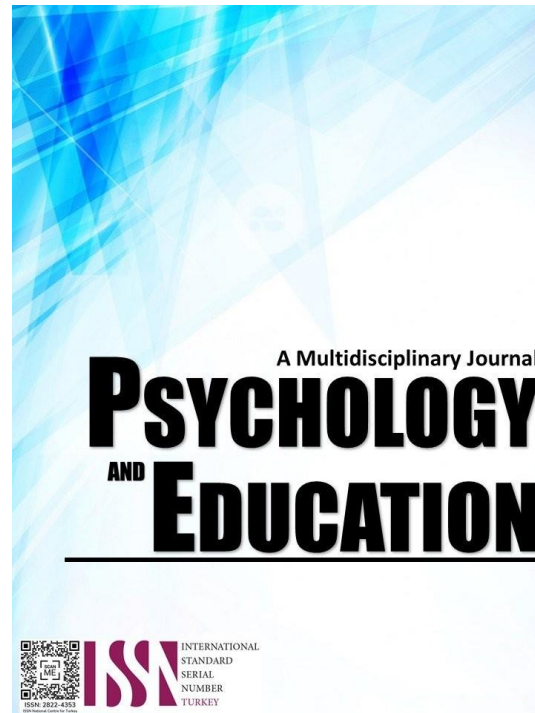


INQUIRY- BASED APPROACH AS LEARNING ENHANCEMENT OF GRADE 9 STUDENTS IN QUADRATIC EQUATION: A LESSON STUDY



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Inquiry-Based Approach as Learning Enhancement Of Grade 9 Students in Quadratic Equation: A Lesson Study

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Abstract

Students frequently doubt the accuracy of the mathematics they are taught in school and how it relates to their everyday lives. There is a logical contradiction between what is studied in the classroom and what would be required for real-life problems when there is doubt that the mathematics learned in school is useful outside of the classroom. As a result, the failure is directly attributed to the way teachers support learning in the classroom to encourage lifelong learning. This action research was conducted to enhance learning in Mathematics in solving quadratic equations using an Inquiry-Based Approach. The respondents were 135 Grade 9 students of Rizal High School, from EBEC sections namely 13, 15, and 31. A quasi-experimental pre-test-post-test design was employed in this study. The results revealed that there is a moderately significant difference in the performance of the students after their involvement in the intervention. This result was proven by a two-tailed z-test where the computed value of 40.81 is greater than the critical value of 1.96 at a 0.05 level of significance. Thus, the result clearly shows that inquiry-based instructional methods had a significant effect on students' ability to solve decontextualized mathematical problems. The researchers recommend using Inquiry-Based Approach in other topics in Mathematics and/or another field of Science to promote unboxed learners.

Keywords: *learning enhancement, inquiry-based approach, lesson study*

Introduction

Teaching Mathematics has been one of the challenges that a high school teacher experiences nowadays. Several factors were identified by many studies to portray the difficulties of the students in learning Mathematics. According to Kelly (2018), students are somewhat intimidated to further learn Mathematics especially if they missed out on the basic knowledge to understand the next competency. This gap, however, varies upon into students' abilities and/ or teachers' instructions. On the same dilemma, the researchers also observed that many students in their classes seem to have failed to develop their problem-solving skill. Consequently, teachers are highlighted by its complexities and challenges, particularly when the goal is to instill the facts to the students and apply it in daily situations. Thus, the utilization of distinct methodologies to address students' individualities lends itself to a great deal of varied strategies. Unfortunately, it appeared that there is still something lacking. To somehow address or lessen the teachers' factors, many studies shown that teaching and instructional approaches are significant factors to promote successful learners in and out of the classrooms.

Students, at the present time, often question the validity of Mathematics that they are exposed to in the classroom and its relationship to their daily. Thus, memorizing facts and data is not the foremost necessary talent in today's world. Facts change, and data is instantly obtainable - what is needed is an understanding of the way to get and be of the mass of knowledge. For teachers to teach meaningfully, they must use an appropriate teaching approach and provide students with varied and suited activities where they can explore and express their ideas. Classes that have poor interaction are usually lecture-based and the students tend to be not so motivated to learn because they are mostly teacher-centered ones. For the past years in Rizal High School where the researchers are affiliated, there were no studies done to improve the above-mentioned challenge. Thus, this leads to drive the researchers to look for an approach that will help students to have interest and perseverance in learning mathematical reasoning.

Research Questions

This study focus to determined the learning enhancement of Grade 9 students using an Inquiry-based approach in teaching quadratic equations of Rizal High School during the academic year 2019 – 2020. Specifically, it aimed to seek answers on the following questions

1. What is the effect of incorporating an Inquiry-Based Approach on the learning enhancement of Grade 9 students in the quadratic equation?
2. How effective is the utilization of the Inquiry-Based Approach in enhancing the Mathematical learning of Grade 9 students in solving quadratic equations?
3. Is there a significant difference in learning enhancement of Grade 9 students in terms of the pre-test and post-test results?

Literature Review

Inquiry-based Approach in Mathematics Education

IBL, or inquiry-based learning, is a method of teaching and learning in which the teacher plays a more decentralized role and the student is an active participant in the classroom setting. This pedagogy is based on guided exploration, which is a reincarnation of the classical Socratic method of instruction.

Andrews-Larson et al. (as cited in Beswick, 2021) examined how two groups of undergraduate mathematics instructors engaged in pedagogical reasoning as part of a workshop on inquiry-oriented instruction. Each group engaged with a mathematics task in either abstract algebra or linear algebra firstly in the role of doers of mathematics and then as mathematics instructors as they viewed video of students working on the same task. Andrews-Larson et al. found that the more deeply the mathematicians engaged with the mathematics inherent in the task, the greater their engagement with the evidence of student mathematical reasoning evident in the video. The group that engaged more deeply with mathematics and student reasoning were more likely to focus on supporting students in their mathematical work and maintaining the students' ownership of the ways in which they represented mathematics. This contrasted with the group that engaged less deeply with mathematics and hence with the evidence of student thinking, which focused more on describing the representational choices that the students made and on evaluating the students' contributions. Andrews-Larson et al. note subtle differences in the ways in which the facilitators of the two groups oriented the participants to their task and speculate that this may account for the difference in the foci of the activity of the two groups. The authors further venture that an initial focus on mathematics rather than on pedagogical issues may be a useful entry point into examining student reasoning for mathematicians because of the greater likelihood that they will share common understandings and beliefs in this regard compared to in relation to matters related to instruction. In addition, they point to the value of using evidence of students' partially formulated understandings rather than completed solutions as a prompt for discussion of students' reasoning.

Banchi and Bell in 2008 (as cited in 'Math Minds', 2022) suggested that teachers should start inquiry instruction at lower levels and gradually move towards open inquiry to effectively develop students' inquiry skills. Open inquiry exercises can only be successful if students are motivated by intrinsic interests, and if they have the skills to conduct their own research.

Methodology

A quasi-experimental of pre-test-post-test design was employed in this study.

Participants

This action research utilized a purposive sampling technique whereby it involved three (3) sections of Rizal High School Grade 9 students, namely 9 – EBEC 13, 9 – EBEC 15 and 9 – EBEC 31, in the academic year 2019 – 2020 because these are the sections handled by the researchers with almost the same range of mean based on the over-all mean score (12.01) of the entire Grade 9 students on the said instrument as shown in Table 1 below. Each section is composed of forty-five (45) students, with a total number of one hundred thirty-five (135) respondents.

Instruments

In this instrument, the researchers used the first 25 validated items allocated only for quadratic equations. At the beginning of this school year, the Grade 9 students were considered unknowledgeable with the competencies in Grade 9 Mathematics specifically in quadratic equations. Based on the K-to-12 basic education curriculum in Mathematics, Grades 7 and 8 competencies dealt with solving equations but it was limited only on linear equations and/ or inequalities in one or more variables. None of these competencies were directly pre-requisite topics for quadratic equations. Thus, the researchers made use of this instrument as the baseline score in choosing the respondents of this study.

Procedure

This study required information that is accurate, correct, and devoid of personal prejudiced judgment. Hence, the researchers employed the use of quasi-experimental of pretest-posttest design to find out the learning enhancement of Grade 9 students in the quadratic equation using the Inquiry-Based Approach. According to Cook and Campbell (1979), quasi-experimental typically allowed the

researchers to control the treatment or condition over the target group before and after the intervention involvement.

In this research, the respondents were exposed to revised lesson plans in such a way that 9 – EBEC 13 will be the subject for the first lesson plan, 9 – EBEC 15 will be the subject for of the revised lesson plan and 9 – EBEC 31 will be the subject for the third revision of the plan.

This study focused on the prescribed content standards and learning competencies directly from the K-to-12 curriculum guide for Grade 9 Mathematics. Furthermore, a 20-item teacher-made pre-test and post-test were used to determine if there is a significant difference between the respondents' test results. This assessment was presented and validated to several people who are experts in the field of Mathematics. The final questionnaire was finalized by eliminating some items or questions. The comments and suggestions were taken into consideration in preparing the final form of the test questionnaire. Furthermore, the mean of the pre-test and post-test results and their difference were used to determine effect of incorporating Inquiry-Based Approach in enhancing the learning of Grade 9 students in quadratic equations. On the other hand, z –test was utilized to identify their significant difference.

Ethical Considerations

In conducting this research, strict adherence to ethical guidelines is paramount. Informed consent was obtained from all participants, ensuring they were aware of the study's purpose and their rights. Data were anonymized to protect confidentiality, with access limited to the research team. Any potential conflicts of interest were also transparently disclosed. Finally, participant well-being and comfort were closely monitored throughout the study.

Results

This section presents the findings according to the study's research questions.

Results of incorporating Inquiry-Based Approach on the learning enhancement of Grade 9 students in quadratic equation

This part is composed of the different tables for the pretest and posttest results of the data collection.

Table 1. *Pretest Results*

<i>Score Interval</i>	<i>Verbal Interpretation</i>	<i>F</i>	<i>%</i>
20-16	Very High	0	0
15-11	High	7	5
10-6	Fair	59	44
5-0	Very Low	69	51
TOTAL		135	100
MEAN ($\bar{x}_1$)	LOW	5.45	

Table 2. *Posttest Results*

<i>Score Interval</i>	<i>Verbal Interpretation</i>	<i>F</i>	<i>%</i>
20-16	Very High	4	3
15-11	High	81	60
10-6	Fair	50	37
5-0	Low	0	0
TOTAL		135	100
MEAN ($\bar{x}_2$)	HIGH		11.30

Table 3. *Mean Difference Between the Respondents' Performance In The Pre-Test And Post-Test*

<i>Tests</i>	<i>Mean</i>	<i>Mean Difference</i>
Pre-Test	5.45	5.85
Post-Test	11.30	

Table 4. *Difference Between the Respondents' Performance In The Pre-Test And Post-Test*

Tests	Mean	Mean Difference	Z-test (Two-tailed)	Critical Value	Decision	Remarks
Pre-test	5.45					
Post-test	11.30	5.85	± 40.81	± 1.96	Reject H_0	Moderately Significant

Discussion

Table 1 portrays that 69 out of 135 Grade 9 students or 51 percent got a score ranges from 0 - 5, which has a verbal interpretation of "Very Low" performance. Then, it is followed by 59 students or 44 percent got "Fair" score which ranges from 6 - 10. There are only 7 students or 5 percent whose score ranges from 11 - 15 and is interpreted as "High" score. On the other hand, no one classified as "Very High" scores.

Right after the researchers implemented the use of Inquiry-Based in teaching quadratic equations. The researchers administered the post-test to determine the effectiveness of the said approach on the enhancement of learners' performance in Mathematics. Below, is the table shows the performance of the students after the implementation of the approach.

Table 2 depicts the post-test results of the respondents after their involvement on the intervention. It can be seen in the table that there are 4 out of 135 respondents or 3 percent got scores range from 16 – 20 with a verbal interpretation of "Very High". It is followed 81 respondents or 60 percent got scores range from 11 – 15 which is interpreted as "High" performance on the said test. The result also showed that there are 50 students out of 135 or 37 percent got scores from 6 – 10 or a "Fair" result, then no one got 0 – 5 or "Low" scores this time.

It is clearly stated on the findings that the post-test result is greater than the pre-test, which can be credited to the usage of the Inquiry-Based approach in teaching. Conventionally, students are learned in such a way that they display unquestioning acceptance of what teachers teach, a spoon-feeding or teacher-centered approach. Students tend to memorize and repeat concepts needed to answer standardized assessments but not to apply and relate it in daily use. However, with the practice of the Inquiry-Based Approach, students are presented with different opportunities to be responsible over their learning process through exploration, discovery, constructing knowledge and understanding, reflect and think critically instead of teacher dictation (Huziak-Clark et. al., 2007). As emphasized by Chong and other researchers (2017), previous studies found that this approach motivates students to seek for answers and generated increases in affective and cognitive outcomes thus a life-long understanding is coherent.

Table 3 displays the comparison between the respondents' pre-test and post-test results. It shows that the post-test result (11.30) is greater than the pre-test result (5.45) which yielded in a mean difference of 5.85. The test results of the respondents show relevance of the approach in their learning process. According to Brune (2010) as he conducted the same study on the experimental group (whereas, on the other hand, conventional approach for the control group), he found that the students who partaken in Inquiry-Based lessons have improved retention rate and enhanced ability to solve problems. Moreover, there were several studies adopted the given approach and found to achieve better results in standardized assessments.

Table 4 shows the significant difference of the study in terms of the respondents' pre-test and post-test results, tested by two-tailed z-test with 0.05 level of significance and with respect to the critical value of ± 1.96 . The result shown that there is a moderate significant difference between the pre-test and post-test results of the respondents. In the study conducted by Brune (2010), the result showed that inquiry-based instructional methods had a great effect on students' ability to solve decontextualized mathematical problems, students' retention of the mathematics, and enhanced students' attitudes about the mathematics in which they were engaged.

The results of this study revealed that the use of Inquiry-Based approach in enhancing Mathematics learning shown a favorable effect with the Grade 9 students in solving quadratic equation.

Conclusion

This study focused to determine the learning enhancement of Grade 9 students using Inquiry-based approach in teaching quadratic equation of Rizal High School during the academic year 2019 – 2020.

1. *What is the effect of incorporating Inquiry-Based Approach on the learning enhancement of Grade 9 students in quadratic equation?*

In conclusion, this research has demonstrated the significant impact of incorporating an Inquiry-Based Approach on the learning enhancement of Grade 9 students in quadratic equations. The post-test results clearly indicate a substantial improvement in the understanding and application of this mathematical concept among the respondents. This innovative pedagogical approach has proven to be an effective method for engaging students in active learning, promoting critical thinking, and fostering a deeper comprehension of quadratic equations.

2. *How effective is the utilization of the Inquiry-Based Approach in enhancing the Mathematical learning of Grade 9 students in solving quadratic equations?*

The findings of this study underscore the importance of adopting learner-centered methodologies in mathematics education. The Inquiry-Based Approach not only encourages students to take ownership of their learning process but also cultivates a spirit of curiosity and exploration. By actively involving students in the discovery and application of mathematical principles, educators can create a more dynamic and enriching learning environment.

Furthermore, the positive outcomes observed in this research suggest that educators should consider integrating similar inquiry-based strategies into their teaching practices across various mathematical topics. This approach has the potential to not only enhance academic performance but also to instill a lifelong appreciation for mathematics.

3. *Is there significant difference in learning enhancement of Grade 9 students in terms of the pre-test and post- test results?*

The observed moderate yet significant difference between pretest and post test results unequivocally demonstrates the effectiveness of this pedagogical method.

The discernible improvement in post-test scores indicates that the Inquiry-Based Approach fosters a deeper understanding and proficiency in handling quadratic equations among the respondents. This approach not only engages students in active learning but also cultivates critical thinking skills and a genuine curiosity for mathematical concepts. By encouraging students to take an active role in their own learning process, this method promotes a sense of ownership and empowerment.

It is imperative for stakeholders in education to recognize the value of innovative teaching methodologies like the Inquiry-Based Approach. Continued research in this area, along with ongoing professional development for educators, can further refine and optimize the implementation of such approaches. By doing so, we can foster a generation of mathematically proficient individuals who are equipped to face the challenges of an increasingly complex and data-driven world.

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