



(RESEARCH ARTICLE)



The effects of mathematical inquiry in developing critical thinking of grade 8 students

Maria Elvira R. Estevez *

Graduate Studies, Daniel B. Peña Memorial College Foundation, Inc., Ziga Avenue, San Juan, Tabaco City, Philippines.

International Journal of Science and Research Archive, 2025, 16(02), 937-946

Publication history: Received on 17 June 2025; revised on 17 August; accepted on 19 August 2025

Article DOI: <https://doi.org/10.30574/ijrsra.2025.16.2.2427>

Abstract

This study determined the effect of mathematical inquiry in developing critical thinking of selected Grade 8 students at Tabaco National High School for School Year 2024–2025. The topics covered in this study are factoring polynomials with the greatest monomial factor, factoring the difference of two squares, factoring the sum and difference of two cubes, factoring perfect square trinomials, factoring general trinomials, simplifying rational algebraic expressions, multiplying rational algebraic expressions, dividing rational algebraic expressions, and adding/subtracting rational algebraic expressions. The researcher applied experimental research wherein pre and post-test design was applied, using two (2) groups, the control and the experimental groups. These groups were tested before and after the experimentation. Test results were utilized as a basis in providing judgment on the effect of the interventions provided.

The main tool used by the researcher to gather the data is a teacher-made pre- and post-test. The performance of the students in each group was determined by computing the mean score in each skill and the corresponding performance level. The researcher utilized a t-test for independent samples to test the hypothesis of whether there is a significant difference in the performance of the control and experimental groups in the pre- and post-tests. After the experimentation process, enhanced lesson plans were presented to address the identified least mastered competencies of the experimental group. Results showed that the performance of the control and experimental groups vary significantly in the post-test using mathematical inquiry approach.

Keywords: Mathematical Inquiry; Critical thinking; Experimental Research; Pre-test; Post-test; Lesson Plans

1. Introduction

Mathematical inquiry refers to an approach to teaching and learning mathematics that emphasizes exploration, questioning, and the development of reasoning and problem-solving skills. It encourages students to engage deeply with mathematical concepts and processes. This approach goes beyond teaching formulas and procedures—it encourages students to ask questions, explore patterns, and make sense of mathematical ideas. Through inquiry-based learning, students develop critical thinking by analyzing problems, testing solutions, and justifying their reasoning. It also enhances their problem-solving abilities as they encounter unfamiliar situations and learn to approach them logically and creatively. Additionally, through this process, learners develop greater confidence and adaptability—skills that are essential not only in mathematics but also in real-life situations and future career paths.

In the context of the DepEd's policies and curriculum, mathematical inquiry is embedded within the K to 12 curriculum and the MATATAG framework. These initiatives focus on developing students' problem-solving and critical thinking skills through engaging and interactive mathematical activities. By incorporating mathematical inquiry into the curriculum, educators aim to create a dynamic and stimulating learning environment that prepares students for future academic and professional success.

* Corresponding author: Maria Elvira R. Estevez

1.1. Statement of the Problem

This study determined the effects of mathematical inquiry in developing critical thinking of Grade 8 students of Tabaco National High School for SY 2024-2025. Specifically, it sought answers to the following questions:

- What is the performance of the control and experimental groups in the pre-test along:
 - Factoring polynomials with greatest common monomial factor;
 - Factoring difference of two squares;
 - Factoring sum and difference of two cubes;
 - Factoring perfect square trinomials;
 - Factoring general trinomials;
 - Simplifying rational algebraic expressions;
 - Multiplying rational algebraic expressions;
 - Dividing rational algebraic expressions; and
 - Adding and subtracting rational algebraic expressions?
- What is the performance of the control and experimental group in the post-test?
- Is there a significant difference in the performance of the control and experimental group in the pre-test and post-test?
- What are the least mastered skills in the post-test?
- What enhanced lesson plans may be proposed to address the least mastered skills?

1.2. Assumption of the Study

This study was based on the following assumptions:

- The performance level of Grade 8 students in Tabaco National High School varies in the pre-test in factoring completely different types of polynomials, simplifying and performing operations on rational algebraic expressions.
- The performance level in the post-test of the control and experimental groups improved with the use of inquiry-based instructions or an approach.
- The least mastered skills of grade 8 students are factoring completely different types of polynomials and simplifying and performing operations on rational algebraic expressions.
- The integration of inquiry-based approaches in designing lesson plans and activities is assumed to effectively support the development of students' critical thinking skills in Mathematics, particularly in addressing least mastered competencies.

1.2.1. Hypothesis

There is no significant difference in the performance between the control and experimental groups in the post-test.

1.3. Scope and Delimitation

The researcher focused on the following topics: factoring polynomials with the greatest common monomial factor; factoring the difference of two squares; factoring the sum and difference of two cubes; factoring perfect squares; factoring general trinomials; simplifying rational algebraic expressions; multiplying rational algebraic expressions; dividing rational algebraic expressions; and adding and subtracting rational algebraic expressions. These are based on the K to 12 Mathematics Curriculum Guide in Mathematics 8. The other topics in Mathematics 8 and other grade levels are not included in the study.

2. Materials and Methods

2.1. Research Method

This study employed an experimental method. Both experimental and control groups were utilized to determine the effectiveness of mathematical inquiry. The focus was on developing Grade 8 students' critical thinking in factoring completely different types of polynomials at Tabaco National High School for the School Year 2024–2025.

2.2. Subjects of the Study

The subjects of the study are the selected two (2) Grade 8 sections of Tabaco National High School. The subjects were divided into two groups. These groups are the control and experimental groups. Each of these groups has thirty-three

(33) students. The researcher made sure that the performance level of each group was equal. The final grades of students in Mathematics during Grade 7 were utilized to determine their mathematical ability. Each group consisted of an equal number of students. "Above-average" students are those with grades from 93 to 100, "average" students attained the grades from 84 to 92, and "below-average" students achieved the grades from 75 to 83.

2.3. Research Instrument

The primary instrument used in this study was a set of researcher-prepared lesson plans focused on factoring various types of polynomials, as well as simplifying and performing operations on rational algebraic expressions. These lessons were designed to integrate mathematical inquiry as a means to develop students' critical thinking skills. To gauge the performance level of the control group and experimental group on the said topic, the researcher prepared a test that was given to the subjects of the study that served as the pre-test and post-test. A table of specification was prepared to identify the weight and proper placement of the items. The said test was composed of forty (40) items, ten (10) items for each type of factoring polynomials, simplifying, and performing operations on rational algebraic expressions.

2.4. Validation of the Research Instrument

The researcher took careful steps to ensure the quality and accuracy of the research instrument and lesson plans by seeking validation from three experienced educators before beginning her study. Two (2) master teachers from the Junior High School Mathematics Department and a master teacher from Senior High School ABM Department. Each validator brought a unique perspective and a wealth of experience that greatly contributed to the refinement of the study materials. Their constructive feedback helped the researcher identify areas for improvement in both the research instrument and the lesson plans. For instance, they provided insights on the clarity and appropriateness of the questions, the alignment of the lessons with learning objectives, and the suitability of the content for the target student group.

3. Results and Discussion

3.1. The Performance of the Control and Experimental Groups in the Pre-Test

Factoring polynomials, simplifying rational algebraic expressions, and performing operations on rational algebraic expressions are critical components of algebra that students often find challenging. These skills require not only a solid understanding of algebraic principles but also the ability to manipulate expressions and apply rules systematically. However, many students struggle with these topics due to various factors, including gaps in foundational knowledge, cognitive overload, and the abstract nature of the concepts.

Table 1 The Performance of the Control Group in the Pre-Test

Skill	No. of Items	Total Score	Mean	PL (%)	Description
Factoring polynomial with greatest monomial factor	4	64	1.94	49	Low Mastery
Factoring difference of two squares	4	78	2.36	59	Near Mastery
Factoring sum and difference of two cubes	4	57	1.73	43	Low Mastery
Factoring perfect square trinomials	4	72	2.18	55	Near Mastery
Factoring general trinomial	8	51	1.55	19	No Mastery
Simplifying rational algebraic expressions	4	23	0.70	18	No Mastery
Multiplying rational algebraic expressions	4	27	0.82	21	No Mastery
Dividing rational algebraic expressions	4	23	0.70	18	No Mastery
Adding/subtracting rational algebraic expressions	4	18	0.55	14	No Mastery

Table 1 implies that before the actual implementation of the study, Grade 8 students in the control group do not have enough understanding of factoring polynomials, simplifying, and performing operations on rational algebraic expressions. The result of the pre-test is proof that many of the students are still struggling with the said topics. This is attributed to the lack of mastery in prerequisite topics such as operations on integers, fractions, and polynomials. This

misconception greatly affects the mastery of the competencies. Non-mastery typically means that a student has not met the established criteria or learning objectives required to demonstrate competence in a specific topic.

In the study of Braza & Supapo, (2014)¹, they claimed that the shortcomings that can affect students' achievements in mathematics could be their lack of mastery of the basic concepts and skills, lack of problem-solving and critical thinking skills, diverse behavior of students, and inappropriate teaching skills and approaches of teachers in dealing with the students in the class of mathematics. Developing critical thinking skills significantly influences the field of education, which goes beyond merely imparting information to students and strives to cultivate individuals who can think critically, analyze situations, and solve problems effectively.

Table 2 The Performance of the Experimental Group in the Pre-Test

Skill	No. of Items	Total Score	Mean	PL (%)	Description
Factoring polynomial with greatest monomial factor	4	65	1.97	49	Low Mastery
Factoring difference of two squares	4	70	2.12	53	Near Mastery
Factoring sum and difference of two cubes	4	54	1.64	41	Low Mastery
Factoring perfect square trinomials	4	71	2.15	54	Near Mastery
Factoring general trinomial	8	50	1.52	19	No Mastery
Simplifying rational algebraic expressions	4	25	0.76	19	No Mastery
Multiplying rational algebraic expressions	4	24	0.73	18	No Mastery
Dividing rational algebraic expressions	4	21	0.64	16	No Mastery
Adding/subtracting rational algebraic expressions	4	20	0.61	15	No Mastery

Table 2 reveals that the students in the experimental group demonstrated low performance in three areas of factoring polynomials, while they showed no mastery in the remaining topics. Factoring, simplifying, and performing operations on rational algebraic expressions were identified as the least mastered competencies in the first quarter. Based on her teaching experience, she often finds it necessary to revisit and reteach prerequisite topics, such as operations on polynomials, special products, laws of exponents, and fractions, to bridge the gaps in understanding. With this backlog of skills, teachers will need to develop strategies to address these foundational issues and support students in mastering the current topics.

According to Schoenfeld, (1992)², learning to think mathematically means (a) developing a mathematical point of view—valuing the processes of mathematization. It also includes abstraction and having the predilection to apply them, and (b) developing competence with the tools of the trade and, using learning to think mathematically, using those tools in the service of the goal of understanding structure—mathematical sense-making. His paper explored how problem-solving in mathematics can develop critical thinking and metacognitive skills.

In like manner, Hernandez's, (2019)³ article underscored the importance of integrating active learning approaches, such as inquiry-based activities, into mathematics instruction to cultivate critical thinking skills. This approach not only enhances academic performance but also prepares students to solve complex problems and make informed decisions in their future endeavors. Hernandez's findings indicate that incorporating inquiry-based activities into mathematics lessons encourages students to think critically. By engaging in problem-solving tasks that require analysis, evaluation, and creativity, students develop deeper conceptual understanding and improve their ability to apply mathematical concepts in various contexts.

3.2. The Performance of the Control and Experimental Groups in the Post-test

The control group received the traditional method of instructions while in the experimental group, lesson plans were made by the researcher employing inquiry approaches in teaching factoring polynomials, simplifying, and performing operations on rational algebraic expressions. After the implementation, a post-test was administered to determine if there were improvements in the performance of the two groups using different approaches. The post-test was the same as the pre-test.

Table 3 The Performance of the Control Group in the Post-Test

Skill	No. of Items	Total Score	Mean	PL (%)	Description
Factoring polynomial with greatest monomial factor	4	88	2.67	67	Near Mastery
Factoring difference of two squares	4	100	3.03	76	Mastery
Factoring sum and difference of two cubes	4	78	2.36	59	Near Mastery
Factoring perfect square trinomials	4	86	2.61	65	Near Mastery
Factoring general trinomial	8	112	3.39	42	Low Mastery
Simplifying rational algebraic expressions	4	59	1.79	45	Low Mastery
Multiplying rational algebraic expressions	4	45	1.36	34	Low Mastery
Dividing rational algebraic expressions	4	44	1.33	33	Low Mastery
Adding/subtracting rational algebraic expressions	4	40	1.21	30	Low Mastery

Table 3 implies that while traditional teaching methods positively impacted students' performance in areas like factoring polynomials and simplifying rational algebraic expressions, there remains room for growth in fostering deeper critical thinking. Although students showed improvement in procedural skills, the current educational climate demands a more dynamic approach to teaching mathematics. The researcher noted significant shifts in educational strategies over the years, with many traditional methods no longer aligning with the evolving needs and interests of today's students. To truly develop critical thinking, teachers must continually adapt their instructional practices to incorporate more inquiry-based and student-centered learning strategies, which are more effective in cultivating analytical and problem-solving skills.

According to Siahaan et. al., (2017)⁴ students tended to be trained to respond to problems by memorizing, which is a traditional practice in teaching mathematics. As a result, students have difficulty in solving problems that need reasoning and analyzing, which are generally components of critical thinking. With these, it is undeniable that there should be a modification as to how teachers should teach mathematics in order to enhance students' critical thinking skills.

Table 4 The Performance of the Experimental Group in the Post-Test

Skill	No. of Items	Total Score	Mean	PL (%)	Description
Factoring polynomial with greatest monomial factor	4	102	3.09	77	Near Full Mastery
Factoring difference of two squares	4	121	3.67	92	Full Mastery
Factoring sum and difference of two cubes	4	99	3.00	75	Near Full Mastery
Factoring perfect square trinomials	4	105	3.18	80	Mastery
Factoring general trinomial	8	184	5.58	70	Near Mastery
Simplifying rational algebraic expressions	4	95	2.88	72	Near Mastery
Multiplying rational algebraic expressions	4	77	2.33	58	Near Mastery
Dividing rational algebraic expressions	4	75	2.27	57	Near Mastery
Adding/subtracting rational algebraic expressions	4	73	2.21	55	Near Mastery

Table 4 means that there is a significant improvement in the students' performance within the experimental group, highlighting the positive impact of using an inquiry-based approach to teaching. The approach fostered the development of the students' critical thinking skills. Instead of merely memorizing lessons and prerequisite topics, the students were

encouraged to think critically, reason effectively, and apply the necessary skills to the topics discussed. The well-structured lesson plans using this method played a key role in promoting deeper understanding and engagement with the material.

This was supported by Duran & Dökme, (2016)⁵. According to them, one of the breakthrough methods in teaching mathematics today is the inquiry-based learning approach. Inquiry-based learning is a teaching method that facilitates asking questions. It also seeks information and finds new ideas related to an event.

Table 5 Test of Difference on the Performance of the Control and Experimental Groups in the Pre-Test

Group	Mean	Mean Difference	Variance	t-value		Remark
				Computed	Critical	
Control	12.52	0.40	7.63	0.57	±1.67	Not Significant
Experimental	12.12		8.67			

The mean of the scores of the control group is 12.52 and 12.12 for the experimental group, with a 0.40 mean difference. The variance of the scores of the control group is 7.63, and for the experimental group, it is 8.67. Based on the data, the t-computed value arrived at 0.57. This t-computed value is within the t-critical value of ±1.67 at the 0.05 level of significance with 64 degrees of freedom. The null hypothesis is accepted that there is no significant difference in the performance of the control and experimental groups in the pre-test.

Table 5 shows that both the control and experimental groups performed similarly on the pre-test, confirming that they had roughly equal levels of knowledge and skills before the intervention. This equivalence in performance is essential for the validity of the experiment. It ensures that any differences observed in the post-test can more reliably be attributed to the teaching methods or intervention applied, rather than pre-existing differences in ability.

Nazir, (2003)⁶, supports the education setup of this century in a classroom where the teacher or educator stands up as the only one active while learners mostly remain passive as they commonly listen to the teacher when teaching. The certainty of learners listening and absorbing the lessons and information relayed by the teacher is vague or unknown, in consideration of their personal state and level of attentiveness during lessons. This depicts how the traditional learning method for centuries, being applied today, has created a big barrier to the relationship of a teacher and learners. Active inquiry or facilitation of discussions is relevant and important as an aspect of engaging the learners in the class discourses.

In addition, Halmo, et al., (2024)⁷ highlighted that strong predictors of academic excellence and good class performance are metacognition and self-efficacy. Primarily, self-efficacy is understood as one’s capacity to do a task effectively. As instilled through the inquiry method of teaching, students are able to think for themselves and solve problems by themselves. Of course, this is still under the supervision of the teacher. The main point is that the inquiry method facilitates the learners to learn self-efficacy.

Table 6 Test of Difference on the Performance of the Control and Experimental Groups in the Post-Test

Group	Mean	Mean Difference	Variance	t-value		Remark
				Computed	Critical	
Control	19.76	-8.45	11.88	-54.18	±1.67	Significant
Experimental	28.21		14.61			

The calculated mean score of the control group is 19.76, while the experimental group has 28.21, providing a -8.45 mean difference. The computed variance from the control group is 11.88, while the experimental group obtained 14.61. The t-computed value from the data is -54.18; this value is beyond the t-critical value of ±1.67 at the 0.05 level of significance with 64 degrees of freedom, so the null hypothesis is rejected. This means that there is a significant difference in the performance of the control and experimental groups in the post-test.

Table 6 reveals that the significant difference in performance suggests that the intervention or instructional method applied to the experimental group had a positive and substantial impact on student learning outcomes. The control group, which did not receive the same intervention, scored much lower, indicating that traditional teaching methods (or the methods used with this group) were less effective in improving student performance. This result implies that the inquiry-based strategy used with the experimental group can be considered more effective in enhancing student understanding and performance in the subject matter. It also suggests that adopting this method more broadly could potentially lead to improved academic outcomes for other groups of students.

In addition, Jaworski, (2006)⁸, explored the pedagogy of inquiry mathematics and its potential to develop critical thinking among students in her journal entitled "Inquiry Mathematics: Conceptualizing the Pedagogy and the Potential for Critical Thinking." As teachers and educators, we can use inquiry as a tool to enable ourselves and others to engage critically with key questions and issues in practice. Such practice can involve addressing mathematical tasks in classrooms, developing approaches to mathematics teaching, or finding ways of working with teachers to promote teaching development. She believes that use of inquiry as a tool can lead to developing inquiry as a way of being when practiced as part of a community in which members collaborate as learners to develop their practice.

Moreover, Numaki et al., (2019)⁹ emphasized the importance of inquiry-based learning in this 21st century, as it may train learners' metacognitive skills. Learners learn how to learn by themselves after class hours or even without any supervision. Especially in large classes, inquiry-based methods of teaching are effective in improving students' problem-solving skills and developing their own learning strategies. This implies how significant it is for learners to be self-aware of the lessons they are being given. This provides them the opportunity to develop personal discipline in terms of self-learning management, especially in times when there will be no one to supervise them. It raises learners who are independent and able to think critically by themselves.

Table 7 Least Mastered Skill of the Experimental Group in the Post-test

Skill	Mean	Performance Level (%)	Description
Factoring general trinomial	5.58	70	Near Mastery
Multiplying rational algebraic expressions	2.33	58	Near Mastery
Dividing rational algebraic expressions	2.27	57	Near Mastery
Adding/subtracting rational algebraic expressions	2.21	55	Near Mastery

After the intervention, among the skills tested in the study, the following are the mastered skills: *factoring general trinomials* with a mean score of 5.58 and performance level of 70 percent and *multiplying rational algebraic expressions* whose average score is 2.33 and performance level is 58 percent. Along with *dividing rational algebraic expressions*, it has a mean score of 2.27 and a performance level of 57 percent; and *adding/subtracting rational algebraic expressions* has an average score of 2.21 and a performance level of 55 percent. The performance of the group along these skills is considered *near mastery*.

Table 7 connotes that among the topics covered, the experimental group struggled the most with factoring general trinomials and performing all four operations on rational algebraic expressions. Based on the researcher's observations, students experience it as particularly challenging to accurately apply previously discussed concepts related to factoring, which are crucial for mastering general trinomials. Consequently, their lack of proficiency in various factoring techniques created a domino effect, hindering their ability to perform operations on rational algebraic expressions effectively. This gap in understanding highlights a broader issue: students often experience difficulty in connecting past lessons to current problem-solving tasks, which can impede their overall mathematical performance.

Based on the study of Maphini, (2018)¹⁰, it is observed that students pay little attention when it comes to math lessons, especially when fractions are involved. He also claimed that students in high school find performing operations on rational algebraic expressions challenging and perceive fractions as a difficult task to accomplish.

For several years, the researcher observed a persistent pattern among her students' learning challenges: certain competencies consistently emerge as the most difficult for them to master. As a teacher who has worked with this grade level for a significant time, she can attest that these areas require a level of understanding that often feels out of reach for many students. This recurring struggle highlights a critical issue—many students have not yet fully mastered the foundational topics necessary to support their learning in these more complex areas.

Despite implementing various interventions and strategies over the years, the researcher discovered that these particular competencies remain a stumbling block for a large number of my students. The researcher believes that to truly address these challenges, it is essential to go beyond conventional teaching methods. It requires a willingness to adapt, to dig deeper into what each student needs, and to continuously refine the teacher's strategies. This journey of discovery and adaptation is one that the researcher is fully committed to because she sees the potential in each of her students and trusts in their ability to overcome these obstacles with the right support.

3.3. Enhanced Lesson Plans Applying Mathematical Modeling Approach to Address the Least Mastered Skills

Mastery of key algebraic concepts such as factoring polynomials, simplifying, and performing operations on rational algebraic expressions is crucial for students' success in mathematics. However, these topics often present significant challenges, resulting in many students struggling to grasp the foundational skills needed for higher-level math. To address these learning gaps, the researcher used enhanced lesson plans that employ an inquiry-based approach, which has emerged as an effective solution.

Inquiry-based learning encourages students to actively engage with the material, promoting critical thinking, problem-solving, and deeper understanding. Rather than simply memorizing rules and procedures, students explore mathematical concepts through questioning, investigation, and discovery. This approach empowers students to take ownership of their learning, fostering a more meaningful connection to the topics discussed.

Incorporating inquiry-based strategies into lesson plans for factoring polynomials and rational algebraic expressions creates an environment where students can develop these least mastered skills more effectively. By guiding students to discover relationships, test hypotheses, and apply reasoning, teachers can help them overcome common difficulties in these areas. The enhanced lesson plans aim to not only improve performance but also cultivate a mind-set that values exploration and inquiry in mathematics, equipping students with the tools they need to approach challenging topics with confidence.

Lesson plans have been carefully enhanced to address the specific competencies that many of the students have found challenging. Each plan is thoughtfully anchored in these least mastered areas, reflecting both observations over the years and the teacher-researcher's commitment to meeting the students' needs. In designing these lessons, she chose to incorporate an inquiry-based approach. This approach allows students to engage more actively with the material, encouraging them to ask questions, explore possibilities, and think critically about what they are learning. Her goal with this method is to nurture not just understanding but also curiosity and resilience in tackling difficult topics. The researcher wants her students to feel empowered to dig deeper and feel confident in their ability to work through complex ideas.

Every lesson is crafted with the students in mind. The teacher has witnessed first-hand the impact that targeted, thoughtful planning can have on student progress and remains dedicated to providing meaningful learning experiences. Through these enhanced lesson plans, the teacher aims to help students build not only the essential skills they need today but also the habits of critical thinking that will benefit them throughout their future learning.

4. Conclusion

The following conclusions were drawn:

- The performance level of the control and experimental groups were considered as with near mastery along factoring difference of two squares and factoring perfect square trinomials. However, the groups' performance level on factoring polynomial with greatest monomial factor and on factoring sum and difference of two cubes were described as with low mastery. In addition, on the skills factoring general trinomial; simplifying rational algebraic expressions; multiplying rational algebraic expressions; dividing rational algebraic expressions; and adding/subtracting rational algebraic expressions, the performance level was described as with no mastery.
- The performance of the control group along factoring difference of two squares was described as with mastery. On factoring polynomial with greatest monomial factor; factoring sum and difference of two cubes; and factoring perfect square trinomials, the performance was considered with near mastery. The group's performance along factoring general trinomial; simplifying rational algebraic expressions; multiplying rational algebraic expressions; dividing rational algebraic expressions; and adding/subtracting rational algebraic expressions were described as with low mastery. However, the experimental group's performance along the factoring difference of two squares was with full mastery; factoring polynomial with the greatest monomial factor; and factoring the sum and difference of two

cubes with near full mastery. On the other hand, on factoring perfect square trinomials, the performance was considered as with mastery. The description used to describe the performance on factoring general trinomials, simplifying rational algebraic expressions, multiplying rational algebraic expressions, dividing rational algebraic expressions, and adding/subtracting rational algebraic expressions was with near mastery.

- There is no significant difference in the performance of the control and experimental groups along the different skills tested in the pre-test, but the results vary significantly in the post-test.
- The least mastered skills of the experimental group in the post-test were factoring general trinomials, multiplying rational algebraic expressions, dividing rational algebraic expressions, and adding/subtracting rational algebraic expressions. The performance along these skills were described as with near mastery.
- The researcher developed enhanced lesson plans to address the least mastered skills.

Compliance with ethical standards

Acknowledgments

The researcher extends her deepest and most sincere gratitude to everyone who contributed to the successful completion of this manuscript. Their unwavering support and encouragement played an invaluable role in making this study a reality.

First and foremost, she offers her heartfelt thanks to the ALMIGHTY GOD, the Creator of all things, for His countless blessings and spiritual guidance throughout this endeavor. Without His divine intervention, none of this would have been possible.

The DANIEL B. PEÑA MEMORIAL COLLEGE FOUNDATION, INC., led by President SALVADOR V. RIOS JR., along with the teaching and non-teaching staff, for providing unwavering support and resources that significantly contributed to the success of this study.

GERONIMO J. VELOSO III, Ph.D., Dean of the Graduate Studies Department, the researcher is profoundly grateful for the opportunity he granted, which did not only help her advance in her academic journey but also instilled in her resilience and a lifelong passion for knowledge.

The Thesis Committee, chaired by DIOLETA B. BORRIS, Ph.D., and composed of esteemed members RAFAEL C. KALLOS, Ph.D., SELINA C. TANCANGCO, Ph.D., and ARLENE N. CABAIS, Ed.D., deserves special recognition for their insightful comments and suggestions, which played a crucial role in refining the study.

ALADINO B. BONAVENTE, Ed.D., whose consistent advice, guidance, and encouragement were pivotal in helping the researcher navigate the challenges along the way. His support was a beacon of motivation that led to the completion of this research.

MARY ROSE P. BASILLA-PELONIO, Ph.D., the thesis editor, for meticulously checking and editing the manuscript, ensuring its clarity and precision.

RUEL B. BRONDO, Ph.D. (CAR), her statistician, for his expertise and assistance in the statistical treatment of the data, which was essential to the accuracy of the study's findings.

To the Secretary of the Defense Committee, DENNIELLE B. CAMU, for recording the insightful comments and suggestions during the defense, her appreciation knows no bounds.

FATIMA D. BUEN, CESO VI, Schools Division Superintendent, Tabaco City Division, and ELENA B. TASIC, Secondary School Principal IV of Tabaco National High School, for their approval and full support, which allowed the researcher to conduct this study within their institution.

SYLVIA B. SARIOLA, Master Teacher II, AISA LYN B. BARRIOS, Master Teacher I of the Mathematics Junior High School Department, and REYNALDO C. CAÑEZO JR., Subject Group Head of the ABM Senior High Department of Tabaco National High School, for generously sharing their time and expertise during the validation of the research instruments.

EFLEDA C. DOLZ, Head Teacher VI of the Mathematics Junior High School Department, and the Mathematics Grade 8 Teachers and Students of Tabaco National High School, for their unwavering support and assistance in the successful completion of this study.

On a personal note, the researcher wishes to express her profound love and gratitude to her family: ELSA R. ESTEVEZ, her mother; MA. FE E. AQUINO, MARIA EVANGELINA E. BISMONTE, MA. CARMEL E. MACASINAG, and MARIE GRACE E. CORNELIO, her sisters; and her cousins, in-laws, nieces, and nephews, for their endless love, encouragement, and understanding, not only throughout the research process but in every aspect of her life.

Lastly, the researcher dedicates this work to FRANCISCO C. ESTEVEZ, her father, who now watches over her from heaven. His unwavering belief in her and enduring inspiration have fueled her perseverance and ultimate success in this endeavor. The researcher knows he would have been one of her biggest fans.

Disclosure of conflict of interest

I declare that I have no conflicts of interest related to this research. I have no personal or financial relationships that could influence my work.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

- [1] Braza, M & Supapao, S. (2014). Effective Solutions in the implementation of the K to 12 Mathematics Curriculum. West Visayas State University. College of Education. La Paz, Ilo- ilo City, Philippines.
- [2] Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition, and sense-making in mathematics. https://jwilson.coe.uga.edu/EMAT7050/Schoenfeld_MathThinking.pdf.
- [3] Hernandez (2019). Promoting Critical Thinking in Mathematics through Inquiry-Based Activities: A Philippine Context
- [4] Siahann, P., Suryani, A., Kaniawati, I., Suhendi, E., & Samsudin, A. (2017). Improving students' scientific process skills through simple computer simulations on linear motion conceptions. In Journal of Physics: Conference Series (pp. 1-5). IOP Publishing
- [5] Duran, M., & Dökme, I. (2016). The effect of the inquiry-based learning approach on student's critical-thinking skills. Eurasia Journal of Mathematics, Science and Technology Education, 12(12), 2887-2908.
- [6] Nazir, I. (2003). A Study of Education of Teaching of General Science at Secondary School :Level in Gujranwala (Unpublished; M.A Thesis) International Islamic University Islamabad (Pakistan). P-25.
- [7] Halmo, S.M. et al. (2024). Metacognition and Self-Efficacy in Action: How First-Year Students Monitor and Use Self-Coaching to Move Past Metacognitive Discomfort During Problem Solving. <https://doi.org/10.1187/cbe.23-08-0158>.
- [8] Jaworski, B. (2006). Inquiry Mathematics: Conceptualizing the Pedagogy and the Potential for Critical Thinking. https://www.researchgate.net/publication/225325923_Theory_and_Practice_in_Mathematics_Teaching_Development_Critical_Inquiry_as_a_Mode_of_Learning_in_Teaching.
- [9] Nunaki, J.K. et al. (2019). The Effectiveness of Inquiry-based Learning to Train the Students' Metacognitive Skills Based on Gender Differences. <https://files.eric.ed.gov/fulltext/EJ1211049.pdf>.
- [10] Maphini, N.V. (2018). Implementing An Intentional Teaching Model to Investigate Grade 9 Learners' Way of Working with Rational Algebraic Fractions. University of the Western Cape. <https://pubs.sciepub.com/jitl/3/1/10/index.html>