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Multiplication Word Puzzle (MWP) as a Tool for Multiplication Skill Enhancement: A Completed Study Among Intermediate Pupils at Calunacon Elementary School

Crizza Mae G. Fruelda [1], Prof. Mario A. Fetalver, Jr., Ph.D. [1]
1 − Romblon State University, San Andres Campus, San Andres, Romblon

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Abstract

This study was conducted to identify the effectiveness of multiplication word puzzle in enhancing the multiplication skills at Calunacon Elementary School. Specifically, the following objectives were met: (1) To identify the scores of pupil's pre-test and post-test results before and after the intervention; (2) To determine the significant difference between the pre-test and the post-test scores before and after the intervention; (3) To describe the "Multiplication Word Puzzle. Purposive sampling technique was used to select the respondents from intermediate grade at selected school. This gave a total sample size of twenty –five (25). The validated instrument – pre – test, and post – test containing 40 items, questionnaire and the booklet were used. Majority of the respondents got high score in post-test compare to their score in pre-test. Significant difference exists between the pre – test and the post – test scores before and after the intervention. The characteristics of multiplication word puzzle in terms of: Quality. The materials used in the booklet enhances pupils' multiplication skills as spaces and fonts used are readable, and arouse their interest. Usability. The material is simple, recognizable, realistic, attractive, relatively light and easy to handle. The simplicity of the book makes it more conducive to learning and can use easily as it does not distract the attention of the learners. Presentation and Organization. The material is engaging, interesting and understandable. It also gives a logical and smooth flow of ideas as well as the vocabulary level is improved.

Keywords: pre – test and post – test, intermediate pupils, puzzle, usability, quality

Introduction

As the COVID – 19 outbreak started, many graduate pupils in elementary had been reported with poor multiplication skills. According to Geary (2014), pupils' frequently find multiplication tasks to be a

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stumbling block in their mathematical progress. Many use inefficient and inaccurate counting methods and encounter difficulties in memorizing multiplication tables.

In relation with that, Elkins (2012) emphasized that Mathematics education today is on developing pupils' understanding through exploration and discovery, wherein the use of concrete materials, pictures, diagrams, games, and discussion increases pupils' familiarity with the process of multiplication and assists in their observation of regularities and patterns.

One of the interactive educational games that makes the concept of numeracy easier to grasp and enjoyable for students to learn is interactive puzzle. Puzzle game can also be used by teachers to introduce the principles of numbers that affect students' Mathematics ability (Safitri et al., 2020). Through this puzzle medium, Mathematics learning becomes more pleasant and compelling; they can also develop good character and can increase the learning outcomes for students.

In this study, the researchers designed a multiplication crossword puzzle that would help the students to enhance their multiplication skill. This improvised multiplication crossword puzzle contains a process of solving word puzzle by multiplying number. In order to complete the crossword puzzle, the pupils need to solve the multiplication problem first.

Rationale

Mathematics proficiency, particularly mastery of fundamental operations like multiplication, remains a significant challenge in educational systems worldwide. In the Philippines, the 2019 Trends in International Mathematics and Science Survey revealed alarming deficiencies, with only 19% of Filipino students demonstrating mastery of basic operations with whole numbers (Magsambol, 2020). This concerning statistic underscores the urgent need for innovative and effective interventions that can strengthen students' multiplication skills, which serve as essential building blocks for more advanced mathematical concepts.

Multiplication word puzzles represent a promising intervention that may effectively address these challenges. Drawing on the theoretical foundations established by researchers like Gorev and Utomov (2016), puzzles serve as powerful tools for developing multiple mathematical skills, including logical thinking, abstract conceptualization, and mathematical memory—all critical components of multiplication proficiency. By embedding multiplication concepts within engaging puzzle formats, this intervention creates opportunities for students to interact meaningfully with mathematical content while simultaneously developing the cognitive processes that support mathematical thinking.

The potential efficacy of puzzle-based interventions has received preliminary support from several studies. Bertram (2020) demonstrated that game-based learning activities significantly enhance student motivation and interest in mathematics, while Zhang et al. (2013) revealed that diverse instructional strategies, including puzzles, effectively promote multiplication skills development among students experiencing mathematical difficulties.

Despite this promising foundation, specific research examining multiplication word puzzles as targeted interventions for enhancing multiplication skills remains notably limited. Questions regarding their quantitative impact on multiplication proficiency, optimal implementation parameters, effectiveness across diverse student populations, and long-term retention of gains represent significant gaps in current understanding.

This study aims to address these gaps by investigating the effects of multiplication word puzzles as a structured intervention on students' multiplication skills. By examining this promising intervention approach, this research seeks to contribute valuable knowledge to educational practice while potentially identifying an effective strategy for addressing persistent challenges in mathematics education. Given the fundamental importance of multiplication proficiency for mathematical success and the continuing difficulties many students experience with this essential skill, investigating

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innovative interventions like multiplication word puzzles represents a meaningful contribution to educational research and practice.

Research Objectives

For its objective, the researchers intended to determine the outcome of applying the multiplication word puzzle to enhance the learners' multiplication skills. Specifically, the research aims:

1. To identify the scores of pupil's pre-test and post-test results before and after the intervention;
2. To determine the significant difference between the pre-test and the post-test scores before and after the intervention;
3. To describe the "Multiplication Word Puzzle" in terms of:
   3.1. Quality
   3.2. Usability
   3.3. Presentation and Organization

Hypothesis

There is no significant difference between the pre-test and the post-test of intermediate pupils.

Methodology

Research Design

An experimental research design that contains a combination of qualitative and quantitative research approach was employed in the study to know if the use of multiplication word puzzle as intervention is effective in enhancing pupil's multiplication skills. To investigate the phenomenon, first-hand information on the intermediate pupils' skills and abilities to multiplication, the pre-test, booklet, the post-test and questionnaire were collected.

Locale and Time of the Study

This study was conducted in Calunacon Elementary School at Calunacon, San Andres, Romblon. The researcher chose the place of conduction of this study because it will give the researcher the opportunity to examine the effectiveness of the intervention in enhancing pupils' multiplication skills. This study was carried out within the month of May, Academic Year 2022-2023.

Respondents of the study

In the conduction of pre – test, there are 48 intermediate pupils involved. The results of the pre – test will be the basis of determining the respondents of the study. A total of 25 respondents from the intermediate pupils in Calunacon Elementary School was included in the study.

Sampling Technique

Purposive sampling technique was used to select the respondents from intermediate grade at Calunacon Elementary School. This gave a total sample size of twenty – five (25). The respondents were also chosen purposively since they are only respondents intended for it.

Data Gathering Procedure

In the conduct the study, coordination was done with the principal of the selected elementary schools for gathering of the data. The intermediate grade pupils are the primary source of data. After

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securing permission from the principal of the selected school, the pre – test was distributed to all intermediate pupils including the Grade 4, 5 and 6. After, the pre – test has been tallied and evaluated, the researchers identified the respondents of the research and distributed the booklet to the selected respondents on the scheduled date. Retrieval of the booklet was done two weeks after the distribution to ensure that respondents have sufficient time to accomplish the needed responses. After the booklet has been gathered, the researcher conducted a post – test to determine if there is an improvement happens in the respondent's skills. Lastly, the researchers conducted a survey to the respondents through survey questionnaire to describe the quality, usability, and presentation and organization of the booklet. Tabulation and analysis of data followed after the retrieval of the instruments.

Statistician Treatment

The following statistical tools were used to treat the data gathered:

Paired t – test was used to determine the difference between the pre-test and the post-test of experimental groups. The researchers also used this tool to determine the difference between the pre-test before the intervention and the post-test after the intervention.

Mean was used to determine the scores between pre – test and post – test of pupils and the characteristic of multiplication word puzzle as an intervention.

Results and Discussion

Table 1 Pupils' pre-test scores

	Pre-test	Frequency	Percent
3	Satisfactory (80-84)	5	20
2	Fairly Satisfactory (75-79)	2	8
1	Did not meet expectation (0-75)	18	72
	Total	**25**	**100**

The results presented in Table 1 reveal a concerning academic performance among the 25 pupils who took the pre-test. A significant majority—72% or 18 students—did not meet the expected level of performance, scoring below 75%. This indicates a substantial gap in their foundational knowledge and suggests that most pupils were not adequately prepared for the instructional content assessed. Only 5 students, or 20%, achieved a satisfactory rating (80–84), while a mere 8% (2 students) fell into the fairly satisfactory range (75–79). Taken together, only 28% of the class met or exceeded the minimum passing standard set by the Department of Education.

This distribution implies a need for immediate academic intervention. The data suggests that many learners are struggling to grasp basic competencies, potentially due to prior learning deficits, ineffective instructional strategies, or external factors such as poor attendance or lack of access to learning resources. It also points to the importance of using diagnostic tools to identify specific areas of weakness. Teachers may need to implement remedial sessions, adopt differentiated instruction techniques, or revise curriculum

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pacing to address the learners' diverse needs. Overall, this pre-test result serves as a crucial baseline for measuring future progress and guiding instructional decisions aimed at improving educational outcomes.

Table 2: Pupils' Post-test score

	Post-test	Frequency	Percent
5	Outstanding (90-100)	12	40
4	Very Satisfactory (85-89)	10	48
3	Satisfactory (80-84)	1	4
2	Fairly Satisfactory (75-79)	1	4
1	Did not meet expectation (0-75)	1	4
	Total	25	100

The data from Table 2 shows a **notable improvement** in pupils' performance on the **post-test**, following instructional intervention. Out of 25 pupils, **12 students (40%) achieved an Outstanding rating** (scores between 90–100), and another **10 students (48%) reached a Very Satisfactory level** (85–89). These two groups combined account for **88% of the class**, indicating that a vast majority of pupils demonstrated high academic achievement after the teaching period.

In contrast, only **one student each** fell into the categories of Satisfactory (80–84), Fairly Satisfactory (75–79), and Did Not Meet Expectations (below 75), each representing **4% of the total**. This sharp decline in the number of underperforming students—from 72% in the pre-test to just 4% in the post-test—suggests that the instructional strategies implemented were highly effective in addressing previous learning gaps.

The post-test results reflect a significant shift in the overall academic performance of the class. Not only did most students surpass the minimum competency level, but many excelled well beyond it. These improvements may be attributed to targeted interventions, more engaging or relevant instruction, and possibly increased learner motivation or support. The data underscores the impact of well-planned instruction and highlights the potential for learners to achieve when provided with the right academic support and resources. Comparing the pre-test and post-test outcomes reveals a transformation in performance that validates the importance of responsive, data-informed teaching practices.

Table 3. Significance test to determine the difference between the result for pre-test and post-test scores of respondents

Null Hypothesis	Test	Sig.	Decision
The result for pre-test is different to the result for post-test scores of the respondents before and after the intervention.	Paired t – test	0.0000	Reject the null hypothesis.

Table 3 shows the significant difference of t-test result between pre – test and post – test scores of the respondents. It can be noticed that the t-value of -11.708 with P=0.000, therefore the null hypothesis was rejected.

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The use of the Multiplication Word Puzzle (MWP) has positively impacted the multiplication skills of intermediate pupils. The study findings showed that 72% of the respondents did not meet expectations in the pre-test, while in the post-test, 40% of the respondents achieved outstanding scores and 48% attained very satisfactory scores. This indicates a significant improvement in scores from the pre-test to the post-test, suggesting that the Multiplication Word Puzzle is beneficial for enhancing basic multiplication skills in pupils. Bertram (2020) supports the use of interactive educational games like the multiplication puzzle as a strategy for assisting students in developing their mathematical abilities. Analyzing the difference between the pre-test and post-test scores of the intermediate pupils, a significant result (p=0.000) was observed with a t-value of -11.708, indicating a substantial difference before and after the intervention. Fatkul (2021) further corroborates the effectiveness of puzzles in reducing difficulties experienced by students when solving multiplication problems.

Table 4.1. Characteristics of multiplication puzzle in terms of quality, n=25

Statements as to Quality	WM	Sd	QI
1. Content is suitable to the pupil's level of development.	4.92	0.28	SA
2. Material enhances the multiplication skills of pupils.	4.80	0.41	SA
3. Spaces between letters, numbers, and words facilitate learning.	4.44	0.58	A
4. Font is easy to read.	4.72	0.46	SA
5. Material has the potential to arouse interest of target reader.	4.72	0.54	SA
Average	4.72	0.45	SA

Legend: Weighted Mean (WM) and Qualitative interpretation (QI); *Standard Deviation (Sd)*
Strongly Agree (SA) – 4.51 to 5.00, Agree (A) – 3.51 to 4.50, Neutral (N) – 2.51 to 3.50, Disagree (D) – 1.51 to 2.50, Strongly Disagree (SDA) – 1.00 to 1.50.

The results in Table 4.1 present the pupils' evaluation of a multiplication puzzle in terms of quality, as assessed by 25 learners. The average **Weighted Mean (WM)** across all five quality indicators was **4.72**, with a **standard deviation of 0.45**, falling under the **"Strongly Agree" (SA)** category based on the rating scale used. This suggests a **high level of satisfaction** among pupils regarding the educational value and design of the multiplication puzzle.

Breaking this down, the statement "Content is suitable to the pupil's level of development" received the **highest rating** with a WM of **4.92**, indicating that learners found the material developmentally appropriate. This supports Vali (2023), who emphasized that tailored learning tools significantly enhance pupil engagement and comprehension in mathematics. Similarly, the statement "Material enhances the multiplication skills of pupils" also scored very high (WM = 4.80), showing strong alignment with findings by Thahir, Mawarni, and Palupi (2019), who demonstrated that instructional materials incorporating interactive methods, such as puzzles, improve mathematical competency among primary learners.

Meanwhile, the visual aspects of the material, such as font readability (WM = 4.72) and the use of space to aid clarity (WM = 4.44), were also positively rated. These findings are consistent with Gorev and Telegina (2018), who found that well-designed visual tools in math education improve accessibility and reduce cognitive load, especially for early learners. Additionally, the puzzle's capacity to arouse interest

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(WM = 4.72) reinforces conclusions by Fokides (2018), who stated that educational games increase student motivation and cognitive engagement, especially in subjects perceived as challenging, such as mathematics.

Overall, the pupils' positive feedback reflects both the **technical quality and pedagogical soundness** of the multiplication puzzle. The findings confirm that integrating such tools into instructional practices aligns with modern educational strategies that prioritize **learner-centered and multimodal approaches** to developing foundational math skills.

Table 4.2. Multiplication word puzzle in terms of usability

Statements as to Easy use	WM	Sd	QI
2.1 Text is clear and easily recognizable.	4.80	0.50	SA
2.2 Realistic/ appropriate color.	4.64	0.57	SA
2.3 Attractive and appealing.	4.80	0.41	SA
2.4 Easy to handle.	4.04	0.54	A
2.5 Relatively light.	4.72	0.46	SA
2.6 Simple (i.e., does not distract the attention of the reader.	4.44	0.58	A
Average	4.65	0.48	SA

Legend: Weighted Mean (WM) and Qualitative interpretation (QI); *Standard Deviation (Sd)*
Strongly Agree (SA) – 4.51 to 5.00, Agree (A) – 3.51 to 4.50, Neutral (N) – 2.51 to 3.50, Disagree (D) – 1.51 to 2.50, Strongly Disagree (SDA) – 1.00 to 1.50.

Table 4.2 presents the respondents' evaluation of the Multiplication Word Puzzle in terms of usability. The overall average weighted mean is 4.65, with a standard deviation of 0.48, indicating a high level of usability. Among the specific indicators, the highest ratings were given to statements such as text clarity and visual appeal, both with a weighted mean of 4.80, reflecting strong consensus on the visual clarity and aesthetic appeal of the material. Similarly, the statement regarding the puzzle's lightness received a high rating of 4.72, suggesting that the physical portability of the puzzle was well appreciated. Slightly lower, yet still positive ratings were given to ease of handling (WM = 4.04) and simplicity (WM = 4.44). These suggest areas that may benefit from minor refinement, particularly in terms of improving ease of physical interaction and minimizing potential distractions. Nonetheless, the consistently high ratings across all indicators support the conclusion that the Multiplication Word Puzzle is well-designed and effectively meets the usability needs of its intended users.

The importance of usability in educational tools is well-documented. For instance, Lu, Schmidt, and Shin (2025) emphasize the need for comprehensive usability evaluation frameworks tailored for learning technologies, highlighting the multifaceted nature of usability beyond mere technological performance. Similarly, Revythi and Tselios (2017) discuss the significance of perceived ease of use in the acceptance of educational learning systems, suggesting that factors like clarity and simplicity play crucial roles in user engagement. Montes, Herrera, and Crisol (2024) further underscore the application of the Universal Design for Learning framework to create accessible and usable virtual educational environments, advocating for the integration of flexible didactics and evaluations to promote constant student motivation. These studies collectively affirm that the positive usability ratings of the Multiplication Word Puzzle align with established research on effective educational tool design.

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Table 4.3. Presentation and organization of multiplication word puzzle

Statements as to Presentation and Organization	WM	Sd	QI
3.1 Presentation is engaging, interesting and understandable.	4.50	0.40	A
3.2 There is logical and smooth flow of ideas.	4.52	0.59	SA
3.3 Vocabulary level is adapted to target reader's likely experience and level of understanding.	4.04	0.54	A
3.4 Length of sentences is suited with the comprehension level of the target reader.	4.52	0.65	SA
Average	4.44	0.54	A

Legend: Weighted Mean (WM) and Qualitative interpretation (QI); *Standard Deviation (Sd)*
Strongly Agree (SA) – 4.51 to 5.00, Agree (A) – 3.51 to 4.50, Neutral (N) – 2.51 to 3.50, Disagree (D) – 1.51 to 2.50, Strongly Disagree (SDA) – 1.00 to 1.50.

Table 4.3 presents the characteristics of multiplication word puzzle as intervention in terms of presentation and organization. Its overall average weighted mean of 4.44 implied agreement on the statement.

The respondents strongly agreed that there is logical and smooth flow of ideas (WM=4.52, Sd=.40), and the length of sentences is suited with their comprehension level (WM=4.52, Sd=0.59), While, they agreed that the presentation is engaging, interesting and understandable (WM=4.50, Sd=0.54), and the vocabulary level is adapted to target reader's likely experience and level of understanding (WM=4.04, Sd=0.54). The researchers interpreted that the booklet used by the pupils as intervention to their multiplication skills is effective in terms of presentation and organization.

This finding is consistent with the study by Milkova (2020), which emphasizes the use of puzzles for the development of logical thinking and abstracting, offering methodological approaches and recommendations for teachers. The engaging presentation of puzzles can strengthen and train students' thinking, solidify their acquired knowledge, and spark their interest in mathematics.

Summary

The use of the Multiplication Word Puzzle (MWP) has positively impacted the multiplication skills of intermediate pupils. The study findings showed that 72% of the respondents did not meet expectations in the pre-test, while in the post-test, 40% of the respondents achieved outstanding scores and 48% attained very satisfactory scores. Analyzing the difference between the pre-test and post-test scores of the intermediate pupils, a significant result (p=0.000) was observed with a t-value of -11.708, indicating a substantial difference before and after the intervention.

The analysis of the characteristics of the multiplication word puzzle reveals that it is highly effective in enhancing the multiplication skills of intermediate pupils, particularly in terms of quality, usability, and presentation and organization.

In terms of quality, the respondents strongly agreed that the content of the puzzle is suitable for the pupils' level of development, enhances their multiplication skills, and has an easy-to-read font. They also expressed that the material has the potential to arouse the interest of the target readers. The overall weighted

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mean score of 4.72 indicates a "Strongly Agree" response, suggesting that the multiplication word puzzle can be highly effective in terms of quality.

Regarding usability, the study found that the multiplication word puzzle was designed to be simple, attractive, and appealing to learning. The booklet used as an intervention was recognized as clear, recognizable, and realistic. It was also described as relatively light and easy to handle, which contributes to a conducive learning environment.

In terms of presentation and organization, the respondents agreed with all statements, indicating that the multiplication word puzzle was logically presented and well organized. The overall weighted mean score of 4.44 reflects an agreement with the idea that the puzzle's presentation is engaging, interesting, and understandable.

Conclusions

In light on the findings, the following conclusions were drawn:

1. The implementation of multiplication word puzzles has significantly enhanced the skills and abilities of intermediate grade pupils, specifically in the context of solving multiplication word problems. The evident gap between the scores achieved in the pre-test and post-test serves as clear evidence that the pupils have made notable improvements in their multiplication skills.

2. The analysis of the pre-test and post-test scores of the intermediate pupils indicated a significant difference before and after the intervention. The implementation of puzzles had a significant impact on the students' ability to solve multiplication problems.

3. The characteristics of the multiplication word puzzle, including its quality, usability, and presentation and organization, contribute to its high effectiveness in enhancing the multiplication skills of intermediate pupils. The puzzle's content is suitable for their level of development, the usability aspects make it appealing and conducive to learning, and its presentation is engaging and well-organized, fostering logical thinking and piquing interest in mathematics.

Recommendations

Based on the conclusion drawn, the researchers recommended the following:

1.Teachers can provide targeted support and additional resources and activities to help these students overcome their challenges in multiplication. Individualized or small group instruction can be employed to provide tailored interventions based on each student's specific needs.

2. Implement regular formative assessments throughout the learning process to track students' progress and identify areas of improvement in solving multiplication word problems. These assessments can be in the form of quizzes, puzzles, or problem-solving tasks. Teachers should provide timely and constructive feedback to guide students' learning, highlighting specific areas that need improvement and offering strategies for further practice and development.

3. Educational institutions should consider integrating puzzle-based learning methodologies into their mathematics curriculum, specifically targeting multiplication word problems. The use of multiplication word puzzles can engage students in a fun and interactive way, promoting critical thinking and problem-solving skills. Teachers can incorporate puzzle activities, worksheets, and games that align with the curriculum to reinforce and practice multiplication skills within the context of word problems.

4. Educational institutions should incorporate high-quality multiplication word puzzles as into their mathematics curriculum. Ensure that the multiplication word puzzles are user-friendly and accessible to all students. Additionally, provide clear instructions and guidelines for solving the puzzles, ensuring that

students can navigate and engage with them independently. Focus on the presentation and organization of the multiplication word puzzles to promote logical thinking and foster interest in mathematics. This progression will help build students' confidence and challenge them appropriately. Teachers should be encouraged to guide students through the puzzles, providing explanations and clarifications when needed.

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