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Effectiveness of PEMDAS Mnemonic Instructional Strategy on Learners' Academic Performance in Mathematics

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ABSTRACT: Mnemonic instructional strategies, such as PEMDAS, enhance learning and retention of the fundamental knowledge and mathematical skills essential for learning high school Mathematics. This study aimed to determine the effectiveness of the PEMDAS mnemonic instructional strategy on learners' academic performance in Mathematics and their attitude towards the subject of Grade 8 learners by comparing pretest and post-test results; determine if there was a significant effect of the strategy on learners' academic performance in Mathematics; and analyze the implications of the study's findings in teaching Mathematics. The quasi-experimental research design and purposive sampling technique, consisting of 100 respondents from two groups (control and experimental), were employed. A modified survey questionnaire on the attitude toward Mathematics and the learners' proficiency tests questionnaire was used to gather data. The data were analyzed using statistical techniques such as mean, standard deviation, t-test, and f-test. The findings showed that learners from the experimental group performed better in the posttest than those from the control group. There was a significant difference in the results of posttest mean rating scores between the control and experimental groups. The instructional strategy was found to have a significant effect on learners' academic performance in the experimental group. This concludes that using PEMDAS mnemonic instructional strategy effectively improves learners' academic performance and attitudes towards the subject. It is recommended that effective instructional strategies such as PEMDAS mnemonics be integrated into teaching and minimize the use of teacher-centered approach to improve learners' fundamental skills, conceptual understanding and procedural fluency in Mathematics

KEYWORDS: PEMDAS mnemonic, instructional strategy, academic performance in Mathematics

I. INTRODUCTION

Mnemonic instructional strategies enhance learning and retention in mathematics, particularly in complex concepts and formulas. Teachers use devices like PEMDAS mnemonic to aid in remembering essential facts and information. In elementary education, learners should master computational skills in four fundamental operations and independently evaluate numbers using different operations in high school mathematics.

However, as observed in Misamis Oriental General Comprehensive High School, some learners promoted to high school lack mastery of Mathematics skills. Mathematics in secondary education requires a strong fundamental background in the four basic operations and mastery of skills in the order of operation. Learners who exhibit poor foundational skills have difficulty understanding high school mathematical concepts. Such problems lead to poor academic performance and a negative attitude towards the subject. This becomes a challenge for teachers to employ effective strategies in teaching High school Mathematics.

This conforms to the recently concluded Online Division Achievement Test (DAT) 2023 result in the Division of Misamis Oriental that reveals the mean score of 31.29 of Misamis Oriental General Comprehensive High School with a percentage of 62.59% in Grade 10 Mathematics. The result showed that there is a need for learners to improve their academic performance in Mathematics. This could be attributed to various factors such as a lack of understanding of basic concepts, insufficient practice, or ineffective teaching methods. Moreover, distractions and lack of motivation can also contribute to poor academic performance. Accordingly, the Division Memo No. 260, s. 2023, mandates the Conduct of Online Division Achievement Test 2023 to identify learning gaps and design interventions to improve learners' performance in Misamis Oriental. The test will reveal the effectiveness of current teaching methods and curricula, requiring collaboration between teachers, learners, parents, stakeholders, and administrators to enhance the learning experience in Mathematics.

Mathematics begins early in a child's life, primarily with counting. As they progress, they learn addition, subtraction, multiplication, and division, which are crucial skills for success in advanced concepts like algebra and calculus. These fundamental operations form the foundation for tackling practical problems in society. The Importance of Mathematics in the Modern World (2021) recognized that Mathematics, despite being a challenging subject, is crucial in everyday life, from expense calculations to scheduling management. It serves as a foundation for fields like science and engineering and is a problem-solving and critical-thinking tool. It enables individuals to analyze data, make informed decisions, and develop innovative solutions to complex problems, making it an essential skill in various professions.

The Department of Education, led by DepEd Secretary Leonor M. Briones, implemented the Learning Continuity Plan (LCP) in 2020 to address the Covid-19 Public Health Emergency. The LCP, outlined in DepEd Order No. 12, focuses on the Most Essential Learning Competencies (MELCS, 2020), ensuring instructional focus on essential learning competencies. This response goes beyond addressing pandemic challenges and ensures educational continuity through the curriculum dimension.

As revealed in the study of Ihechukwu (2021), the PEMDAS mnemonic instructional strategy is effective in teaching Mathematics and developing mathematical skills on the order of operations among learners. The use of mnemonic instructional strategy is not only limited to worksheets but also includes the use of drills, video lessons, games, and other engaging learning activities that can be integrated with PEMDAS mnemonic to drive learners' attention and interest, making the lesson more appealing to the learners. Based on the findings, it was suggested that secondary school Mathematics teachers should employ a mnemonic instructional strategy in teaching to promote learner retention and improve Mathematics skills. This strategy involves using memory aids to help students remember complex mathematical concepts and formulas. The mnemonic instructional strategy has been found to enhance students' understanding and retention of mathematical concepts. It is a valuable tool for teachers to incorporate into their lesson plans in teaching Mathematics.

Accordingly, the two-year modular classes have greatly affected the learners' academic performance. Thus, teachers are encouraged to employ innovative teaching strategies and design interventions and instructional strategies to aid learners in increasing retention to learn Mathematics effectively, which would help bridge the gap in computational fluency among learners.

With this, the researcher decided to conduct this study to determine the effectiveness of the PEMDAS mnemonic instructional strategy in improving Mathematical skills among Grade 8 learners in Misamis Oriental General Comprehensive High School. Furthermore, this study aims to determine whether the scores in the experimental and control groups in the Pretest and Posttest differ significantly.

II. METHODOLOGY

A. Research Design

This study employed quasi-experimental research with a pretest and posttest design, adapted and modified from the study of Manuta (2022) entitled "The Effectiveness of Intervention Strategy in Teaching Selected Concepts in Mathematics Using Modular Learning." A quasi-experimental design seeks to establish a relationship between an independent and a dependent variable. Unlike an actual experiment, a quasi-experimental does not rely on random assignment. Subjects were instead assigned to groups based on non-random criteria in situations where actual experiments cannot be used for ethical and practical reasons. This design was employed to determine the effects of the PEMDAS mnemonic instructional strategy on learners' academic performance in Mathematics and attitude toward Mathematics. Two groups of participants, the experimental group and the control group, were randomly chosen. Two intact classes with fifty (50) learners in each group participated in this study. The experimental group underwent a series of drills and learning activities involving the PEMDAS mnemonic as an instructional strategy, while the control group had conventional instructions only. The lessons or topics of both groups were the same. Moreover, both groups received the same pretest and posttest that were evaluated and compared. Both groups of learners received a set of indicators before and after the study's conduct to measure their attitude toward Mathematics. This study used questionnaires on attitudes toward Mathematics and learner proficiency tests intended for Grade 8 learners. Moreover, it also involved analyzing and making implications based on the respondents' results.

B. Sampling Technique

This study applied a purposive sampling technique in which the control and experimental groups were identified in the two sections of the Grade 8 level in MOGCHS. The two selected sections had fifty (50) learners who served as the respondents of this study. One section was the control group, and the other was the experimental group. The research utilized and incorporated the PEMDAS mnemonic instructional strategy in teaching Mathematics lessons to the experimental group.

C. Research instrument

This study used test questionnaires to gather the necessary data. The research instrument has two parts: Part I dealt with the attitude toward Mathematics subjects, which was determined using fifteen (15) indicators patterned and modified from the study of Manuta (2022) titled "The Effectiveness of Intervention Strategies in Teaching Selected Concpets in Mathematics using Modular Learning". Part II measures the learners' academic performance in Mathematics. The questionnaire comprised fifty (50) questions intended for Grade 8 learners. The questions were patterned and modified from the Grade 8 learning modules based on the Grade 8 learning domains as stated in the K to 12 Most Essential Learning Competencies (MELCS).

III. RESULTS AND DISCUSSION

Problem 1. How effective is the PEMDAS mnemonic instructional strategy in terms of learners' academic performance and their attitude towards Mathematics in the pretest and posttest of the control and experimental groups?

Table 1. Distribution of the Learners' Academic Performance in Mathematics Pretest of the Control and Experimental Group

Performance Level in Mathematics	Control Group		Experimental Group	
	Frequency	Percentage	Frequency	Percentage
Outstanding (90-100)	0	0	0	0
Very Satisfactory (85-89)	7	14	3	6
Satisfactory (80-84)	10	20	11	22
Fairly Satisfactory (75-79)	23	46	21	42
Did Not Meet Expectations Below 75	10	20	15	30
Total	**50**	**100.00**	**50**	**100.00**
Mean	**76.44**		**76.17**	
SD	**1.83**		**1.63**	
Description	*Fairly Satisfactory*		*Fairly Satisfactory*	

Table 1 displays the distribution of the respondents' academic performance in Mathematics pretest of the control and experimental group. Data shows that both the control and experimental groups obtained a Fairly Satisfactory performance and interpreted To Some Extent during the pretest, as indicated by the mean equivalent ratings of 76.44 (SD=1.83) and 76.16 (SD=1.63), respectively. It implies that students responded to the questionnaire based on their prior knowledge. The results indicate that learners from both control and experimental groups struggled with Mathematics and that their prior knowledge was insufficient to support their understanding of the level of Mathematics. It also suggests that the students in both groups employed various techniques in answering the pretest depending on their prior experiences.

Additionally, the similar performance levels and fairly high standard deviations (SD=1.83) for the control group and (SD=1.63) for the experimental group) highlight that both groups had considerable difficulty with the pretest material. This suggests a general trend of struggling with Mathematics concepts among the respondents. This result demonstrates that the learners' prior knowledge was insufficient to grasp the mathematics level being tested thoroughly. This insufficient foundation might hinder their ability to progress in more advanced topics unless addressed. The control and experimental groups have a comparable and fairly satisfactory understanding of Mathematics, yet they struggle with the content to some extent. This indicates a need for improved instructional strategies to enhance their mathematical skills and comprehension. Ozcan (2021) emphasized in his study that learners often struggle with new concepts due to insufficient foundational knowledge and a heavy workload from extracurricular activities or schoolwork. To address these challenges, teachers should design instructional strategies that incorporate interactive activities, offer flexible deadlines, manage extracurricular commitments, and enhance students' engagement and performance on assessments.

Table 2. Distribution of the Learners' Academic Performance in Mathematics Posttest of the Control and Experimental Group

Performance Level in Mathematics	Control Group		Experimental Group	
	Frequency	Percentage	Frequency	Percentage
Outstanding (90-100)	0	0	4	8
Very Satisfactory (85-89)	9	18	9	18
Satisfactory (80-84)	10	20	24	48
Fairly Satisfactory (75-79)	24	48	13	26
Did Not Meet Expectations (Below 75)	7	14	0	0
Total	**50**	**100.00**	**50**	**100.00**
Mean	**77.88**		**84.34**	
SD	**1.76**		**1.81**	
Description	*Fairly Satisfactory*		*Satisfactory*	

Table 2 displays the distribution of the respondents' academic performance in mathematics posttest of the control and experimental groups. The table reveals the control group's equivalent rating of 77.88 (SD=1.76) is described as Fairly Satisfactory and interpreted To Some Extent during the posttest. This means that the result of the control group infers that, in Mathematics, the teacher's discussion alone is insufficient. This means further that most learners of the control group were not able to understand the concept during the discussion. Based on the result, the control group obtained a slight increase compared to the pretest. This could be attributed to various factors that include the teaching methods used by the teachers not suiting the learners, learners are not satisfied with the teacher's discussion, the lesson being discussed being beyond the learners' basic knowledge, and the language used in the discussion has an impact on their learner's comprehension. Teachers need to consider these factors and adjust their teaching methods accordingly to ensure that all students can learn and retain information effectively. By addressing these issues, greater improvements may be possible in future assessments.

Hassan et al. (2020) found that teacher-centered teaching strategies significantly impact low student achievement scores compared to learner-centered in secondary schools. They also noted that teaching methods affect learners' social development over time. Teaching methods are utilized in classrooms for effective teaching-learning. The study recommended that public school principals and secondary school teachers use teaching strategies to engage pupils in effective learning, which increases achievement results. Additionally, incorporating student-centered teaching approaches can enhance critical thinking skills and promote a more interactive learning environment. By implementing various teaching methods, teachers can cater to diverse learning styles and better support overall student growth and development.

Accordingly, a similar study compares the effectiveness of a mnemonic strategy approach, including the PEMDAS strategy, with a math fact rehearsal approach for students with learning disabilities. The study found that the mnemonic strategy approach significantly improved students' math fact fluency (Okoro et al, 2020). The results suggest that integrating mnemonic strategies into math instruction could be a more effective way to support students with learning disabilities. By using mnemonics, teachers can help students build stronger mental associations and better recall math procedures, leading to improved fluency.

Consequently, PEMDAS mnemonic instructional strategies can help students by providing a structured and memorable way to recall information, resulting in improved math fact fluency. This approach can be particularly beneficial for students who struggle with the rote memorization of math facts by integrating memory aids that make the recall process more efficient. By breaking down complex mathematical operations into smaller, more manageable steps, students can better understand the order of operations and develop a deeper comprehension of mathematical concepts. Additionally, utilizing mnemonic devices can make learning math more engaging and enjoyable for students, leading to increased motivation and confidence in their abilities.

Table 3. Summary of Learners' Academic Performance in Mathematics

Groups	Pretest			Posttest		
	Mean	SD	Description	Mean	SD	Description
Control	76.44	1.83	Fairly Satisfactory	77.88	1.76	Fairly Satisfactory
Experimental	76.17	1.63	Fairly Satisfactory	84.34	1.81	Satisfactory
Overall	76.31	1.73	Fairly Satisfactory	81.11	1.79	Satisfactory

Table 3 presents the summary of learners' Academic Performance in Mathematics pretest and posttest for the control and experimental groups. The table reveals the combined pretest mean of 76.31 (SD=1.73), which is described as a Fairly Satisfactory performance and interpreted To some extent, by the control and experimental groups. The results suggest that students in both groups had a below-average level of understanding or proficiency in mathematics before the intervention, with room for improvement. In addition, the standard deviation infers there is minimal variation in the students' performance scores. Most learners in both groups scored close to the mean. This indicates consistency in the learners' initial understanding of the subject across both groups. Overall, the pretest data indicates that students had a basic understanding of mathematics, but there is potential for improvement.

The study by Aguhayon et. al (2023) investigated how pretest scores influenced learning outcomes in math. The result showed that students with satisfactory pretest scores were more likely to demonstrate significant changes after receiving instructional intervention than students with either higher or lower baseline performance. It can be inferred that the learners who began at a very good level, could benefit from additional educational interventions. This suggests that targeting instructional interventions towards students with average pretest scores may be more effective in promoting learning outcomes.

The table reveals further the combined posttest mean of 81.11 (SD=1.79), which is described as Satisfactory performance and interpreted To Moderate Extent, of the control and experimental groups. The result indicates that there was an improvement in learners' academic performance. This could mean further that the learners met the basic learning competencies of the lessons, showing a solid understanding or accomplishment of the skills or content being assessed from the posttest. Overall, the results infer that both groups (control and experimental) performed reasonably well, but the impact of the intervention was not revolutionary—indicating that there might still be room for improvement or more powerful methods in future studies or interventions.

The study by Osborne (2021) concluded that meaningful and relevant use of instructional intervention in Mathematics could lead to a greater increase in learners' level of self-efficacy and conceptual understanding and help improve academic performance. The study highlighted the importance of incorporating real-world applications and hands-on activities in teaching Mathematics to enhance learner engagement and comprehension. Overall, these findings emphasize the significant impact of instructional strategies on students' learning outcomes in Mathematics.

Table 4. Distribution of the Learners' Attitude towards Mathematics of the Control Group

Indicator	Mean	SD	Description
As a student,…			
I prefer Mathematics to English and History subjects. I love this subject.	2.82	0.77	Agree
I believe the Math subject develops good reasoning ability.	2.94	0.91	Agree
I enjoy going beyond the assigned work in Mathematics.	2.72	0.78	Agree
I always choose a math subject, no matter what happens.	2.42	0.86	Disagree
I study this subject rather than eat.	2.06	0.84	Disagree
I think Math subject teaches me to be accurate.	2.78	0.91	Agree
I am willing to spend my time studying Math.	2.66	1.02	Agree
I believe this subject will not do anybody harm.	2.00	0.95	Disagree
I believe Math is necessary to attain success in life.	3.28	0.76	Strongly Agree
I consider Mathematics an interesting and enjoyable subject especially if the teacher is very friendly and approachable.	3.42	0.73	Strongly Agree
I can easily understand the language used in teaching Math.	2.96	0.81	Agree
I find the concepts and problems in math easy to comprehend.	2.70	0.65	Agree
I can relate the concept in Math to other subject matter.	2.54	0.81	Agree
I find Math concepts applicable to actual daily activities.	2.62	0.67	Agree
I find Mathematics relevant to my daily life.	2.92	0.72	Agree
Overall	**2.72**	**0.81**	**Agree**

Legend: *3:26-4:00 Strongly Agree/Very Positive* *1.76-2.50 Disagree/Negative*
2:51-3:25 Agree/Positive *1.00-1.75 Strongly Disagree/Very Negative*

Table 4 shows the distribution of learners in terms of attitude towards Mathematics of the control group. The results reveal the overall mean of 2.72 (SD=0.81) described as Agree and interpreted as Positive. This means that the students in the control group exhibit a positive attitude towards Mathematics. This indicates further that the majority of respondents in the control group have a positive perception of the subject. Additionally, the result shows that the standard deviation in attitude toward Mathematics of the control group is 0.81 which implies that the group's responses were close to the average scores. This further

means that most learners in the control group share a common interest. The results revealed that Mathematics is an engaging subject in the control group, and it can be inferred that learners have had positive learning experiences in Mathematics or possess a strong appreciation for the subject, resulting in a high level of interest.

According to Manaza (2021), establishing a positive attitude in a learner increases their sense of confidence, expands their mathematical expertise, and stimulates their belief in their potential to gain mastery in learning Mathematics. In addition, learners will develop an increased readiness to learn ideas presented by the teacher and will exhibit a willingness to deal with new challenges in Mathematics. The results also indicate that when students with a positive attitude towards Mathematics encounter peers who possess a negative attitude towards Mathematics, their behavior may be influenced distinctly.

The table also revealed that the indicator, As a student, I consider Mathematics an interesting and enjoyable subject, especially if the teacher is very friendly and approachable, obtained the highest mean score of 3.42 (SD=0.73) and a description of Strongly Agree and interpreted as Very Positive attitude towards Mathematics. This means that students consider Mathematics as an interesting and enjoyable subject, especially if the teacher is very friendly and approachable. This further explains that the difficulty in learning Mathematics is often associated with strict and unapproachable teachers. Based on the feedback from some respondents in the control group, they understand the math lesson quickly when the teacher is friendly and approachable since they are not afraid to ask questions whenever they are confused about the topic or lesson.

According to the study of Lukashova and Kadyr (2023), teachers' personalities tend to influence their teaching methods and approaches in the classroom and their relationships with students. The study suggests that teachers who exhibit empathy, patience, and enthusiasm are more likely to create a positive learning environment and foster strong connections with their students. This influence can impact students' overall learning experience and academic performance. Understanding these dynamics can help teachers tailor their teaching strategies to better meet their students' needs.

In contrast, as a student, I believe this subject will not do anybody harm by obtaining the lowest mean of 2.00 (SD=0.95), which describes Disagree and is interpreted as a Negative perception toward the subject. This implies that learners in the control group had experiences of math anxiety and stress in their Mathematics class. It implies further that learner in the control group believe that the subject causes harm and stress when students no longer understand the lesson and are pressured to pass the examination. Students who have difficulty grasping Mathematics concepts often experience increased stress, which contributes to their negative perception of the subject. When students cannot keep up with lessons, their frustration and feelings of inadequacy are exacerbated.

This result is supported by the study of Moussa and Saali (2022), which focuses on the factors influencing students' attitude towards learning Mathematics. It highlights that many students perceive Mathematics as an exhausting and effortful subject, triggering fear and anxiety. The study also suggests that negative experiences with Mathematics teachers and a lack of confidence in their abilities contribute to students' negative attitudes toward the subject. These findings emphasize the importance of creating a supportive and encouraging learning environment to help students develop a positive attitude toward Mathematics.

To address the perception of harm in Mathematics, it is essential to establish a strong foundation for young learners. This can be achieved through interactive learning experiences, hands-on activities, and visual aids. This helps develop a deeper understanding of mathematical principles and overcome negative perceptions. A supportive learning environment and growth mindset can further strengthen this foundation. Overall, fostering a positive attitude towards Mathematics is crucial for young learners.

Table 5. Distribution of the Learners' Attitude towards Mathematics of the Experimental Group

Indicator	Mean	SD	Description
As a student,…			
I prefer Mathematics to English and History subjects. I love this subject.	3.32	0.92	Strongly Agree
I believe the Math subject develops good reasoning ability.	3.46	1.03	Strongly Agree
I enjoy going beyond the assigned work in Mathematics.	3.20	0.89	Agree
I always choose a math subject, no matter what happens.	3.22	0.78	Agree
I study this subject rather than eat.	2.87	0.93	Agree
I think Math subject teaches me to be accurate.	3.34	0.89	Strongly Agree
I am willing to spend my time studying Math.	3.26	0.79	Strongly Agree
I believe this subject will not do anybody harm.	2.95	1.01	Agree
I believe Math is necessary to attain success in life.	3.68	0.80	Strongly Agree
I consider Mathematics an interesting and enjoyable subject especially if the teacher is very friendly and approachable.	3.64	0.97	Strongly Agree

I can easily understand the language used in teaching Math.	2.57	0.78	Agree
I find the concepts and problems in math easy to comprehend.	3.26	0.80	Strongly Agree
I can relate the concept in Math to other subject matter.	3.36	0.83	Strongly Agree
I find Math concepts applicable to actual daily activities.	3.34	0.82	Strongly Agree
I find Mathematics relevant to my daily life.	3.55	1.11	Strongly Agree
Overall	**3.27**	**0.89**	**Strongly Agree**

Legend: *3:26-4:00 Strongly Agree/Very Positive* *1.76-2.50 Disagree/Negative*
2:51-3:25 Agree/Positive *1.00-1.75 Strongly Disagree/Very Negative*

Table 5 shows the distribution of learners' attitudes towards the Mathematics of the Experimental Group. The overall mean of 3.27 and (SD=0.89) was described as Strongly Agree and interpreted as a Very Positive attitude toward Mathematics. This means that respondents have acquired a highly positive attitude toward Mathematics subjects. The result has significant implications for the process of teaching and learning. The study observed that participants from the experimental group appreciated the teacher's instructional method in teaching Mathematics. The results also indicate that the progress of learning, specifically in Mathematics, was influenced by the strategies employed by the teacher during class discussions or lesson presentations, as well as the experiences encountered by students along the learning process. These factors contributed to their better understanding of the subject of Mathematics. The results of the study by Sarma et al. (2021) noted that curricula and teaching methods greatly influence students' attitudes toward Mathematics. Anxiety can be addressed, and attitudes can be improved using student-centered learning, problem-based learning, creative learning, inclusive teaching methodologies, and inquiry-based learning. Students' attitudes and views are also influenced by teachers' methods and delivery of their instruction. Science and math classes can be more engaging and meaningful by incorporating them within an academic framework.

Teachers must strengthen Mathematics education to ensure students have the necessary skills to succeed in the workforce and contribute to a thriving economy. By fostering a strong mathematical foundation, students will be better prepared to tackle real-world challenges and make informed decisions in their personal and professional lives. Bokova (2021) suggests that mathematical content should help students develop global competency, enabling effective communication and understanding of alternative perspectives. This involves rethinking traditional Mathematics content, illustrating the universe's mathematical problems and phenomena, and incorporating real-world examples. This approach fosters critical thinking and problem-solving skills, which are crucial for navigating an interconnected and diverse world, and promotes a better understanding of math in various global contexts.

Based on the result, the indicator As a student, I believe Math subject is necessary to attain success in life, obtained the highest mean score of 3.68 and (SD=0.80) is described as Strongly Agree and is interpreted as a Very Positive attitude toward Mathematics. This infers that the students in the experimental group believe that Mathematics subject is necessary to attain success in life. This means further that a positive attitude may increase motivation and effort in the subject, ultimately contributing to academic success.

This is supported by the study of Callaman and Itaas (2020), which reveals that students' attitudes towards math and their numerical skills are significant predictors of their achievement in Mathematics, which often translates to overall academic success. This highlights the importance of fostering positive attitudes towards math and developing strong numerical skills in students to enhance their academic performance across all subjects. Teachers should focus on creating a supportive learning environment that promotes confidence and proficiency in Mathematics.

On the other hand, the data also showed that as a student, I can easily understand the language used in teaching math and obtained the lowest mean rating of 2.57 (SD=0.78), described as Agree and interpreted as a Positive attitude towards Mathematics. This implies that the respondents found it difficult to understand the concept of Mathematics for several reasons, one of which was the language used to present the idea. It implies further that the experimental group developed a highly positive attitude toward Mathematics but struggled to grasp some mathematical concepts due to language. As an observation, the Phil-IRI results for the School Year 2023-2024, which is DepEd's reading program, offered assistance and support. The results of the Phil-IRI 2024 assessment have unveiled a notable issue about reading and comprehension skills among students.

Consequently, using English as the medium of instruction in Mathematics education is a contributing element that impedes students' grasp of the topic, primarily due to their limited reading and comprehension abilities. Although research indicates that a significant number of learners experience fear or anxiety when dealing with numbers, there is still potential for improvement and resolution. This conforms to the findings of the study revealed by Prediger et al. (2021) that language proficiency has the strongest correlation with Mathematics achievement. This underscores the need for improved language skills and resources,

which can positively impact mathematical performance. Teachers should also consider implementing strategies that promote language development alongside mathematical instruction to further enhance student success.

Problem 2. Is there a significant difference in the learners' academic performance in the Mathematics pretest of the control and experimental groups?

Table 6. Comparison of the Learners' Academic Performance in Mathematics Pretest of the Control and Experimental Group

Group	Pretest	SD	df	t-test	p-value	Interpretation
Control	76.44 (*Fairly Satisfactory*)	1.83	49	-1.087	0.141	Not Significant
Experimental	76.16 (*Fairly Satisfactory*)	1.63	49			

Legend: *Ho is rejected if Significant* *Significant if p-value <0.05*
Ho is accepted if Not Significant.

Table 6 shows the comparison of learners' academic performance in mathematics pretest of the control and experimental groups. As revealed in the table, the control and experimental groups obtained a fairly satisfactory result with equivalent ratings of 76.44 and 76.16, respectively. The table revealed a t-test value of -1.087 with a p-value of 0.141, greater than the significance level ($\alpha = 0.05$). This led to the acceptance of the null hypothesis. This means there is no significant difference in the learners' academic performance in Mathematics pretest on the control and experimental groups. This implies that both groups started at a similar level of understanding or performance. The result indicates that the academic performance of the control and experimental groups did not show a significant difference in the pretest. Further, the result establishes a good baseline that implies any future improvements or changes in the academic performance of both groups can be more confidently attributed to the intervention or teaching strategies employed. This baseline helps determine the intervention's effectiveness by comparing posttest results to the pretest results in the control and experimental groups.

Many factors may have influenced the similarity of academic performance among learners in both groups which leads to statistically non-significant results in the pretest scores. Aguhayon et al (2023) highlighted the effects of the COVID-19 pandemic on the similarity of learners' academic performance and underachievement in Mathematics. This could refer to the homogenization of performance levels due to widespread disruptions in traditional learning environments, resulting in a generalized decline or convergence in scores.

Additionally, the 2020 National Achievement Test (NAT) results, which showed a below-average mean percentage score in the subject, highlight Filipino students' poor or unsatisfactory performance in Mathematics. These findings suggest that the pandemic may have exacerbated existing challenges in Mathematics education, leading to a further decline in academic achievement. Teachers and school administrators must address these issues and implement effective interventions to support students in improving their mathematical skills.

Moreover, the results imply that both groups started at a similar level of understanding or performance. The similarity in scores suggests that the groups were well-matched in terms of their initial academic performance in Mathematics. The lack of a significant difference in pretest scores supports the effectiveness of the random assignment process. It indicates that the process successfully created equivalent groups, which is crucial for ensuring that any observed effects in the posttest can be attributed to the instructional strategy rather than pre-existing differences. The comparable pretest scores establish a baseline, or a level playing field, for both groups. This is important because it means that any differences observed in the posttest can be more confidently attributed to the instructional strategy being tested (PEMDAS mnemonic instructional strategy) rather than differences in initial knowledge or ability. Since the pretest scores are not significantly different, the focus can shift to evaluating the impact of the instructional strategy on post-test performance. This is where meaningful differences might emerge, indicating the effectiveness of the intervention.

Problem 3. Is there a significant difference in the learners' academic performance in Mathematics posttest on the control and experimental groups?

Table 7. Comparison of Learners' Academic Performance in Mathematics Posttest of the Control and Experimental Group

Group	Posttest	SD	Df	t-test	p-value	Interpretation
Control	77.88 (*Fairly Satisfactory*)	1.76	49	4.801	0.001	Significant
Experimental	84.34 (*Satisfactory*)	1.81	49			

Legend: *Ho is rejected if Significant* *Significant if p-value <0.05*
Ho is accepted if Not Significant.

Table 7 shows the comparison of learners' academic performance in mathematics posttest of the control and experimental groups. The table reveals that the control group obtained a fairly satisfactory result with an equivalent rating of 77.88, while the experimental group obtained a satisfactory result with an equivalent rating of 84.34. The table further revealed a t-test value of 4.801 with a p-value of 0.001, which is less than the level of significance (α=0.05). This led to the rejection of the null hypothesis. This means there is a significant difference in the learners' academic performance in Mathematics posttest on the control and experimental groups. The results suggest that the instructional strategy applied in the experimental group had a meaningful positive impact on the learners' academic performance in mathematics. Additionally, the results imply that whatever method, technique, or strategy applied in the experimental group enhanced learning academic outcomes compared to the traditional or alternative method used in the control group.

A related study collected data from students about their use of mnemonics on exams and found that mnemonics were frequently used and beneficial in exam situations. This suggests that mnemonic strategies like PEMDAS could effectively improve posttest results (Kuepper-Tetzel, 2024). Moreover, the study found that students who utilized mnemonic devices reported feeling more confident recalling information during exams. This indicates that incorporating mnemonic strategies into studying routines could increase academic performance.

Accordingly, the result implies that the control group's academic performance in the posttest did not significantly increase. The posttest result indicates that the traditional teaching method employed in the control group does not significantly improve learners' academic performance. This result conforms to the study of Osuh and Mwankon (2022), which emphasizes the greater need for techniques, strategy, and style in teaching the concept of Mathematics to improve academic performance. Several factors may influence their performance, including prior knowledge, interest, and how the lesson is presented. Traditional teaching methods, such as the chalkboard, may also have a less significant impact on their acceptance of concepts. Intervention and instructional strategies may affect or improve their academic performance. Moreover, the study revealed that mnemonic instruction and specific mnemonic strategies were practical and useful in addressing memory difficulties among students with learning and behavioral challenges. Understanding the factors influencing student performance and implementing appropriate intervention strategies can greatly impact their academic success.

On the other hand, the table shows that the experimental group obtained a satisfactory performance in the posttest. This result suggests that the PEMDAS mnemonic instructional strategy employed by the teacher has a measurable effect on the performance of the groups. Boon et al. (2021) claimed that mnemonic strategies improve students' Mathematics instruction performance. These strategies involve using memory aids such as acronyms, visualization techniques, and chunking information to help students retain and recall mathematical concepts more effectively. Implementing a mnemonic strategy in the classroom can increase engagement, understanding, and success in Mathematics for students of all levels. Teachers can create a more inclusive and supportive learning environment for all students by incorporating mnemonic strategies into lesson plans.

The study of Bala and Kishor (2022) found that mnemonic instructional strategies outperformed traditional methods for teaching concepts and theories. This research concludes that teachers who employ mnemonic strategies in teaching obtain more favorable results than traditional teaching methods. Mnemonic strategies and technologies may be utilized to assist students better grasp educational concepts. The diverse approach of Mnemonic may be tailored to meet the needs of the pupils. That is also one of the reasons it is such a productive method of instruction. Furthermore, incorporating mnemonic techniques can also enhance students' retention and recall of information, ultimately leading to improved academic performance. By catering to different learning styles and preferences, mnemonic tools can create a more engaging and interactive learning experience for students.

Furthermore, the result provides empirical evidence that integrating mnemonic strategies into teaching practices can significantly improve students' academic performance by enhancing their understanding, retention, and engagement. Teachers should consider adopting these strategies to create a more inclusive, supportive, and effective learning environment.

Problem 4. Is there a significant effect of the PEMDAS mnemonic instructional strategy on learners' academic performance in Mathematics?

Table 8. Regression Analysis on the Effect of PEMDAS Mnemonic Instructional Strategy on Learners' Academic Performance in Mathematics

Group	Academic Performance		t-test	f-test	p-value	Interpretation
	Pretest	Posttest				
Experimental	76.16	84.34	5.543	8.237	0.001	Significant

Legend: *Ho is rejected if Significant* *Significant if p-value <0.05*
Ho is accepted if Not Significant.

Table 8 shows the statistical analysis results on the significant effect of the PEMDAS mnemonic instructional strategy on the learners' academic in Mathematics of the experimental group. The table shows the mean equivalent rating of the experimental group in the pretest and posttest is 76.16 and 84.34, respectively. The table revealed a t-value of 5.543 with a p0.001, which is less than the level of significance (α=0.05), leading to the rejection of the null hypothesis. This further means that the PEMDAS mnemonic instructional strategy has a significant effect on learners' academic performance in the experimental group. This indicates that the PEMDAS mnemonic instructional strategy effectively improves learners' mathematical and computational skills.

Based on the results, the significant t-value (5.543) and the very low p-value (0.001) indicate that the PEMDAS mnemonic strategy is highly effective in improving students' understanding and retention of mathematical concepts. Mnemonic devices help simplify complex information, making it easier for students to recall and apply mathematical rules. The substantial improvement in the experimental group's scores suggests that the PEMDAS strategy likely increased student engagement and understanding. Mnemonics can make learning more interactive and enjoyable, which can lead to better academic outcomes. The success of the PEMDAS mnemonic instructional strategy in the experimental group highlights the potential benefits of incorporating similar mnemonic and student-centered strategies into the curriculum. This approach could be adopted more widely to enhance mathematical proficiency among students.

Related research finding by Odeyemi and Akinsola (2021) supports this result. The study found that using mnemonic and prior knowledge instructional strategies positively influenced students' attitudes toward Mathematics and significantly improved Mathematics achievement. The study found that the use of mnemonic and prior knowledge instructional strategies positively influenced students' attitudes toward Mathematics and significantly improved Mathematics achievement. These findings suggest that incorporating mnemonic devices and activating students' prior knowledge can effectively enhance students' motivation and performance in Mathematics.

It is clear from the table results that the higher increase in their scores justifies that the PEMDAS Mnemonic Instructional strategy positively impacts their academic performance. This study suggests further that using the PEMDAS Mnemonic instructional strategy as an instructional learning material in teaching the learning competencies in Mathematics could potentially improve the skills and performance of Grade 8 learners (Trinidad et al., 2022).

Furthermore, the impact of the PEMDAS mnemonic instructional strategy on students' mathematical reasoning and skills is examined in the Tan et al. (2021) study. Students who were taught the PEMDAS mnemonic strategy significantly improved their capacity to solve complex mathematical problems compared to those who were not. This further suggests that incorporating instructional mnemonic devices like PEMDAS can enhance students' mathematical skills.

Problem 5. What are the implications of the findings of the study in teaching Mathematics to Grade 8 learners?

The findings of this study imply that instructional strategies can promote learners' better understanding and retention of mathematical concepts, improve learners' engagement and motivation, and enhance learners' overall academic experience through technology integration. Integrating interactive tools and multimedia resources into lessons can cater to diverse learning styles and provide real-world applications of mathematical concepts. Additionally, ongoing professional development for teachers on effective technology integration can further support the implementation of these instructional strategies.

IV. CONCLUSIONS

Grade 8 students' academic performance improved after using the PEMDAS mnemonic instructional strategy for order operations and mathematical equations. This approach made the learning process easier, and more enjoyable, and increased the retention of lessons, compared to traditional classroom teaching methods.

Thus, the integration of PEMDAS mnemonics as an instructional strategy in teaching Mathematics while maintaining a friendly and approachable personality of teachers are valuable tools to enhance learners' academic performance and attitude towards Mathematics and help in creating a more engaging and support learning environment.

V. RECOMMENDATIONS

Based on the findings and conclusions presented, the following recommendations are suggested:

1. Mathematics teachers should minimize the use of a teacher-centered approach and instead integrate effective instructional strategies to avoid the monopoly of knowledge, cater to the diverse needs of the learners, and provide them with various opportunities to learn and experience.
2. Mathematics teachers may use the PEMDAS mnemonic instructional strategy in Mathematics classes to improve learners' fundamental and computational skills, conceptual understanding, and procedural fluency. They may also collaborate with peers and colleagues to share resources and valuable insights to improve the implementation of the instructional strategy.
3. School heads may encourage teachers to consider adopting and utilizing the PEMDAS mnemonic instructional strategy in teaching Mathematics to determine its effectiveness in other grade levels.
4. Teachers may incorporate interactive digital tools or apps that allow students to practice the PEMDAS mnemonic instructional strategy in a fun and engaging way. They may also explore mnemonic strategies for other challenging concepts in Mathematics, such as algebra, geometry, and trigonometry that could further enhance students' learning and retention.
5. Teachers can use this study's findings to create and innovate more comprehensive resources for the PEMDAS mnemonic instructional strategy. The worksheets, jingles, video lessons, digital resources for PEMDAS mnemonic games, and other supplemental learning materials used in this study may be reviewed further, revised, or improved to promote better results.

REFERENCES

1) Abaidoo, A., (2021). GRIN - Factors contributing to the academic performance of students in a Junior High School. Factors Contributing to Academic Performance of Students in a Junior High School - GRIN. https://www.grin.com/document/450284
2) Abalde, G. D., & Oco, R. M. (2023). Factors Associated with Mathematics Performance. Asian Research Journal of Mathematics, 19(6), 45–60. https://doi.org/10.9734/arjom/2023/v19i6665
3) Aguhayon, Hernalyn, et al. (2023). Addressing Students Learning Gaps in Mathematics through Differentiated Instruction. International Journal of Educational Management and Development Studies, vol. 4, no. 1, Mar. 2023, pp. 69–87. https://doi.org/10.53378/352967.
4) Ampadu, E., & Anokye-Poku, D. (2022). Influence of personal, motivational, and learning environment factors on students' attitudes toward mathematics. International Journal of Research in Education and Science (IJRES), 8(2), 378 392. https://doi.org/10.46328/ijres.2666
5) Apelo. E. C, & Arcenas, W. P. (2023). Mathematics Proficiency Of Grade 10 Junior High School Students. Globus Journal of Progressive Education. A Refereed Research Journal. Vol 13 / No 2 / Jul-Dec 2023 P - ISSN: 2231-1335, E- ISSN: 2582-7200. DOI: 10.46360/globus.edu.220232010
6) Arroyo, R. (2021). Project Fowega: Improvement of PEMDAS Mastery of Grade Six Pupils of Sampaga Elementary School through Fundamental Operations Using Worksheets and E-Games. Vol. 3 No. 2N: Ascendens Asia Journal of Multidisciplinary Research Abstracts. https://ojs.aaresearchindex.com/index.php/AAJMRA/article/view/11386
7) Ayebale, L., Habaasa, G., & Tweheyo, S. (2020). Factors affecting students' achievement in mathematics in secondary schools in developing countries: A rapid systematic review - IOS Press. Factors Affecting Students' Achievement in Mathematics in Secondary Schools in Developing Countries: A Rapid Systematic Review - IOS Press. https://doi.org/10.3233/SJI-200713
8) Bah, Y. M. (2021). Poor Performance in Mathematics Among Senior Secondary School Students: Lessons for Education Planners and Parents. nnpub.org. https://doi.org/10.53555/nnel.v7i11.968
9) Bala, K., and Kishor, N., (2022). Developing Student's Science Subject Achievement Using Mnemonic Techniques at the Secondary Level. https://www.researchgate.net/publication/357602149_developing_student's_science_subject_achievement_using_mnemonic_techniques_at_secondary_level
10) Banaszak, B. and Bergstresser, M., (2022). How to Use Mnemonic Devices for Math. Study.com. https://stufcdy.com/learn/lesson/math-mnemonics-examples-use.html

11) Barrera, J., & Cerna, J. D. (2022). Perceived Effectiveness of Mathematics Teaching Strategies and Students' Academic Performance in Blended Learning Modality. Social Science Research Network. https://doi.org/10.2139/ssrn.4168090
12) Basco, R. O. (2020). Effectiveness of Song, Drill and Game Strategy in Improving Mathematical Performance. International Educational Research, 3(2), p1. https://doi.org/10.30560/ier.v3n2p1
13) Boon, R., Urton, K., Grünke, M., & Rux, T. (2021). Mnemonic Strategies in Mathematics Instruction for Students with Learning Disabilities: A Narrative Review. Learning Disabilities: A Multidisciplinary Journal, 24, 49–62. https://doi.org/10.18666/LDMJ-2021-V24-I2-9901
14) Bokova, I. (2021), Understanding the World Through Math." Asia Society, 2021, asiasociety.org/education/understanding-world-through-math.
15) Cabuquin, J. & Abocejo, F. T. (2023). Mathematics Learners' Performance and Academic Achievement at a Public High School Institution in Leyte, Philippines. Formatif Jurnal Ilmiah Pendidikan MIPA 13(2):123-136. DOI:10.30998/formatif.v13i2.17235
16) Callaman, R. A., & Itaas, E. C. (2020, June 4). Students' mathematics achievement in Mindanao context: A metaanalysis. JRAMathEdu (Journal of Research and Advances in Mathematics Education)/JRAMathEdu (Journal of Research and Advances in Mathematics Education). https://doi.org/10.23917/jramathedu.v5i2.10282
17) Chand, S., Chaudhary, K., Prasad, A., & Chand, V. (2021). Perceived Causes of Students' Poor Performance in Mathematics: A Case Study at Ba and Tavua Secondary Schools. Frontiers in Applied Mathematics and Statistics. https://doi.org/10.3389/fams.2021.614408
18) Choi, J., & Han, H. (2023). Understanding the Influence of Teacher-Student Relationship on Mathematics Achievement: Evidence From Korean Students. SAGE Open, 13(4), 21582440231208548. https://doi.org/10.1177/21582440231208548
19) DepEd Order No. 12, series 2020. Adoption of the Basic Education Learning Continuity Plan For School Year 2020-2021 in Light of the Covid-19 Public Health Emergency
20) DepEd Order No. 34, series 2022. School Calendar and Activities for the school year 2022-2023
21) Digitale, E. (2021). Positive attitude toward math predicts math achievement in kids. News Center.
22) https://med.stanford.edu/news/all-news/2021/01/positive-attitude-toward-math-predicts-math-achievement-in kids.html
23) District, M., Godfrey, W., Silvia, N., & Catherine, M. (2023). The Effect Of Teacher's Instructional Methods On The Learners' Academic Performance In Mathematics Subject. . . ResearchGate. https://www.researchgate.netpublication/368987190_The_Effect_Of_Teacher's_Instructional_Methods_On_The_Learners_Academic_Performance_In_Mathematics_Subject_In_Secondary_Schools_A_Case_Study_Of_Buwesswa_Secondary_School_In
24) Division Memo No. 260, series 2023. The Conduct of Online Division Achievement Test 2023, Division of Misamis Oriental.
25) Glover, E. (2021). Teacher Understanding of Instructional Strategies in Elementary Mathematics. Walden Dissertations and Doctoral Studies Collection. https://scholarworks.waldenu.edu/cgi/viewcontent. cgi?article=12558&context=dissertations
26) Hagan, Atteh, E., & Lawer, V. (2020). Students' Perception towards Mathematics and Its Effects on Academic Performance. Asian Journal of Education and Social Studies, 8–14. https://doi.org/10.9734/AJESS/2020/v8i130210
27) Hassan, M. U., & Akbar, R. A. (2020). Tracing the Effects of Teachers' Centered Teaching Methods on Students' Achievement Scores: Secondary Level Study. Bulletin of Education and Research, 42(1), 29–43. http://files.eric.ed.gov/fulltext/EJ1258057.pdf
28) Hwang, S., & Son, T. (2021). Students' Attitude toward Mathematics and its Relationship with Mathematics Achievement. Journal of Education and E-Learning Research, 8(3), 272–280. https://doi.org/10.20448/journal.509.2021.83.272.280
29) Ihechukwu, N. (2021). Effect of Mnemonic Instructional Strategy on Secondary School Students' Achievement\in Mathematics. Journal of CUDIMAC (J-CUDIMAC). ISSN 2651-6063 (Online). Vol 6, No.1 2021. https://cudimac.unn.edu.ng/wp-content/uploads/sites/ 52/2021/04/Nwoke-72-79.pdf
30) Islam, M. H. (2020). Thorndike Theory and Its Application in Learning - CORE. Thorndike Theory and Its Application in Learning - CORE. https://core.ac.uk/display/288101368?utm_source=pdf&utm_ medium=banner&utm_campaign=pdf-decoration-v1

31) John, A., (2021). "10 Causes of Poor Academic Performance in School – EduAnsa." EduAnsa, 26 Sept. 2021, www.eduansa.com/10-causes-of-poor-academic-performance-in-school-most-students-never-admit-8.
32) Kimeli, P., Kuboja, J., (2023). Effects of Teaching Approaches on Students' Academic Performance From Selected Public Secondary Schools In Arumeru District, Tanzania. International Journal of Social Science and Humanities Research.ISSN 2348-3156 (Print), ISSN 2348-3164 (online). Vol. 11, Issue 4, October 2023 - December 2023. Page No: 359-365. DOI: https://doi.org/10.5281/zenodo.10148534
33) Kuepper-Tetzel, C. (2024, March 14). Digest #172: Mnemonic Devices — The Learning Scientists. The Learning Scientists. https://www.learningscientists.org/blog/2023/10/26/digest-172
34) Kumar, S. Agarwal, M., Agarwal, N., (2021). Defining And Measuring Academic Performance of the Students Critical Review. Turkish Journal of Computer and Mathematics Education.Vol.12 No.6 (2021), 3091-3105.
35) Landicho, R. R. (2021). Factors Affecting Performance in General Mathematics of Grade Eleven Students in Talumpok Integrated School: Basis for Intervention Activities An Action Research. International Journal of Innovative Science and Research Technology. ISSN No:-2456-2165
36) Lepnevich, A. (2022). Study: When Math Class is Boring, Students Lose Interest in Related Careers. Cuny Graduate Center. https://www.gc.cuny.edu/ news/study-when-math-class-boring-students-lose-interest-related careers
37) Liao, Y.-H., Kung, W.-C., & Chen, H.-C. (2021). Testing the effectiveness of creative map mnemonic strategies in a geography class. Instructional Science, 47(5), 589–608. https://doi.org/10.1007/s11251-019-09494-1
38) Manuta, J. (2022). The Effectiveness of Intervention Strategy in Teaching Selected Concepts in Mathematics Using Modular Learning".
39) Metsämuuronen, J., & Räsänen, P. (2021). Cognitive–Linguistic and Constructivist Mnemonic Triggers in Teaching Based on Jerome Bruner's Thinking. PubMed Central (PMC). https://doi.org/10.3389/fpsyg.2021.02543
40) Moussa, N. M., & Saali, T. (2022). Factors Affecting Attitude Toward Learning Mathematics: A Case of Higher Education Institutions in the Gulf Region. SAGE Open, 12(3), 21582440221123023. https://doi.org/10.1177/21582 440221123023
41) Munusamy, S., Koenigsfeld, C., & Torry, R. (2023). Longitudinal Impact of Mnemonics Use on Students' Exam Performance and Perceptions of Knowledge Retention. https://doi.org/10.1124/jpet.122.219830
42) Odeyemi, E. O., & Akinsola, M. K. (2021). Effects of Mnemonic and Prior Knowledge Instructional Strategies on Students' Achievement in Mathematics. https://www.semanticscholar.org/ paper/Effects-Of-Mnemonic-And-Prior-KnowledgeStrategies-Odeyemi-Akinsola/c70a6f18e6d4f9851c011e604cf0013e04b50914
43) Okoro, D., Akaraonye, J., & Unamba, E. (2020). Assessment of the Impact of Mnemonic Instructional Strategy on Pupils' Achievement in Mathematics; A Case for Sustainable Development. 15, 164–172.
44) Osborne, Tiffany. (2021). Impact of Interventions on Student Performance Among Eighth Graders in Algebra 1. All Dissertations. 2919. https://tigerprints.clemson.edu/all_dissertations/2919
45) Osuh, J. I., & Mwankon, S. B. (2022). The Effect of Different Mnemonic Strategies and Gender on Ability to Recall Among Secondary School Students in Jos, Plateau State. Gender and Behaviour, 20(4), 20741–20753. https://doi.org/10.10520/ejc-genbeh_v20_n4_a31
46) Ozcan, M. (2021). Factors Affecting Students' Academic Achievement according to the Teachers' Opinion. Education Reform Journal, 6(1), 1–18. https://doi.org/10.22596/erj2021.06.01.1.18
47) Padernal, R. (2023). Effect of Mnemonic-Aided Instruction on Academic Performance of Maritime Students in Calculus. Pure and Applied Mathematics Journal. Vol. 12, No. 1, 2023, pp. 16-22. doi: 10.11648/j.pamj.20231201.13
48) Peterson, R. and Doll, B. (2023). Mnemonics. Why are Mnemonics Helpful Tools? Student Engagement Project. University of Nebraska–Lincoln. https://k12engagement.unl.edu/mnemonics
49) Prado, J. (2021). The Effect of Math Anxiety on the Numerical Brain. Research Scientist, French National Center for Scientific Research (CNRS) and Lyon Neuroscience Research Center (CRNL), France 17 September 2021. https://solportal.ibe-unesco.org/articles/the-effect-of-math-anxiety-on-the-numerical-brain/
50) Prediger, S., Wilhelm, N., Büchter, A. et al. (2021). Language Proficiency and Mathematics Achievement. J Math Didakt 39 (Suppl 1), 1–26 (2021). https://doi.org/10.1007/s13138-018-0126-3
51) Ramirez, G., Chang, H., Maloney, E. A., Levine, S. C., & Beilock, S. L. (2021). On the relationship between math anxiety and math achievement in early elementary school: The role of problem-solving strategies. Journal of Experimental Child Psychology, 141, 83–100. https://doi.org/10.1016/j.jecp.2015.07.014
52) Ruark, A. D. (2021). The Effect of Expressive Writing on the Math Anxiety Scores of Middle School Students Enrolled in a Public School in East Texas. https://digitalcommons.liberty.edu/cgi/viewcontent. cgi?article=3030&context=doctoral

53) Sarma, M., Das, G. C., Sharma, N., Sharma, M., & Mishra, V. N. (2021). Parameters influencing the attitude of students towards learning mathematics and of teachers towards teaching mathematics. J. Math. Comput. Sci., 11(4), 4332–4350. https://doi.org/10.28919/10.28919/ jmcs/5770
54) Seato, J and Seaton, S. (2023). Order of Operations. Twinkl. https://www.twinkl.com.ph/teaching-wiki/order-of operations
55) Siregar, N. R., Wimbarti, S., & Ilham, M. (2021). Individual differences in attitudes toward mathematics. Journal of Physics. Conference Series, 1188, 012005. https://doi.org/10.1088/1742-6596/1188/1/012005
56) Stafford, J. et al., (2021). "Importance of Math and Science for Elementary Students." Mississippi College Online, 23 Nov. 2021, online.mc.edu/degrees/education/med/elementary/math-science-elementary-students.
57) Stocker, J. D. Jr. and Kubina, R. M. Jr. (2021). Building Prealgebra Fluency Through a Self-Managed Practice Intervention: Order of Operations. Behav Anal Pract.14(3):608-622. doi: 10.1007/s40617-020-00501-3. PMID: 34631368; PMCID: PMC8458516.
58) Surur, A. (2021). Thorndike's Theory for Improving Madrasah Teacher's Creative Thinking and Publication. Proceedings of the International Conference on Engineering, Technology and Social Science. Advances in Social Science, Education, and Humanities Research, volume 529
59) Tan, A., Ali Rahman, E. S., Shahrill, M., & Abbas, N. A., (2021). Developing Students' Mathematical Skills Involving Order of Operations. International Journal Of Research In Education And Science, 373–373. https://doi.org/10.21890/ijres.327896
60) The Importance of Mathematics in the Modern World. (2021). The Superprof Blog - UK. https://www.superprof.co.uk/blog/maths-and-the-modern-world/
61) The PEMDAS Rule Explained! (Examples Included) — Mashup Math. (2021). Mashup Math. https://www.mashupmath.com/blog/pemdas-rule-math-order-of-operations
62) Tiedeman, S. (2021). The Impact of Early Math and Numeracy Skills on Academic Achievement in Elementary School Payton Guhl. Northwestern College, Iowa NWCommons. https://nwcommons.nwciowa.edu/cgi/viewcontent. cgi?article =1145&context=education_masters
63) Tobias, C. and Diego, C. (2022). Factors Predicting the Mathematics Performance of Grade 8 Students in the New Normal. Asian Research Journal of Mathematics, 2022, 18 (11), pp.287-300.ff10.9734/arjom/2022/v18i11602 ff. ffhal-03850580f
64) Torres, K. and Corpuz, G. (2024). Effectiveness of Cooperative Learning on Learners' Performance in Mathematics", International Journal of Emerging Technologies and Innovative Research (www.jetir.org), ISSN:2349-5162, Vol.11, Issue 6, page no.d186-d195, June-2024, Available:http://www.jetir.org/papers/JETIR2406321.pdf
65) Trinidad, M., et. al, (2022). "Utilization of Video Lessons as Mathematics Intervention Material in Modular Distance Learning - IRE Journals." IRE Journals, 2022, www.irejournals.com.
66) Tutorax. (2022). Why is it important to follow the order of operations? Blogue Tutorax. https://tutorax.com/blogue/en/why-is-it-important-to-follow-the-order-of-operations/
67) Ulpah, M., & Novikasari, I. (2020). Developing Islamic Context-Based Learning Materials in Increasing Students' Mathematical Understanding. Al-Jabar : Jurnal Pendidikan Matematika, 11(1), 29–38. https://doi.org/10.24042/ajpm.v11i1.5432
68) Villalobos, R. (2020). Issues Affecting the Academic Performance in Mathematics of Senior High School Students at Selected Schools in Zambales: Basis for the Support of University's Administration Department by Roy
69) Wakhata, R., Mutarutinya, V. & Balimuttajjo, S. (2022). Secondary school students' attitude towards mathematics word problems. Humanit Soc Sci Commun 9, 444. https://doi.org/10.1057/s41599-022-01449-1]
70) Wongupparaj, P., Kadosh, R.C. (2022). Relating mathematical abilities to numerical skills and executive functions in informal and formal schooling. BMC Psychology 10. Article no. 27. https://doi.org/10.1186/s40359-02200740-9
71) Zorin, B., & Carver, D. (2021). Operation: Save Aunt Sally. Mathematics Teaching in the Middle School, 20(7), 438–443. https://doi.org/10.5951/mathteac middscho.20.7.0438