

Manipulative Tool in Solving Division Within 1 000 000 with 1-Digit Advisor

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Abstract

This study aims to identify the patterns of errors committed by respondents when doing calculations in division within 1 000 000 with 1-digit divisor. In addition, this study also examined the effectiveness of the use of teaching aid 'Division with Pocket Doraemon' in division among respondents in year 5. The design of this study is quantitative experiments that involved two groups which treatment and control groups. The instruments used in this study were pre-test and post-test. The study population comprised 232 respondents in schools in Kulai, Johor. While samples involved were 44 students' year 5 in the school. The main objective of this study is to determine the effectiveness of the teaching aid, 'Division with Pocket Doraemon' in division. The data obtained was analyzed by using the Statistical Package for Social Science (SPSS) version 20.0. The study findings show a 26.1 % increase in the passing percentage in pre-test and post-test. The researcher used a paired sample t-test to compare the pre-test and post-test scores of the treatment group. By using the value of $\alpha = 0.05$ and the degree of freedom of 22, the researcher found that the value of t is -4.440, which falls within the critical region on the left side ($t = \pm 2.074$). The mean of both pre-test and posttest was significant for the treatment group. It shows that there is a difference and a change in the mean between the two tests conducted by the researcher. Therefore, it can be concluded that the teaching aids introduced by the researcher helps respondents in solving division operations within 1 000 000 with a 1-digit divisor.

Keywords: Division, Pre-Test, Post-Test, Statistical Package for Social Science (SPSS), Percent, T-Test, Sample, Population

Introduction

Mathematics is a field of science that studies quantity, structure, space and change. It is known as the study of structural patterns, changes, space or in other words the study of numbers and diagrams. Mathematics is seen as a simple extension to the language of conversation or writing with clear vocabulary and grammar to describe the relationship of physical and conceptual in life. The basic operations in mathematics consisting of addition,

subtraction, multiplication and division that must be mastered by students before exploring other skills in mathematics. One of the most important basic operations in mathematics is division. Division is a mathematical operation which involves the sharing of an amount into equal-sized groups (Sophie Bartlett, 2025). In addition, division is a fundamental operation that is closely related to multiplication, and is a necessary skill for understanding fractions and some algebraic concepts. Outside the classroom, children often face division-situations such as exchanging snacks with siblings or breaking into groups for a game (Thevarasa Mukunthan, 2021). In mathematics, this is written with the division symbol, called an obelus (\div). Division can also be presented as a fraction such as $\frac{6}{2}$. In a division, the first number which is the amount being divided (6) is called the dividend and the second number which is being divided by (2) is called the divisor. Then, the answer for the division in calculation (3) is called the quotient (Sophie,2025). However, many students still find it difficult and failed to solve problems involving division.

Division is the inverse operation for multiplication (Johnson,2020), whereas Van de Walle et al.,2019 defined division as a process of repeated subtraction, where a given quantity is decreased incrementally by equal parts until it reaches zero. Normally, division is commonly taught through two structurally distinct models includes partitive division (repeated subtraction) and quotative division known as equal sharing (Mazlini Adnan et al.,2025). But in reality, there are three models that represent the concept of division, knownly as repeated-subtraction model,the grouping model (quotative), and the sharing model (partitive). However, Krisnadi et al., (2025) in his article states that teachers tend to rely on a single model of division which is equal sharing without introducing other conceptual model such as division as repeated subtraction or finding the number of groups. As a result, students end up with a limited understanding of conceptual meaning of division itself.

Mathematical error can be described as a mistake in a calculation (Thevarasa ,2021). In division, there are several types of mathematical error occur among the students. There is careless error, problems in mastering of multiplication tables and problem in algorithm for long division. These three error patterns frequently occur in the learning of division. Thevarasa (2021) states that six types of error pattern in division found in her research. They were recalling error (11.58%), direction of operation error (10.82%), operation sign related errors (6.84%), zero related error (15.7%), concept related error (2.84%) and imcomplete operation error (52.82%). Hung-Hsi Wu (2020) in her article states that one of the main causes of error in division occur because of the long division algorithm. It can relate to one of the error patterns by Thevarasa (2021),imcomplete operation error that recorded the highest percentage in division. Hung-His Wu (2020) defined an algorithm as a finite sequence of precise instructions for carrying out specific computations to result in the desired outcome at the end. Therefore, many students unable to solve division problems because they fail to apply the division algorithm correctly.

To address this issue, the implementation of appropriate interventions can enhance and help students' understanding of division skills in mathematics, in line with the main objectives of the KSSR to promote students' holistic, balanced and integrated development (Norazah et al.,2022). Halil and Mahmud (2022) in previous studies have shown that an alternative calculation methods that incorporate visual and manipulative approaches can help students gain a deeper understanding of mathematical operation concepts.

Literature Review

Division is considered one of the most difficult mathematical operations for students to master. Students tend to show less interest in learning mathematics due to the difficulty in mastering basic operations such as multiplication and division, as well as their lack of understanding of the relationship between these two operations (Teng & Ng,2020; Wong ,2021). Karthikesan (2025) reported that students frequently make numerous errors when solving division operation these errors include mistakes in bringing down digits during division process, failing to place zero in the appropriate position, carelessness in writing the digits of the answer and the lack of checking their solutions. In addition, Wulan (2025) stated that most of the students are indicated to have comprehension errors,problem in process skill and transformation errors. Based on data, the errors observed are not just in the final answers provided by students, but also in their ability to read, comprehend, and execute the steps or procedures required to solve mathematical problems.

Research Contribution

This study contributes to the field of mathematics education by introducing the use of learning aids specifically designed to help students in understanding the concept of division with one-digit divisor in more concrete and meaningful way. This approach provides an alternative to traditional teaching methods that focus on procedural calculations. Other than that, this study also assists other researchers in refencing the patterns of errors made by students when solving division as well as serving as a guide for mathematic teachers in exploring alternative instructional methods during teaching and learning session at school.

Objectives of the study

Identifying the common mistakes made by students when performing division with one-digit divisor.

Determine the effectiveness of teaching aid 'Division with Pocket Doraemon' in solving problems involving division with a one-digit divisor among Year 5 students.

Research questions of the study

What are the common mistakes or error made by students when performing division with a one-digit divisor?

Are there any difference and a change in the mean between both pre-test and posttest for a treatment group by using teaching aid 'Division with Pocket Doraemon' among year 5 students?

Methodology and Results*Research Design*

Research design is formulated to explain the methods used in collecting, testing, analyzing information and data including research hypothesis, research techniques, research instruments and the scope of the study (Fuad Mohamed Berawi ,2024). Research design sometimes known as research methodology among the researchers. This study focused on quantitative research approach which refers to the use of objective measurement to generate numerical data and analyzed using statistics (Othman Talib,2022). This kind of approach used to find the measurement and relationship between the related variables in the study. Thus, this study is quantitative experiment that uses two groups of research subjects in Sekolah

Kebangsaan LKTP Bukit Ramun, Kulai, Johor which 5 bestari as a treatment group and 5 Cemerlang as a control group.

Sampling and Population

Sampling is a fundamental technique in research which involves selecting a smaller group or sample from a larger population to represent the whole (Jessica, 2024). Ali Hussain (2025) stated that sampling is a statistical technique for efficiently analyzing large datasets by selecting a representative subset which is sample. This study involved a sample of 44 respondents, consisting of 19 male students (43.2%) and 25 female students (56.8%) from Year 5 In Sekolah Kebangsaan LKTP Bukit Ramun, Kulai, Johor. All of the sample selected were divided into two main groups known as the control group (21 samples) and the treatment group (23 samples).

Instrument

Instrument is a list of equipment, tools, software used in a study (Fuad, 2024). Equipment in research consists of the questionnaires, notebooks, videos, cameras or voice recorders. While, for the software in research consists of SPSS, SAS or Ms Excel. In this study, the researcher used pre-tests and post-tests as research instruments.

Pre-Test and Post -Test

A pre-test is an assessment that given to participants or respondents before they have undergone some type of treatment in study, while a post-test is an assessment measure to the respondent after they have treatment as part of the research study (Jennifer, 2023). Therefore, in this study, the researcher used pre-tests and post-tests as an instrument to identify the respondents' level of understanding before and after the treatment session is conducted. The pre-tests conducted is to identify the issues and problems faced by students in solving division, while the post-test conducted is to identify any changes after the treatment using new kit introduced known as 'Poket Doraemon'.

Document analysis is a systematic procedure for reviewing or evaluating documents—both printed and electronic (computer-based and Internet-transmitted) material.

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Statistical Test Used

This study analyzed by using Statistical Package for Social Science (SPSS) version 20.0. Thus, the findings of the study aim to address the second research question which the effectiveness of using teaching aid in division through pre-test and post-test achievement, whereas t-test used to make comparison in post-test between these two groups, treatment and control group.

Result*Analysis of Pre-Test and Post-Test in Percentage*

Table 1

Analysis of Scores and Respondent Percentages In the Pre-Test and Post-Test

No	Group	Score (/12) Pre-Test	Percentage (%)	Score (/12) Post-Test	Percentage (%)	Difference in percentage
1	Control Group	1	8.3	11	91.7	83.4
2		1	8.3	5	41.7	33.4
3		1	8.3	10	83.3	75.0
4		2	16.7	8	66.7	50.0
5		3	25.0	9	75.0	50.0
6		5	41.7	9	75.0	33.3
7		5	41.7	10	83.3	41.6
8		5	41.7	9	75.0	33.3
9		6	50.0	10	83.3	33.3
10		7	58.3	8	66.7	8.4
11		8	66.7	9	75.0	8.3
12		8	66.7	9	75.0	8.3
13		8	66.7	10	83.3	16.6
14		8	66.7	9	75.0	8.3
15		9	75.0	9	75.0	0
16		9	75.0	7	58.3	-16.7
17		9	75.0	10	83.3	8.3
18		10	83.3	10	83.3	0
19		11	91.7	11	91.7	0
20		11	91.7	11	91.7	0
21		11	91.7	8	66.7	-25.0
1	Treatment Group	1	8.3	12	100	91.7
2		3	25.0	10	83.3	58.3
3		3	25.0	12	100	75.0
4		4	33.3	11	91.7	58.4
5		4	33.3	10	83.3	50.0
6		4	33.3	10	83.3	50.0
7		6	50.0	12	100	50.0
8		6	50.0	11	91.7	41.7
9		7	58.3	9	75.0	16.7
10		8	66.7	11	91.7	25.0
11		8	66.7	10	83.3	16.6
12		8	66.7	9	75.0	8.3
13		8	66.7	9	75.0	8.3
14		8	66.7	12	100	33.3
15		9	75.0	10	83.3	8.3
16		9	75.0	9	75.0	0
17		10	83.3	10	83.3	0
18		10	83.3	9	75.0	-8.3
19		10	83.3	9	75.0	-8.3
20		10	83.3	10	83.3	0
21		11	91.7	11	91.7	0
22		11	91.7	10	83.3	-8.4
23		11	91.7	10	83.3	-8.4

Table 1 shows the analysis of scores in the pre-test and post-test among the respondents in this study. In pre-test, there were only 11 out of 44 respondents in both control and treatment groups got more than 80% scores, while the remaining 31 respondents scored below 80% and 11 of them scored less than 40% which considered a failure. The table 6.2 below presents a summary of the analysis of scores obtained according to grade.

Analysis of Pre-Test and Post-Test of Treatment Group in Grade

Table 2

Analysis of Scores In Grade for Treatment Group

Score (/12)	Grade	Pre-Test	Post-Test
10-12	A	7	17
8-9	B	7	6
5-7	C	3	0
0-4	D	6	0
	Total	23	23

Based on the table 2 above, in Pre-Test for Treatment Group, 7 out of 23 respondents classified as Grade A (30.4%), 7 of respondents as Grade B (30.4%), 3 of respondents as Grade C (13.0%) and the remaining 6 of respondents as Grade D (26.1%). Thus, based on the scores obtained by each respondent, researcher conducted a review of written documents through the worksheets from pre-test to identify and list out the error patterns made by the respondents while answering question involving division. In the Post-Test, 17 out of 23 respondents (73.9%) scored 10 or higher, representing an improvement from the Pre-Test, where only 7 of them reached this level. The remaining 6 respondents (26.1%) scored between 8 and 9, which corresponds to a grade B in the Post-Test. Thus, there was an increase in the percentage of students achieving grade A, B and C (40% and above) in post-test compared to the pre-test with an improvement of 26.1%.

Analysis of Pre-Test and Post-Test of Control Group in Grade

Table 3

Analysis of Scores in Grade for Control Group

Score (/12)	Grade	Pre-Test	Post-Test
10-12	A	4	9
8-9	B	7	10
5-7	C	5	2
0-4	D	5	0
	Total	21	21

Based on the table 3 above, in Pre-test for Control Group, 4 out of 21 respondents classified as Grade A (19%), 7 of respondents as Grade B (33.3%), 5 of respondents as Grade C and D (23.8%). While, for the Post-Test, 9 out of 21 respondents classified as Grade A (42.9%), 10 respondents as Grade B (47.6%) and 2 of respondents as Grade C (9.5%). Thus, there was an increase in the percentage of students achieving grade A, B and C (40% and above) in post-test compared to the pre-test with an improvement of 23.8%.

Error Patterns in Division

Errors was a systematic in nature and stem from misconceptions or incorrect interpretations resulting from overgeneralizations of prior knowledge. (Gardee and Brodie,2015,2022). Thus,in this study, the researcher found 5 error patterns in division.

Difficulty in Multiplication Tables'

Confusion in writing answers involving the zero digit

Errors during the subtraction process

Carelessness in writing the item and copying answers

Place value errors

Difficulty in Multiplication Tables'

Based on the observation conducted through the worksheet of multiplication tables, the researcher found that 31 out of 44 respondents (70.5%) had difficulties in mastering multiplication tables from two to nine. Table below shows the analysis of score in multiplication table test. This test consists of 120 questions.

Table 4

Analysis Of Score And Percentage In Multiplication Table Test

Multiplication table	Score (80% and above)	Percentage (%)	Score (80% and below)	Percentage (%)
0-4 (50 item)	20	45.5	24	54.5
5-9(70 item)	13	29.5	31	70.5

Table 4 shows the score and percentage in multiplication table test conducted. The researcher found that 24 out of 44 respondents (54.5%) had difficulties in mastering multiplication table 0 to 4, while 31 out of 44 respondents (70.5%) had difficulties in mastering multiplication table 5–9. Diagram below shows the worksheet of multiplication tables. It shows the error made by the respondents while answering the multiplication tables.

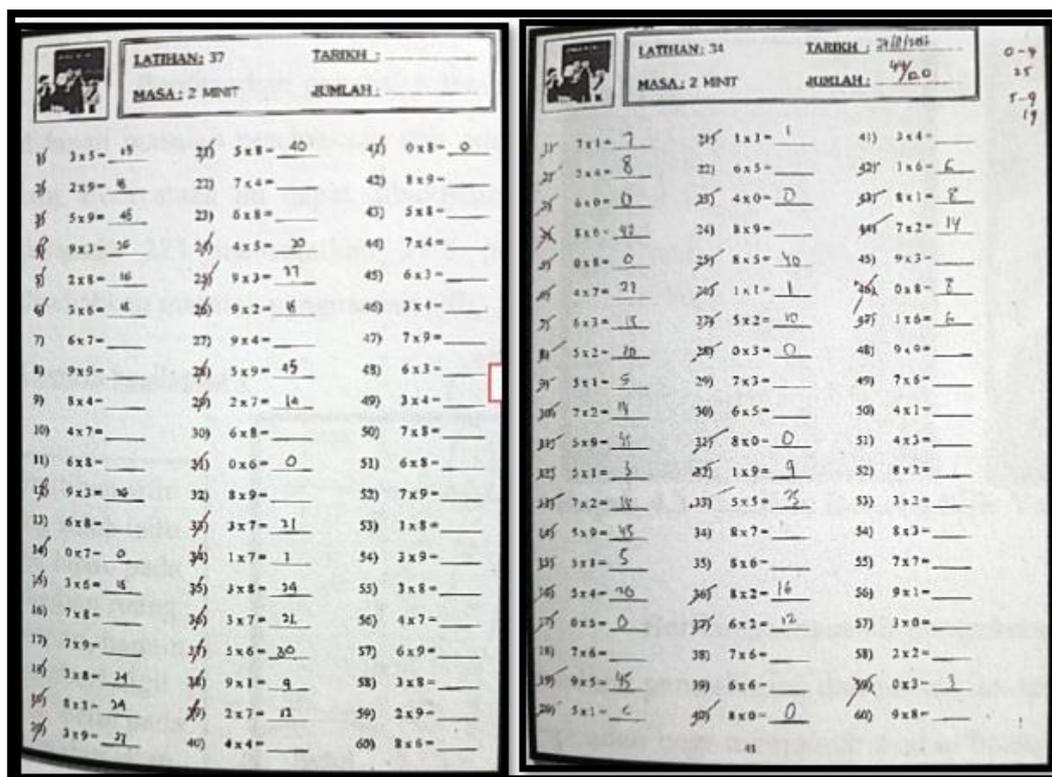


Figure 1. Written Multiplication Exercise (Times Tables 2-9)

Confusion in writing answers involving the zero digit

The other mistake made by respondent in solving division was confusion in writing answers involving zero digit. In this study, the researcher found that 24.2 %, which 54 out of 223 of the errors involved confusion regarding the value of zero. The figure below illustrates the respondents' answer scripts for the pre-test.

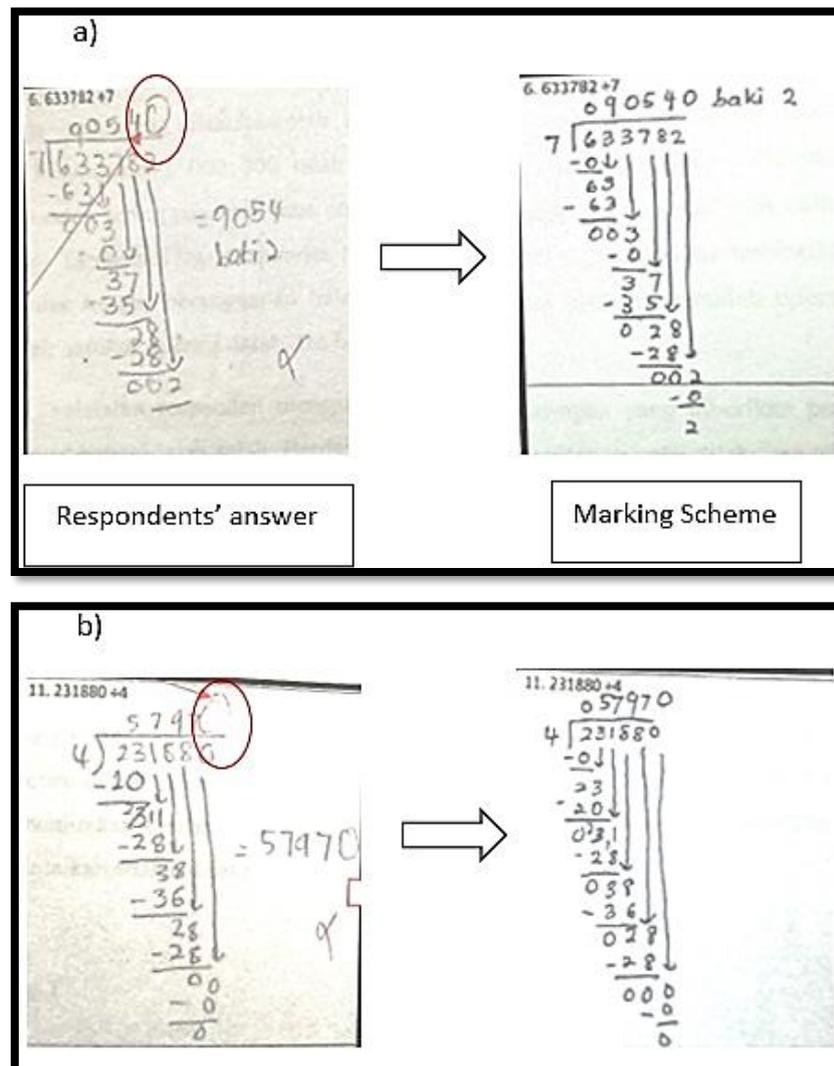


Figure 2. Errors Due to Confusion the Digit Zero

Errors During the Substraction Process

In this study, errors in substraction also accured when respondents answered division questions. The findings indicate that 64.8% of respondents involved in carelessness of substraction during division. The figure below shows the examples of respondents' answer scripts from the pre-test.

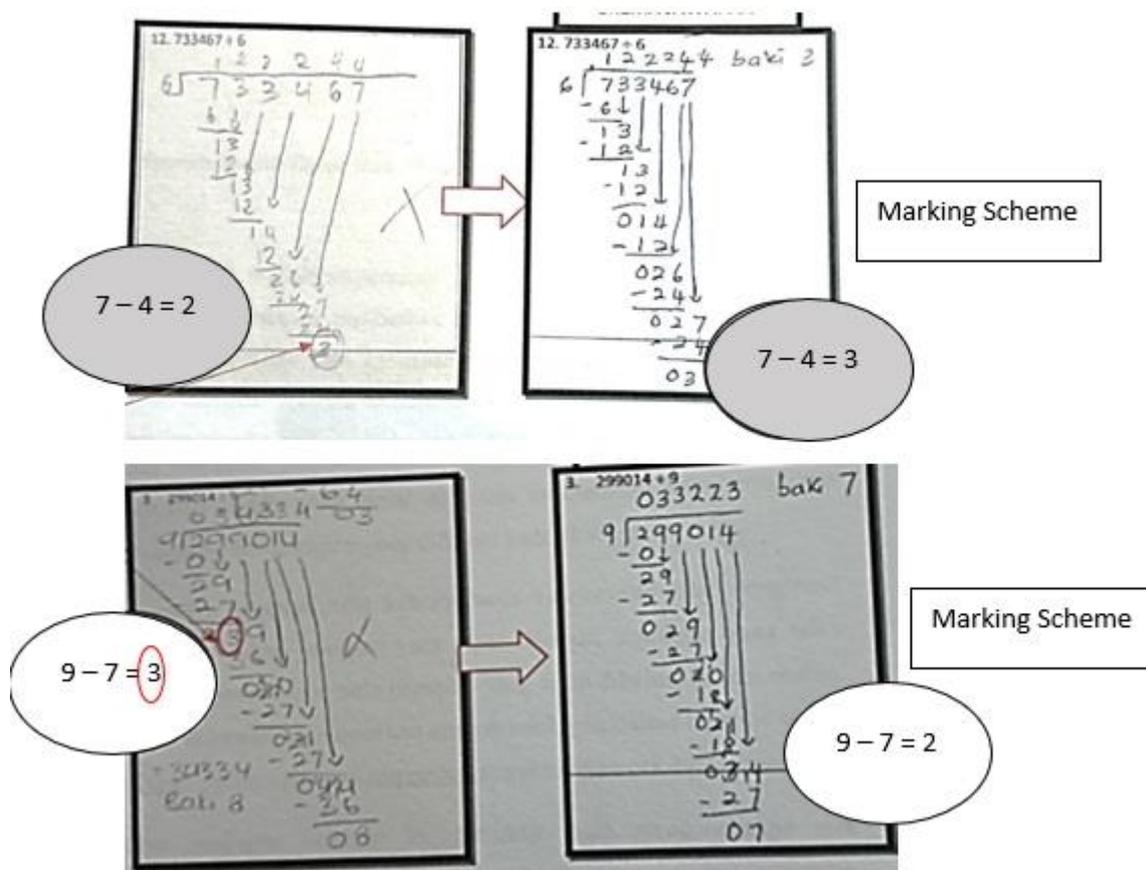


Figure 3. Errors in Subtraction involving Regrouping and Non-Regrouping

Carelessness in Writing the item and Copying Answers

Errors in writing both the questions and the final answers also posed a problem for respondents when answering division questions. Findings of the study shows that 11.7% of the 223 cases (26 cases) were associated with errors in writing the questions and final answers. These errors occurred because they did not recheck or review in both questions and final answers before submission.

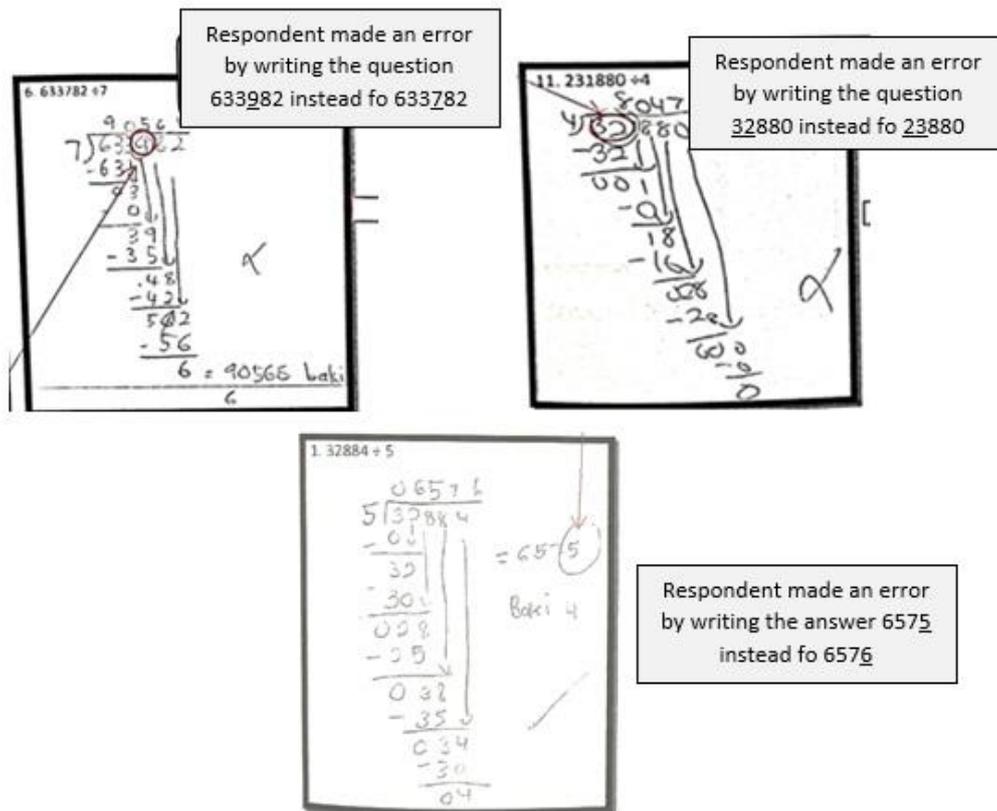


Figure 4. Errors in Writing the Question and Final Answer

Place Value Errors

Errors in place value during division often happen due to respondents' negligence in correctly bringing down digits according to their respective place values. In this study, it shows that 10.3% (23 out of 223 cases) of errors were due to place value mistakes.

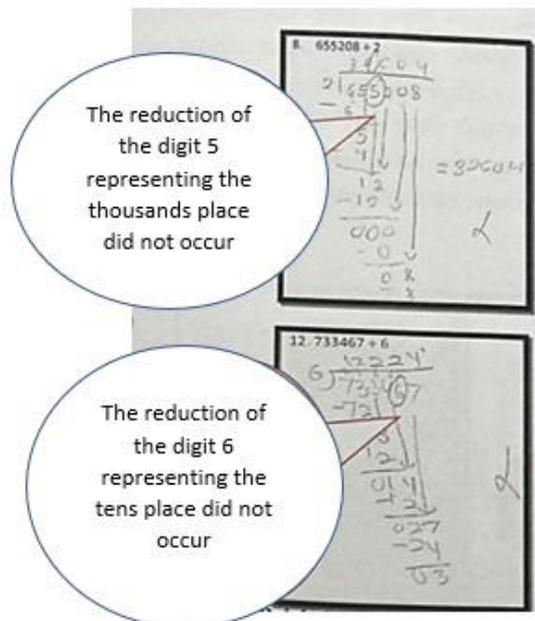


Figure 5. Place Value Errors

Manipulative tool (Bahagi Bersama Poket Doraemon) for Intervention

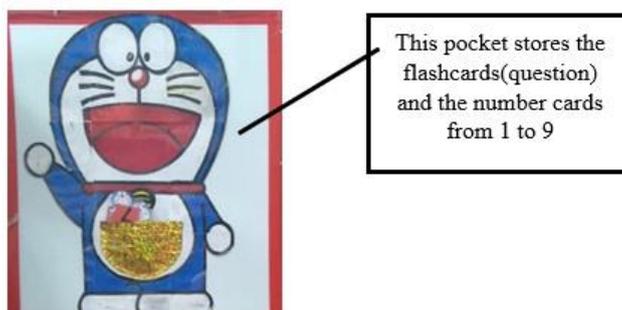


Figure 6. Manipulative Tool in Division

In this study, researcher created a manipulative tool known as “Bahagi Bersama Poket Doraemon” to help students in solving division. Here is a guidelines for using this teaching aid.

Station 1 : Finding Numbers

In this station, teacher will provide flashcard to show the question in division within 1 000 000.



This pocket stores the flashcards(question) and the number cards from 1 to 9

Figure 7. Station 1

Station 2 : Times Table Building Station

This station requires pupils to build and make their own times table from 1 to 9 based on the questions selected from station 1. Pupils will use counters (straw) to build times table and enhancing pupils understanding about multiplication concept.



Figure 8. Station 2

Station 3 : Digit Shifting Station

This station focus on solving long division which help pupils to find the correct digit or numbers using times table they built in station 2.

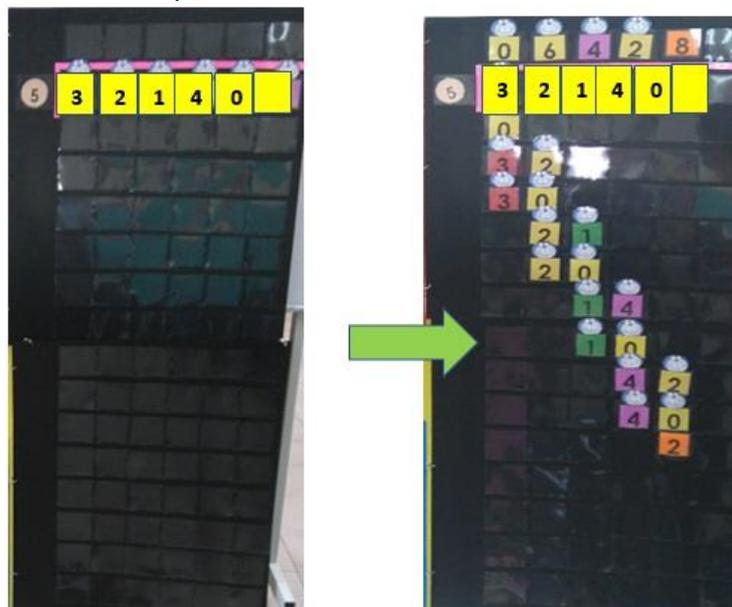


Figure 9. Station 3

Finding

Common Mistakes in Division with One-Digit Divisor

Overall, in order to answer the first objective in this study, which identifying the common mistakes made by respondents when performing division with one-digit divisor, the researcher concluded that five main types of errors were identified. The table below shows the frequency of common mistakes that occurred in division with one-digit advisor.

Table 5
Error Type and Number of Wrong Answers

Type of Error	Number/Frequency (/223)	Percentage (%)
Place value errors	23	10.3
Carelessness in writing the item and copying answers	26	11.7
Confusion in writing answers involving the zero digit	54	24.2
Difficulty in Multiplication Tables and Errors during the subtraction process	120	53.8
Total	223	100

The data above can be illustrated using a graph as shown below.

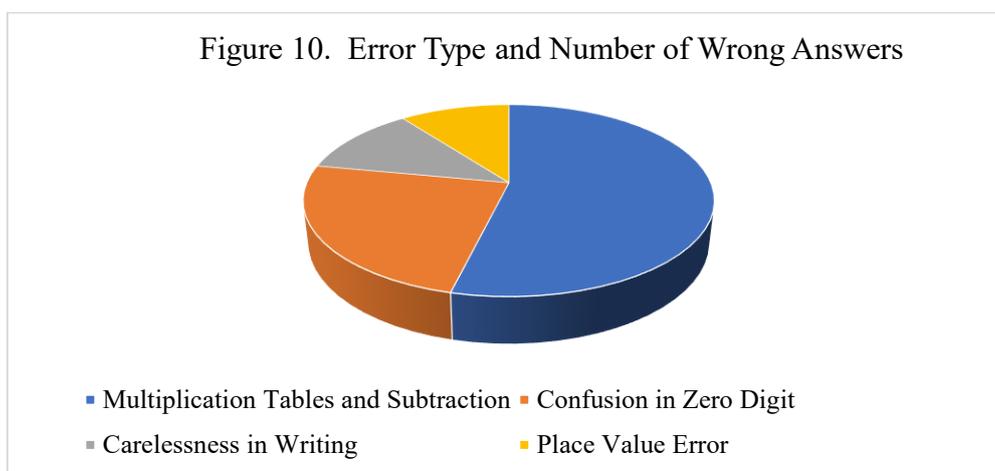


Figure 10. Error Type and Number of Wrong Answers

The Comparison of Pre-Test and Post-Test Using a t-test for a Treatment Group

The second objective of this study focused on identifying the effectiveness of the teaching aid in to solve division involving numbers within 1 000 000 with one-digit divisor. The researcher used three inferential statistical analysis to determine significant differences in mean scores. First, a paired-samples t-test to examine the significant difference between the pre-test and post-test scores of the treatment group. Second, an independent-samples t-test was performed to determine whether there was a significant difference in the pre-test mean scores between the treatment and control groups. Third, an independent-samples t-test was carried out to examine the significant difference in post-test mean scores between the treatment and control groups.

Data were analyzed using a paired sample t-test in SPSS 20. Based on $\alpha = 0.05$ and $df = 22$, the t-value of -4.440 falls into the left critical region ($t = \pm 2.074$) with a p-value (0.000) less than 0.05, indicating a statistically significant difference.

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	pre_test_treatment - post_test_treatment	-2.913	3.147	.656	-4.274	-1.552	-4.440	22	.000

Figure 11. Pre-Test and Post-Test for a Treatment Group

Independent Samples t-test Result for Pre-test Scores of the Treatment and Control Groups
 Based on $\alpha = 0.05$ and $df = 42$, the t-value of 0.913 didn't falls within the critical region ($t = \pm 2.021$) with a p -value (0.913) more than 0.05, indicating a statistically significant difference. The mean of the treatment group was not significantly different from the Pre-test mean of the control group, indicating that there was no significant difference in the mean between the two tests.

Independent Samples Test									
skor	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.609	.439	.913	42	.367	.872	.955	-1.056	2.799
Equal variances not assumed			.907	39.896	.370	.872	.961	-1.071	2.814

Figure 12. Pre-test Scores of the Treatment and Control Groups

Independent Samples t-test Result for Post-Test Scores of the Treatment and Control Groups
 Based on $\alpha = 0.05$ and $df = 42$, the t-value of 2.928 and falls into the right critical region ($t = \pm 2.021$) with a p -value (0.005) less than 0.05, indicating a statistically significant difference.

Independent Samples Test									
skor	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.817	.371	2.928	42	.005	1.023	.349	.318	1.728
Equal variances not assumed			2.904	39.162	.006	1.023	.352	.311	1.735

Figure 13. Post-Test Scores of the Treatment and Control Groups

Conclusion

In conclusion, this study successfully achieved both research objectives. The findings revealed five common errors made by respondents in solving one-digit division problems. Regarding the second objective, the inferential statistical analyses demonstrated a significant improvement in the post-test scores of the treatment group compared to the pre-test scores. Furthermore, significant differences were identified between the treatment and control groups in the post-test results. The study finding indicated a 26.1% increase in the pass rate between the pre-test and post test. Based on the data analysis, 17 out of 23 respondents in treatment groups (73.9%) passed the pre-test, while in the post-test, all of them (100%) achieved a passing score. These findings indicate that the teaching aid ' Bahagi Bersama Poket Doraemon' effectively supports and helps the respondents in mastering division involving numbers up to 1 000 000 with a one-digit divisor.

Recommendations

This study was conducted focusing on only one school. Therefore, the future research is recommended to expand the scope of the study to several schools in order to make comparisons of students' error patterns among the school invoved. In addition, it can be further improved by identifying students' level of motivation in answering questions after

undergoing the intervention provided by the researcher. Overall, the researchers are encouraged to use a more simplified and systematic division model to enhance students' computational efficiency in solving division problems.

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