



TAMIL PRIMARY SCHOOL TEACHERS' UNDERSTANDING ON CONSTRUCTING HOTS ITEMS IN MATHEMATICS

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ABSTRACT

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Many studies indicate that it is crucial for teachers to understand the levels of higher order thinking skills (HOTS) questions and how to construct HOTS Mathematics items in order to teach effectively and constructively in classrooms. The objective of this study was to investigate Tamil Primary school teachers' understanding (from cognitive, affective and behavioral aspects) of the construction of HOTS Mathematics items based on their teaching experiences. This quantitative study employed descriptive research design. The sample of this study consists of 254 Mathematics teachers from Tamil Primary schools in three states in Malaysia. Stratified sampling was adopted in selecting the sample. The researchers used an adapted survey questionnaire to measure teachers' understanding on constructing HOTS Mathematics items based on three constructs namely cognitive, affective and behavioral. Findings of this study indicate that teachers with high and average experience in teaching Mathematics have significantly better understanding (in terms of cognitive, affective and behavioral aspects) in constructing HOTS Mathematic items compared with teachers who have low experience. In terms of pedagogical implications, the findings of this study suggests that senior teachers should conduct more workshops and training for teachers with less experience to convey their experiences and skills. In terms of practical implications.

Contribution/Originality: The paper's primary contribution is finding that teachers' with high and average experience in teaching Mathematics have significantly better understanding (in terms of cognitive, affective and behavioral aspects) in constructing HOTS Mathematic items compared with teachers who have low experience. As such, this paper has crucial pedagogical implications.

1. INTRODUCTION

Higher order thinking skills (HOTS) and problem solving skills are essential for every student to be able to think and solve their daily problems and be more productive in their future careers. According to Suhaili (2014) HOTS are seen as an essential component of competition in today's globalized world as argued by Rajendran (2010) the workforce needs workers who are able to use the maximum level of thinking in problem solving. According to the Malaysian Education Development Plan 2013-2025 (2013), high-level thinking skills (HOTS) should be applied in all subjects especially Mathematics since Mathematics is the driving force for development in the field of Science and Technology, which also develops the quality of their daily life.

The effectiveness of teaching and learning of HOTS items in Mathematics is very much depends on the teachers' understanding and their readiness to teach the subject (Abdullah, Alhassora, & Abu, 2017). Teachers' understanding of HOTS and their skills in teaching HOTS Mathematics items is crucial in facilitating the students in learning to solve HOTS Mathematics items (Gómez-Chacón, 2013). Ranai (2013) also emphasized that in order to answer the HOTS items, students should do something more than just memorize facts. Students need to analyze the facts first in order to answer the items in various situation.

According to Murray (2011) effective items need to have specific features, which are objective and clear, concise, provocative, interrogative and tailored to the student level. HOTS requires an intellectual process of thinking with a broad and deep mind to find meaning and understanding of problem solving. In this context, the role of the teacher in disseminating the knowledge of HOTS is very important. Teachers should have effective questioning techniques to engage students in teaching and learning activities (Bond, 2007).

In 2014 and 2015, 40 percent of the HOTS items were applied in the Primary School Assessment Exam (UPSR) using the old format. By 2016, the percentage of HOTS questions added up to 80 percent in all subjects in Primary School Assessment Test (UPSR items). The change in the UPSR format in 2016 came as a shock in the UPSR results when the Mathematics results dropped slightly to 14.7 percent in grade A and 18.3 percent in grade B. This was due to students whom were still unprepared and did not have the knowledge to answer the HOTS questions (Ministry of Education, 2013).

Seman, Yusoff, and Embong (2017) conducted a qualitative study to identify the Mathematics teachers' understanding of HOTS items in Mathematics. The findings show that most teachers failed to ask HOTS items during the teaching and learning process. The findings also revealed that teachers still lacked understanding in the construction of HOTS items in Mathematics. According to Moore and Stanley (2010) teachers' understanding and readiness in implementing HOTS Mathematics items during teaching and learning was still at a low level. Teachers viewed that the HOTS item need not be taught as it is a skill that develops naturally in the students (Tajudin & Chinnappan, 2017).

The findings of the Trends in International Mathematics and Science Study (TIMSS, 2011) and the Programme for International Student Assessment (PISA, 2012) show that the thinking and problem-solving skills of Mathematics among Malaysian students were relatively low compared to other Southeast Asian countries. This comparison covers the following content domains namely, Number, Size of Data, Geometry and Algebra. In this regard, the Ministry of Education emphasized on teaching the HOTS items across the curriculum from primary to secondary schools to enhance students HOTS (Ministry of Education, 2013).

Most teachers find it difficult to improve students' confidence in responding to HOTS items (Louis, Febey, & Schroeder, 2005). A study by Kiuahara, Graham, and Hawken (2009) found that 47 percent of Mathematics teachers only give students lower order thinking skills (LOTS) items. This is because the teachers themselves lacked understanding and confidence in implementing the teaching HOTS Mathematics questions in the classroom (Szymanski & Shaff, 2013). According to Sabri, Hayhoe, and Ai (2006), most teachers do not have the knowledge and skills to apply HOTS questions in teaching Mathematics. They also pointed out that the in-service HOTS courses that teachers attended were not effective enough in equipping them with comprehensive knowledge and skills in the teaching of HOTS Mathematics items.

Abdullah et al. (2017) in their study found that HOTS training and knowledge among Mathematics teachers were very poor. Zoller (2001) also emphasized that teachers were weak in their understanding of HOTS items and they too lacked in knowledge and pedagogical skills in teaching Mathematics. In addition, Makeleni and Sethusha (2014) emphasized that HOTS programme and courses were crucial to improve teachers' skills in constructing HOTS items and to carry out regular assessments in the classroom. Studies on teachers' knowledge and understanding of HOTS items are very limited in Malaysia as such, it creates the gap for the researchers to focus on the Tamil Primary School teachers' understanding in constructing HOT items in the current study.

1.1. Null Hypotheses

The objective of the study is to investigate Tamil Primary school teachers' understanding (from cognitive, affective and behavioral aspects) of the construction of HOTS Mathematics items based on their teaching experience. Based on the objective, four null hypothesis's were formulated as follows:

Ho 1. There was no significant difference among teachers' understanding (in terms of cognitive, affective and behavioural aspects) in the construction of HOTS Mathematics items according to their teaching experience.

Ho 2. There was no significant difference among teachers' understanding in terms of cognitive aspect in the construction of HOTS Mathematics items according to their teaching experience.

Ho 3. There was no significant difference among teachers' understanding in terms of affective aspect in the construction of HOTS Mathematics items according to their teaching experience.

Ho 4. There was no significant difference among teachers' understanding in terms of behavioural aspect in the construction of HOTS Mathematics items according to their teaching experience.

2. REVIEW OF LITERATURE

This quantitative study is based on the modified Bloom's Taxonomy (Anderson & Krathwohl, 2001). In the Bloom's Taxonomy modified by Anderson and Krathwohl (2001) there are six levels, namely two low level thinking skills (LOTS), which include knowledge and understanding where its recalling facts and basic concepts explaining ideas or concepts. Then the four levels of HOTS namely, applying, analyzing, evaluating and creating. Applying is using information in new situation. Analysing is drawing connections among ideas. Evaluating is justifying a stand or decision. Creating is producing new and original work.

According to Anderson and Krathwohl (2001) cognitive ability is the ability to think in a hierarchy consisting of knowledge, understanding, applying, analyzing, evaluating and creating. Cognitive Development Theory consists of three parts: behaviorism, constructivist and cognitive. According to Hasan (2016) the theory of cognitive development is an active and dynamic process in learning. The inner mental process influences the result or the outcome of any action or behavior. These stimuli are stored for information and transmitted to short-term memory and then to long-term if memory is used frequently.

Piaget (1933) has divided cognitive development according to the levels of sensory, pre-operative, concrete and formal operations. In this regard, teachers should organize the content of their lessons in cognitive development, ranging from concrete to abstract, from near to far, from existing experiences to new experiences and from rough to fine (Hasan, 2016). In brief, cognition brings about a profound change in mental processes among students. Cognitive development can arouse pupil's thinking to move forward. This is not just about students being advanced in education but they can create something new for everyone to use.

In term of affective development Yahya (2009) argued that affective domains include behaviours related to attitude, interest, attention, responsibility and value. Affective domains are consistent with character education. Character education can be the solution to problems in the global age. Teachers' understanding from the affective aspects can be seen as Mathematics teacher's attitude, interest, attention and responsibility in the construction of HOTS Mathematics items. Responsible teachers are always ready to receive the knowledge and skills in the construction of HOTS Mathematics items. However, Uminur and Zakaria (2017) found that the Mathematics teachers' attitude is high and that they respond to the process of implementing HOTS Mathematics items in a positive manner.

Aspects of behaviour include work-related competence by engaging members of the body and competencies related to behaviour. It consists of reflex movements, basic movement skills, perception of ability, accuracy, complex skills, as well as expressive and interpretive. Behavioural domains are also related to the skills and ability to act after someone receives a particular learning experience. Ismawati (2017) highlighted that learning behaviour is

actually a continuation of cognitive learning (understanding something) and affective learning (behavioral tendency).

Behavioral outcomes can be measured through direct observation and assessment of students' behaviours and practice in the learning processes. Learning motivates students to measure knowledge, skills, attitudes and appreciate the environment. This element can be seen in the study of teachers' understanding of HOTS Mathematics items from the aspects of behaviour. In this regard, teachers can indirectly master the 21st century pedagogy, using the strategy of inquiry-based in the construction of HOTS questions as well as managing personal and students behaviour (Rizaldi, Makhrus, & Doyan, 2019).

According to Kruger (2013) HOTS involves a number of activities such as conceptualization, critical and creative thinking, brainstorming, problem solving, mental representation, application of rules, reasoning, and logical thinking to find new solutions to problems. Since HOTS Mathematics items enhance problem solving skills among students (Retnawati, Djidu, Apino, & Anazifa, 2018) teachers should incorporate HOTS items in student learning activities and facilitate students in answering HOTS items. In this regard, the HOTS understanding among the teachers provides a high level of capital in delivering effective teaching. This will help the students to improve their understanding towards HOTS activities.

Moss and Brookhart (2015) provide evidence-based information for all students, teachers, and administrators who have excelled through the journey of the HOTS activity process for academic improvement. This process involves understanding among fellow teachers and administrators to set and pursue professional learning goals. As for the teachers, they should understand their teaching goals and create the activities for the achievements of the pupils.

According to Murray (2011) effective HOTS items need to have specific features, such as clear objectives, concise and provocative, interrogative and tailored to students' level. HOTS Mathematics items requires intellectual process of thinking with a broad and deep mind to find meaning and understanding of problem solving. In this context, the role of the teacher in the dissemination of HOTS items is very important. Teachers should have effective questioning techniques to engage students actively in the learning process (Bond, 2007).

A study by Sabri., Zawawi, and Omar (2006) revealed teachers could not adequately apply proper techniques and procedures in teaching HOTS Mathematics items due to limited understanding of HOTS items. Furthermore, Anthony and Walshaw (2009) reiterated that only teachers who have thorough knowledge and training on HOTS can produce students who are skilled in problem solving in Mathematics.

Seman et al. (2017) explored primary school teachers' knowledge of HOTS items in Mathematics using interviews. This qualitative study determines the understanding of HOTS items in Mathematics among national primary school teachers in Terengganu. The findings show that most teachers inadequately apply the HOTS items while teaching. Only a few of them holistically understands the very requirement of HOTS items based on Bloom's Taxonomy. The findings show that teachers' understanding and readiness of HOTS constructing Mathematics items are very far from expectations.

According to Gareis and Grant (2015) teacher's pedagogy brings changes among students and the effectiveness can be seen as evidence through students' learning outcomes. In this context, teachers should have a thorough understanding of the process of teaching and learning and the knowledge in constructing the HOTS items. If the teachers have knowledge and skills in HOTS they can make pupils more inclined towards learning and confident in responding to HOTS items. Unfortunately, teachers have not yet acquired a satisfactory level of understanding in HOTS items construction. According to Remillard and Bryans (2004), Schoenfeld (2008), Rivera and Becker (2008) teachers' knowledge, teachers' attitudes and beliefs influence their instructions in the classroom and the way in which they construct HOTS Mathematics items. As such, in order to inculcate HOTS among students, teachers' understanding of HOTS is very important in the teaching and learning process (Tastan, 2018).

Driana and Ernawati (2019) explored primary school teachers' understanding about higher order thinking skills (HOTS), its implementation in classroom assessments, and the quality of the HOTS assessment instrument constructed by the teachers in Jakarta, Indonesia. The findings indicated that teachers do not have a comprehensive understanding of HOTS. The majority of the HOTS items that they constructed were still limited to remembering and understanding. Teachers had the tendency to perceive the items that they had made as HOTS items, although those items were categorized as HOTS. Schulz and FitzPatrick (2016) carried out a study to investigate teachers' understanding of HOTS and its role in their instruction. They interviewed 38 teachers in kindergarten to Grade 9 classrooms from 14 schools in Newfoundland, Labrador and Canada, to obtain their understandings of critical and higher order thinking in social studies and science, and how this affects instruction and assessment. The teachers indicated uncertainty about what higher order thinking means, and believed they were not well prepared to teach or assess higher order thinking.

More experienced teachers confer benefits to their colleagues, their students, and to the school as a whole (Podolsky, Kini, & Darling-Hammond, 2019). According to a study by Wolff, Jarodzka, and Boshuizen (2017) high experienced teachers have different classroom management than low experienced teachers. Wolff, van den Bogert, Jarodzka, and Boshuizen (2015) also argued that less experienced teachers often practice strict classroom rules and procedures. On the other hand, experienced teachers always give priority to students' thinking, students' behaviour and students' focus on learning. Experienced teachers are always well prepared, understand the classroom environment and can adapt to the classroom climate more quickly. These facilitate teachers' efforts in implementing HOTS in their classroom teaching.

Podolsky et al. (2019) reviewed 30 studies and analyzed the impact of teaching experience on students' learning outcomes in the United States. Researchers have found that positive teaching experience is strongly associated with successful student achievement throughout the teacher's career. Teacher-related success was not satisfactory in the early years of teaching, but continued to be proficient and successful in their later careers. An experienced teacher is an excellent indicator that students can improve their skills in all their fields, not only knowledge, as measured by standardized tests, but they are also more likely to take further success such as their school attendance. In addition (Kraft & Papay, 2014) stressed that experienced teachers have strong professional effectiveness in classroom teaching which is reflected in their ability in handling HOTS items.

3. METHODOLOGY

This quantitative study employed a descriptive design. Stratified sampling was adopted to collect data from 254 Mathematics teachers in 78 schools in three states to determine their understanding on construction of HOTS Mathematics items based on their teaching experience in Mathematics. The questionnaire in this study was aimed at measuring teachers' understanding on constructing HOTS Mathematics items based on three constructs namely cognitive (5 items), affective (5 items) and behavioral (5 items). The questionnaire was adapted from Nooraini and Abdul Halim (2017); Sulistyaningsih and Sugiman (2016) and Norashikin (2011). Five Likert scales were used in the questionnaire (1= Strongly Disagree, 2= Disagree, 3= Not Sure, 4= Agree, 5= Strongly Agree). Prior to the actual study, a pilot test was conducted among 50 Mathematics teachers (Tamil Primary School) to obtain the reliability of the instrument. The reliability was tested using Cronbach's Alpha and the value obtained was .92 for cognitive domain, .86 for affective domain and .61 for behavioral domain. As such, the findings indicated that the instrument was reliable. In this study, teachers' experience in teaching Mathematics were divided into three categories: Low (5-10 years), Average (11-15 years) and High (16 – 25 years).

The questionnaire was distributed to the teachers by the researcher. The data obtained were analyzed using SPSS Program for Windows, version 23. One Way ANOVA and Tukey HSD Test were conducted to test the hypotheses.

4. FINDINGS AND DISCUSSION

Ho 1. There was no significant difference among the teachers' understanding (in terms of cognitive, affective and behavioural aspects) in the construction of HOTS Mathematic items according to their teaching experience.

Table-1. Overall mean for teachers' understanding (based on cognitive of cognitive, affective and behavioral aspects) in constructing HOTS Mathematics items.

Experience in teaching Mathematics	Mean	N	Standard Deviation
Low	38.64	85	9.61
Average	51.99	101	6.51
High	53.46	68	5.72
Total	47.91	254	9.99

Table-2. Results of One-way ANOVA test on teachers' understanding (in terms of cognitive, affective and behavioral aspects) in constructing HOTS Mathematics items.

Group	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	11084.78	2	5542.39	98.13	.000
Within Groups	14176.47	251	56.48		
Total	25261.26	253			

Note: *. Level of significance is at < 0.05.

The results of mean in Table 1 and the One-way ANOVA tests in Table 2 show that there is a significant difference in the overall mean of teacher understanding (cognitive, affective and behavioral aspects) in constructing HOTS Mathematics items based on their Mathematics teaching experience ($F = 98.13$, $df = 2$, $p = .000$).

Table-3. Tukey HSD test on teachers' understanding (in terms of cognitive, affective and behavioural aspects) in constructing HOTS Mathematic items.

Experience	Teaching experience	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low	Average	-13.36*	1.11	.000	-15.96	-10.74
	High	-14.82*	1.22	.000	-17.7	-11.93
Average	Low	13.35*	1.11	.000	10.75	15.96
	High	-1.47	1.79	.429	-4.25	1.31
High	Low	14.82*	1.22	.000	11.93	17.7
	Average	1.47	1.19	.429	-1.31	4.24

Note: *. Level of significance is at < 0.05.

Subsequently, the Tukey HSD Test was conducted and the results are described in Table 3. The Tukey HSD findings show that low experience teachers scored lower than average-experienced teachers (Mean difference = -13.36, $p = .000$) and the difference was significant. Low experience teachers also scored lower than high experience teachers (Mean difference = -14.82, $p = .000$) and the difference is significant. The mean difference between the high experience teachers and the average experience teachers is not significant (Mean difference = 1.47, $p = .429$).

The results of the One-way ANOVA clearly show that there is a significant difference in the overall mean of teachers' understanding (cognitive, affective and behavioral aspects) in constructing Mathematical items based on their Mathematics teaching experience. Subsequent Tukey HSD test findings indicate that low experience teachers have significantly lower mean score compared with average and high experience teachers. However, Tukey HSD test results show that there is no significant difference between high experience teachers and average experience teachers. As such, these results failed to accept H_0 . These findings support findings by Ismawati (2017) who described that learning behaviour is actually a continuation of cognitive learning (understanding something) and affective learning (behavioral tendency). As such, high and average experienced teachers had significantly better scores in constructing HOTS Mathematics items compared to their counterparts with low experience in teaching. This finding is also parallel to the findings by Podolsky et al. (2019).

Ho 2. There was no significant difference among Tamil Primary School teachers' understanding in terms of cognitive aspect in the construction of HOTS Mathematics items according to their teaching experience.

Table-4. Mean for teachers' understanding in term of cognitive aspect in constructing HOTS Mathematics items.

Experience in teaching Mathematics	Mean	N	Standard Deviation
Low	12.31	85	3.72
Average	20.51	101	4.76
High	20.84	68	2.73
Total	17.85	254	5.57

Table-5. Results of the One-way ANOVA test on teachers' understanding in term of cognitive aspect in constructing HOTS Mathematics items.

	Sum of Squares	df	Min Square	F	Sig.
Between groups	3920.87	2	1960.43	125.06	.000
Within groups	3934.62	251	15.68		
Total	7855.5	253			

Note: *. Level of significance is at < 0.05 .

The results of mean in Table 4 and the One-way ANOVA test in Table 5 explain that there is a significant difference in the mean score of teachers' understanding in term of cognitive aspect in constructing HOTS Mathematics items based on their Mathematics teaching experience ($F = 125.06$, $df = 2$, $p = .000$).

Table-6. Tukey HSD test on teachers' understanding (in terms of cognitive aspect) in constructing HOTS Mathematic items.

Experience	Teaching experience in Mathematics	Mean Difference e (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low	Average	-8.19	.58	.000	-9.56	-6.81
	High	-8.52	.64	.000	-10.03	-7.00
Average	Low	8.19	.58	.000	6.81	9.56
	High	-.33	.62	.854	-1.79	1.13
High	Low	8.52	.64	.000	7.00	10.03
	Average	.33	.62	.854	-1.13	1.79

Note: * Level of significance is at < 0.05 .

The Tukey HSD test results show that low-experienced teachers had lower mean score than the average experienced teachers (Mean difference = -8.19 , $p = .000$), and the difference is significant. Subsequently, teachers with low experience also scored lower mean score than those teachers with high experience in teaching Mathematics (Mean difference = -8.52 , $p = .000$) and the difference is significant. The findings also indicate that high experienced teachers also scored higher mean than moderate experienced teachers (Mean difference = 8.19 , $p = .000$) but the difference was not significant.

The results of One-way ANOVA show that there is significant difference in teachers' understanding in term of cognitive aspects in the construction of Mathematical items based on their Mathematics teaching experience. Subsequently findings from Tukey HSD test indicate that low experienced teachers have significantly lower mean scores than the average experienced teachers and the high experienced teachers. As such, these results reject Ho 2. These findings support that low experienced teachers find it more difficult to construct HOTS items and that teachers with less experience in teaching need more guidance and training in constructing HOTS items.

Ho 3. There was no significant difference among teachers' understanding in terms of affective aspect in the construction of HOTS Mathematics items according to their teaching experience.

Table-7. Mean for teachers' understanding in term of affective aspect in constructing HOTS Mathematics items.

Experience in teaching Mathematics	Mean	N	Standard Deviation
Low	16.21	85	4.61
Average	19.47	101	2.71
High	20.12	68	2.93
Total	18.55	254	3.88

Table-8. Results of the One-way ANOVA test on teachers' understanding in term of affective aspect in constructing HOTS Mathematics items.

Group	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	716.45	2	358.23	29.00	.000
Within Groups	3100.37	251	12.35		
Total	3816.83	253			

Note: * Level of significance is at < 0.05.

The results of mean in Table 7 and the one-way ANOVA tests in Table 8 show that there is a significant difference on teachers' understanding in term of affective aspect in constructing HOTS Mathematics items based on their Mathematics teaching experience ($F = 29$, $df = 2$, $p = .000$).

Table-9. Tukey HSD test on teachers' understanding (in terms of affective aspect) in constructing HOTS Mathematics items.

Experience in in teaching Mathematics		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low	Average	-3.25	.52	.000	-4.47	-2.03
	High	-3.91	.57	.000	-5.25	-2.55
Average	Low	3.25	.52	.000	2.03	4.47
	High	-.65	.55	.464	-2.95	.64
High	Low	3.91	.57	.000	2.56	5.25
	Average	.65	.55	.464	-65	1.95

Note: * Level of significance is at < 0.05.

Subsequently the Tukey HSD Test was conducted and the results are described in Table 9. Tukey HSD findings indicate that low experienced teachers have significantly lower mean score compared with teachers with average experience (Mean difference = .25, $p = .000$) and Low experienced teachers also scored significantly lower mean than teachers with high experience (Mean difference = -3.91, $p = .000$). Teachers with high experience scored higher mean than teachers with average experience but the difference is not significant.

The results of the one-way ANOVA clearly show that there is a significant difference in the mean of teachers' understanding in term of affective aspects in the construction of Mathematics items based on their experience in teaching Mathematics. Results from Tukey HSD test also indicate that low experienced teachers have significantly lower mean score than the teachers with high experience and average experience. These findings reject H_0 3. These results supports findings by Remillard and Bryans (2004), Schoenfeld (2008), Rivera and Becker (2008) which indicate teachers' knowledge, teachers' attitudes and beliefs influence their instructions in the classroom and the way in which they construct HOTS Mathematics items. Current study revealed that teachers with less experience had poorer understanding in term of affective aspects in the construction of HOTS Mathematics items compared with teachers with high experience and average experience in teaching Mathematics.

Ho 4. There was no significant difference among Tamil Primary School teachers' understanding in terms of behavioral aspect in the construction of HOTS Mathematics items according to their teaching experience.

Table-10. Mean for teachers' understanding in term of behavioural aspect in constructing HOTS Mathematics items.

Experience in teaching Mathematics	Mean	N	Standard Deviation
Low	10.51	85	2.94
Average	12.17	101	1.48
High	12.38	68	1.44
Total	11.67	254	2.23

Note: * Level of significance is at < 0.05.

Teachers with high experience in teaching Mathematics scored the highest mean (Mean = 12.38, SD= 1.44) for understanding in term of behavioral aspect in constructing HOTS Mathematics items, followed by teachers with average experience (Mean= 12.17, SD= 1.48).and the lowest are teachers with low experience (Mean=10.51, SD=2.94).

Table-11. Results of the One-way ANOVA test on teachers' understanding in term of behavioral aspect in constructing HOTS Mathematics items.

Group	Sum of Squares	df	Min Square	F	Sig.
Between Groups	260.48	2	130.23	23.53	.000
Within Groups	1389.01	251	5.53		
Total	1649.48	253			

Note: * Level of significance is at < 0.05.

The results of mean in Table 10 and the one-way ANOVA tests in Table 11 reveal that there is a significant difference in teacher comprehension in term of behavioral aspect in the construction of HOTS Mathematics items based on their Mathematics teaching experience ($F = 23.53$, $df = 2$, $p = .000$).

Table-12. Tukey HSD test on teachers' understanding (in terms of behavioural aspect) in constructing HOTS Mathematic items.

Experience in teaching Mathematics I	Experience in teaching Mathematics J	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low	Average	-1.91	.35	.000	-2.73	-1.09
	High	-2.39	.38	.000	-3.29	-1.49
Average	Low	1.91	.35	.000	1.09	2.73
	High	-.48	.37	.396	-1.35	-.38
High	Low	2.39	.38	.000	1.49	3.29
	Average	.48	.37	.396	-.39	1.35

Note: * Level of significance is at < 0.05.

Subsequently the Tukey HSD test was conducted and its findings are described in Table 12. The Tukey HSD findings show that low experienced teachers had lower mean score compared with average experienced teachers (Mean difference = -1.91, $p = .000$) and the difference is significant. Low experienced teachers also scored lower mean score than teachers with high experience in teaching (Mean difference = -2.39, $p = .000$). Teachers with high experience in teaching had higher mean score than teachers with average experience in teaching but the difference is not significant (Mean Difference = .48, $p = .396$). As stressed by Gareis and Grant (2015) teachers' pedagogy can enhance students' learning outcomes. Only teachers with thorough understanding of constructing the HOTS items will be able to engage students actively in responding to HOTS items. Wolff et al. (2015) also highlighted that less experienced teachers often practice strict classroom rules and procedures. Hence, students getting feared and the capacity of thinking level gets lower due to uncomfortableness. On the other hand, experienced teachers always give priority to student thinking, student behaviour and students' focus on learning as such, they are able to facilitate students effectively in answering HOTS items in Mathematics.

5. DISCUSSION

The purpose of this research is to explore primary school teachers' understanding towards constructing HOTS mathematics items. The findings shows that, high experience teachers have high level of understanding in terms of cognitive, affective and behavioural aspects in constructing HOTS mathematics items compared with average experienced teachers and low experienced teachers. This finding is also consistent with [Unal and Unal \(2019\)](#) which identifies teachers' beliefs and practices in assessment. Teachers playing important role in constructing HOTS items to create a high level assessment. Experienced teachers support students learning as well as to deliver better teaching. Highly experienced teachers have a higher level of understanding in each activity of the teaching and learning process, and in assessment when constructing HOTS mathematics items compared with low experience teachers. According to [Boyd \(2008\)](#) findings shows that most of the teachers' understanding towards developing HOTS items at the LOTS. This shows that the mathematics teachers must be always aware towards understanding in terms of cognitive, affective and behavioral aspects in their teaching and learning process.

6. CONCLUSION

In conclusion, the findings of this study indicate that teachers with high and average experience in teaching Mathematics had significantly better understanding (in terms of cognitive, affective and behavioral aspects) in constructing HOTS mathematics items compared with teachers who have low experience. Similarly, teachers with high and average experience in teaching mathematics had significantly better understanding in terms of cognitive aspects in constructing HOTS mathematics items compared with teachers with low experience. Teachers with high and average experience also had significantly better understanding in terms of affective aspect in constructing HOTS mathematics items compared with teachers with low experience in teaching mathematics. Lastly, teachers with high and average experience also showed significantly better understanding in terms of behavioral aspect in constructing HOTS mathematic items compared with teachers with low experience. As such, it can be concluded that teachers' teaching experience in mathematics has a significant impact on their understanding (in terms of cognitive, affective and behavioural aspects) in constructing HOTS mathematics items.

This study has important theoretical, pedagogical and practical implications. In term of theoretical implications it supports the revised version of Bloom's taxonomy by [Anderson and Krathwohl \(2001\)](#) which clearly indicates that HOTS items are more difficult to construct compared to LOTS items. As such, the findings too indicate that teachers with less experience find it difficult to construct HOTS Mathematics items. According to the analysis, HOTS items constructed by the mathematics teachers show that teachers are facing difficulties in constructing HOTS mathematics items.. On the other hand, teachers with high experience and average experience were able to construct HOTS item significantly better than teachers with low experience in teaching.

In term of pedagogical implications, the findings of this study clearly indicate that the teachers with high experience and average experience had better knowledge in constructing HOTS Mathematics items than the teachers with low experience. As such these findings suggest that senior teachers should conduct more workshops and training for teachers with less experience to share their experiences and skills. In term of practical implications the findings reveal that more courses are needed to train Mathematics teachers in order to enhance their understanding on HOTS items. In addition, the courses should also emphasize on the practical aspects especially on how to construct HOTS items.

This study has some limitations. Firstly, the researchers only employed quantitative data in the analysis. As such, it is hoped that future research will triangulate quantitative and qualitative data which will give deeper insight to the study. Secondly, the samples were only Mathematics teachers from Tamil schools in three states. It is hoped that future researchers will use a larger sample including teachers from all types of primary schools in Malaysia so that the findings can be generalized to all Mathematics teachers in primary schools in Malaysia.

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