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The Development and Effectiveness of the HOTS Mathematical Problem-Solving Framework with the Bar Model Strategy on Student Achievement

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Abstract: - This study aims to develop and assess the effectiveness of the HOTS Mathematical Problem Solving Framework (HMPSF) with the Bar Model Strategy on the achievement of Year Five Students. This study is a design and development study involving three phases. The first phase is a needs analysis study administered to 65 National School Mathematics teachers and 102 Year 5 students. The second phase is the design and development phase using the Fuzzy Delphi method involving 15 experts in Mathematics Education. Phase three is the implementation and testing phase of HMPSF with the Bar Model Strategy. In this phase, the study was conducted through a quasi-experimental design of a non-equivalent group of pre-post analysis involving 63 Year Five students from two schools in Kinta Utara district, Perak, Malaysia. The sampling process is done randomly. Data were analyzed through ANOVA and MANOVA. The needs analysis conducted show that 92.2% of teachers and 98.04% of students stated that there is a need to develop the HMPSF. Fuzzy Delphi analysis showed that the three main conditions were met (i) Threshold value, $D \leq 0.2$, (ii) Percentage of expert agreements,> 75% and (iii) α-cut value (Fuzzy score), ≥ 0.5. This finding shows that the HMPSF with the Bar Model Strategy has been successfully developed through the agreement of 15 experts. The findings in phase three indicate that there is a significant difference in the mean of the post-group test for student achievement. The findings of the Multivariate Pillai's Trace test also show that there is a significant effect between the pre and post-test. In conclusion, the HMPSF with the Bar Model Strategy developed is proven can enhance student achievement. Conclusively, the HMPSF with the Bar Model Strategy is suitable as a main guide for teachers and students in strengthening problem-solving skills in the field of Numbers and Mathematical Operations.

Keywords:

I. INTRODUCTION

The concept of higher-order thinking skills (HOTS) has been the emphasis through the transformation of the curriculum implemented in the Malaysian Education Development Plan (PPPM) 2013-2025. It aims to increase the creativity and ability of students to solve problems to meet the challenges of the 21st century in order for Malaysia to compete internationally [1]. Through PPPM, the number of problem-solving questions in the form of HOTS, especially in Mathematics, will increase yearly in public examinations in Malaysia [2]. In addition, the performance of our country's education at the international level will also be assessed by the extent to which our students are able to solve problems in the form of HOTS in international assessments such as TIMSS and PISA. Based on PPPM, our country's target in TIMSS and PISA is to be in the top third group within the next 15 years [2].

A. Problem Statement

The increase in the number of HOTS problem-solving questions, as high up to 80% in public examinations in Malaysia by 2016 as contained in the MEB [2] is seen as a surprise to students and could not be very well handled [3]. The results of the Elementary School Achievement Test (UPSR) 2016 which is a public examination in Malaysia for Year 6 students showed that the student's performance significantly declined compared to the previous years. The National Average Grade points that showed a significant decrease in the 2016 UPSR Examination occurred due to the existence of HOTS problem-solving questions where that challenge the candidate's level of thinking [3]. Meanwhile, the UPSR results in 2018 and 2019 showed that the largest percentage of students' marks for the subject of Mathematics was in grade D, which only reached the minimum level with 29.8% in 2018 and 30.23% in 2019 [4], [5]. Moreover, the student's poor performance in solving mathematical problems was also proven in international assessments, especially TIMSS and PISA. For Mathematics subjects, the performance of our students in TIMSS which started in 2007, and PISA which started in 2009, did not reach the target and were below the international average achievement [6]–[8]. This caused our country to be in the bottom third group until the latest round.

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The study shows that the HOTS problem-solving questions that prevailed in it are the main cause of this problem [6], [9]. Malaysian students are still having difficulties solving problem-solving questions, especially the HOTS level Mathematics [10]. Mathematical facts, knowledge and skills were unable to be applied when solving mathematical problems, especially when involving HOTS elements [9], [11]. Students were also not used to solving problem-solving questions in Mathematics involving HOTS elements [12].

This problem exists because the pupils cannot comprehend the problems posed in the problem-solving questions, students are unable to understand the concept, accompanied by a lack of basic mathematical facts and various other related problems [6]. If this situation is allowed to continue, it is feared that the most worrying problem will arise in learning Mathematics, that students will not be interested in solving Mathematics problem-solving questions [13].

The inability of students to answer HOTS Mathematics problem-solving questions is a serious matter and needs to be given extra observation. This is because students who constantly face this cycle of failure, not only will affect their motivation, but also their attitude and self-confidence [14]. Simultaneously, it will also affect the educational performance of our country globally. Therefore, we need to identify an appropriate strategy or method to help students understand and be able to solve problem-solving questions involving HOTS in Mathematics better [3]. In this matter, teachers have to play a very important role. Teachers who have a good HOTS strategy will produce students who are HOTS literate [15].

Studies that have been carried out by [9], [16], [17] as well as [18], found that the Bar Model strategy is an effective method that can help enhance pupils' performance in solving mathematical problems with HOTS elements. The Bar Model Strategy is one of the best methods for solving mathematical problems in Singapore [19]. Singapore always reaches the top in TIMSS and PISA on every round to date. However, not many studies have been carried out until now to develop a framework that teachers can use as guidance to apply the Bar Model strategy effectively in their teaching and learning (TnL) sessions. This gap provides a reasonable justification to researchers in the need to develop the HOTS Mathematical Problem-Solving Framework (HMPSF**)** with the Bar Model Strategy. This framework that was developed will be able to provide the best reference to teachers in their efforts to guide their students to solve problem-solving questions involving HOTS elements in Mathematics well through the Bar Model strategy.

B. Research Objective and Research Questions

The objective of the research are (i) to identify the need to develop a HOTS Mathematics problem-solving framework; (ii) to develop a framework for solving-problems in HOTS Mathematics with the Bar Model strategy based on the agreement of experts and (iii) to test the effect of using the HMPSF framework with the Bar Model Strategy on the achievement of Year Five students on Number and Mathematical Operations HOTS problem-solving, compared to conventional methods. The research questions that need to be answered are (i) What is the need to develop a problem-solving framework for HOTS Mathematics?, (ii) Does the developed HMPSF framework with the Bar Model Strategy attain the expert agreement? (iii) Is there a significant difference in the mean of the HMAT post-test, between the treatment group and the control group? (iv) Is there a significant difference in mean HMAT achievement, between pre-test and post-test for the treatment group? and (v) Is there a significant difference in mean HMAT achievement, between pre-test and post-test for the control group?

II. PROCEDURE

A. Research Design

In this study, the Design and Development Research (DDR) proposed by [20] was used. This DDR is a modification of the DDR proposed by [21]. According to [20], DDR is capable of providing reliable and useful information. Three phases that need to be carried out in this modified DDR. The first phase is the needs analysis, the second phase is the design and development and then the third phase is the implementation and evaluation. In the first phase, a needs analysis was conducted to identify the need for the development of the HMPSF framework with the Bar Model Strategy. Needs analysis was administered to 65 teachers and 102 students based on McKillip's 1987 Mismatch Model.

In the second phase, the Fuzzy Delphi Method (FDM) was the main method used to obtain the expert consensus. FDM is an appropriate method to be used as a tool to obtain expert agreement [22]. In this phase, 15 experts in Mathematics education were appointed as the expert assessors of the HMPSF framework with the Bar Model Strategy developed based on the recommendation of [23]. This experts group consists of three Mathematics Lecturers from Public Universities, three Mathematics Lecturers from the Teacher Education Institute, three Excellent Mathematics Teachers and six Teachers with experience teaching Mathematics for over 10 years. Through FDM, the process of obtaining expert agreement is carried out in two rounds. The first round is through a structured interview while the second round is through a questionnaire developed from the result of the interview findings in the first round and also the needs analysis findings. Structured interviews were administered until reaching a saturation level [24] involving seven out of 15 experts to determine what components are required in the framework of the HMPSF with the Bar Model Strategy as well as to verify the need to conduct this study. After the structured interviews were completed, a prototype of the HMPSF framework with the Bar Model Strategy was developed to obtain expert agreement along with an expert evaluation questionnaire. The questionnaire that was developed was referred back to seven experts who were interviewed to obtain validity through the Content Validity Index (CVI) method before it was administered in the second round of FDM. Findings show that this expert evaluation questionnaire has satisfactory validity with the S-CVI value of 1.0 [25]. After the validity was obtained, this questionnaire was administered to 15 experts to obtain their agreement on the prototype of the HMPSF framework with the Bar Model Strategy that was developed. In FDM, three conditions can be used in verifying whether a component, item or element developed is agreed upon by a group of experts [22], namely:

i. Requirement 1 : using the value of Threshold, d [26], [27]. The Threshold value, d determined by using this formula :

$$d(\tilde{m},\tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2}$$

If $d \leq 0.2$, the item is accepted. If $d > 0.2$, the item is not accepted or a second round need to be done with experts who disagreed.

ii. Requirement 2 : According to Delphi Tradisional method [28], [29]. This requirement states that an item will be accepted if the percentage of the expert consensus is ≥ 75%

iii. Requirement 3 : Based on α-Cut [30], [31]. The α-Cut value is the middle value or the median between the *fuzzy* (0 – 1) number. This means the value of α-Cut is 0.5. If the value score *fuzzy* (A_{max}) is more than 0.5, then the item is accepted based on the expert consensus.

In the third phase of DDR, the HMPSF framework with the Bar Model Strategy developed was tested for its effectiveness by evaluating the achievement of Year Five students in the classroom. The effectiveness of this framework was tested using a quasi-experimental method through a quasi-experimental design of pre-test and post-test unequal groups based on the Concept-Input Process-Product Model. Testing the effectiveness of this framework is conducted through TnL sessions in the classroom over 8 weeks. For this purpose, the module for using the HMPSF framework with the Bar Model Strategy was developed based on Sidek's Module Construction Model as a guide for applying the HMPSF framework with the Bar Model Strategy in the classroom. A quantitative approach was utilized to see the difference in the mean score of students' achievement in solving math problems in the form of HOTS before and after undergoing treatment using the HMPSF framework with the Bar Model Strategy. The difference in mean student achievement scores in solving math problems in the form of HOTS is deducted through the pre-test and post-test. This approach contains two groups, the Control Group (CG) consisting of 33 students and the Treatment Group (TG) consisting of 30 students. CG went through the TnL process conventionally while TG went through TnL using the HMPSF framework with the Bar Model Strategy through the framework usage module. Overall, the process of developing and testing the effectiveness of the HMPSF framework with the Bar Model Strategy on the achievement of Year Five students in answering problem-solving questions and mathematical operations in the form of HOTS using Isman's Instructional Design Model (2011) as a backup model. Isman's Instructional Design Model has been the interest of many DDR study practitioners [20].

B. Research Instrument

In the first phase, two instruments were utilized, namely the teachers' needs analysis questionnaire and the students' needs analysis questionnaire. In the second phase, two instruments were used which structured interviews and a questionnaire. Through FDM, the process of obtaining expert agreement was done in two rounds, namely a structured interview (round 1) and an expert validity questionnaire (round 2). This questionnaire was adapted from the questionnaire proposed by [22]. The developed questionnaire was referred back to the 7 experts for confirmation through the CVI Method. A validated expert validity questionnaire was administered to all 15 experts in the second round to obtain their agreement on the components contained in the HMPSF framework with the Bar Model Strategy

In the third phase, the HOTS Mathematics achievement test instrument (HMAT) was used. HMAT consists of eight problem-solving questions and Mathematical operations in the form of HOTS. The validity of HMAT was obtained through the CVI method from 10 Mathematics education experts, including three Mathematics lecturers, three excellent Mathematics teachers and four teachers with more than 10 years of experience teaching Mathematics. Findings show that the HMAT Instrument has satisfactory validity as the S-CVI/Ave value is 0.89 [32]. The reliability of the HMAT instrument was obtained through a pilot study conducted through a test and retest method on 33 Year 5 students with a Cronbach's Aplha value of .971.

C. Data Analysis Method

In the first phase, the data was analyzed quantitatively. In the second phase, the findings of the structured interviews were analyzed through thematic analysis while the findings from the Expert Evaluation Questionnaire form were analyzed using FDM. As discussed earlier, in FDM, three conditions that can be used in verifying whether a component, item or element developed is agreed upon by a group of experts, namely: (i) requirement 1 : using the value of Threshold, d (ii) requirement 2: According to Traditional Delphi method and (iii) requirement 3 : Based on α-Cut value. In the third phase, the findings from the HMAT pre-test and post-test were analyzed using ANOVA and MANOVA analysis.

III. RESULTS AND DISCUSSION

The needs analysis conducted show that 92.2% of teachers and 98.04% of students stated that there is a need to develop the HMPSF. Findings from the structured interviews have identified four main components in HMPSF with the Bar Model Strategy namely (i) concept, (ii) procedure / algorithm, (iii) representation and (iv) strategy. There is one item under the procedure / algorithm component which is the Polya Model, and one more item under the representation component and the strategy component which is the Bar Model Strategy. These four items will be covered by two special components which are Values and Cybergogy. Cybergogy is a framework for creating engaged learning online [33]. Through cybergogy, pupils can discuss online with their teachers or friends to solve HOTS mathematical problems. Cybergogy components are identified based on three factors, namely (i) the views of experts who were interviewed, (ii) literature studies that have been conducted and (iii) the experiences of teachers and students when our country was hit by a pandemic and the movement control order came into force.

All components and items have been identified through the guidance of a senior lecturer in Mathematics education who is also one of the expert panel who has been interviewed. This selection is further strengthened through a literature review that has been carried out. All of these components and items have secured expert agreement in the second round of FDM. The findings from the questionnaire conducted in the second round of FDM are shown in Table 1.

Table 1. Fuzzy Delphi Method Analysis For Expert Validity Questionnaire Form

Component	Threshold	Percentage	Skor	Expert

& Item	**Value, d**	**of Expert Consensus (%)**	**Fuzzy (A)**	**Consensus**
Concept	0.076	100	0.920	ACCEPT
Procedure	0.068	100	0.933	ACCEPT
Model Polya	0.092	100	0.902	ACCEPT
Representative	0.068	100	0.933	ACCEPT
Strategy	0.093	93.33	0.916	ACCEPT
Bar Model	0.060	100	0.940	ACCEPT
Value	0.094	93.33	0.909	ACCEPT
Cybergogy	0.076	100.00	0.920	ACCEPT

Based on Table 1,

i. Requirement 1: calculate the value of Threshold, d for each component and item ≤ 0.2. So, this means all components and items are acceptable.

ii. Requirement 2: it is found that the percentage of expert agreement for each component and item is ≥ 75%. So, this means all components and items are acceptable.

iii. Requirement 3: obtained the value of α-Cut (Fuzzy score) for each component and item ≥ 0.5. So, this means all components and items are acceptable.

The overall findings from Table 1 show that all three conditions in the FDM have been met. This means that all components and items in the HMPSF with the Bar Model Strategy have obtained expert consensus, have satisfactory validation,are acceptable and can be used. Figure 1 shows the final framework of HMPSF with the Bar Model Strategy

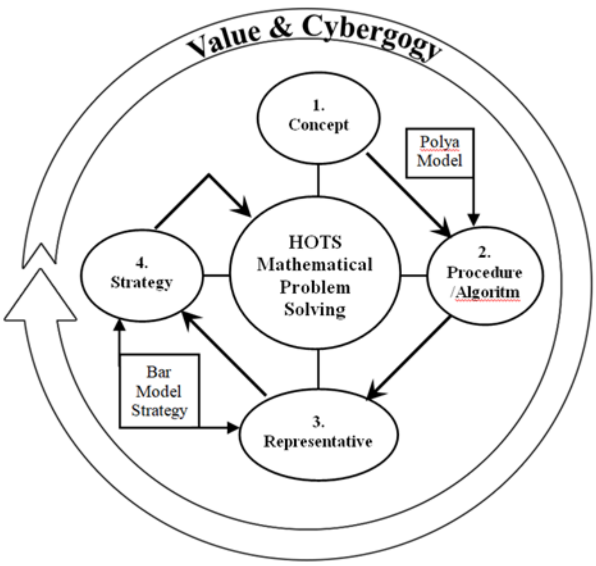

Figure 1. HMPSF with the Bar Model Strategy

Based on Figure 1, the HMPSF with the Bar Model Strategy framework consists of four main components (Concept, Procedure/Algoritm, Representative, Strategy) and two items (Polya Model, Bar Model Strategy). These four main components and two items are covered by two special components namely Values and Cybergogy.

In phase 3, before the MANOVA and ANOVA analysis was carried out, the basic conditions of its use, namely normality, linearity, equality of variants [34] and outliers [35] were checked and tested first. Findings show that all the basic conditions for the use of MANOVA and ANOVA have been met.

For the third research question, the findings from the Pillai's Trace test show that, overall, there is a significant group effect (independent variable) on the HMAT post-achievement test. Findings from the analysis of the between-subject effect test show that there is a significant post-test mean difference between the groups at the $p < .05$ level for HMAT achievement [$F(1,61) = 73.527$, $p = 0.000$]. The *partial value of eta square* shows that the treatment has contributed as much as 54.7% of the change in HMAT achievement. So, all these findings show that the HMPSF framework with the Bar Model Strategy has an effect on students' HMAT achievement after the treatment is given.

The results from the one-way ANOVA test analysis between the treatment group and the control group show that the mean difference of the HMAT post-achievement test between the groups is significant [$F(1,61) = 73.527$, $p = .000$] overall with a large effect size through the *partial value of eta square* = 0.547 [36]. Through pair wise comparison analysis by controlling type 1 error using the Bonferroni method, it was found that the mean value of HMAT achievement of the treatment group was greater and significantly different from the control group (mean difference = 28.382, $p < 0.05$). This means that the treatment group has better HMAT achievement compared to the control group. For the fourth and fifth research questions, the results of the Multivariate Pillai's Trace test through the repeated measurement MANOVA test conducted show that there is a significant effect of treatment on student achievement. There is a significant difference between the pre-test and post-test mean for HMAT achievement [$F(3,59) = 557.56$, $p = .000$]. This proves that the treatment process has had a positive effect on student achievement. The results of the difference test between the subjects conducted showed a significant effect on HMAT achievement [$F(1,61)=621.55$, $p =.000$]. This finding shows that the treatment given can improve the level of student achievement. Figure 2 shows a comparison plot of the pre-test and post-test of HMAT achievement for the treatment group and the control group.

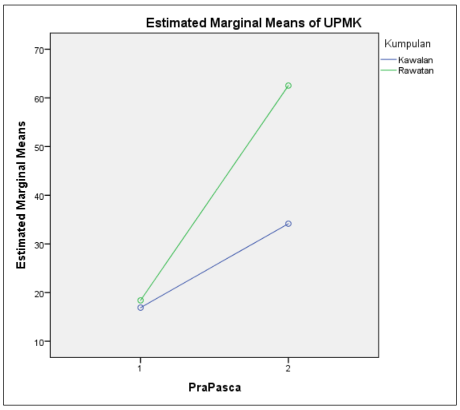

Figure 2. Comparison Plot of Pre-Test and Post-Test HMAT Achievement Differences

Based on Figure 2, the shape of the linear line graph shows that the disparity at the initial stage is small. This means that the HMAT achievement levels of the treatment group and the control group were almost the same at the beginning of the study. After the intervention was carried out, the results from Figure 2 show that the mean post-test of the treatment group was significantly higher than the control group. This means that the disparity in HMAT achievement between groups is getting bigger where a very significant improvement has been shown by the treatment group. This finding shows that the TnL method of the treatment group has a better effect on aspects of HMAT achievement compared to the control group.

IV. CONCLUSION

The findings of the study in the first phase showed that 92.2% of the teachers and 98.04% of the students involved stated that there is a need to develop a framework for solving Mathematical problems in the form of HOTS. This finding has answered the first research question. The FDM analysis that has been carried out shows that the prototype of the HMPSF with the Bar Model Strategy framework developed has successfully obtained the agreement of 15 experts when all three basic conditions in FDM have been met. With this, the actual HMPSF with the Bar Model Strategy framework has been successfully formed as shown in Figure 1.

At the beginning of the study, which was before the treatment was given, the respondents for the treatment and control groups had no difference in terms of HMAT achievement. This is proven through the Pillai's Trace test as well as the MANOVA test analysis of the mean difference of the students' pre-HMAT tests that have been conducted. The test that has been carried out shows that there is no significant group effect with an independent variable on the students' HMAT achievement at the beginning of the study. In conclusion, there is no significant difference in the mean of the pre-test of the HMAT between the treatment group and the control group.

The mean change of the HMAT achievement variable of the treatment group also shows that the effect of the HMPSF framework with the Bar Model Strategy on the achievement of the treatment group is better than the effect of the conventional method on the achievement of the control group. This is proven through MANOVA and ANOVA analysis of the post-test mean difference between the control group and the treatment group which shows a significant difference. In conclusion, there is a significant difference in the mean of the HMAT post-test between the treatment group and the control group. For the mean aspect of the HMAT post-achievement test, both groups showed an improvement compared to the pre-test. However, the mean of the treatment group showed a better improvement pattern than the control group. This proves that the treatment using the HMPSF framework with the Bar Model Strategy on the treatment group provides a better improvement effect than the conventional method on the control group. In conclusion, there is a significant difference in mean HMAT achievement between the pre-test and post-test for the treatment group. The same goes for the control group. However, the increase in post-test achievement compared to pre-test for the treatment group was higher than in the control group.

All of the findings summarized above show that the HMPSF framework with the Bar Model Strategy has succeeded in obtaining expert agreement and provides higher effectiveness in improving student achievement compared to conventional methods.

REFERENCE

[1] Ministry of Education Malaysia [MOE]. Pelan Pembangunan Pendidikan Malaysia 2013-2025 (Pendidikan Prasekolah hingga Lepas Menengah). Putrajaya: Kementerian Pendidikan Malaysia. 2013

[2] Ministry of Education Malaysia [MOE]. “Laporan Awal Pelan Pembangunan Pendidikan Malaysia 2013-2025” Putrajaya: Kementerian Pendidikan Malaysia, 2012.

[3] Azrul Azwan Mohd Abdul Aziz, Marzita Puteh & Mazlini Adnan. “The Development of The HOTS Mathematical Problem-Solving Framework Using the Bar Model Strategy - A Need Analysis.” Review of International Geographical Education (RIGEO), Vol. 11, No. 4, pp 972-981, 2021.

[4] Ministry of Education Malaysia [MOE]. Pelaporan Pentaksiran Sekolah Rendah 2018. Putrajaya: Kementerian Pendidikan Malaysia, 2018.

[5] Ministry of Education Malaysia [MOE]. Pelaporan Pentaksiran Sekolah Rendah 2019. Putrajaya: Kementerian Pendidikan Malaysia, 2019.

[6] Mohd Azarul Mohd Mokhtar, Ahmad Fauzi Mohd Ayub, Rozita Radhiah Said, Siti Salina Mustakim. “Analysis of Year Four Pupils’ Difficulties in Solving Mathematical Problems Involving Fraction.” International Journal of Academic Research in Business and Social Sciences, Vol. 9, No. 11, pp 1561-1569, November 2019.

[7] Ministry of Education Malaysia [MOE]. “Kad Pelaporan Pencapaian Malaysia dalam PISA 2018.” Putrajaya : Kementerian Pendidikan Malaysia, 2018.

[8] Ministry of Education Malaysia [MOE]. Laporan TIMSS 2015. Putrajaya: Bahagian Perancangan dan Penyelidikan Dasar Pendidikan, Kementerian Pendidikan Malaysia, 2016.

[9] Abdul Halim Abdullah, Nur Liyana Zainal Abidin, Mahani Mokhtar (2017). “Using Thinking Blocks to Encourage the Use of Higher Order Thinking Skills among Students When Solving Problems on Fractions.” World Academy of Science, Engineering and Technology International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, Vol. 11, No. 2, pp 252–258. 2017.

[10] Arihasnida Ariffin, Zainora Baisar, Norhasyimah Hamzah, Siti Nur Kamariah Rubani & Tamil Selvan Subramaniam. “Kaedah Melukis Gambarajah: Satu Pendekatan Dalam Proses Penyelesaian Masalah Matematik.” Online Journal for TVET Practioners. 4811, pp 1-7, January 2018.

[11] Yap & Siti Rahaimah. “Pendekatan Model Bar Dalam Penyelesaian Masalah Berayat Matematik Operasi Tolak Tahun Empat.” Jurnal Pendidikan Sains & Matematik Malaysia, Vol. 8, No. 2, 35-44, December 2018.

[12] Abdul Halim Abdullah, Nur Liyana Zainal Abidin & Marlina Ali. “Analysis of Students’ Errors in Solving Higher Order Thinking Skills (HOTS) Problems for the Topic of Fraction.” Asian Social Science, Vol. 11, No. 21, pp 133–142, July 2015.

[13] Phonapichat, P., Wongwanich, S., & Sujiva, S. "An analysis of elementary school students' difficulties in mathematical problem solving." Procedia-Social and Behavioral Sciences, Vol. 116, pp 3169-3174, February 2014
[14] Muenks, K., Wigfield, A., & Eccles, J. S. "I can do this! The development and calibration of children's expectations for success and competence beliefs". Developmental Review. Vol. 48, pp 24–39, April 2018.
[15] Rajendran Nagappan "Teaching and Acquiring Higher Order Thinking Skills: Theory and Practise." Tanjung Malim: Universiti Pendidikan Sultan Idris. 2019.
[16] Erni Sofinah Matzin & Mundia, L. "Effective Learning of Mathematics by Year 7 Students using the Bar Model Method: Case of Brunei Students." Journal of Studies in Education, Vol. 8, No. 1, pp 1-16, 2018.
[17] Ragu Ramasamy & Marzita Puteh. "Bar Model Method for Higher Order Thinking Skills Questions in Mathematics for Dual Language Program Pupils." International Journal of Academic Research in Business and Social Sciences, Vol. 8, No. 9, pp 1456–1462, October 2018.
[18] Augustine and Effandi. "Penggunaan Model Bar Dalam Menyelesaikan Masalah Tahun 6." Jurnal Dunia Pendidikan, Vol. 2, No. 1, pp 113-124, Mac 2020.
[19] Marin K.A. "Modeling Whole Number Operations." Lesley University Summer Institute. 2015
[20] Saedah Siraj, Norlidah Alias, Dorothy DeWitt & Zaharah Hussin "Design and Developmental Research. Emergent Trends In Educational Research." Kuala Lumpur: Pearson. 2013.
[21] Richey, R. C., & Klein, J. D. "Design and Development Research Methods, Strategies, and Issues." Mahwah, NJ Lawrence Erlbaum Associates, Publishers. 2007.
[22] Mohd Ridhuan Mohd Jamil & Nurulrabihah Mat Noh. "Kepelbagaian Metodologi Dalam Penyelidikan Rekabentuk dan Pembangunan." Shah Alam: Qaisar Prestige Resources. 2020
[23] Othman Lebar. "Penyelidikan Kualitatif: Pengenalan Kepada Teori dan Metode. Cetakan Keenam." Tanjong Malim: Penerbit Universiti Pendidikan Sultan Idris. 2015.
[24] Polit, D. E. & Beck, C. T. "Essentials of Nursing Research. 6th Edition." Lippincott Williams & Wilkins, Philadelphia. 2006.
[25] Chen, C. T. "Extensions of The TOPSIS for Group Decision-Making Under Fuzzy Environment." Fuzzy Sets and Systems, Vol. 114, pp 1-9, August 2000.
[26] Cheng, C. H. & Lin, Y. "Evaluating The Best Main Battle Tank Using Fuzzy Decision Theory With Linguistic Criteria Evaluation." European Journal of Operational Research, Vol. 142, No. 1, pp 74-86, October 2002.
[27] Chu, H. C. & Hwang, G. J. "A Delphi-based Approach To Developing Expert Systems With The Cooperation of Multiple Experts." Expert System With Applications, Vol. 34, No. 28, pp 24-40, May 2008.
[28] Murray, J. W. & Hammons, J. O. "Delphi: A Versatile Methodology For Conducting Qualitative Research." Review of Higher Education, Vol. 18, No. 4, pp 23-26, 1995.
[29] Tang, C. W. & Wu, C. T. "Obtaining a Picture of Undergraduate Education Quality: A Voice From Inside The University." Springer, Higher Education, Vol. 60, pp 269-286, September 2010.
[30] Bodjanova, S. "Median Alpha-Levels of a Fuzzy Number." Fuzzy Sets and Systems, Vol. 157, No. 7, pp 879-891, April 2006.
[31] Lynn, M. "Determination and Quantification of Content Validity Index." Nursing Research, Vol. 35, pp 382-386, November 1986.
[32] Wang, M. J. & Kang, J. "Cybergogy of engaged learning through information and communication technology: A framework for creating learner engagement." In D. Hung & M. S. Khine (Eds.), Engaged learning with emerging technologies (pp. 225-253). New York: Springer Publishing. 2006.
[33] Chua, Y. P. "Kaedah dan Statistik Penyelidikan: Ujian Univariat dan Multivariat. Edisi Kedua." Kuala Lumpur: Mc Graw Hill Education (Malaysia) Sdn. Bhd. 2014.
[34] Pallant, J. "SPSS Survival Manual (6th ed.) A step by step guide to data analysis using IBM SPSS." Sydney: Allen & Unwin. 2016.
[35] Cohen, L., Manion, L., & Morrison, K. "Research Method in Education. 7th Ed." London: Routledge. 2011.