Proceedings of the International Conference on Special Education
Vol.5 (2023) / e-ISSN 2948-4731 (103-111)
SEAMEO Regional Centre for Special Educational Needs

THE EFFECTIVENESS OF THE MATH KEYWORD SHEET AND THE CUBES-V STRATEGY IN SOLVING MATHEMATICAL PROBLEMS IN REMEDIAL CLASS

[1*]Tan Siew Joey, [1]Chan Mun Syuen, [1] Lewis Sia Qi Kai, [1]Afian Akhbar Mustam & [1]Hanani Harun Rasit

Institut Pendidikan Guru Kampus Pendidikan Teknik, Malaysia

[*]501-*8-tan@epembelajaran.edu.my*

ABSTRACT

This action research was conducted with the aim of assisting Year Four students in mastering problem-solving skills in the topic of whole numbers and basic operations using the Mathematics Keyword Sheet and CUBES-V strategy. Four students from class 4A of a SJKC (Chinese vernacular school) in Taiping, Perak, were selected as the research subjects based on a diagnostic test. Two participants faced serious difficulties in reading and understanding the questions due to their mother tongue not being Chinese, while the other two participants had a moderate level of understanding but lacked skills in solving mathematical word problems. The research instruments used to collect data for this action research included pre-tests, post-tests, observations, and structured interviews. The quantitative analysis was applied to the data obtained from the pre-test and post-test, while qualitative analysis was used for observations and structured interviews. Two interventions were implemented using the Mathematics Keyword Sheet and CUBES-V strategy. The study findings indicated a significant improvement in the minimum scores of all four students. In terms of attitude, the students transformed from being passive to active, and those who lacked confidence became more assured in answering mathematical word problems. Clearly, the Mathematics Keyword Sheet encompassing three main languages helped the students comprehend the requirements of questions written in Chinese. Additionally, the use of the CUBES-V strategy served as a guideline to assist the students in formulating mathematical sentences from the context of word problems accurately and effortlessly.

Keywords: CUBES-V, mathematics keyword sheet, problem-solving

INTRODUCTION

The researcher is a trainee teacher pursuing the option of Primary Mathematics Education at the Institute of Teacher Education, Campus of Technical Education (IPG KPT), where the course duration is five and a half years. Throughout the practicum, the researcher was assigned to teach Mathematics to Class 4A at a Chinese National-type School (SJKC) in Taiping, which has a total of 30 students. During the teaching period, the researcher noticed that some students were not achieving satisfactory marks in solving mathematical word problems. According to the Ministry of Education Malaysia (2013), problem-solving is the core of mathematics as it emphasizes not only the subject's learning but also the development of thinking skills. Additionally, a study by Susanti et al. (2014) found that students find it difficult to solve mathematical word problems, and some of the challenges they face include reading and interpreting data, identifying and representing data, and using appropriate strategies

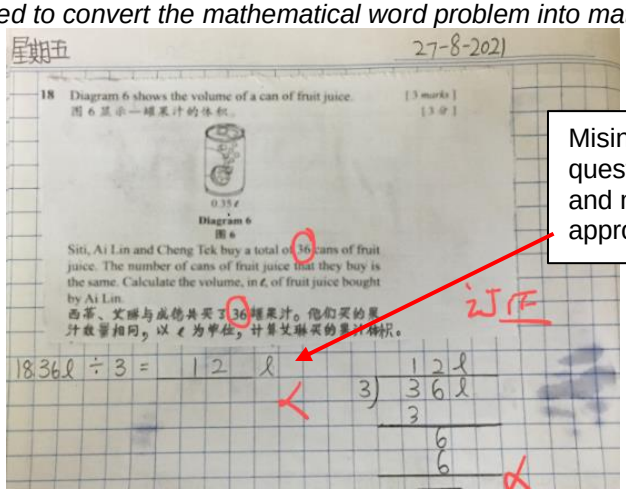
DOI: https://zenodo.org/record/8336752
Published by: https://publication.seameosen.edu.my/index.php/icse/issue/view/5

Therefore, the researcher decided to use the CUBES-V strategy (Circle the numbers, Underline the question you need to answer, Box the keywords, Evaluate and eliminate unnecessary information, Solve and Verify the answer) to enhance students' systematic problem-solving skills in mathematical word problems after they understand the questions with the help of the provided mathematics keyword sheet.

Problem Statement

Based on the researcher's experience and observations during providing exercises related to solving mathematical word problems, some students struggle to correctly convert narrative mathematical problems into mathematical sentences (Figure 1).

Figure 1: *Student failed to convert the mathematical word problem into mathematical sentences.*



Therefore, the researcher conducted a diagnostic test, document review, observations, and interviews as initial data collection to select study participants who had difficulties in understanding and solving mathematical word problems. Ultimately, four students were chosen as participants for the study. These four students had a common characteristic, which was showing low interest when the researcher taught the solution of mathematical word problems on any topic. After conducting interviews with their mathematics teacher, the researcher found out that they were students who had recently transferred to a Chinese National Type School (SJKC). Among the participants, there was an Indian student who was not a native Chinese speaker, and a few Chinese students who were raised in an English-speaking environment and faced challenges in being fluent in the Chinese language, which caused them not to understand the question requirements. The most significant problem identified was that these students did not grasp the strategies for solving mathematical word problems. As a result, the focus of the researcher's study was to enable the participants to comprehend the question requirements and to assist them in mastering the CUBES-V strategy in solving mathematical word problems. This focus was crucial because solving mathematical word problems involves more than just finding the final answer; it entails understanding and mastering more complex strategies, such as understanding the question's meaning, connecting information with operations, performing identified operations, and obtaining the desired solution.

Research Objectives

1. To ensure that students can follow the steps in the CUBES-V strategy while solving mathematical word problems.
2. To examine the effectiveness of using mathematics keyword sheet and the CUBES-V strategy in assisting Year Four students in solving mathematical word problems.

Research Questions

1. Would students follow the steps in the CUBES-V strategy while solving mathematical word problems?
2. Would students use of mathematics keyword sheet and the CUBES-V strategy assist Year Four students in solving mathematical word problems?

METHODOLOGY

There are various research models that can be utilized, but in this study, the researcher has chosen the model and process of action research by Kurt Lewin (1946). In the first cycle, this model consists of five steps, namely identifying the aspects of practice, planning, observing, and reflecting on the effectiveness of the actions taken. This cycle will be repeated starting with the planning step if the findings in the first cycle are unsatisfactory. Figure 2 shows Kurt Lewin's (1946) model and process of action research.

Figure 2: *Model and process of action research by Kurt Lewin (1946)*

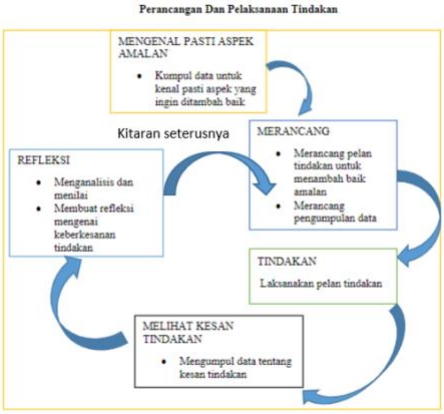


Table 1 is my plan following the steps in the selected cycle model.

Table 1: *Implementation of Planning*

Steps	Implementation of Planning
Identifying the aspects of practices.	● Conducting reflections on Teaching and Facilitation (PdPc) and determining the research focus ● Carrying out diagnostic tests, conducting interviews with mathematics teachers, reviewing documents, and making observations to determine the study participants.

<table>
<tr><td>Designing</td><td>

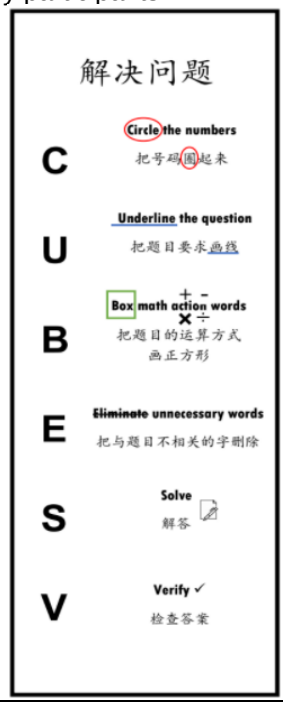
Determining the research objectives, research questions, and designing the intervention actions.
Developing a data collection plan and determining data collection instruments (pre-test, post-test, structured interviews, structured observations).

</td></tr>
<tr><td>Implementing Action</td><td>

Conducting the first intervention, which is teaching the study participants to understand the question requirements with the help of the Mathematics Keyword Sheet.

ISTILAH MATEMATIK TOPIK SATU
数学练习词汇-第一课
<table>
<tr><th>Bil.</th><th>华文 Bahasa Cina</th><th>英文 Bahasa Inggeris</th><th>马来文 Bahasa Melaysia</th></tr>
<tr><td>1.</td><td>总共</td><td>total</td><td>jumlah</td></tr>
<tr><td>2.</td><td>比较</td><td>compare</td><td>bandingkan</td></tr>
<tr><td>3.</td><td>被除数</td><td>dividend</td><td>dividen/nombor yang dibahagi</td></tr>
<tr><td>4.</td><td>倍数</td><td>multiple</td><td>gandaan</td></tr>
<tr><td>5.</td><td>算/数</td><td>count</td><td>bilang</td></tr>
<tr><td>6.</td><td>乘以</td><td>times</td><td>darab</td></tr>
<tr><td>7.</td><td>两倍 两</td><td>doubles</td><td>gandaan</td></tr>
<tr><td>8.</td><td>倍</td><td>times</td><td>ganda</td></tr>
<tr><td>9.</td><td>多于</td><td>more than</td><td>lebih daripada</td></tr>
<tr><td>10.</td><td>少于</td><td>less than</td><td>kurang daripada</td></tr>
<tr><td>11.</td><td>相差</td><td>difference</td><td>beza</td></tr>
<tr><td>12.</td><td>全部</td><td>altogether</td><td>kesemuanya</td></tr>
<tr><td>13.</td><td>最简形式</td><td>simplest form</td><td>bentuk termudah</td></tr>
<tr><td>14.</td><td>余数</td><td>remainder</td><td>baki</td></tr>
<tr><td>15.</td><td>数量</td><td>numbers</td><td>bilangan</td></tr>
<tr><td>16.</td><td>相同的</td><td>similar</td><td>serupa</td></tr>
<tr><td>17.</td><td>平分</td><td>sharing equally</td><td>kongsi sama banyak</td></tr>
<tr><td>18.</td><td>等于</td><td>equals to</td><td>sama dengan</td></tr>
<tr><td>19.</td><td>除数</td><td>divisor</td><td>pembahagi</td></tr>
<tr><td>20.</td><td>除</td><td>divide</td><td>bahagi</td></tr>
<tr><td>21.</td><td>乘</td><td>multiply</td><td>darab</td></tr>
<tr><td>22.</td><td>二等</td><td>half</td><td>separuh</td></tr>
</table>

Implementing the second intervention, which involves introducing CUBES-V to the study participants.



</td></tr>
<tr><td>Observing the Impact of Actions</td><td>

Comparing the pre-test scores with the post-test scores and illustrating the differences using a bar graph.
Analysing interview transcripts and presenting them in narrative form.
Analysing and presenting the frequency results from the checklist in narrative form.

</td></tr>
<tr><td>Reflection</td><td>Evaluating the strengths and weaknesses throughout the study and proposing appropriate improvements.</td></tr>
</table>

FINDINGS AND DISCUSSION

Question 1:

Can students follow the steps in the CUBES-V strategy while solving mathematical word problems?

Observation

Observations were conducted before the study to identify the students' mastery of the CUBES-V strategy and their confidence level. Post-intervention observations aimed to assess any changes that occurred in the mastery of the CUBES-V strategy and the level of confidence in solving mathematical word problems, whether there was an improvement or not. Table 2 presents the observed items.

Table 2: *Observed Items*

No.	Item Observed
1.	Students understand the requirements of the question.
2.	**C - Circle the number.** Students can round the numbers or digits found in the question.
3.	**U- Underline the question** Students can identify and underline the question's content.
4.	**B- Box the keywords.** Students can comprehend and enclose the important keywords in the question.
5.	**E- Evaluate and eliminate unnecessary information** Students can determine the operation (addition, subtraction, multiplication, or division) needed to solve the given question.
6.	**S- Solve** Students can solve the given question using the correct method.
7.	**V- Verify** Students can review the answer using the obtained value to ensure it is correct.

The findings obtained have been analysed in the form of percentages (Table 3). The level of students mastery are divided by 3, High (H), Moderate (M) and Low (L).

Table 3: *Item Observed*

Item	Before intervention			After intervention		
	H	M	L	H	M	L
1. Students understand the requirements of the question.	0 (0%)	8 (50%)	8 (50%)	14 (87.5%)	2 (12.5%)	0 (0%)
2. C- Circle the number. Students can round the numbers or digits found in the question.	0 (0%)	6 (37.5%)	10 (62.5%)	16 (100%)	0 (0%)	0 (0%)
3. U- Underline the question. Students can identify and underline the question's content.	0 (0%)	4 (25%)	12 (75%)	16 (100%)	0 (0%)	0 (0%)
4. B- Box the keywords.	0 (0%)	1 (6.25%)	15 (93.75%)	16 (100%)	0 (0%)	0 (0%)

Students can comprehend and enclose the important keywords in the question.						
5. E- Evaluate and eliminate unnecessary information Students can determine the operation (addition, subtraction, multiplication, or division) needed to solve the given question.	0 (0%)	2 (12.5%)	14 (87.5%)	15 (93.75%)	1 (6.25%)	0 (0%)
6. S- Solve Students can solve the given question using the correct method.	0 (0%)	1 (6.25%)	15 (93.75%)	11 (68.75%)	5 (31.25%)	0 (0%)
7. V- Verify Students can review the answer using the obtained value to ensure it is correct.	0 (0%)	0 (0%)	16 (100%)	12 (75%)	4 (25%)	0 (0%)
Overall	0%	19.64%	80.36%	75%	25%	0%

Overall, based on Table 3, before the intervention, the percentage at the high level was 0%. After the intervention, the percentage at the high level has increased to 75%. The percentage at the moderate level increased from 19.64% to 25%, while the percentage at the low level decreased from 80.36% to 0%. This is because the CUBES-V strategy is an easily applicable strategy by the study participants in solving mathematical word problems.

Interview

To strengthen the findings from observations, the researcher conducted interviews with study participants to gather further information, and all interviews were transcribed to support the obtained data. Table 4 shows the items asked to the study participants.

Table 4: *Pre-intervention Interview Items*

No.	Questions
1.	How do you feel when given mathematical word problems? 当你遇到数学应用题时，你有什么感受？
2.	Does the teacher use any strategies to solve mathematical word problems? 老师曾否使用数学应用题的解决策略？
3.	Can you read and understand all the words in the given questions? 你可以读问题中的所有单词吗？
4.	Do you understand all the words in the given questions? 你明白问题中的所有单词吗？
5.	Are you capable of verbally explaining to the teacher how to solve mathematical word problems? 你能用口头方式告诉老师如何解决数学应用题吗？

The findings from the interviews with all four participants before the intervention revealed that they were not interested and lacked confidence in solving mathematical word problems. They tended to avoid attempting mathematical word problems because they were not familiar with strategies for solving them. They felt unsure about converting word problems into mathematical sentences accurately. Additionally, they had difficulty selecting the appropriate mathematical operation based on the requirements of the problem.

After the intervention was provided, the researcher conducted structured interviews once again. Table 5 represents the items discussed with the study participants.

Table 5: *Post-intervention Interview Items*

No.	Questions
1.	How do you feel when given mathematical word problems? 当你遇到数学应用题时，你有什么感受？
2.	Do you understand all the words in the given questions? 你明白问题中的所有单词吗?
3.	Are you capable of verbally explaining to the teacher how to solve mathematical word problems? 你能用口头方式告诉老师如何解决数学应用题吗？
4.	Does the CUBES-V strategy help you solve mathematical word problems? Why? CUBES-V 策略是否可以帮助你解决数学应用题？
5.	Does the mathematics keyword sheet aid you in solving word problems? Why? 三语的数学关键字表是否有帮助你理解数学应用题问题？

After analysing the interview transcripts with the study participants, the conclusion that can be drawn is that the CUBES-V strategy can help students improve their mathematical word problem-solving skills, and the mathematics keyword sheet can aid their understanding of problem requirements. This is evident as the study participants were able to explain the acronym for the CUBES-V problem-solving strategy introduced to them. Furthermore, they were able to state the actions required for each letter in the CUBES-V acronym, demonstrating their comprehension of the introduced method. Additionally, the study participants could grasp the keywords or terms related to the topic of numbers and operations because the mathematics keyword sheet included three languages: Chinese, English, and Malay.

Question 2:

Can the use of the CUBES-V strategy (Circle the numbers, Underline the question you need to answer, Box the keywords, Evaluate and eliminate unnecessary information, Solve and Verify the answer) help Year Four students solve mathematical word problems?

Written Test

Findings from the pre-test and post-test study indicate that the use of the CUBES-V strategy can assist Year Four students in solving mathematical word problems. This is based on the analysis of score differences between the pre-test and post-test for all four participants in the study. There was an improvement in scores between the pre-test and post-test. The following (Table 6) is an analysis of the pre-test and post-test that proves the effectiveness of the CUBES-V strategy in aiding students in solving mathematical word problems:

Table 6: *Comparison Between Pre-Test and Post-Test*

Study Participants	Marks (/20)		Percentages (%)		
	Pre-Test	Post-Test	Pre-Test	Post-Test	Improvement
A	5	17	25	85	60
B	1	17	5	85	80
C	7	16	35	80	45
D	4	16	20	80	60

Furthermore, a comparison of the minimum test scores was conducted by calculating the pre-test and post-test minimum test scores as shown in Table 7.

Table 7: *Min Marks for Pre-Test and Post-Test*

Study Participants	Pre-Test (%)	Post-Test (%)
A	25	85
B	5	85
C	35	80
D	20	80
	21.25	82.5
Increase in mean= 82.50% - 21.25% = 61.25%		

Based on Table 7, the minimum score for the pre-test was 21.25 because all the students were unable to correctly solve the given problems. However, the minimum score for the post-test increased to 82.5. Clearly, the study participants achieved higher scores in the post-test compared to the pre-test. This achievement also indicates that the use of the CUBES-V strategy can assist Year Four students in solving mathematical word problems.

CONCLUSION

The researcher has gained much knowledge and experience through this action research. Among the knowledge acquired is the way to write a research proposal and report for action research. Learning the proper format of writing has been a valuable experience that will facilitate future action research endeavours. Furthermore, the precision in analysing and reviewing data carried out in this action research provided the opportunity for the researcher to examine the work done by the study participants and identify the root causes of any issues that arose.

Moreover, this action research has also had a positive impact on all four study participants. Overall, they demonstrated improvements in both confidence and skills in solving mathematical word problems through their worksheets. The increase in confidence among the study participants regarding solving mathematical word problems is particularly gratifying for the researcher, as the CUBES-V strategy and the mathematics keyword sheet produced by the researcher proved to be effective in helping the study participants. They exhibited a positive and efficient attitude towards learning the problem-solving strategy despite finding the word problem questions challenging throughout the intervention period.

During the observation conducted during the intervention sessions, the researcher found some suggestions to further enhance the effectiveness of this study and help improve the students' skills even more. The first improvement suggestion is to address the issue of study participants not joining the Google Meet session on time by setting specific rules for all four study participants and explaining the merit-demerit system before the intervention starts. Rules such as 'students who join the Google Meet on time receive two points, while latecomers receive a one-point demerit' and 'students who submit exercises to the teacher on time receive two points, while late submissions receive a one-point demerit' could be established. Furthermore, the researcher could provide rewards to study participants who achieve the highest scores. Setting rules at the beginning of the intervention is crucial to ensure the study participants' behaviour is well-managed. For future studies, the researcher suggests enlarging the target group size to enhance the generalizability of the research findings and improve the accuracy and reliability of the test results. The target group could include students from diverse backgrounds, such as Malays, Indians, Chinese, Kadazandusun, and Iban. The rationale for this action is that the researcher can assess the effectiveness of the mathematics keyword sheet on students from different ethnic backgrounds.

REFERENCE

Kementerian Pendidikan Malaysia (2013). Pelan Pembangunan Pendidikan Malaysia 2013-2025. Putrajaya: Bahagian Pendidikan Guru.

Lewin, K. (1946).*Action Research and Minority Problems*. Journal of Social Issues, 2, 34-46. http://dx.doi.org/10.1111/j.1540-4560.1946.tb02295.x

Susanti, E., & Darhim, Y. S. K. J. S. (2014). Computer-Assisted Realistic Mathematics Education for Enhancing Students' Higher-Order Thinking Skills (Experimental Study in Junior High School in Palembang, Indonesia). Computer, 5(18).