Jurnal Elemen, 9(1), 132-152, January 2023
https://doi.org/10.29408/jel.v9i1.6864

e- ISSN: 2442 - 4226

Using CUBES strategy in a remote setting for primary mathematics word problems

Christina Teo Lian Wan, Nor Azura Abdullah *

Sultan Hassanal Bolkiah Institute of Education, Universiti Brunei Darussalam, Brunei-Muara District, Brunei Darussalam

* Correspondence: azura.abdullah@ubd.edu.bn

Abstract

Various research has been carried out worldwide over the years to identify ideal methods that are helpful to pupils when solving mathematical word problems. This study aims to examine the use of the CUBES Maths Strategy, a mnemonic device, to solve word problems and was conducted in a remote setting. An action research approach using a mixed method research was conducted where all data collected were analysed both quantitatively and qualitatively. The participants involved were pupils from a small local government primary school, aged between 8 and 9. Pupils' test results from the given pre and post-tests were quantitatively analysed using Wilcoxon Signed-Rank Test, which concluded that there was no significant change in the difference in test scores. Newman's Error Analysis interview was conducted to investigate the source of errors committed by the pupils, which concluded that the most prominent type of error made is the Comprehension error, followed by the Transformation error. From the observations and reflections, it can be deduced that, as the research was done in a remote setting, the use of the CUBES Maths Strategy was not fully utilised. These results could be based on the interactions between teachers and students during remote online learning.

Keywords: mathematics education; Mnemonic device; Newman's error analysis; remote learning; word problems

How to cite: Teo, L. W. C., & Abdullah, N. A. (2023). Using CUBES strategy in remote setting for primary mathematics word problem. *Jurnal Elemen*, *9*(1), 132-152. https://doi.org/10.29408/jel.v9i1.6864

Received: 29 October 2022 | Revised: 19 November 2022
Accepted: 10 December 2022 | Published: 2 January 2023

Introduction

The outbreak of Covid, which is an infectious disease caused by the SARS-CoV-2 virus that is highly transmittable (WHO, 2020), has disrupted education worldwide. The traditional physical classroom setting was changed to an online setting, where pupils learn from the comfort of their individual homes while following the social distancing and physical distancing policies. This is similar to Brunei Darussalam (hereafter, referred to as Brunei)'s response to the COVID situation, where task workforce and school students were practising the Work from Home or Learning Online procedures, respectively. However, in the Third Wave, between January 2022 to March 2022, the pandemic has lessened, and parents are gradually going to work while school children in the primary sectors and below continue to be at home for online learning due to physical school closure. Thus, asynchronous online lessons were carried out due to the lack of parental supervision and the limitation of personal devices.

The purpose of this research is to investigate the use of the CUBES mathematics strategy in an asynchronous online lesson for primary pupils. This strategy is a mnemonic device that allows one to break down a given word problem into smaller parts which aids one in further understanding and better comprehension of the passage. From the authors' past experience, it was observed that pupils were unable to comprehend and identify the steps to take when given a mathematical word problem. Hence, the research sought to discover whether the use of this strategy will affect the performance of primary pupils when solving mathematical word problems.

Mathematics, being one of the core subjects which starts from the early years of education, is found to be one of the most challenging subjects worldwide. Similarly, in Brunei, for several decades, not only are the pupils struggling to solve mathematical problems, but the teachers are also experiencing difficulties in the teaching and learning process of the subject (MoE, 1993). There were growing concerns regarding the drop in pupils' mathematical achievements and their lack of motivation for learning the subject (Majeed et al., 2002; Mundia & Metussin, 2019), which is why various research are continuously being carried out to find the ideal solution to address these problems. The study of Gafoor and Kurukkan (2015) concluded that mathematics is considered a difficult subject due to the aversive teaching styles, difficulties in following the instructions, understanding the subject, and remembering the equations and ways to solve the problem.

Word Problems is one of the main topics in the syllabus that many pupils struggle with. The difficulties of word problems are influenced by the numerical factors, the complexity of linguistic factors, and the interrelation between the two (Daroczy et al., 2015). Gooding (2009) conducted a study and compiled five categories of difficulties that pupils may face while solving mathematical word problems: reading and understanding the language used, recognising and imagining the context, forming a number sentence, carrying out the mathematical calculations, and interpreting the answer.

Most of the pupils who are struggling in solving mathematical word problems were found to have difficulties in reading the word problem and are unable to comprehend it. This is because they might not fully possess the conceptual knowledge required to solve the problems correctly (Cummins et al., 1988). They tend to misinterpret the given keywords, which leads them to identify the wrong mathematical operation to be used. This commonly happens when the given word problem seems too lengthy to the pupils. Due to the lack of textual understanding, instead of taking time to comprehend the passage carefully, the pupils were seen to be skimming through the passage and trying to identify the keywords that would alert them on which operation was to be used (Pungut & Shahrill, 2014).

Especially in the case of pupils from monolingual backgrounds with little or close to no exposure to the English Language (Jones, 2016), they are struggling and trying to comprehend what the passage meant due to the fact that Mathematics is taught using the English Language. Although Yusof (2003) reported that there is no correlation between comprehension and transformation in word problems with language, Cummins et al. (1988) stated that in order to solve word problems, asides from mathematical computation, other kinds of knowledge, which include linguistic knowledge are required for understanding and comprehending the problems.

It is crucial to examine the issues regarding word problems because not only is Word Problems a vital topic in Mathematics, but it also plays a huge role in education as it offers practice for everyday situations where pupils will apply different skills to solve problems and use mathematical modelling (Verschaffel et al., 2020). The pupils are not just simply solving a mathematical word problem but are enhancing their mental skills at the same time where they will be able to strengthen their problem-solving skills, improve comprehension and analysis, and build logical and critical thinking skills. They will also slowly be able to relate word problems to their everyday life scenarios and be able to apply the learned knowledge and skills effectively in different situations encountered in daily life (Dewolf et al., 2014). Hence, finding the reason why pupils are having difficulties in solving word problems and identifying the solution would highly contribute to lessening the burden for both the teachers and pupils.

There is hardly any academic literature found to date regarding this strategy but seems to have been created and recommended by teachers, as it can be found on teachers' websites. To date, a research dissertation involving CUBES strategy with special education children was done by Tibbitt (2016). Therefore, the research aims that by introducing the CUBES Maths Strategy, the pupils will be able to make use of the mnemonic device that provides pupils with an actionable step-by-step procedure that enables them to pick apart and comprehend what is being asked in the story problem. Each letter of CUBES represents an action to be carried out when solving word problems and assists the pupils in narrowing down what to focus on in stages.

1. **C** is for circling the numbers present in the word problem.
2. **U** is for underlining the question found within the story problem.
3. **B** is for boxing the keywords or operation clues
4. **E** is for examining the word problem with three "What" questions
   i) What label or units will my answer be?
   ii) What information have I obtained?
   iii) What information do I need?
5. **S** is for solving and checking if the answer makes sense

Step-by-step process

1. **C**ircle all the numbers that are in the given word problem

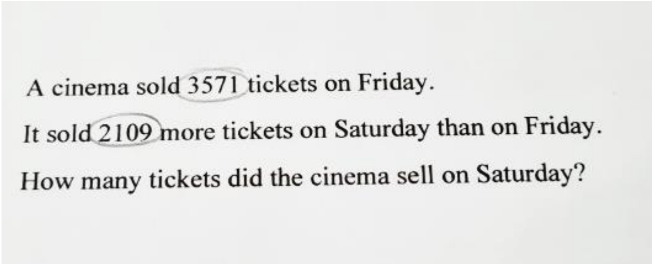
A cinema sold 3571 tickets on Friday.
It sold 2109 more tickets on Saturday than on Friday.
How many tickets did the cinema sell on Saturday?

Figure 1. Circle the numbers

2. **U**nderline the question that is found in the word problem

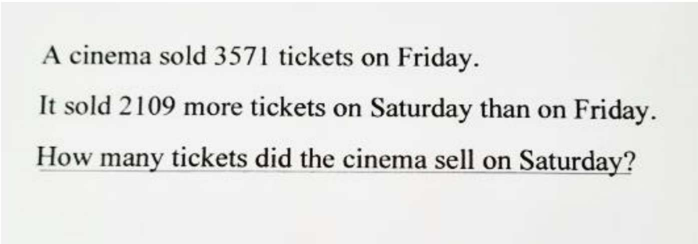
A cinema sold 3571 tickets on Friday.
It sold 2109 more tickets on Saturday than on Friday.
How many tickets did the cinema sell on Saturday?

Figure 2. Underline the question

3. **B**ox the keywords which give information on which operation to use

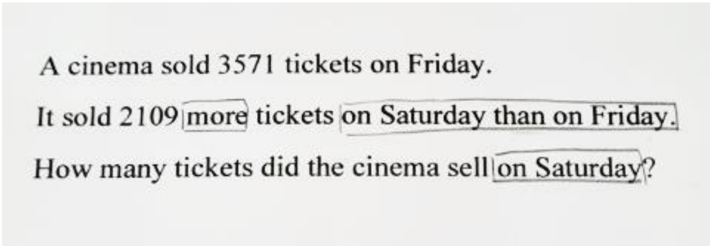
A cinema sold 3571 tickets on Friday.
It sold 2109 more tickets on Saturday than on Friday.
How many tickets did the cinema sell on Saturday?

Figure 3. Box the keywords

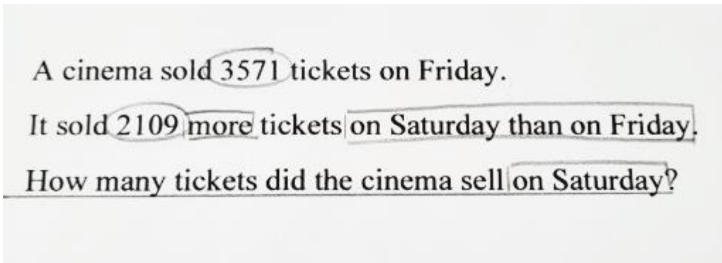
A cinema sold 3571 tickets on Friday.
It sold 2109 more tickets on Saturday than on Friday.
How many tickets did the cinema sell on Saturday?

Figure 4. Combination of the first three steps

4. **E**xamine the word problem with the following questions
   i) What label or units will my answer be?
   ii) What information have I obtained?
   iii) What information do I need?

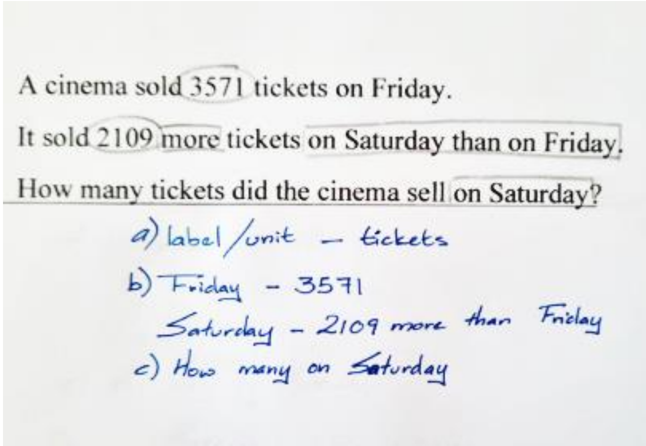

Figure 5. Examine the word problem

5. **S**olve and check that the information taken are correct and if the answer makes sense

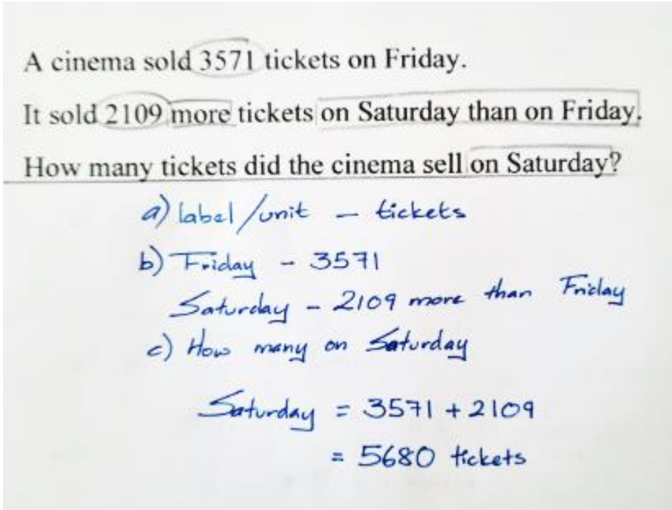

Figure 6. Solve and check

Tibbitt (2016) conducted a study comparing the effectiveness of two different problem-solving strategies, Solve It! and the CUBES Maths Strategy, for special education pupils in the general education classroom. The difference between Tibbitt's study and this study is that this study solely focuses on the use of the CUBES Maths Strategy, which is worth to be studied as there is a lack of published studies to date regarding the use of this strategy to solve mathematical word problems.

Methods

Research is commonly done nowadays to better understand and make sense of the world's complexity, and the techniques used depend on the problem of the study. An action research approach utilising mixed method research methodology was adapted for this study, where a combination of theory and practice is put together to form a cycle of activities (Avison et al., 1999). The data collected through this process were analysed quantitatively and qualitatively to provide an in-depth understanding of the research problem. The cycle starts with identifying a problem, developing and carrying out the action intervention, then interpreting and reflecting on the consequences. The action research spiral by Lewin (1946), illustrated in Figure 7, consists of four main phases: Planning, Acting, Observing, and Reflecting, which best explains this cycle.

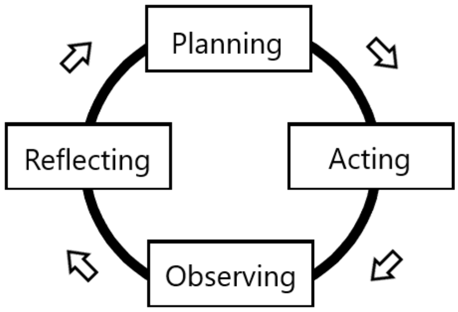

Figure 7. Kurt Lewin's action research spiral

The researcher identified that pupils are struggling in solving mathematical word problems and made plans to help them overcome the difficulties and reduce their errors by introducing the CUBES Maths Strategy. The research started with a written pre-test to assess the pupils' prior knowledge and the method they use to solve word problems. It was then followed by two rounds of intervention lessons, where solving word problems we re-taught by introducing the use of the CUBES Maths Strategy. A written post-test was then conducted after the intervention lessons to measure the pupils' achievement as well as to study the effectiveness of the newly taught method.

Questions in the post-test were slightly different from the pre-test but were of the same concept. For example, the first question in both papers are word problems on the addition between a 5- and 4-digit number but they are written in different scenarios. The following questions are in the same format. This ensures that pupils are not just recalling from memory to solve the same word problem but also trying to fully comprehend and solve the given word problem. The data collection process of this research is concluded by conducting a semi-structured interview with the pupils. The main questions are based on Newman's Error Analysis, a powerful diagnostic tool that involves five stages and is commonly used to assess pupils' numeracy and literacy abilities combined when solving word problems (White, 2009). All recorded results from the written tests and interviews were further analysed and concluded. The following flow chart (Figure 8) summarises the data collection process.

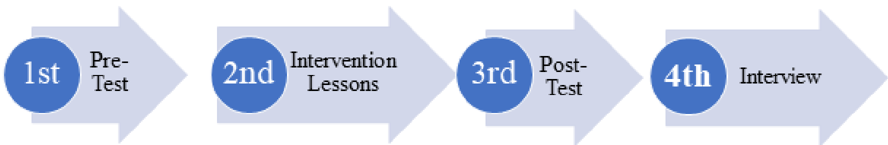

Figure 8. Flowchart for the summary of data collection process

The participants involved in this research were pupils from a small Brunei government primary school between the ages of 8 and 9 and were at the Year 4 level. This is because pupils at this level are at the developing stage where they would be able to read and understand the word problems, although they might not be able to fully comprehend them mathematically. This is also the stage where they will begin to understand mathematical problems that are more complex and they are developing reasoning thinking skills, where they truly grasp and differentiate between right and wrong (Zander, 2019). Pupils at this stage will also be able to communicate and express themselves in words which is advantageous, especially during the interview stage of this research.

The three instruments used in the data collection in this research are pre-test, post-test, and semi-structured interviews. The pre- and post-test design is selected for this research as it is commonly used to identify whether modifications that are made to the learning process that causes change in educational outcomes (Dugard & Todman, 1995) are successful or not. Scores from both tests will be recorded and analysed using Excel Software, where a Paired T-Test will be used to compare the mean differences (Hsu & Lachenbruch, 2014) of scores to conclude the effect of using the CUBES Maths Strategy on pupils' learning performance in solving word problems.

Newman's Error Analysis Interview will be used to identify the pupils' errors when solving word problems as it provides a link between literacy and numeracy where results completed by pupils will be analysed from the beginning to the end (Rr Chusnul et al., 2017). The theory behind this analysis indicates that there are five stages to solving word problems. The Reading (Decoding) Stage is the initial stage where pupils start off by reading and understanding the given word problem. It is then followed by the Comprehension Stage, where pupils will be able to identify what is given and what is required to be found. The Transformation or Modelling Stage requires pupils to use strategies, methods, or the correct formula to solve problems. The Process Skills Stage checks if the pupils are able to carry out the operation correctly. The final stage is the Encoding Stage, where pupils have to write their answers completed with the correct units.

Results

Intervention lessons

The first intervention lesson focuses on introducing the new strategy to the pupils, and the objective of the lessons is that pupils will be able to accomplish the first five steps of the steps-to-success checklist when using the CUBES Maths Strategy to solve word problems. As the lesson was done asynchronously, the researcher sent the pdf file of the lesson worksheet, steps-to-success card, and the video link of the lesson to the pupils involved through their parents via the WhatsApp application. The pupils were instructed to prepare themselves with hard copies of both the given worksheet and the Steps-to-Success Card before watching the given video. They were to attempt the word problems while following the researcher's step-by-step teaching in the video to solve the two given example word problems. The first example showed and explained how the CUBES Maths Strategy is to be used when solving word problems, while the second example concentrates only on the first five steps of the steps-to-success checklist.

The pupils were also given a couple of word problems to practice while concentrating only on the first five steps to enable them to get accustomed to using the new strategy. Once they had completed their tasks, they were to submit a soft copy of their work to the researcher.

From the pupils' submitted work, many of the pupils had not used the new strategy to solve the given word problems. As there was no instantaneous interaction between both the researcher and the pupils, the researcher could not confirm if the pupils had either watched or understood the given video or just went straight to completing the provided worksheet. The researcher then made changes to the second intervention lesson accordingly. Instead of another video, the researcher used an online application, Quizizz, that enables one to create a lesson slide quiz that promotes interaction with the pupils, although not synchronously. The questions given on Quizizz were to test the pupils on the steps of the CUBES Maths Strategy taught in the previous lesson. A word problem was also given to check if the pupils understood the use of the CUBES Maths Strategy. Toward the end of the Quizizz lesson, there were some questions regarding the CUBES Maths Strategy, which acts as the Exit Ticket for the intervention lesson. The questions were as follows:

1) What do you think of the CUBES Maths Strategy?
2) Do you have any questions about the CUBES Maths Strategy?
3) Do you think the CUBES Maths Strategy is easy or difficult?
4) Do you like the CUBES Maths Strategy?
5) Will you use the CUBES Maths Strategy when solving word problems?
6) State your reason.

The use of the Exit Ticket provides an opportunity to enhance the teaching and learning process as the pupils' experiences are being evaluated. It also encourages the researcher to reflect and develop personalised interventions based on their responses (Paz-Albo et al., 2022). In addition, it provides the researcher with information on the pupils' thoughts and opinions regarding this new method. Once the pupils completed Quizizz, they had to completely solve the word problems in the lesson worksheet. Figure 9 below shows the summary of the intervention lessons.

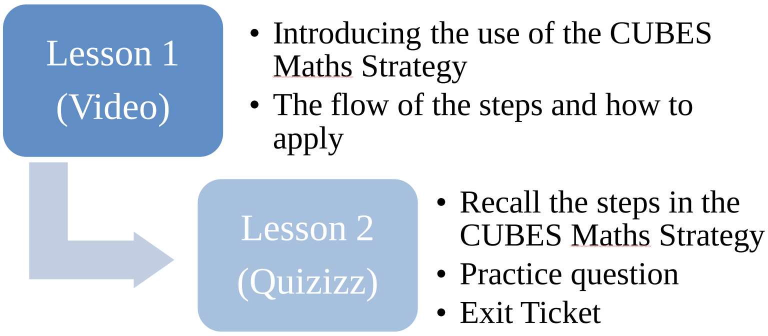

Figure 9. Flowchart for the summary of the intervention lessons

In addition, the results of the Exit Tickets are shown in the following figures.

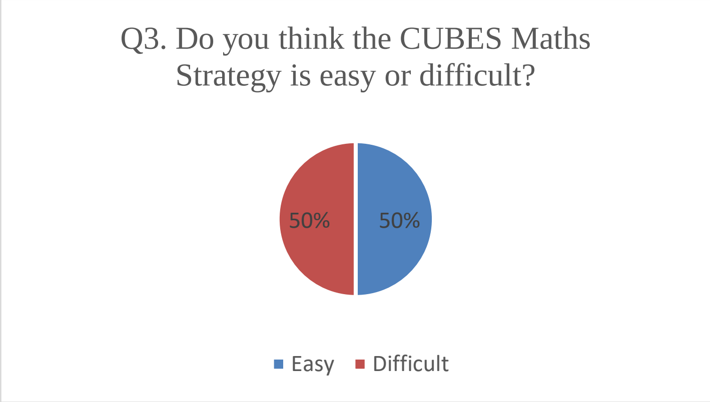

Figure 10. Quizizz exit ticket question 17

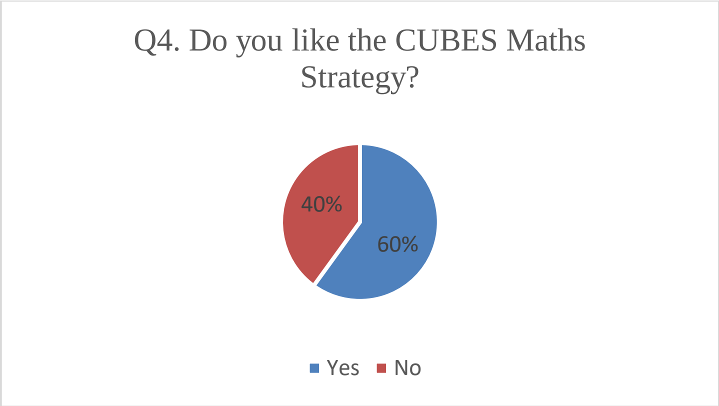

Figure 11. Quizizz exit ticket question 18

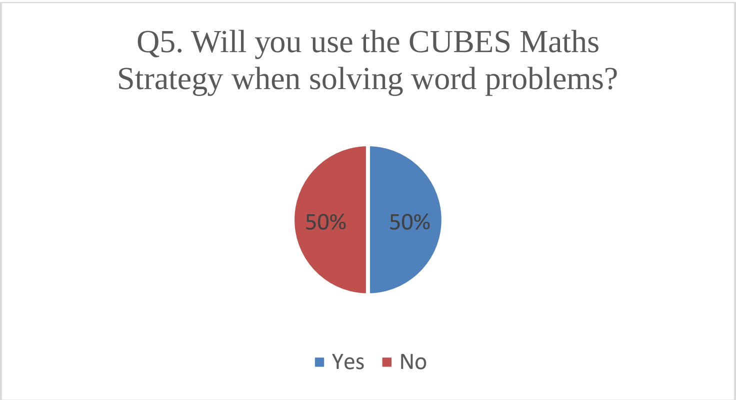

Figure 12. Quizizz exit ticket question 19

The last question in the Exit Ticket asked the pupils to state their reason for their answer to question 5. Below are some of the responses from the pupils, where they are divided on using the CUBES strategy.

"Yes. Easy for me to answer all the questions."

"No. Because it is hard to understand the cube strategy."

"No. It is difficult unless if there is more explanation by the teacher."

"Yes. Easy to know how to solve."

Pre- and post-tests

Among the 20 pupils who initially consented to participate in this research, 7 withdrew, and only 13 participants remained. Hence, only the 13 pupils who participated throughout the research will be considered for the analysis of the data collected. The study started with a written pre-test, and the scores collected were analysed, and Table 1 below shows the descriptive statistics. The central tendency of the pre-test scores shows that the average (mean) of the scores is 5.538, while the median and the mode are both at 6. The minimum score of 3 and the maximum score of 8 show that most pupils are familiar with solving mathematical word problems. The standard deviation of the scores, which is 1.761, shows that the scores are not very dispersed.

Table 1. Pre-test descriptive statistics

No. of pupils	Marks					
	Min.	Max.	Mean	Mode	Median	St. Dev
13	3	8	5.538	8	6	1.761

As for the written post-test, the average (mean) of the scores is found to be 5.769, while the median is 6 and the mode is 8. The standard deviation of the scores is 2.315, where the minimum score is 1, and the maximum score is 8. It was found that from the written post-test, only 3 pupils made use of the CUBES Maths Strategy; however, they only did half of the taught procedure. Samples of these pupils' work are shown in Figure 13, which shows that the pupil has done C, U, B, and S while omitting the E step, Figure 14 shows that the pupil underlined the important information required to solve the given word problem instead of Circle, Underline and Box, and Figure 15 shows the pupil only circled the number and underlined the identified keyword. Other findings, such as careless mistakes, were made by pupils where they wrote the wrong numbers in the algorithm and miscalculated them as well. The descriptive statistic of the written post-test is shown in Table 2.

Table 2. Post-test descriptive statistics

No. of pupils	Marks					
	Min.	Max.	Mean	Mode	Median	St. Dev
13	1	8	5.769	8	6	2.315

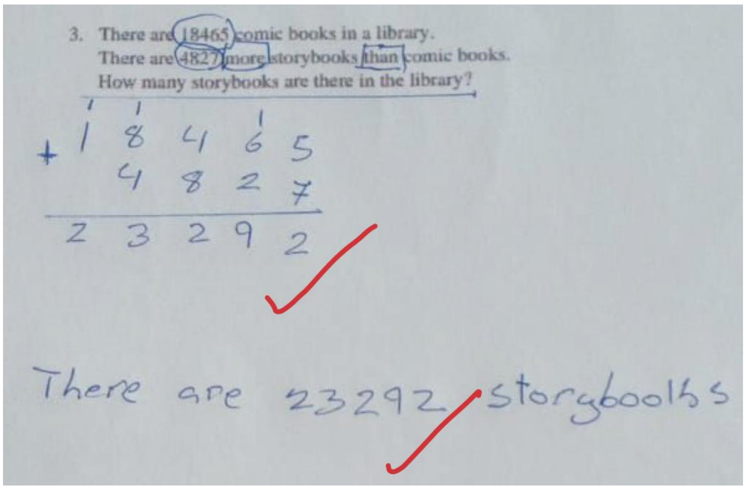

Figure 13. Sample of pupil E's work on using the CUBES maths strategy for question 3 in post-test

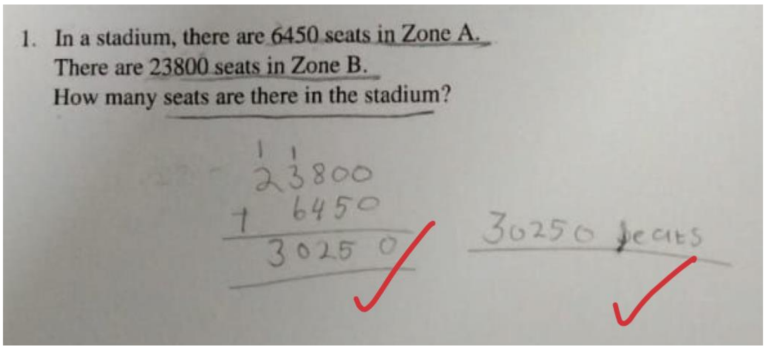

Figure 14. Sample of pupil F's work on using the CUBES maths strategy for question 1 in post-test

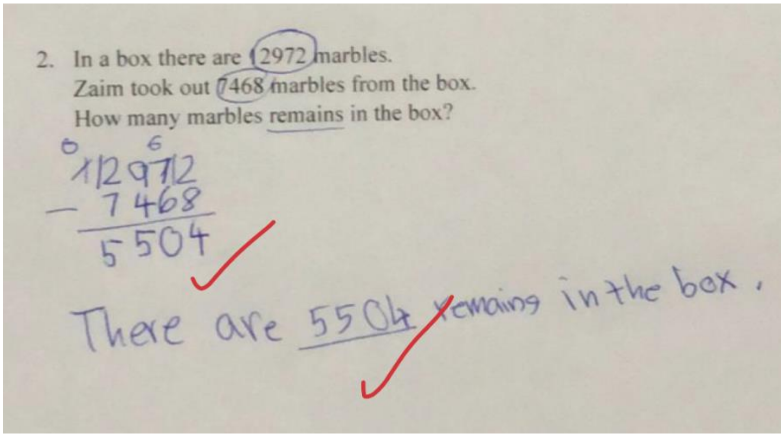

Figure 15. Sample of pupil H's work on using the CUBES maths strategy for question 2 in post-test

Comparison of pre- and post-test scores

To identify the effects of using the CUBES Maths Strategy to solve word problems, the scores from both the written pre- and post-test were analysed. The bar graph (Figure 16) below displays the overview of the pupils' pre- and post-test scores. As seen from the graph, there are some pupils whose scores either remained the same, increased, or decreased in the post-test. The boxplot (Figure 17) shows no outliers in the scores, meaning no scores are more than the upper quartile or less than the lower quartile. Hence, this indicates that both the mean of the data set and the skewness of the distribution will not be affected.

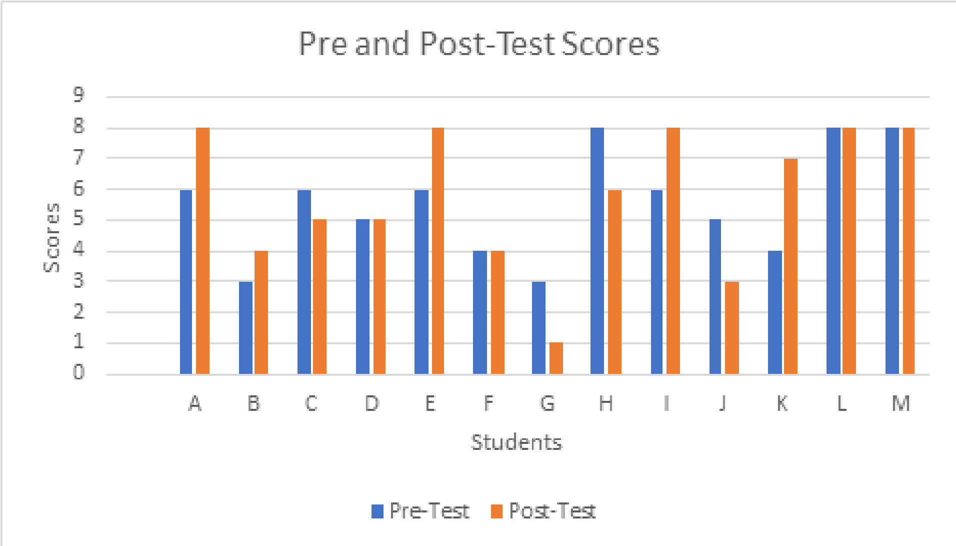

Figure 16. Bar graph of pre- and post-test scores

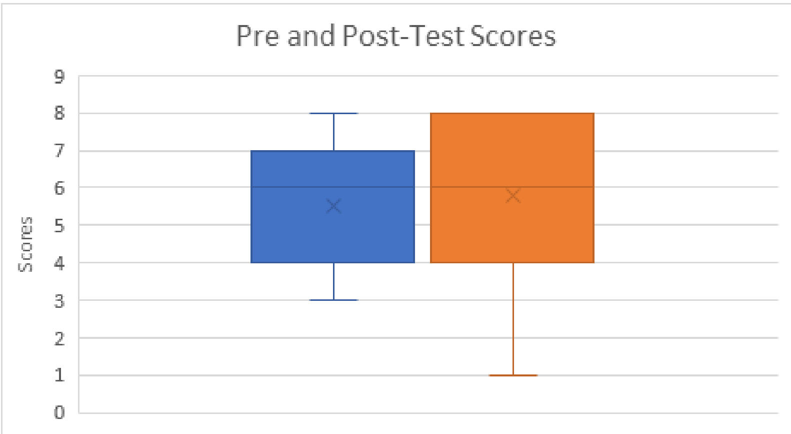

Figure 17. Boxplot of pre- and post-test scores

The data obtained meet the assumptions required to run a Paired T-Test. First, the subjects are independent as each pupil completes their own work for both the pre- and post-test. Second, each pair of measurements (test scores) are obtained from the same pupil on a continuous scale. Third, the distribution of differences in scores is normally distributed as shown in the boxplot (Figure 18), histogram (Figure 19), Normal Probability Plot (NPP) (Figure 20), and the data in Table 3 shows the descriptive statistic of the difference in scores as well as the results of the Shapiro-Wilk Normality Test (Table 4) by using the statistic functions in Excel Software.

Figure 18. Boxplot of difference in scores

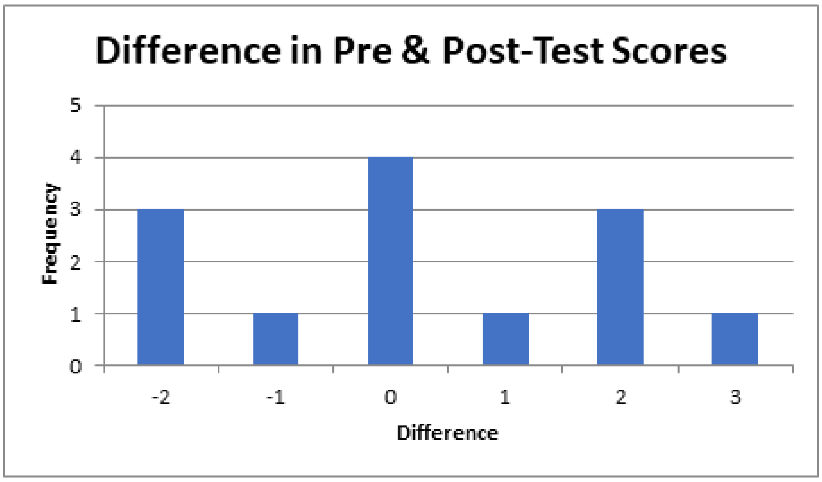

Figure 19. Histogram of difference in scores

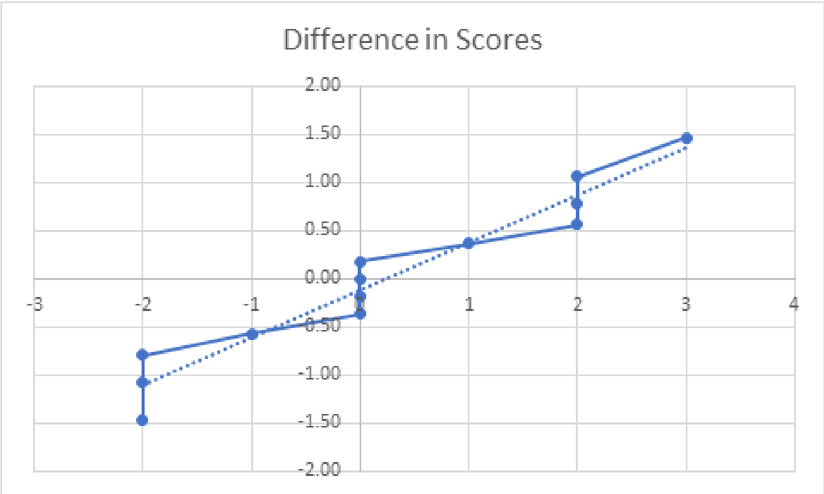

Figure 20. Normal Probability Plot (NPP) of difference in scores

Table 3. Descriptive statistic of the difference in scores

	Mean	Mode	Median	Std. Error	Std. Dev.	Var.	Min	Max	Skewness	Kurtosis
Post-test – Pre-test	0.230769	0	0	0.468957	1.69085	2.858974	-2	3	0.062927	-1.14144

Table 4. Test of normality using Shapiro-Wilk

W-Statistic	*df*	*p-value*
0.912716	12	1.99754

Regarding the normality of the data, from Table 3, both the mean and median of the differences in scores, which are 0.230769 and 0, respectively, are relatively close. At the same time, the skewness is found to be 0.062927 and is close to 0. The boxplot (Figure 18) shows no outliers present in the data, and the normal probability plot (Figure 20) shows a straight line indicating that the data is normally distributed. This is also confirmed by the results of the Shapiro-Wilk Test (Table 4), where the *p*-value is 1.99754 and is greater than 0.05. This means that the data are normally distributed and the null hypothesis is accepted.

Although the data obtained meet all the assumptions required to run a Paired T-Test, supported by the above figures, with the sample size being only 13, a Wilcoxon Signed Rank Test will be conducted instead. Hence, using Excel Software and the built-in Real Statistic Resource Pack, a Wilcoxon Signed-Rank Test is run to analyse the scores recorded with α =0.05 and the null hypothesis, H0: There is no effect.

The results from the test show that the median of both tests is 6. The sum of the positive ranks T+ is 27, while the sum of the negative ranks T- is 18, which indicates that the test statistics T=18. The p-value is found to be p>0.05 with a small size effect (r=0.096). When using the Wilcoxon Signed-Rank Test Critical Value Table, the critical value of this test corresponds to α =0.05, and the sample size of 9 is found to be 5. Since the test statistic (18) is not less than the critical value of 5, we fail to reject the null hypothesis. Hence, it is identified that there is no effect when using the CUBES Maths Strategy on pupils' learning performance in solving word problems.

Newman's error analysis interview analysis

Due to the small sample size, all the participants were to be interviewed to better identify the types of errors made by pupils when solving word problems by checking each pupil individually. However, out of the 13 pupils, only 10 pupils were able to make time to be interviewed through the Zoom meeting platform. The word problem that was used while interviewing the pupils was the last question from the written post-test paper because, from the breakdown of scores, the last question was identified to be the question that produced incorrect responses from 9 out of 13 of the pupils. Hence, all the pupils were interviewed using the same questions regardless of their answers in the written post-test. From the interviews, it was found that some of the pupils who committed careless mistakes could identify their errors while referring to their post-test papers during the interview.

Table 5. Interview results based on Newman's error analysis

ID	Reading	Comprehension	Transformation	Process Skills	Encoding
A					
B	/	/	/	/	/
C	/	/	/	/	/
D	X	/	X	X	X
E	X	/	X	X	X
F	X	/	/	X	X
G	X	X	X	X	X
H	X	X	X	X	X
I					
J	X	/	/	/	/
K	X	/	/	/	/
L					
M	X	X	X	X	X
Freq.	2	7	5	4	4
%	20%	70%	50%	40%	40%

Note: X Pupils have no problems in that stage
/ Pupils have problems in that stage

There were 4 interviews that were conducted bilingually and mainly in the Malay Language as the pupils had difficulties understanding what was asked or spoken in the English Language. Out of which, 2 of the pupils could not read the given word problem without assistance from their parents, where they were repeating word by word after their parents. Some pupils could read the given word problem smoothly but struggled when reading the given numbers mathematically.

Being able to read does not indicate that they are able to fully understand and comprehend the given word problem. It was identified that 70% of the pupils could not fully comprehend the given word problem. Most of the pupils, when asked, 'Can you explain what the sentence "Cinema B sold 3826 more tickets last month." meant?' replied by repeating the sentence. When followed by the question 'Which is more/less?' 7 out of 10 pupils answered by identifying the larger or smaller number respectively. This indicated that the pupils did not fully comprehend the word problem.

Although 8 of the pupils could identify the correct operation to be used, only half of them could make the connection between the operation to be used from the given keyword. However, this does not indicate that they are free of the transformation error, as they might just recall from their prior knowledge regarding the word 'more'; it suggests that addition should be used. This seems to be the case for 2 pupils as they were unable to comprehend the word problem but were able to identify the correct operation to be used.

From the results obtained, although only 40% of the pupils had errors in the process skill stage, there was a pupil who had errors in the transformation stage but was able to perform the mathematical calculation accurately. During the interview, this pupil was able to identify the correct operation to be used but was unable to justify it. As errors in the process skill stage occur only when the pupil cannot complete the operation accurately, the fact that the pupils solve the word problems without using the CUBES Maths Strategy or following the given procedures was ignored. It was found that only 3 pupils were seen to have solved the word problems in the post-test paper using the CUBES Maths Strategy but were only applying the first three steps of the procedure, as shown in Figure 13, Figure 14, and Figure 15 above. When asked in the interview why the next step was omitted, they stated that the fourth step (Examine the problem) is difficult; hence they skipped the step and proceeded to solve it. The remaining pupils who did not use the strategy mentioned that it was because they did not understand it.

For the Encoding stage, pupils who were able to identify the mistakes made in their post-test during the interview were seen to recalculate the numbers and give the correct answer by representing it appropriately with the correct units. The same happened for those who answered the question correctly but did not include the correct units in their post-test paper, while the other 40% of the pupils were unable to state the correct answers with the appropriate units. Therefore, the results shown in Table 5 above show that most of the pupils have errors in both the Comprehension (70%) and Transformation (50%) stages.

Discussion

Due to the COVID-19 restrictions and policies, the research was conducted not only in a remote setting but also asynchronously. This is because, during this endemic stage, pupils of the primary sectors still study from their homes while most parents work from their offices. This meant there might be a lack of adult supervision while the pupils attended the synchronous live classes. Another reason for classes being conducted asynchronously is due to the fact that the majority of the pupils do not own personal devices and have no stable internet connection, which results in them having to wait for their parents to get home from work to use their devices. In addition, those with multiple siblings who share only one device among themselves meant that they might not be able to attend the synchronous classes during the assigned period. This is especially the case for pupils from families with socio-economic disadvantages who cannot afford the necessary gadgets or reliable internet access (Qazi et al., 2020) that allows them to be connected and attend the online classes held by their teachers.

As most of the pupils do not own a personal device, the means of communication between the pupils and teachers is through their parents via the WhatsApp application, one of the most used applications that can be utilised for multiple works and purposes, including learning (Kholis, 2020). Although this application is convenient for sending instant messages and supports the function of sending multimedia messages, because the parents are the middle persons, it reduces the social interaction that is essential for children's learning and development. The study of Hurst (2013) concluded that interaction between peers highly contributed to learning as it enhanced both the pupils' critical thinking and problem-solving skills. Okita et al. (2007) found that when novel social variability is present in one's responding tone during interaction with one another, it leads to superior learning.

With the lack of interaction between the researcher and participants, pupils were seen to have difficulties relating to the lesson contents and felt uncertain about what the teacher was explaining (Syahputri et al., 2020). The researcher is also unable to identify if the pupils fully understood the content of the given lessons (Mukhtar et al., 2020) and if further clarifications were required as there was no feedback regarding the lessons taught. In the case where feedback is given, it is not immediate as it requires one to wait for the other to review the given tasks and give comments (Vlasenko & Bozhok, 2014). In addition, the researcher is also unable to observe the pupils when they are answering the pre- and post-test papers and is unable to check and verify if the pupils are taking the tests on their own or with assistance from others. As the pupils do not own their own devices, the researcher had to schedule appointments with the pupils for interviews by relying on their parents' availability.

The first intervention lesson was conducted with a video that introduced the CUBES Maths Strategy, which includes two examples of solving word problems using a straightforward step-by-step procedure of approach. When using a video, pupils can easily access it, allowing them to pause, reverse or replay the video (Bell & Bull, 2010) whenever required. The video must show clear visuals and audio, enabling the pupils to follow and understand what is being shown and explained. There was no instantaneous feedback, and the only interaction was when the pupils submitted their given worksheets which showed that most pupils did not use the newly taught strategy. This leads the researcher to presume that the pupils were neither fully attentive when watching the given video nor were they taking note of the instructions and might have just downloaded the given worksheet and completed it as it was.

For the second intervention lesson, taking the first lesson and its outcome into consideration, the researcher then used the Quizizz Online Platform to create a lesson-like quiz. This game-based education application includes interactive features where participants will be able to draw and write on the screen where required. As the application is widely used to encourage pupils to have friendly competitions among their peers and motivate them to study (Zhao, 2019), the researcher hopes that by using this application, the pupils will be more interactive and take the initiative to participate in the lesson. The responses from the pupils indicated that the pupils were struggling in the part of Examine the problem but did not reach out to the researcher regarding this matter, and the researcher was unable to clarify and assist the pupils.

The findings of this study which identified the pupils' errors are similar to the analysis done by Raduan (2010), which showed that many of the mistakes made when solving word problems were due to comprehension and were followed by transformation skills. This study also showed that the majority of the pupils did not have any difficulties in reading which is similar to Triliana and Asih (2019)'s findings, where the pupils were able to read the words accurately; however, they were unable to fully understand the overall problem including specific terms that were in the problem.

An Exit Ticket section was included in the Quizizz, which asked the pupils about their thoughts regarding using the CUBES Maths Strategy when solving word problems. However, only 10 pupils did the interactive activity, and from their responses, the researcher conjectured that the pupils do think that the CUBES Maths Strategy is simple for them to use to solve word problems. However, they need more explanation to fully understand how to use the strategy easily. This also indicates that the pupils are not ready for full independent learning and are highly reliant on teachers. Jorgensen (2003) stated in her research that although she believes that Asynchronous Learning Networks (ALN) are able to foster and offer a rich collaborative learning environment, they might not be suitable for everyone. She also mentioned that young college students may still require a face-to-face learning environment, suggesting that pupils much younger than that level would highly require the traditional face-to-face classroom settings.

In reference to the responses received from the pupils, it showed that the pupils were willing to learn more about this strategy and were not applying it because they had not fully understood it. Hence, there is a need for teachers' professional development regarding the use of the CUBES Maths Strategy, which will allow teachers to receive proper training and gain the adequate knowledge required to teach this strategy. In addition, teachers will be able to explore the strategy as a group and produce multiple ways to help pupils to understand the strategy compatible with their individual abilities and needs.

As the pupils are found to be struggling in both the comprehension and transformation stages, it is important for the teachers to assist pupils in processing the given information so that they are able to translate the sentences from words to numerals. Teachers can also help pupils to relate the word problems and perhaps include the use of diagrams to help them to visualise the problem.

Conclusion

Although this study found no significant difference in solving word problems using the CUBES Maths Strategy, Newman's Error Analysis found that the problem lies even deeper where pupils in this study could not comprehend the word problems. Even if the pupils were able to Circle, Underline, and Box the important details, they are still short of the E and S parts of CUBES, where without comprehension, the pupils are still unable to Examine the problem and are even find it difficult to Solve. Furthermore, the remote learning situation exacerbated this problem where synchronous interaction between teacher and pupils was absent.

Acknowledgment

The authors gratefully acknowledge the participants of this study, the school, and the parents that allowed us to conduct this study. This study is based on the first authors' unpublished Research Exercise submitted to Universiti Brunei Darussalam.

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript.

Funding Statement

This work received no specific grant from any public, commercial, or not-for-profit funding agency.

Author Contributions

Christina Teo Lian Wan: Conceptualization, investigation, formal analysis, writing - original draft, editing, and visualization; **Nor Azura Abdullah:** Writing - review & editing, validation, and supervision.

References

Avison, D. E., Lau, F., Myers, M. D., & Nielsen, P. A. (1999). Action research. *Communications of the ACM*, *42*(1), 94–97. https://doi.org/10.1145/291469.291479

Bell, L., & Bull, G. (2010). Digital video and teaching. *Contemporary Issues in Technology and Teacher Education*, *10*(1), 1–6.

Cummins, D. D., Kintsch, W., Reusser, K., & Weimer, R. (1988). The role of understanding in solving word problems. *Cognitive Psychology*, *20*(4), 405–438. https://doi.org/10.1016/0010-0285(88)90011-4

Daroczy, G., Wolska, M., Meurers, W. D., & Nuerk, H. C. (2015). Word problems: a review of linguistic and numerical factors contributing to their difficulty. *Frontiers in Psychology*, *6*, 348. https://doi.org/10.3389/fpsyg.2015.00348

Dewolf, T., Dooren, W., Ev Cimen, E., & Verschaffel, L. (2014). The impact of illustrations and warnings on solving mathematical word problems realistically. *The Journal of Experimental Education*, *82*(1), 103–120. https://doi.org/10.1080/00220973.2012.745468

Dugard, P., & Todman, J. (1995). Analysis of pre-test-post-test control group designs in educational research. *Educational Psychology*, *15*(2), 181–198. https://doi.org/10.1080/0144341950150207

Gafoor, K. A., & Kurukkan, A. (2015). *Why high school students feel mathematics difficult? An exploration of affective beliefs*. Online Submission.

Gooding, S. (2009). Children's difficulties with mathematical word problems. *Proceedings of the British Society for Research into Learning Mathematics*, *29*(3), 31–36.

Hsu, H., & Lachenbruch, P. A. (2014). *Paired t test*. Reading Horizons.

Hurst, B., Wallace, R. R., & Nixon, S. B. (2013). *The impact of social interaction on student learning*. Reading Horizons.

Jones, G. M. (2016). Policy and practice in the use of English in Brunei primary school classes. *World Englishes*, *35*(4), 509–518. https://doi.org/10.1111/weng.12222

Jorgensen, D. (2003). The challenges and benefits of asynchronous learning networks. *The Reference Librarian*, *37*(77), 3–16. https://doi.org/10.1300/J120v37n77_02

Kholis, A. (2020). The use of whatsapp app in distance language learning in pandemic COVID-19: A case study in Nahdlatul Ulama University of Yogyakarta. *LET: Linguistics, Literature and English Teaching Journal*, *10*(2), 24–43. https://doi.org/10.18592/let.v10i2.4051

Lewin, K. (1946). Action research and minority problems. *Journal of Social Issues: A Journal of the Society for the Psychological Study of Social Issues* *2*(4), 34-46. https://doi.org/https://doi.org/10.1111/j.1540-4560.1946.tb02295.x

Majeed, A., Fraser, B. J., & Aldridge, J. M. (2002). Learning environment and its association with student satisfaction among mathematics students in Brunei Darussalam. *Learning Environments Research*, *5*(2), 203–226. https://doi.org/10.1023/A:1020382914724

MoE. (1993). *Report of the working committee on mathematics for examination, Brunei-Cambridge GCE 'O' level*. Ministry of Education.

Mukhtar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, limitations and recommendations for online learning during COVID-19 pandemic era. *Pakistan Journal of Medical Sciences*, *36*(COVID19-S4), 27. https://doi.org/10.12669/pjms.36.COVID19-S4.2785

Mundia, L., & Metussin, H. (2019). Exploring factors that improve mathematics achievement in Brunei. *Studies in Educational Evaluation*, *60*, 214–222. https://doi.org/10.1016/j.stueduc.2018.10.003

Okita, S. Y., Bailenson, J., & Schwartz, D. L. (2007, 2007). *The mere belief of social interaction improves learning* Proceedings of the Twenty-ninth Meeting of the Cognitive Science Society,

Paz-Albo, J., Ruiz, J. M., Bernárdez-Vilaboa, R., Huerta-Zavala, P., & Hervás-Escobar, A. (2022). The impact of socrative exit tickets on initial teacher training. *College Teaching*, *70*(4), 413–421. https://doi.org/10.1080/87567555.2021.1971602

Pungut, M. H. A., & Shahrill, M. (2014). Students' English language abilities in solving mathematics word problems. *Mathematics Education Trends and Research*, 1–11. https://doi.org/10.5899/2014/metr-00048

Qazi, A., Naseer, K., Qazi, J., AlSalman, H., Naseem, U., Yang, S., & Gumaei, A. (2020). Conventional to online education during COVID-19 pandemic: Do develop and underdeveloped nations cope alike. *Children and Youth Services Review*, *119*, 105582. https://doi.org/10.1016/j.childyouth.2020.105582

Raduan, I. H. (2010). Error analysis and the corresponding cognitive activities committed by year five primary students in solving mathematical word problems. *Procedia-Social and Behavioral Sciences*, *2*(2), 3836–3838. https://doi.org/10.1016/j.sbspro.2010.03.600

Rr Chusnul, C., Mardiyana, S., & Retno, D. (2017). Errors analysis of problem solving using the Newman stage after applying cooperative learning of TTW type. *American Institute of Physics Conference Series*, *1913*(1), 1–7.

Syahputri, V. N., Rahma, E. A., Setiyana, R., Diana, S., & Parlindungan, F. (2020). Online learning drawbacks during the Covid-19 pandemic: A psychological perspective. *EnJourMe (English Journal of Merdeka): Culture, Language, and Teaching of English*, *5*(2), 108–116. https://doi.org/10.26905/enjourme.v5i2.5005

Tibbitt, M. (2016). *Comparing the effectiveness of two verbal problem solving strategies: Solve It! and CUBES* [Masters Thesis, Rowan University, United States]. https://rdw.rowan.edu/etd/1632/

Triliana, T., & Asih, E. C. M. (2019). Analysis of students' errors in solving probability based on Newman's error analysis. *Journal of Physics: Conference Series*, *1211*(1), 012061. https://doi.org/10.1088/1742-6596/1211/1/012061

Verschaffel, L., Schukajlow, S., Star, J., & Dooren, W. (2020). Word problems in mathematics education: A survey. *ZDM*, *52*(1), 1–16. https://doi.org/10.1007/s11858-020-01130-4

Vlasenko, L., & Bozhok, N. (2014). Advantages and disadvantages of distance learning. http://dspace.nuft.edu.ua/jspui/handle/123456789/20684

White, A. L. (2009, 2009). *A revaluation of Newman's error analysis* MAV Annual Conference,

WHO. (2020). *Coronavirus*. https://www.who.int/health-topics/coronavirus#tab=tab_1

Yusof, J. (2003). *Mathematics errors in fractions work: a longitudinal study of primary level pupils in Brunei [Unpublished doctoral dissertation*. Curtin University.

Zander, M. (2019). A milestone development stage: The age of reason. https://www.scholastic.com/parents/family-life/social-emotional-learning/development-milestones/age-reason.html

Zhao, F. (2019). Using quizizz to integrate fun multiplayer activity in the accounting classroom. *International Journal of Higher Education*, *8*(1), 37–43. https://doi.org/10.5430/ijhe.v8n1p37