TRADITIONAL AND INSTRUCTIONAL APPROACHES IN TEACHING MATHEMATICS: AN EXPERIMENTAL STUDY

Elaine Jane V. Begornia, Romulo G. Doronio

Teacher I, Department of Education, Philippines
Grad School Faculty, Assumption College of Nabunturan, Philippines

ABSTRACT

This study investigates the effectiveness of Traditional versus Instructional teaching approaches in improving Grade 8 students' comprehension and application of mathematics. Using purposive sampling, 50 students from sections Gemelina and Narra at Monkayo National High School were divided into two groups. The experimental group received instruction through collaborative and visual-based strategies, while the control group used traditional methods. Both groups were assessed to compare their problem-solving and arithmetic skills. Pretest and posttest were administered before and after the approaches had been implemented. Following the administration of the pretest and posttest using paper and pen, the results were compared to determine the learners' achievements. The competency level of both the control and experimental groups at the beginning of the experiment were equivalent, as shown in the computation of their class proficiency in their pretest scores. The competency level of the students in the experimental group after the experiment was significantly different. Therefore, the interference of using instructional approach in mathematics was effective. The instructional approach involves collaborative learning and visuals such as Damath integration can be used to actively involve students during knowledge development, increase computational skills, and foster critical thinking to do arithmetic easily. The findings revealed that both approaches were successful in teaching mathematics, however the instructional approach strategy had a higher mean than the other. Thus, the Instructional Approach was more effective than the Traditional Approach technique. When performing math remediation, teachers must look for the most engaging and enjoyable learning ways for students. This can be achieved through an instructional approach that allows students to collaborate with their peers while also developing their computing skills. As a result of the trial's positive results, the researcher urged math teachers to adopt an instructional approach, the use of visuals, and a collaborative strategy.

Keywords: *The use of Visuals (Damath), instructional approach, assessment tool, paper-and-pen test, experimental research*

1. INTRODUCTION

Many students still have difficulty understanding basic Mathematical ideas, which results in poor performance on exams even though teaching techniques are becoming increasingly important in Mathematics education. This study examines the efficacy of traditional approaches and instructional teaching methods as best to apply in improving students' comprehension and application of Mathematics.

In Turkey, an investigation of Necdet Guner on why Turkish secondary school students struggle with Mathematics, respondents claimed that their Mathematics teacher did not educate properly, utilized the appropriate methods and approaches, or stimulated their interest in the subject. They also stated that they did not study enough, had insufficient fundamental Mathematics understanding, and struggled because they did not grasp the courses (Yayla & Bangir-Alpan, 2019) [1]. In another study, seventh graders viewed Mathematics as a difficult and dull topic, and they suggested that Mathematics teachers enhance their class delivery and student interactions (Memnun & Akkaya, 2010). [2]

In the Philippines, Math and Filipino subjects are often taught through traditional methods like lectures, memorization, and drills. While these aid quick recall, they lack engagement and deeper understanding. Bernardo (2017) noted that focusing too much on grammar and recitation in classes is becoming less relevant [3]. To address this, the K to 12 curriculum promotes more student-centered and interactive teaching. DepEd (2016) and SEI-UP NISMED (2011) highlight the importance of using visuals, group work, and real-life examples to help students understand concepts better. However, many teachers still stick to old methods due to large class sizes, limited materials, and lack of training.[4]

In the context of Davao de Oro where the researcher was currently teaching, in the first-class municipality of the province which is Monkayo. The researcher carried out her research study in Monkayo National High School. As a Grade 8 adviser, handling the special program in sports class, and manage regular classes in other sections. The researcher seen that majority of students struggle with basic integer operations and occasionally become confused, especially when dealing with algebraic expressions like negative numbers paired with variables. Even though they had already been introduced to and talked with integers in the seventh grade, my eighth-grade students still struggled to do basic arithmetic involving negative signs which affects their overall math performance because they are more equipped with traditional than instructional methods.

Moreover, this study explores the effectiveness of traditional teaching and instructional approach like collaborative learning and use of visuals in teaching Mathematics. While traditional methods focus on direct instruction, collaborative and visual methods such as models, images, and tools may enhance engagement and understanding. The goal is to determine which approach better supports students' learning in Mathematics.

2. RESEARCH METHODOLOGY

2.1. Research Design

The study used a quasi-experimental research approach to collect its data. Donald T. Campbell developed the quasi-experimental method for generalizing causal inference. A two groups pretest-posttest research design was used for the study, with pretests administered to both groups at the start of each period and posttests at the end of each period (Padua, 2000).

In order to determine the degree of a relationship between a number of variables through the use of statistical data, this study used a quantitative research design which is Quasi-Experimental, which includes a two-group pretest and posttest design. Quantitative research provides interpretation and meaning to the data through the use of statistics from the survey technique, which includes the analysis of numerical data using specific statistical tools (Apuke, 2017).

A total of 50 students were chosen for this study, which is divided into two sections: 25 students from a Special Program in Sports class, the control group and 25 students from a regular class experimental group. Both the experimental and control groups came from heterogeneous or average areas with varying levels of dissatisfaction. Both groups and these two portions got pretests and posttests via paper-and-pen assessment.

2.2 Research Subject

The subject of the study is coming from Monkayo National High School students. respondents were selected through purposive sampling, in which the researcher selected average students. The target respondents were coming from Grade 8. Table 1 below illustrates the subject of the study given the two sections the Special Program in Sports Class (Gemelina) and regular class (Narra) in Grade 8 level.

Table 1
Subject of the Study

Grade Level	Grade 8 Gemelina	Grade 8 Narra	Total
Total number of Respondents	25	25	50

2.3 Research Instruments

In collecting data, the researcher used an adapted 40-item unified test questionnaire with Table of Specification (TOS) from the Department of Education Davao de Oro in order to conduct her study. The mathematics test items consisted Grade 8 topics from most essential learning competencies including problem-solving analysis.

Validation of Instrument. Before being administered to respondents, the questionnaire was validated to ensure that the modified instrument was valid. This was done to determine whether the items in the questionnaire were appropriate to be answered by respondents. Following validation, the researcher administered a pilot test to a sample of students who were not participants in the main study to check the instrument's reliability and consistency. To assess reliability, the test-retest procedure was used, in which the same group of students completed the questionnaire twice within a certain period. The data were then examined to assess response consistency across time, ensuring the instrument's reliability and validity prior to final administration.

2.4 Procedure

The required procedures were followed throughout the data being collected.

Seeking permission to conduct the study. The researcher requested permission to perform the study from the graduate school's Research Ethics Committee (REC). Furthermore, the researcher acquired an endorsement letter from the Dean of Graduate Schools. The researcher also provided a letter of authorization that they all signed granting for approval. First, to the Davao de Oro Schools Division Superintendent office for the conduct of this research at Monkayo National High School. A documented letter of request will then be promptly given to the School Principal IV of Monkayo National High School to obtain formal permission. Following approval, the researcher was handed a copy to the principal of the school where she conducted her research.

Administering the Questionnaire. To begin the study, the questionnaire was given to the designated Grade 8 students. The researcher was in charge of administering, with proper coordination of the teacher in-charge. To ensure that the questionnaire had been grasped completely, the researcher discussed the items in detail, and respondents were given adequate time to complete it.

Data Gathering. The researcher obtained and collected all of the data; all raw scores were compiled and tallied. The tabulated data were sent to the statistician for statistical analysis in order to find solutions to the issues mentioned in the first chapter of the study.

2.5 Statistical Treatment of the Data

The data collected was tallied and tabulated. The researcher utilized the paired t-test to compute the significant association of the samples, ensuring accuracy in the analyses and interpretations of the findings.

Mean. The Mean was used to determine the respondents' average performance based on their pre-test and post-test results.

Class Proficiency. This was used to determine the competency level of two groups or the number of students who are actually meeting learning goals rather than just relying on the average score.

Paired t-test. This was used to calculate the t-value by comparing the mean difference between the pre- and post-test of each group to find whether there is a significant difference between the subjects' scores.

Independent t-test. This t-test was utilized to compute the t-value of the post-tests of both groups and find whether there is a significant difference between the subjects' scores.

2.6 Ethical Considerations

According to Bhashin (2020), ethical consideration describes the values and ideals that should be upheld throughout the investigation. With this, the researcher will guarantee that ethical standards are properly maintained during the study, which will address the following areas.

Social Value. The research will be conducted using pretests and posttests to ensure that traditional and instructional approaches to teaching mathematics highlight the social benefit of ensuring equitable access to learning by meeting student needs. Promoting inclusion and creating an equitable and effective learning environment.

Informed Consent. This consent enables the participants to understand their role in the study and what is expected of them. This covered the goals of the study, the procedures that would be employed, the potential results, and the dangers, discomforts, and inconveniences that the volunteers could experience. The researcher explained to them that they were free to decline or withdraw from participating in the research at any moment, as stated on the form. The researcher informed them that the pretest and posttest ensure students' learning is appropriately evaluated after teaching by fostering accountability and openness. This enables teachers to pinpoint areas in which children might still require assistance, promoting an equal learning environment.

Vulnerability of the Research Participants. The researcher will describe the full procedure of the in-depth pretest and posttest that will be administered, emphasizing that participants have the option to opt out of the examination if they are uncomfortable, and it will not affect them in any way.

Risks, Benefits, and Safety. The researcher will explain the benefits of the participant's participation in the study. The in-depth pretest and posttest will be conducted during the most convenient time and place for the participants and any expense incurred by them for the study will be reimbursed by the researcher. The researcher will also emphasize that the test results will not affect the participants' academic grades.

Privacy and Confidentiality of Information. Confidentiality was maintained for the recorded data from this study. No other reports or publications mentioned or used any specific entities. The researcher will make sure that the participant's personal information, identity, and data gathered will be kept confidential and secured to ensure that the Data Privacy Act of 2012 is being followed. All information resulting from this study was kept confidential at all times. This study would not reveal any personal information about the people who contributed ideas and viewpoints to specific study subjects. The collected data will be recorded using a mobile phone and the files will be transferred to a Google drive, which only the researcher can access. The data will be destroyed after the conduct of the study.

Justice. The research participants are chosen based on inclusion criteria: must be a Grade 8 students and enrolled in Monkayo National High School, have been integrated to approaches like traditional and instructional approaches and must be actively attending classes for S.Y 2024-2025. The selected participants coming from different gender and economic status. In any case that research participants might incur their expense during the conduct of the test, the researcher will reimburse them. They will also be given a token of appreciation for the inconvenience that the study might have caused.

Transparency. To address this aspect, the researcher will disclose the study's affiliations and objective. The research participants will also be given a copy of the transcript of their answers to verify the reliability and validity of the data gathered.

Qualification of the Researcher. The researcher gained valuable research experience in conducting a study during college and graduate school studies.

3. RESULTS

This chapter shows the findings from the data collection and subsequent analysis in an order corresponding to the problems presented. Data and basic information were also supplied as the foundation for the computation and interpretation of the findings. These results were obtained using SPSS software.

Competency Level of the Pretest Scores of the Groups

Table 2 illustrates the competency levels reflected in the pretest scores for both the control and experimental groups, highlighting key differences and insights that merit attention.

Table 2
Competency Level of the Pretest Scores of Control and Experimental Group

Pretest	No. of Students	Mean	Class Proficiency	Competency Level
CONTROL	25	16.08	40.2%	Near Mastery
EXPERIMENTAL	25	16.6	41.5%	Near Mastery

The table above illustrates the students' levels of achievement prior to the study of the two groups. Each group includes 25 students as research participants. The class proficiency reveals that the experimental group obtained 41.5% and the control group got 40.2%, but both groups did not surpass the competency level expectations. Group A and Group B had mean scores of 16.08 and 16.6, respectively. The two groups have nearly similar mean scores, with a 0.52 difference. This shows that the two groups are comparable.

Competency Level of the Posttest Scores of the Group

Table 3 illustrates the posttest competency level results for the control and experimental group.

Table 3
Competency Level of the Posttest Scores of Control and Experimental Group

Posttest	No. of Students	Mean	Class Proficiency	Competency Level
CONTROL	25	24.76	76%	Mastery
EXPERIMENTAL	25	28.44	81%	Mastery

Table 3 shows the students' performance level after examining the two groups. The competence level indicates that both the control group (76%) and experimental group (81%) has a Mastery level of class proficiency. Groups A and B belongs to mastery level which means this group met the competency standards. However, the result proves that the instructional approach like collaborative learning, and use of visuals through Damath integration is more effective because it has 81% class proficiency than the traditional approach that has 76% class proficiency.

Difference between the pretest and posttest Mean scores of the students in the control group.

Table 4 shows the results of the paired t-test use to compare the achievement of the students in the control group

Table 4
Comparison of the Achievement of the Student in the Group A (Control)

	Mean	t-value	P-Value	Remarks
PRETEST	16.08	-9.985	0.000	Significant
POSTTEST	24.76			

The table illustrates the achievement levels of students in Group A (Control). Paired t-test was conducted to test if there is significant difference in the pretest and posttest. The mean value for the pretest was 16.08, whereas the posttest was 24.76 and it has a computed t-value of -9.985. This means that the P-value is 0.000, which is less than 0.05, indicating that the decision was significant. There is significant evidence to reject the null hypothesis. As a result, the null hypothesis was rejected, and it proves there was a significant difference between the achievements of the students when using traditional approach strategy in developing students numerical understanding.

Difference between the pretest and posttest Mean scores of the students in the experimental group.

Table 5 shows the results of the paired t-test used to compare the achievement of the students in the experimental group.

Table 5
Comparison of the Achievement of the Students in the Experimental Group

	Mean	t-value	P-Value	Remarks
PRETEST	16.6	-20.84	0.000	Significant
POSTTEST	28.24			

The table shows that the mean score of the students in pretest was 16.6, while the posttest mean score increased to 28.24. The computed t-value is -20.84, and the p-value is 0.000, which is less than the significance level of 0.05. This indicates that the difference is statistically significant. Therefore, there is strong evidence to reject the null hypothesis. This means that there is significant difference in the achievement of students when instructional approaches such as the use of visuals like Damath and collaborative strategies are applied in mathematics.

Difference between the posttest Mean scores of the students in Control and Experimental group.

Table 6 shows the results of the computations comparing the students' achievements between the control and experimental groups as reflected in their posttest scores.

Table 6
Comparison of the Achievement of the Students between the Control and Experimental Group

Posttest	Mean	t-value	P-Value	Remarks
Group A (Control)	24.76	4.98	0.000	Significant
Group B (Experimental)	28.44			

Table 6 shows the students' performance level after the study of the two groups. An independent t-test was used to determine the difference between the posttest of both groups. The mean indicates that Group A section Gemelina (Control) got 24.76 and Group B section Narra (Experimental) got 28.44. The computed t-value is 4.98 and the P-value is 0.000 less than 0.05, indicating that it is significant. Therefore, the null hypothesis was rejected and there is a significant difference between the students' achievements in the control and experimental group as reflected on their posttest scores.

4. DISCUSSIONS, CONCLUSION AND RECOMMENDATION

4.1. DISCUSSION

Competency Level of the Pretest Score of Control and Experimental Group.

In the pretest score of control and experimental group, both got low mastery level of the subject since their class proficiency was below 50% based on the result. This implies that the teacher needs to use another strategy in teaching mathematics that can help students understand, able to compute with critical thinking and reasoning skills, and at the same time can enjoy the activity. There are many instructional strategies for developing students' computational literacy that can ensure effective learning outcome, just like presenting visuals/models, the use of Damath, and collaborative approach that makes learning more enjoyable for them.

Jean Piaget believed that instruction should be adapted to each learner's developmental stage, allowing children to explore and interact with their surroundings in order to gain understanding. In contrast to passively receiving information, He was a major supporter of active discovery-based learning, which involves pupils participating in hands-on experiences (Shaffer et al., 2010). Jean Piaget's views on approaches to instruction are inextricably linked to his cognitive development and constructivism theories. He emphasizes the importance of child-centered instruction, with a focus on how learners construct knowledge via active involvement.

Competency Level of the Posttest Scores of Control and Experimental Group.

Based on the posttest score result of the control and experimental group both groups got a satisfactory level of achievement since their class proficiency was above 50%. However, the experimental group got higher level of achievement than that of control group. This implies that instructional approach just like integration of collaborative learning and use of visuals such as Damath as tool for learning in mathematics is more appropriate and has a great impact on students critical thinking skills that they can make mathematics more enjoyable to learn. According to Kilpatrick, Swafford & Findell (2001) define instructional approach to mathematics as the set of activities and teaching methods that aim to develop students' mathematical understanding, procedural fluency, and problem-solving abilities. They argue that effective instruction balances conceptual understanding with procedural skills, fostering both reasoning and computational fluences.

Comparison of the Achievement of the students in the Control Group.
In comparing the accomplishments of the students in the control group, the null hypothesis was rejected and it demonstrates that there was a significant difference between the pretest and posttest scores of students' performance when teaching mathematics using the traditional strategy approach. The traditional approach is beneficial for students specially to those students in special program in sports class, because sometimes they need extra attention and step-by-step guidance in order to grasp the lesson and solve problems. While this Traditional approach helps them catch up, shifting to a child-centered approach is more effective. Perhaps a result of teacher-centered or traditional approach has been proven to be less successful. This research implies that a sustained reliance on teacher centered teaching methods cannot ensure students success, because it limits a student potential, it allows teachers to compare the results of other students; hence it cannot be considered an interactive, participatory or engaging learning activity in accordance with Zemelman, Daniels, and Hyde (2012).

Comparison of the Achievement of the students in the Experimental Group.
In comparison of the result of the student in the experimental group, the null hypothesis was rejected and it demonstrates that there was a significant difference between the pretest and posttest scores of the students' performance when teaching mathematics using the instructional approach in teaching mathematics.
According to Mayer 2009, visual representation can help learners integrate new information by organizing and making sense of complex ideas. Additionally, Tufte 2001 emphasize that well-designed visuals can "reveal data" and support analytical thinking, especially when concluding detailed analysis. In using visuals such as Damath, Montenegro 2006 highlighted that Damath promotes active learning, which allows students to apply math concepts in a dynamic environment that promotes fun and effective ways to learn and improve students mathematical skills.

Comparison of the Achievement of the students between the Control and Experimental Group. In comparing the achievement test of both groups between the control group and experimental group it implies that the null hypothesis was rejected and there was a significant difference between the achievement test of control group and experimental group based on their posttest result. It shows that the result had achieved Mastery level, so it means that both traditional and instructional approaches are useful teaching strategy techniques to implement in mathematics. In control group the traditional approach was utilized and it shows better academically. The experimental group utilizing instructional approach such as the use of visuals through Damath integration has been proven to be more effective, since the result reached more than 5% higher than the traditional approach of the control group. Kilpatrick, Swafford, and Findell (2001) define an instructional approach to mathematics as a collection of activities and teaching approaches designed to improve students' mathematical understanding, procedural fluency, and problem-solving ability. They propose that good training strikes a balance between conceptual comprehension and procedural skills, promoting both reasoning and computational fluency. Lesh and Doer (2003) also emphasize the use of modeling in mathematical education, in which students construct, test, and develop mathematical models to meet real problems. This strategy encourages active learning and a better understanding of the real-world applications of mathematics.

4.2. CONCLUSION

The result of the competency level of both the control group and experimental group were almost equivalent, and the result belongs to the nearly mastery level as shown on the table in the previous chapter in their pretest score class proficiency level computation.

The competency level of the students in the experimental group after the experiment was significantly different. Therefore, the interference of using instructional approach such as the use of visual like Damath as intervention in developing students mathematical skills was effective. The instructional approach can be used to actively involve

students, since it allows collaborative learning during the development of knowledge, increase comprehension skills, and fosters critical thinking.

The results show that the achievement tests of both the control group and experimental group in solving problems and critical analysis in mathematics were effective, as they had reached a mastery level. However, instructional approaches such as the use of visuals and integrating Damath as an intervention are more effective than traditional approaches, since the instructional approach strategy in the experimental group is higher than that of the control group.

4.3. RECOMMENDATIONS

Based on the conclusion derived from the findings of the study, the following recommendations are hereby presented in the study.

1. There is a need for Mathematics teachers to explore problem-solving skills that would develop learners critical thinking, especially in analyzing word problems and solving equations or doing arithmetic that would make mathematics easier and fun to learn. This could be done through instructional approach or interactive approach, the use of visuals like board games such as the integration of Damath can make learners able to identify coordinates and it can also foster students' computational skills and develop their ability to analyze math concepts.

2. The process of traditional and instructional approaches should be between teachers and students as it addresses different learning needs. Traditional approaches ensure mastery of basic arithmetic skills and procedural understanding, while instructional approaches encourage students' participation collaborative learning through group activity, conceptual thinking, and problem-solving, making math concepts more comprehensive, meaningful, and fun to learn.

3. Just as other activities, the work of teachers depends on the school community. By sharing the administrator's resources to develop rich literacy experiences for students, the School Administrators should encourage, support, and strictly implement in summer class the national learning camp wherein Math subject is always included for interventions.

4. The use of instructional approaches, such as the integration of visuals like board games the DAMATH is recommended for future researchers to implement, as it has a relevant effect on the achievement level of students, as it fosters students' ability to perform arithmetic and solve math operations mentally.

5. ACKNOWLEDGEMENT

The researcher extends heartfelt gratitude to all those who contributed to the completion of this thesis. Their unwavering support, invaluable advice, and constant encouragement have made this study possible. The following individuals deserve special attention for their significant involvement in making this study possible:

Her adviser, Dr. Romulo G. Doronio, whose unwavering support, dedication, and genuine care made a significant difference in the journey of this study; for devoting countless hours to reading and refining the manuscript, for generously sharing his methods, expertise, and guiding questions that paved the way during the proposal defense preparation, and for providing invaluable insights and encouragement that deeply shaped and strengthened the development of this work.

Dr. Roel P. Villocino, Dean of Graduate School and Chairman of the Defense Panel, for his words of advice, encouragement, and for sharing his expertise throughout this research. He has been an exceptional mentor.
Prof. Delfin J. Enargan and Dr. Elizabeth D. Dioso, the defense panel members, made important improvements to the study through their invaluable recommendations and insightful comments that significantly improved the quality of this study. Their expertise, encouragement, and genuine concern for the development of this research have been deeply appreciated.

Madam Pheobe Gay L. Refamonte, Schools Division Superintendent of Davao de Oro through Annalyn M. Loreto, SEPS, Planning and Research Section of School Governance and Operations Division, for the prompt response to her request to conduct a study to the selected school in Davao de Oro.

For the clearance of this study, thanks to Ma'am Kristian Anhara L. Martesio, School Principal IV of Monkayo National High School, Monkayo West District, for the immediate approval of the request to conduct this study in her prestigious school.

Monkayo National High School Grade 8 learners of section Gemelina and section Narra, who are the research informants, the researcher is so grateful for their willingness to participate in this study.

To Charly M. Buaron, her husband, for providing his words of wisdom, encouragement and motivation, during this master's degree journey whenever she feels tired and loses interest in pursuing this degree. He is always there to cheer her up whenever she feels that she can't do it.

To Sharon B. Valdez, her supportive aunt, for always supporting her dreams and aspirations. Her guidance from her college days until she became a regular teacher has been unwavering.

To the people who have been part of this study, who made significant contributions in so many and various ways.

Above all, to ALMIGHTY GOD, for enough wisdom, good health, strength, knowledge, and guidance in overcoming challenges and obstacles to complete this study.

6. REFERENCES

[1]. AlAli, R. M., & Al-Barakat, A. A. (2023). Role of teacher understanding about instructional visual aids in developing national and international student learning experiences. *Journal of International Students, 13*(4), 331–354. https://doi.org/10.32674/jis.v13i4.3652

[2]. Aydin-Guc, F., Aygun, D. (2021). Errors and misconceptions of eighth-grade students regarding operations with algebraic expressions. International Online Journal of Education and Teaching (IOJET), 8(2). 1106-1126.

[3]. Babbin, E. C. (2020). *Examination of the effects of a Tier Two middle school mathematics intervention on academically at-risk students* (Publication No. 27961928) [Doctoral dissertation, Lehigh University]. ProQuest Dissertations & Theses Global.

[4]. Ballenas, G. J. (2023). Improving the computational skills in integers, fractions, and decimals through Technology-Enhanced Mathematics Instruction (TEMI). *American Journal of Educational Research, 11*(9), 603–613. https://doi.org/10.12691/education-11-9-9

[5]. Bantillo, R. B., & Ngag, J. B. J. U. (2024). CHANGING LANDSCAPE OF FILIPINO EDUCATION: TEACHERS' PERSPECTIVES ON TRADITIONAL VS. MODERNIZED APPROACHES TO TEACHING FILIPINO. Ignatian International Journal for Multidisciplinary Research, 2(6), 2409–2420. https://doi.org/10.5281/zenodo.12635314

[6]. Bofferding, L. (2010). Addition and subtraction with negatives: Acknowledging the multiple meanings of the minus sign. In P. Brosnan, D. Erchick, & L. Flevares (Eds.), Proceedings of the 32nd annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education Columbus, OH: The Ohio State University.

[7]. Comstock, M., Shores, K. A., Polanco, C., Litke, E., Hill, K. L., & Desimone, L. M. (2022). Typologizing teacher practice: How teachers integrate culturally responsive, ambitious, and traditional teaching approaches (EdWorkingPaper: 22-506). Annenberg Institute at Brown University. https://doi.org/10.26300/tnqfqb36

[8]. Duisenbayev, A., Shavaliyeva, Z., Khassanova, I., Turebayeva, S., Seitenova, S., & Medeubayeva, K. (2024). The study of effective methods and strategies for the professional development of educators: Mentorship, collaboration, and self organization skills. *International Journal of Education in Mathematics, Science, and Technology (IJEMST), 12*(2), 450–469. https://doi.org/10.46328/ijemst.4014

[9]. Department of Education. (2016). *K to 12 Curriculum Guide: Mathematics*. DepEd Philippines. SEI-DOST & UP NISMED. (2011). *Framework for Philippine K to 12 Mathematics Curriculum*. Science Education Institute, Department of Science and Technology.

[10]. Guglietti, M. (2023). Redefining visual literacy in an era of visual overload: The use of reflective visual journals to expand students' visual thinking. Journal of University Teaching & Learning Practice, 20(4). https://doi.org/10.53761/1.20.4.03
[11]. Guner, N. (2020). Difficulties encountered by high school students in mathematics. International Journal of Educational Methodology, 6(4), 703-713. https://doi.org/10.12973/ijem.6.4.703
[12]. Hine, G., Blackley, S., & Cooke, A. (Eds.). (2019). *Mathematics education research: Impacting practice* (Proceedings of the 42nd annual conference of the Mathematics Education Research Group of Australasia, pp. 508–515). MERGA.
[13]. Leibold, N., & Schwarz, L. M. (2015). The art of giving online feedback. *The Journal of Effective Teaching*, *15*(1), 34–46. https://files.eric.ed.gov/fulltext/EJ1060438.pdf
[14]. Lessani, A., Abu Bakar, S., & Kamariah. (2017). Comparison of new mathematics teaching methods with traditional method. *International Journal of Social Sciences, 3*(2), 1285–1297. https://doi.org/10.20319/pijss.2017.32.12851297
[15]. Litke, E., Candela, A., Boston, M., et al. (2024). Unraveling high-quality mathematics teaching in algebra: Insights from overlaying domain-specific and content-specific observation instruments. *ZDM Mathematics Education, 56*, 1011–1027. https://doi.org/10.1007/s11858-024-01606-7
[16]. Martus, J. K., Alburo, C. M., Carangue, P. J. P., Dayupay, C. M., Lapay, J. B., Calinao, J. L. C., Gorres, S., & Cano, A. C., Jr. (2024). DAMATH integration in teaching mathematics: Inputs on teaching styles. *PEMJ, 19*(7), 852–863. https://doi.org/10.5281/zenodo.11173321
[17]. Mohammed, I. A., & Bello, A. (2024). Performance of mathematics students using video learning in flipped and flipped collaborative learning settings. Pedagogical Research, 9(3), em0213. https://doi.org/10.29333/pr/14699
[18]. Nurnberger-Haag, J., Kratky, J., & Karpinski, A. C. (2022). The Integer Test of Primary Operations: A Practical and Validated Assessment of Middle School Students' Calculations with Negative Numbers. International Electronic Journal of Mathematics Education, 17(1), em0667. https://doi.org/10.29333/iejme/11471
[19]. Qureshi, M. A., Khaskheli, A., Qureshi, J. A., Raza, S. A., & Yousufi, S. Q. (2021). Factors affecting students' learning performance through collaborative learning and engagement. *Interactive Learning Environments, 31*(4), 2371–2391. https://doi.org/10.1080/10494820.2021.1884886
[20]. Sari, P., Hajizah, M.N., & Purwanto, S. (2020). The neutralization on an empty number line model for integer additions and subtractions: Is it helpful?. Journal on Mathematics Education, 11(1), 1-16. http://doi.org/10.22342/jme.11.1.9781.1-16.
[21]. Ünal, Z. E., Ala, A. M., Kartal, G., Özel, S., & Geary, D. C. (2023). Visual and symbolic representations as components of algebraic reasoning of numerical cognition. *Journal of Numerical Cognition, 9*(2), 327–345. https://doi.org/10.5964/jnc.11151
[22]. Yang, X., & Iqbal, B. (2023). A historical review of collaborative learning and cooperative learning. *TechTrends, 67*, 718–728. https://doi.org/10.1007/s11528-022-00823-9
[23]. Yu, S., Jantharajit, N., & Srikhao, S. (2024). Collaborative inquiry-based instructional model to enhance mathematical analytical thinking and reasoning skills for fourth grade students. *Asian Journal of Education and Training, 10*(1), 10–17. https://doi.org/10.20448/edu.v10i1.5323

BIOGRAPHY

ELAINE JANE V. BEGORNIA

Elaine Jane V. Begornia is a graduating Master of Education in Teaching Mathematics student at Assumption College of Nabunturan. With a strong interest in students' mathematical understanding and problem-solving skills, she conducted this research to gain deeper insights into traditional and instructional approaches in teaching mathematics. This study serves as part of her graduate thesis requirement. Beyond academics, she is also a dedicated public school mathematics teacher.