedagogical skills in relation to the implementation of HOTS among primary school teachers. The research methodology adopted for this study is, therefore, quantitative, based on data collection using self-developed questionnaires to obtain the required information from the sample.

Population & Study Sample

This study was conducted on 160 teachers in 40 national schools in the Northeast zone of Penang. The sample studied was chosen by using stratified random sampling, where the population comprises 204 teachers in 50 national schools in the Northeast zone. This study only used 160 teachers as a sample for the study to represent the teachers in primary schools in the Northeast zone of Penang. The imposition of the study on necessity or needs that the

researcher had to consider and also identified RBT teachers who met the objectives and questions of the study.

Research Instrument

The questionnaire was used as the instrument of research because the researcher applied a quantitative approach in the research design. Review and refinement were made to the items of the survey based on literature and previous research reviews. Instrument validation was sought by the researcher from a panel of experts selected from the education management lecturers, namely Dr. Hazwan, at Universiti Putra Malaysia. This was necessary so that the expert panel could review the items in the research instrument in relation to the researcher and therefore ensure vocabulary, sentences, and item content were used correctly and suitably to ensure it fell within the research objectives. The questionnaire was divided into two parts: Part A and Part B. Part A covers the background information about the respondent's gender, age, academic qualifications, field of specialization, and exposure to HOTS courses. It is divided by the second part of the questionnaire, Part B: the level of teachers' knowledge in applying HOTS and the level of teachers' pedagogical skills in applying HOTS in the Design and Technology subject.

Data Analysis

In this study, data analysis involved the use of quantitative data. Data obtained from the questionnaire were analyzed using SPSS version 22.0 software. Collected data were analyzed descriptively using frequencies, percentages, means, and standard deviations.

Descriptive statistics were analyzed by percentages, frequencies, means, and standard deviations to indicate the level of teachers' knowledge and pedagogical skills in implementing HOTS in the Design and Technology subject. To analyze the meaning of the mean values for rating scale scores such as 5 – 'very satisfactory', 4 – 'satisfactory', 3 – 'somewhat satisfactory', 2 – 'unsatisfactory', and 1 – 'very unsatisfactory', the researcher divided them into three levels: high, moderate, and low.

Research Findings

a) Identifying Teachers' Knowledge Level about HOTS in Design and Technology

Table 1

Teachers' Knowledge Level of HOTS in Design and Technology

Question	Item	Mean	Standard Deviation	Level
1	I know how to improve students' thinking skills when first starting teaching.	4.22	0.62	High
2	I conduct brainstorming activities individually or in groups to generate ideas in detail.	4.21	0.62	High
3	I know how to assess students' progress in HOTS.	4.21	0.64	High
4	I know and am skilled in developing students' thinking skills.	4.15	0.63	High
5	I use various levels of questioning techniques.	4.14	0.71	High
6	I conduct group movement activities to complete tasks collaboratively in the Design and Technology subject.	4.14	0.63	High
7	I use supporting materials that can enhance students' thinking.	4.12	0.71	High
8	I use HOTS questions during teaching and learning.	4.10	0.66	High
9	I use student-centered learning.	4.00	0.69	High
10	I am aware of HOTS elements in the Design and Technology curriculum.	3.84	0.63	High
	Total	4.11	0.40	

In this section, teachers' knowledge level about HOTS in Design and Technology was examined. A total of 10 items were asked within this construct. Descriptive analysis was conducted to identify the teachers' knowledge level about HOTS in Design and Technology. The findings show that this construct is at a high level ($m=4.11$; $SD=0.40$). The mean and standard deviation regarding teachers' knowledge level about HOTS in Design and Technology were analyzed. The mean values for each item were at a high level, ranging from 3.84 to 4.22. The item with the highest mean score was Item 9, "I know how to improve students' thinking skills when first starting teaching" ($m=4.22$; $SD=0.62$). The second highest mean score was Item 8, "I know how to assess students' progress in HOTS," with a mean of ($m=4.21$; $SD=0.64$). Meanwhile, the item with the lowest mean score ($m=3.84$; $SD=0.63$) was Item 1, "I am aware of HOTS elements in the Design and Technology curriculum." This data indicates that Design and Technology teachers' knowledge of HOTS elements remains low.

b) Identifying Teachers' Pedagogical Skills in Implementing HOTS in Design and Technology

Table 2

Teachers' Pedagogical Skills in Implementing HOTS in Design and Technology

Bil	Item	Min	Sisihan piawai	Tahap
1	I encourage students to express opinions and make decisions.	4.34	0.61	High
2	I assess students' progress in HOTS.	4.32	0.59	High
3	I provide effective feedback to students to help them achieve HOTS levels.	4.24	0.61	High
4	I teach Design and Technology and HOTS using an integrative approach	4.22	0.70	High
5	I develop students' individual potential in HOTS learning	4.21	0.61	High
6	I use thinking tools such as mind maps and graphic organizers to help students think systematically and focused	4.16	0.67	High
7	I prepare activities that require students to conduct inquiries, research, project-based learning, and collaborative learning in Design and Technology teaching.	4.15	0.62	High
8	I have sufficient teaching resources such as textbooks, digital materials, and websites for teaching and learning purposes	4.14	0.66	High
9	I use various strategies and techniques, such as constructivism and contextual learning, in Design and Technology teaching	4.13	0.63	High
10	I plan Design and Technology lessons with activities that allow students to use HOTS	3.97	0.58	High
	Total	4.19	0.39	

In this section, the level of teachers' pedagogical skills in HOTS implementation in Design and Technology was examined. A total of 10 items were asked within this construct. Descriptive analysis was conducted to identify teachers' pedagogical skills in HOTS implementation in Design and Technology. The findings indicate that the construct is at a high level ($m=4.19$; $SD=0.39$). The mean and standard deviation regarding teachers' pedagogical skills in HOTS implementation in Design and Technology were analyzed. The mean values for each item were at a high level, ranging from 3.97 to 4.34. The item with the highest mean score was Item 7, "I encourage students to express opinions and make decisions" ($m=4.34$; $SD=0.61$). The second-highest mean score was Item 8, "I assess students' progress in HOTS" ($m=4.21$; $SD=0.64$). Meanwhile, the item with the lowest mean score ($m=3.84$; $SD=0.63$) was Item 1, "I plan Design and Technology lessons with activities that allow students to use HOTS."

- c) Determining the Relationship Between Teachers' Knowledge Level About HOTS and Pedagogical Skills in Implementing Higher Order Thinking Skills (HOTS) in Primary School Design and Technology

Table 3

Pearson Correlation Analysis of Teachers' Knowledge Level About HOTS and Pedagogical Skills

		KNOWLEDGE	PEDAGOGY
KNOWLEDGE	Pearson Correlation	1	.540**
	Sig. (2-tailed)		.000
	N	160	160
PEDAGOGY	Pearson Correlation	.540**	1
	Sig. (2-tailed)	.000	
	N	160	160
** . Correlation is significant at the 0.01 level (2-tailed).			

Table 3 shows the relationship between teachers' knowledge level and pedagogical skills in implementing Higher Order Thinking Skills (HOTS) in primary school Design and Technology. The study findings indicate a significant relationship between teachers' knowledge level and pedagogical skills. There is a positive relationship between the level of teachers' knowledge ($r=.540$) and pedagogical skills ($r=.540$), with a positive strength.

Discussion

Results on the knowledge of the implementation of HOTS from this study showed that the responding teachers have a high level of knowledge with a mean score of 4.11 (SD = 0.40). This finding is supported by Zamri (2014), who he concluded that a high level of teacher knowledge about HOTS is essential in the course of enabling teachers to plan activities effectively and to ensure the development of the knowledge of HOTS in the processes of teaching and learning among students. Indeed, it has been supported by Syazana Sahari & Zamri Mahamod (2018), who noted that the level of knowledge in HOTS among teachers is proportional to their proficiency in implementing HOTS in teaching and learning processes.

By implication, the teachers' pedagogical skills in implementing HOTS were also found to be high, as expressed by a mean score of 4.19 (SD=0.39). Teachers are prepared for mastering both skills in teaching strategies and curriculum reform goals. As Mohd Nazri Hassan et al (2017), declare, teaching and learning processes are often dependent on the creativity of teachers when considering the application of HOTS, although sometimes it does not affect enhancing students' mastery of HOTS as it should. In this connection, Husni Abdullah et al (2018), claim that the traditional instructional method, like "chalk and talk," can be less effective for students during learning because they cannot involve the students in teaching.

The correlation of the level of teachers' knowledge with their pedagogical skills in HOTS implementation is further brought forth through the findings presented by the mean scores for both knowledge and pedagogical skills levels in HOTS. From this study, it is concluded that the teachers of Design and Technology must carry out the teaching of RBT with the integration of HOTS. Moreover, teachers are also competent enough to develop students' thinking skills. Teachers can apply their knowledge in planning and using different techniques and strategies to successfully implement HOTS (Nor Hazmaliza, 2016). Teachers are also involved in personal initiatives towards finding out the best way to inspire creativity

through reading and attending relevant workshops. Through this, the teachers will develop their potential in inspiring creativity and be confident in teaching RBT subjects hence generating creative and innovative students.

Conclusion

Emphasis on HOTS is no longer limited to an emphasis but must be demanded for more concrete solutions. This is because the ability to think is an important aspect of learning, and teachers play a significant role as agents of educational development in enhancing classroom learning processes for the betterment of its quality. The effectiveness of thinking skills implementation during the learning process will shape students to think of ideas and solutions to various problems faced in their lives. RBT teachers need to be equipped with knowledge and information on methods, strategies, and techniques for integrating HOTS in teaching and learning. Ability and interest in understanding the design and technology subject can be increased by applying different methods and teaching strategies. These findings from the study will assist teachers in teaching theory and solving students' problems during practical work, particularly when tackling low-level ideas. This study is significant in guiding the application of HOTS in the RBT subject for primary school students, teachers, the Curriculum Development Center, and researchers since the application of HOTS in the RBT subject will lead to quality and meaningful teaching.

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