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Year Five Pupils' Perception Towards Higher Order Thinking Skills in Learning Mathematics

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Abstract

Higher-order thinking skills (HOTS) are the cognitive skills that mathematics should apply to fulfil current needs. Unfortunately, Mathematics achievement in Trends in International Mathematics and Science Study (TIMSS) has shown that the thinking ability of Malaysian pupils still needs improvement. Identifying pupils' perceptions of implementing HOTS in mathematics is essential. Thus, this study was conducted to determine Year Five pupils' perception towards implementing HOTS in terms of attitude, readiness and belief in Mathematics learning, as well as the differences in these three aspects based on gender. The survey study involved 142 Year Five pupils at a Sekolah Jenis Kebangsaan Cina (SJKC) in Johor Bahru district. The instrument used in this study is a questionnaire. The data was analysed using Statistical Package for Social Sciences (SPSS) software version 27. The descriptive statistical analysis results found that pupils' perception towards HOTS in Mathematics in terms of Attitude and readiness are moderate. At the same time, pupils' perception towards HOTS in mathematics in terms of belief is high. The Mann-Whitney U test results found a significant difference in pupils' attitudes towards HOTS in Mathematics based on gender. However, this study showed no significant difference in student's readiness and belief towards HOTS in Mathematics based on gender. This study brings implications for educators in schools to realise the importance of modifying HOTS teaching practices by considering pupils' perceptions.

Keywords: higher order thinking skills, perception, attitudes, readiness, belief, mathematics

1. Introduction

Thinking skills are one of the six student aspirations outlined in Malaysia's Education Blueprint 2013-2025. The Malaysian Ministry of Education's (MOE) effort to launch this blueprint focusing on higher-order thinking skills (HOTS) is crucial to meet current needs. This is due to the importance of HOTS elements in today's market for innovation and development, especially in Science, Technology, Engineering and Mathematics (STEM) (Mitani, 2021). The increase in HOTS content from year to year demonstrates that the Malaysian government prioritises the implementation of HOTS in the education system. Statistics have shown that the percentage of HOTS questions in the Primary School Achievement Test (UPSR) and the Malaysia Certificate of Education (SPM) has increased from 10% in 2013 to 40% and 50%, respectively, in 2016 (Hassan et al., 2020).

In 21st-century education, the effective teaching of HOTS has received a positive response in Trends in International Mathematics and Science Study (TIMSS) (Tajudin & Chinnappan, 2017). Thus, the implementation of HOTS in Mathematics should be prioritised to improve Malaysia's Mathematics performance at the international level. This is important as Malaysia's Mathematics achievement in TIMSS is deteriorating, with the average score dropping from 465 in 2015 to 461 in 2019 (KPM, 2020). This scenario can be related to the declining HOTS in Mathematics among Malaysian pupils (Soh et al., 2019). This indicates that the thinking ability of Malaysian pupils still needs improvement.

The successful implementation of HOTS should always consider pupils' knowledge and understanding of the concept. Previous studies have found that most pupils believe HOTS elements in Mathematics are always tricky and at the top three levels of Bloom's Taxonomy (Alhassora et al., 2017; Tanujaya & Mumu, 2020). Despite previous studies that have proved that there is a misconception relating to pupils' understanding of HOTS in Mathematics, there still needs to be more research on pupils' perceptions towards HOTS in mathematics.

Pupils who have misconceptions about HOTS will possess a negative attitude towards them. Previous studies have revealed that such pupils always need to be more confident in their abilities to solve mathematical problems related to HOTS (Alhassora et al., 2017). This Attitude may be associated with a need for more confidence in answering HOTS questions, especially in making inferences and predictions in Mathematics (Raflee & Halim, 2021).

Furthermore, pupils' readiness is one of the factors determining the effectiveness of implementing HOTS in Mathematics. According to a study by Kusaeri et al. (2019), 56.1% of pupils needed more preparation to sit for Mathematics tests containing HOTS elements. This finding is supported by Ibrahim et al. (2020), who discovered that pupils will feel uncomfortable encountering HOTS questions on the topic of measurement and geometry for the first time, particularly rural pupils. Rajoo (2018) also stated that routine mathematical problem-solving makes many pupils more at ease.

Through the findings of previous studies, the study conducted by Alhassora et al. (2017) only looked at the teachers' perspectives on pupils' attitudes towards HOTS. This has resulted in a research gap because teachers' views do not necessarily reflect the pupils' genuine attitudes.

Besides, although the study of Raflee and Halim (2021) was conducted on pupils, it was only action research involving a small number of respondents, where the findings could not provide any statistical data to explain further to what extent pupils' attitudes towards implementing HOTS. In addition, Kusaeri et al. (2019) only studied Indonesian secondary pupils' readiness towards HOTS in Mathematics. The findings of this study did not involve primary pupils, and they also did not describe the state of pupils' readiness in our country.

According to Russo and Minas (2020), male pupils have a positive attitude toward solving challenging HOTS questions in Mathematics, whereas female pupils are ambivalent. This finding contrasts with the study of Subeli and Rosli (2021), who found that female pupils have a more positive attitude towards implementing HOTS in Mathematics than male pupils. As a result, the findings of these two studies proved a significant difference in the mean score of attitudes towards Mathematics based on gender (Deringöl, 2018). However, some previous studies have shown no significant difference in Attitude between male and female pupils regarding interest and confidence towards Mathematics (Ghasemi & Burley, 2019; Thapa & Paudel, 2020).

Research on past studies has revealed the gap related to the studied context. This is because the scope of previous studies only looked at pupils' attitudes and beliefs towards Mathematics instead of their readiness (Deringöl, 2018; Ghasemi & Burley, 2019; Thapa & Paudel, 2020). Furthermore, those previous studies also lacked focus on HOTS elements in mathematics. Given the occurrence of research gaps and differences in the results obtained, a more comprehensive survey based on gender factors of pupils' attitudes, readiness and beliefs is required.

In general, this study aims to determine Year Five pupils' perception towards HOTS in terms of their attitudes, readiness, and belief in mathematics learning, as well as the differences in these three aspects based on gender. The two research questions formed are:

1. What is Year Five pupils' perception of towards HOTS in terms of their attitude, readiness and belief in Mathematics learning?

2. To what extent is there a gender difference in Year Five pupils' attitudes, readiness, and beliefs towards HOTS in mathematics?

2. Method

This study is designed as a quantitative survey study. The rationale for selecting this research design is that the survey allows information about opinions, behaviours, attitudes, and views to be collected from a group of specific persons (Farmer & Farmer, 2020). Besides, the quantitative survey approach saves time and energy (Ruel, 2019), allowing the researchers to devote adequate time to planning and carrying out the study, analysing and analyzing data, and drawing conclusions.

2.1 Population and Sampling

This study was carried out at a Sekolah Jenis Kebangsaan Cina (SJKC) in Johor Bahru district. The population consisted of 317 Year Five pupils at the selected school. The sample size was determined using G*Power version 3.1.9.7. because it covers various statistical tests to calculate sample size precisely (Faul et al., 2007; Kang, 2021). Based on the significant level, $\alpha = 0.05$, a power of 0.80 and an effect size of 0.50 (Cohen, 1988; Cohen, 1992), a minimum of 128 samples are required in this study. However, the questionnaire was distributed to 150 respondents, exceeding the sample size needed to ensure a sufficient number of respondents in case of data loss.

A stratified random sampling technique was used to select the sample in this study. The rationale for choosing this sampling technique is that the characteristics of the population are known, so it can be stratified before selecting a sample (Fowler, 2009). This sampling technique is used based on class (Year 5A to Year 5I) and gender, as the pupils in the school are placed according to their academic achievement. This allows the researcher to ensure that each category of academic achievement has an equal number.

2.2 Instrument

This study used a questionnaire as an instrument, adapted based on Model ABC developed by Ostrom (1969). According to Model ABC, all the items in the questionnaire focus on three constructs, namely affective (Attitude), behaviour (readiness) and cognitive (belief). The adaptation of the items in this instrument was based on previous research, specifically "Perceptions of How Teachers Perceive Their Teaching of Critical Thinking Skills and How Pupils Perceive Their Learning of Critical Thinking Skills" (Steffen, 2011) and "Motivation for Achievement and Attitudes toward Mathematics Instruction in a Required Calculus Course at the Norwegian University of Science and Technology" (Sundre et al., 2012).

The questionnaire was divided into four sections. Section A consists of information related to respondents' demographics, such as gender, race, school streams and mid-year Mathematics test scores. Section B consists of 13 questions that measure pupils' Attitudes towards HOTS in Mathematics, including two reverse-worded items. These items included enjoyment dimension (five items), motivation dimension (three items) and self-confidence dimension (five items). Section C consists of 11 items that measure pupils' readiness towards HOTS in Mathematics, while section D consists of 12 items that measure pupils' belief towards HOTS in Mathematics.

A 4-Point Likert Scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree) was used in Sections B, C and D. The use of 4-Point Likert Scale is to obtain more reliable results as pupils are more likely to choose the neutral point and avoid making their own decisions (Eweda, 2019). Table 1 shows the item distributions according to each construct.

Table 1. Item Distribution

Section	Construct	Items	Sources
B	Pupils' attitudes towards HOTS in mathematics		Sundre et al. (2012)
	▪ Enjoyment	B1, B3, B6*, B7, B12	
	▪ Motivation	B2, B4, B5	
	▪ Self-confidence	B8, B9*, B10, B11, B13	
C	Pupils' readiness towards HOTS in mathematics	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11	Steffen (2011) and Year 5 Mathematics Standard Curriculum and Assessment Document (KPM, 2019)
D	Pupils' belief towards HOTS in mathematics	D1, D2, D3, D4, D5*, D6, D7, D8, D9, D10, D11*	Sundre et al. (2012)

*Reverse-worded items

2.3 Validity and Reliability

In this study, the content validity was evaluated by three experts based on Lynn's (1986) recommendation. The three experts chosen are lecturers who have worked for over 15 years at the Institute of Teacher Education Campus Temenggong Ibrahim, Johor Bahru. After considering the experts' suggestions, some improvements have been made to the sentence structures so that the items are clear and suitable for the respondents' understanding.

Table 2. Cronbach's Alpha Values

Section / Construct	Number of Items	*Cronbach's Alpha*	Interpretation
Section B (Pupils' attitudes towards HOTS in mathematics)	13	0.85	Good
Section C (Pupils' readiness towards HOTS in mathematics)	11	0.85	Good
Section D (Pupils' belief towards HOTS in mathematics)	11	0.80	Good

As suggested by Browne (1995), a pilot test was conducted on 30 respondents. The results show that Cronbach's Alpha coefficient for each construct is in the range of 0.80 to 0.90, indicating that this instrument has a high level of reliability (Hair et al., 2016). Table 2 shows the coefficient of Cronbach's Alpha for each construct in the questionnaire.

2.4 Data Analysis

The data obtained from the questionnaire was analysed using the Statistical Package for Social Science (SPSS) version 27. Descriptive statistical analysis on frequency, percentage, mean, and standard deviation was used to answer the first research question. Mann-Whitney U test was used as an inferential statistical analysis to answer the second research question. This non-parametric test was chosen based on the justification that the assumption of normality failed to be met (Doogue, 2019; Usman, 2016).

3. Results

Using a stratified random sampling technique, 150 copies of the questionnaires were distributed to 150 Year Five pupils at the selected school. After data cleaning, this study involved 142 pupils, 71 male pupils and 71 female pupils.

3.1 Pupils' Level of Perception towards HOTs in term of Their Attitudes

The results of this study showed that pupils' attitudes towards HOTS in Mathematics are moderate (M = 2.51, SD = 0.59). It is found that all three dimensions under the construct of pupils' attitudes towards HOTS in Mathematics are moderate. The mean score for the enjoyment dimension is the highest (M = 2.70, SD = 0.68), followed by the motivation dimension (M = 2.55, SD = 0.72) and self-confidence dimension (M = 2.31, SD = 0.62). Table 3 shows the level of pupils' perception in terms of Attitude based on frequency, percentage, mean and standard deviation.

Table 3. Pupils' level of perception towards HOTS in term of their attitudes based on percentage, mean and standard deviation

No.	Item	Strongly Disagree, *f* (%)	Disagree, *f* (%)	Agree, *f* (%)	Strongly Agree, *f* (%)
B1	I enjoy learning HOTS in Mathematics.	5 (3.52)	43 (30.28)	70 (49.30)	24 (16.90)
B2	I get satisfaction in solving a mathematics HOTS problem.	10 (7.04)	31 (21.83)	60 (42.25)	41 (28.87)
B3	I like to solve HOTS problems in	24	48	48	22

	mathematics.	(16.90)	(33.80)	(33.80)	(15.50)
B4	I am willing to take more than the required amount of HOTS questions in mathematics.	19 (13.38)	56 (39.44)	51 (35.92)	16 (11.27)
B5	I prefer to do HOTS assignments in mathematics over other subjects.	31 (21.83)	62 (43.66)	29 (20.42)	20 (14.08)
B6	I find HOTS in mathematics boring.	48 (33.80)	62 (43.66)	23 (16.20)	9 (6.34)
B7	I feel happier in a mathematics class that uses the HOTS approach.	16 (11.27)	40 (28.17)	62 (43.66)	24 (16.90)
B8	I am able to solve HOTS problems in mathematics without much difficulty.	36 (25.35)	75 (52.82)	24 (16.90)	7 (4.93)
B9	I am nervous when it comes to HOTS in mathematics.	23 (16.20)	30 (21.13)	58 (40.85)	31 (21.83)
B10	I am confident that I am good at solving mathematics HOTS problems.	16 (11.27)	55 (38.73)	58 (40.85)	13 (9.15)
B11	I expect to do well in the mathematics HOTS lesson.	20 (14.08)	55 (38.73)	56 (39.44)	11 (7.75)
B12	I like to solve challenging HOTS problems in athematics.	16 (11.27)	58 (40.85)	49 (34.51)	19 (13.38)
B13	I am comfortable answering HOTS questions in a mathematics class.	29 (20.42)	55 (38.73)	42 (29.58)	16 (11.27)
Overall			**M = 2.51, SD = 0.59**		

Based on Table 3, item B6 has the lowest percentage of agreement. As it is a reverse-worded item, it has the highest agreement rate among the respondents. Statistics have shown that 110 (77.46%) respondents strongly disagreed and disagreed that HOTS in Mathematics is boring. Conversely, the majority of respondents agree that HOTS in Mathematics is interesting. According to the analysis of the findings, most items have less than 50% agreement: items B3, B4, B5, B8, B9, B11, B12 and B13. In this regard, item B8 records the least favourable results, with only 31 (21.83%) respondents agreeing and strongly agreeing with their ability to solve HOTS problems in Mathematics without much difficulty. This showed that pupils' self-confidence in their abilities has not reached an appropriate level. All three dimensions, which were at a moderate level, had contributed to the moderate level of pupils' Attitude towards HOTS in Mathematics.

3.2 Pupils' Level of Perception towards HOTS in term of Their Readiness

The results of this study showed that pupils' readiness towards HOTS in mathematics is moderate (M = 2.51, SD = 0.56). Table 5 shows the level of pupils' perception of HOTS in term of their readiness based on frequency, percentage, mean, and standard deviation.

Table 4. Level of pupils' perception in terms of readiness based on frequency, percentage, mean and standard deviation

No.	Item	Strongly Disagree, *f* (%)	Disagree, *f* (%)	Agree, *f* (%)	Strongly Agree, *f* (%)
C1	I can use problem-solving skills to find possible solutions.	7 (4.93)	33 (23.24)	74 (52.11)	28 (19.72)
C2	I can use critical thinking skills in different situations to accomplish a task.	14 (9.86)	49 (34.51)	62 (43.66)	17 (11.97)
C3	I can use analysing skills to understand complex mathematical reasoning.	18 (12.68)	52 (36.62)	56 (39.44)	16 (11.27)
C4	I can use decision-making skills to consider possible options.	10 (7.04)	52 (36.62)	58 (40.85)	22 (15.49)
C5	I can give justification based on decisions made.	10 (7.04)	32 (22.54)	77 (54.23)	23 (16.20)
C6	I can make predictions based on actual evidence.	12 (8.45)	44 (30.99)	65 (45.77)	21 (14.79)
C7	I can compare and contrast significant Mathematics patterns.	17 (11.97)	52 (36.62)	58 (40.85)	15 (10.56)
C8	I can solve complex routine Mathematics problems using various strategies.	24 (16.90)	61 (42.96)	39 (27.46)	18 (12.68)
C9	I can solve non-routine Mathematics problems creatively.	26 (18.31)	60 (42.25)	43 (30.28)	13 (9.15)
C10	I can become a mentor to peers practising HOTS in Mathematics.	44 (30.99)	57 (40.14)	34 (23.94)	7 (4.93)
C11	I can express my ideas when solving HOTS problems in Mathematics.	23 (16.20)	39 (27.46)	68 (47.89)	12 (8.45)
Overall			M = 2.51, SD = 0.56		

Based on Table 4, only two items, C1 and C5, reach a percentage of agreement of more than 70%. Item C1 has recorded the highest agreement rate, with 102 (71.83%) respondents agreeing and strongly agreeing with their ability to use problem-solving skills to find possible solutions. According to the findings analysis, only items C8, C9 and C10 are less than 50% of

agreement. In this regard, item C10 has the lowest percentage of agreement. The descriptive statistical analysis results revealed that 101 (71.13%) respondents strongly disagreed with categories regarding their ability to become mentors to their peers practising HOTS in mathematics. Some items have a very high percentage of agreement, while others have a meagre percentage of agreement, so this has led to a moderate level of pupils' readiness towards HOTS in mathematics.

Analysis of data and the reporting of the results of those analyses are fundamental aspects of the conduct of research. Accurate, unbiased, complete, and insightful reporting of the analytic treatment of data (be it quantitative or qualitative) must be a component of all research reports. Researchers in the field of psychology use numerous approaches to the analysis of data, and no one approach is uniformly preferred as long as the method is appropriate to the research questions being asked and the nature of the data collected. The methods used must support their analytic burdens, including robustness to violations of the assumptions that underlie them, and they must provide clear, unequivocal insights into the data.

3.3 Pupils' Level of Perception towards HOTS in terms of Their Belief

The results of this study showed that pupils' belief towards HOTS in Mathematics is high (M = 3.09, SD = 0.51). Table 5 shows the level of pupils' perception in terms of belief based on frequency, percentage, mean and standard deviation.

Table 5. Level of Pupils' Perception in terms of Belief Based on Frequency, Percentage, Mean and Standard Deviation

No.	Item	Strongly Disagree, *f* (%)	Disagree, *f* (%)	Agree, *f* (%)	Strongly Agree, *f* (%)
D1	HOTS in Mathematics is essential in everyday life.	10 (7.04)	18 (12.68)	68 (47.89)	46 (32.39)
D2	HOTS in Mathematics could help me in my school life.	5 (3.52)	11 (7.75)	69 (48.59)	57 (40.14)
D3	HOTS in Mathematics could help me in my future career life.	4 (2.82)	22 (15.49)	64 (45.07)	52 (36.62)
D4	HOTS in Mathematics would be very helpful in my future.	8 (5.63)	14 (9.86)	61 (42.96)	59 (41.55)
D5	HOTS in Mathematics is an unnecessary skill.	37 (26.06)	37 (26.06)	48 (33.80)	20 (14.08)
D6	Studying HOTS in Mathematics will help me solve problems in other areas.	11 (7.75)	33 (23.24)	63 (44.37)	35 (24.65)

D7	HOTS in Mathematics helps develop my mind.	11 (7.75)	23 (16.20)	62 (43.66)	46 (32.39)
D8	HOTS in Mathematics helps me to think.	7 (4.93)	21 (14.79)	69 (48.59)	45 (31.69)
D9	HOTS in mathematics can be applied in many ways.	5 (3.52)	13 (9.15)	77 (54.23)	47 (33.10)
D10	HOTS can develop my mathematical skills.	10 (7.04)	16 (11.27)	62 (43.66)	54 (38.03)
D11	Studying HOTS in Mathematics is useless.	85 (59.86)	37 (26.06)	14 (9.86)	6 (4.23)
Overall		**M = 3.09, SD = 0.51**			

Based on Table 5, item D2 has the highest percentage of agreement, with 126 (88.73%) respondents agreeing and strongly agreeing that HOTS in mathematics could help them in their school life. Statistics have shown that the majority of pupils place a high value on mastering HOTS in mathematics, which corresponds to the increase in the percentage of HOTS questions in national examinations in our country (Hassan et al., 2020). All the items have reached more than 50% of the agreement. In this regard, an item with the lowest percentage of agreement after recoding was item D5. Only 74 (52.12%) respondents agree that HOTS in mathematics is a necessary skill. Statistically, apart from items D5, D6, and D7, the other eight items have recorded more than 80% agreement. With such a high percentage of agreement, these eight items have contributed to a high level of pupils' belief in HOTS in mathematics.

3.4 Gender Differences in Pupils' Attitudes, Readiness and Belief towards HOTS in Learning Mathematics

Kolmogorov-Smirnov test was used to test the normality assumption, and the data was found to be not normally distributed. Hence, the Mann-Whitney U test was used to determine whether there are gender differences in pupils' attitudes, readiness and beliefs towards the implementation of HOTS in mathematics learning. According to Bonferroni Correction, the alpha value that should be used in this study is $\frac{.05}{3}$, which is 0.017, in order to reduce the increased risk of the error (Andrade, 2019). Three null hypotheses are formed as follows:

H_o2a: There is no significant difference in Year Five pupils' attitudes towards HOTS in learning mathematics based on gender.
H_o2b: There is no significant difference in Year Five pupils' readiness towards HOTS in learning mathematics based on gender.
H_o2c: There is no significant difference in Year Five pupils' belief towards HOTS in learning mathematics learning based on gender.

Table 6. Results of the Mann-Whitney U test

	Gender	N	Rank Mean	Sum of Rank	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)
Pupils' attitudes towards HOTS	Male	71	80.44	5711	1886	-2.592	.010
	Female	71	62.56	4442			
Pupils' readiness towards HOTS	Male	71	75.80	5382	2215	-1.249	.212
	Female	71	67.20	4771			
Pupils' belief towards HOTS	Male	71	75.25	5342.50	2254.50	-1.088	.277
	Female	71	67.75	4810.50			

Based on Table 6, it is found that the significant value, p, for the difference in pupils' attitude towards HOTS in Mathematics is 0.01 (<0.05), indicating that the null hypothesis (Ho2a) is successfully rejected. Thus, this study has found a significant difference in pupils' attitudes towards HOTS in mathematics based on gender (U = 1886.00, z = -2.59, p = 0.01) with a small effect size (r = 0.22). Based on the rank mean, male pupils (Mean rank= 80.44, n = 71) have a better attitude towards HOTS in mathematics than female pupils (Mean Rank = 62.56, n = 71). This has revealed that the male pupils in the study population have a more positive attitude towards implementing HOTS in mathematics. Furthermore, the significant value, p, for the difference in pupils' readiness and belief towards HOTS in mathematics are 0.21 and 0.28, respectively. Both values obtained are more than 0.017. Thus, null hypotheses, Ho2b and Ho2c, failed to be rejected. As a result, there is no significant difference in pupils' readiness towards HOTS in mathematics (U = 2215.00, z = -1.25, p = 0.21) and pupils' belief towards HOTS in mathematics (U = 2254.50, z = -1.09, p = 0.28) based on gender.

4. Discussion

This study determines the pupils' perception towards implementing HOTS in terms of attitude, readiness, and belief in mathematics learning, as well as the differences in these three aspects based on gender. The findings of this study have shown that pupils' attitudes toward mathematics are at a moderate level. This finding is consistent with the study of Ngah and Zakaria (2016), who found that pupils' attitudes towards HOTS in mathematics problem-solving are moderate. However, these findings differ from the study of Subeli and Rosli (2021), who reported that the level of pupils' Attitude towards HOTS in Mathematics is moderately high. The slight difference in pupils' attitudes can be attributed to the difference in the mean score interpretation used. If this study used a similar mean score interpretation as the study of Subeli and Rosli (2021), the results would likely be the same. Considering previous studies have only revealed positive attitudes (Ozdemir, 2022; Rosaini et al., 2019; Russo & Minas, 2020) or negative attitudes (Abdullah et al., 2019; Alhassora et al., 2017; Asrafil et al., 2020) towards HOTS in Mathematics learning, the findings of this study have contributed to the literature by providing data on attitude levels statistically.

Moreover, the findings of this study have shown that the level of pupils' readiness towards

HOTS in Mathematics is moderate. This means that the mastery of HOTS in Mathematics is moderate. The finding is consistent with the study of Shukla and Dungsungnoen (2016), which also found that the overall level of readiness among university pupils in Thailand towards HOTS in Mathematics was moderate. However, when examined in more detail according to the type of HOTS measured, the mean score for decision-making skills was low, with a score of 1.76 (Shukla & Dungsungnoen, 2016). This finding contradicts the results of this study, which found that this skill recorded 56.34% agreement, which is considered moderate. It is difficult to explain such a situation, but it may be related to the emphasis of Mathematics teachers on specific mathematical skills in the study country. This statement is supported by the study of Abdullah and Rahman (2020) on 2583 Form Four pupils in Kuala Lumpur, which found that the mean score of the five dimensions under the decision-making skill was moderate. Thus, the findings of Abdullah and Rahman (2020) were consistent with the findings of this study. Despite that, this study contradicts the study of Subeli and Rosli (2021), which reported that the level of readiness of pupils towards HOTS in Mathematics was moderately high. The inconsistency of the findings may be due to the difference in the readiness measures. This is because the study of Subeli and Rosli (2021) defined readiness as enjoyment. In contrast, readiness in this study refers to the mastery of HOTS that corresponds to the ABC Model used. Specifically, since the readiness for HOTS measured based on the Mathematics Standard Curriculum and Assessment Document is more characteristic of the Malaysian education context, this study has added value to the literature that enables other researchers to further their research in our country's context.

In contrast to Attitude and readiness, this study found that pupils' belief towards HOTS in Mathematics is high. This means that respondents in this study have a favourable view of the usefulness of HOTS in Mathematics from various perspectives. This finding is qualitatively supported by previous studies that indicated that most pupils hold positive views that HOTS in Mathematics help people think and enable them to relate a particular skill to daily life (Warner & Kaur, 2017). However, one unexpected finding is that almost half of the respondents agreed that HOTS is an unnecessary skill. This finding contradicts other items that received high agreement regarding the importance of HOTS, whether in daily life, school life, career or other fields. This is a limitation of the study since there is no qualitative data to delve into the findings obtained. Studies on literature review have found that HOTS in Mathematics is indeed valid, but there needs to be more studies on the usefulness of HOTS in Mathematics from pupils' perspective (Anggraini et al., 2019; Sachdeva & Eggen, 2021). Therefore, the findings of this study provide statistical data on the level of pupils' belief towards HOTS in Mathematics to validate the qualitative findings of previous studies.

It is known that pupils' attitudes, readiness, and beliefs are essential elements that need to be identified. In this case, a moderate level of attitude can still be categorised as suitable and sufficient, and it can be improved to a higher level through efforts (Adharini & Herman, 2019). This can be proven through the study of Rosaini et al. (2019), which stated that pupils' attitudes could be changed when exposed to appropriate stimuli. Thus, Mathematics teachers should alter their teaching strategies accordingly. Cooperative learning can be implemented to increase pupils' self-confidence in mathematics classrooms (Khun-Inkeeree et al., 2017).

Furthermore, a moderate level of readiness towards HOTS in Mathematics can be explained as not all pupils have the opportunity to receive HOTS-based Mathematics education adequately (Mitani, 2021). Thus, problem-based learning techniques can allow pupils to explore, investigate and solve problems, thereby developing critical thinking skills (Firdaus et al., 2015). As the pupils' belief towards HOTS in Mathematics is high, Mathematics teachers should maintain their positive views by constantly relating HOTS contents to real-life situations.

From the aspect of gender, this study found a significant difference in pupils' attitudes towards HOTS in Mathematics based on gender. The finding is consistent with previous studies (Demirel et al., 2015; Subeli & Rosli, 2021). The consistency of the findings reflects the fact that gender influences student's attitudes towards the implementation of HOTS in mathematics learning. This finding has confirmed the issue of "gender stereotypes" that is often raised in Mathematics Education (Makarova et al., 2019; Sekhar & Parameswari, 2019) and also support several previous studies which proved that male pupils have a more positive attitude when facing challenging mathematical problems (Demirel et al., 2015; Deringöl, 2018; Russo & Minas, 2020). Obviously, the inferential analysis conducted in this study is essential to narrow the gap between previous studies that only reported descriptive findings (Russo & Minas, 2020). In addition, these findings have raised awareness among mathematics teachers about designing various activities suitable for female pupils to cultivate a positive attitude towards HOTS in mathematics. This is crucial in narrowing the gap in attitudes between genders in Mathematics, thus ensuring a smooth implementation of Mathematics teaching and learning.

Furthermore, this study found that there is no significant difference in pupils' readiness towards HOTS in Mathematics based on gender, which is in line with several previous studies (Daher et al., 2017; Demirel et al., 2015; Riadi et al., 2019; Subeli & Rosli, 2021; Yavuz et al., 2017). This means gender does not affect pupils' attitudes towards implementing HOTS in Mathematics. However, some differences have still been identified. Most of the previous studies only focused on one skill, such as reflective thinking skills (Demirel et al., 2015), creativity in Mathematics (Daher et al., 2017), and problem-solving skills (Yavuz et al., 2017). Therefore, this study has added value to the literature as pupils' readiness towards HOTS in Mathematics was examined comprehensively.

In addition, this study also found that there is no significant difference in pupils' belief towards HOTS in Mathematics based on gender. This finding revealed that pupils' views on HOTS in Mathematics learning are not influenced by gender. The result of this study is consistent with the study of Ghasemi and Burley (2019), which proved that there is no significant difference between male and female pupils in terms of the usefulness of HOTS in Mathematics. The consistency of these findings showed that male and female pupils hold the same perspective on the value, importance and usefulness of HOTS in Mathematics. Since Ghasemi and Burley's (2019) study was conducted on high school pupils, the findings of this study, which focused on primary school pupils, have contributed somewhat to the literature.

As a suggestion for further research, the scope of the study can be expanded by involving

several schools that cover various streams, such as Sekolah Kebangsaan (SK) and Sekolah Jenis Kebangsaan Tamil. A larger sample size not only increases the reliability of the study, but the findings can also represent the study's population more accurately. Additionally, considering that this quantitative study has limitations in providing reasons and causality, it is recommended to conduct further research using a mixed-method approach to obtain information on pupils' attitudes, readiness and belief towards HOTS in Mathematics. This is because qualitative data can provide more detailed explanations of quantitative findings, strengthening the research findings.

5. Conclusion

Despite the emphasis on HOTS since the launch of Malaysia Education Blueprint in 2011, much work still needs to be done to improve pupils' mastery of HOTS in Mathematics. Limited studies examine pupils' perceptions of HOTS in mathematics, particularly in terms of readiness and belief, compared to attitudes. Therefore, guided by the ABC Model, all three components related to perception, namely Attitude (affective), readiness (behaviour) and belief (cognitive), can be comprehensively examined. This study has statistically contributed to the literature on pupils' attitudes, readiness, and belief towards HOTS in mathematics. Gender is also a factor that needs to be considered to narrow the gap in attitudes between male and female pupils to ensure the effectiveness of teaching and learning in Mathematics. In essence, the findings of this study have implications for the teaching practices among Mathematics teachers. Mathematics teachers can raise awareness of the importance of using various strategies, methods and techniques to meet pupils' differences. This is crucial to improve pupils' attitudes, readiness and belief towards HOTS in Mathematics. Moreover, the findings of this study also enable the Ministry of Education to design various courses to enhance Mathematics teachers' knowledge and skills in implementing HOTS appropriately. Lastly, the findings of this study also guide other researchers interested in conducting further studies on pupils' perceptions towards HOTS in Mathematics to improve the quality of education in our country.

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