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PEER TUTORING: EXPLORING THE EFFECTS ON LEARNING GRADE 9 MATHEMATICS

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Abstract

This descriptive-comparative study aimed to develop session plans with learning activities for peer tutoring on quadratic equations. It involved five classes of Grade 9 students of Bantayan National High School, Tabaco City, Albay, Philippines wherein one class was randomly selected as the peer tutored group while the remaining four classes were considered the non-peer tutored groups. The peer tutoring sessions were conducted during the Independent/Cooperative Learning (ICL) period. The sources of data included the students' reflection entries, observation notes, responses from focus group discussions, and periodic examination results. Findings showed that there were nine session plans with learning activities developed with the integration of cooperative and contextualized learning approaches. The peer tutors were able to master the lessons since they have the opportunity to study it again and revise what they have learned. They also gained more friends, boosted their confidence, and became more interested and enthusiastic in learning and teaching Mathematics together with their peer tutees. On the other hand, the peer tutees grasped the lessons because their tutor gave immediate feedback to them. They also learned how to cooperate and participate with their

group to achieve their goal. It was also showed that the peer tutees were very much engaged and eager to learn during the peer tutoring. These were some of the significant learning experiences of the peer tutors and peer tutees during the conduct of peer tutoring. In terms of performance, based on the results of their periodic examination, the peer tutored group had a better performance than those non-peer tutored groups. The session plans with learning activities for peer tutoring were then concluded to give benefits in the learning experiences and enhanced the Mathematics performance of the learners.

Keywords

Peer Tutoring, Session Plans with Learning Activities, Significant Learning Experiences, Performance

1. Introduction

Mathematics serves as the foundation of scientific and technological knowledge that is essential in the socio-economic development of a nation (Oloo, Mutsotso, & Masibo, 2016). Conversely, its abstract nature disinterests students until they develop a negative feeling about it. This is also one of the subjects where most learners experienced a difficulty which led to low performance in the subject.

These challenges were encountered by most students in the Philippines. Thus, teachers are in constant quest of finding strategies and interventions which will suit the diverse needs of the learners especially in teaching the subject Mathematics. One of these strategies is the use of peer learning. One type of peer learning which this study emphasizes is peer tutoring. This is cost-effective and beneficial to all the students (Dvorak, 2004). According to Topping and Ehly, peer tutoring is a condition whereby one or many students tutor one or many other students in an academic subject by acting as a mentor and providing hints, questions, and instructional guidance (Zeneli & Tymms, 2015). Moreover, mixed-ability groupings in peer tutoring were recommended since it provides more opportunity in helping students in difficulties and at the same time strengthening those of the others (Rahmasari, 2017 & Dvorak, 2004).

Based on the aforementioned studies, this study focused on peer tutoring in Grade 9 Mathematics with the topic quadratic equations that served as an intervention strategy during Independent/Cooperative Learning (ICL) of the students. Also, this study aimed to develop session plans with learning activities for peer tutoring. The features integrated into the developed session plans with learning activities were cooperative and contextualized learning approaches. Likewise, it sought to determine the significant learning experiences of the peer tutors and peer tutees, as well as the

performance of the peer tutored group and the non-peer tutored group.

This study was conducted at Bantayan National High School during First Quarter, School Year 2018-2019. Specifically, the respondents of this study were the five classes in Grade 9 level namely 9-Honesty, 9-Perseverance, 9-Tact, 9-Confidence, and 9-Humility. These five classes were heterogeneously divided during the enrolment period. Using draw lots, Grade 9-Honesty was selected to undergo peer tutoring sessions during their ICL schedule and considered as the peer tutored group while the remaining four classes were considered as the non-peer tutored groups.

2. Methodology

This study utilized a descriptive research design wherein the goal is to describe a phenomenon and its characteristics. Further, this is more concerned with what rather than how or why something has happened (Gall, Gall, & Borg, 2007). This design was used since this study involved the development and validation of session plans with learning activities for peer tutoring with the integration of cooperative and contextualized learning approaches. Also, it included the process of determining the significant learning experiences of the peer tutors and peer tutees every after the peer tutoring sessions.

Likewise, the comparative research design was also used in this study. The comparative analysis is conducted mainly to explain and gain a better understanding of the causal processes involved in the creation of an event, feature or relationship usually by bringing together variations in the explanatory variable or variables. Conventionally, comparative research emphasized the “explanation of differences, and the explanation of similarities” (Pickvance, 2005). By using this type of research design, the study determined the performance in quadratic equations of the peer tutored group and the non-peer tutored groups.

2.1 Instruments

The following instruments were used in collecting pertinent data for the study:

Evaluation Sheet for the Developed Session Plans with Learning Activities. The developed session plans with learning activities for peer tutoring were evaluated using a checklist with scaled responses. This evaluation tool was modified by the researcher from the previously used assessment tool to fit the requirements of the session plans with learning activities for peer tutoring. The criteria include: (a) instructional planning, (b) features of the learning activities (cooperative and

contextualized learning approaches), and (c) use of peer tutoring. It also adopted a five-point Likert scale such that 5 is Excellent while 1 is Very Poor.

Student's Reflection Guides. The reflection guides were given to the peer tutors and peer tutees every after the peer tutoring session. This was used to determine the significant learning experiences of the peer tutors and peer tutees in the conduct of peer tutoring.

Teacher's Observation Guide. This was used by the teacher-observers of the actual conduct of peer tutoring. It served as a support on the observed significant learning experiences of the peer tutored group and their comments on the use of peer tutoring as an intervention.

Focus Group Discussion Guide Questions for Students. Two sets of focus group discussion guide questions were given to the students. One for the peer tutors and the other for the peer tutees. These were used to gain insights about their learning experiences in using the peer tutoring strategy on learning quadratic equations.

Focus Group Discussion Guide Questions for Teachers. The guide questions for the teacher-observers were used to gather insights, comments, and on the use of the peer tutoring strategy in the Mathematics classroom.

Periodic Examination. The periodic examination was used to determine the performance in quadratic equations of the peer tutored group and the non-peer tutored groups. The results of their examination were subjected to comparative analysis.

2.2 Data Gathering

To achieve the desired goal of the study, the researcher prepared the research instruments to be validated. This part also included the evaluation of the developed session plans with learning activities for peer tutoring. Ten Mathematics teachers served as the evaluators of the developed session plans with learning activities for peer tutoring to improve its content and presentation.

Moreover, the researcher made formal permission to the school authorities. Then, draw lots procedure was used to determine the respondents of the study since the Grade 9 classes were heterogeneously group during enrollment. Hence, Grade 9-Honesty served as the peer tutored group and the remaining four classes were the non-peer tutored groups. A parent's consent was given to the respondents for their parents to be informed about the study.

The next part was the orientation of the respondents about peer tutoring and the dos and don'ts during the peer tutoring sessions. There were eight peer tutors and the remaining students in the class were considered as the peer tutees. Thus, everyone in the class has a role in the peer tutoring session.

Also, the peer tutors were trained and undergone peer tutoring review before every implementation of the peer tutoring session.

The researcher was the one implemented the peer tutoring sessions. The role of the researcher was to monitor, supervise, and facilitate the peer tutoring session. Moreover, another role also was to provide answers to the queries of the peer tutors when they encountered difficulty. Every after the peer tutoring session, the peer tutors and peer tutees write their reflections regarding their experiences during the conduct of peer tutoring. Besides, there were rewards given to them.

Thus, there were nine (9) peer tutoring sessions. After all the sessions, focus group discussions for students and teachers were conducted to gather meaningful insights and significant learning experiences during the conduct of the peer tutoring sessions. The scores of the students in the periodic examination were tabulated and analyzed to determine the performance of the students after the implementation of the developed session plans with learning activities for peer tutoring. Further, the results of the examination of the non-peer tutored groups were also gathered for comparative analysis of the study. The results of the analyses were further supported by reflection entries of the students, observation notes from observers, and the results of the Focus Group Discussion for students and teachers. Lastly, all the data gathered were carefully analyzed as well as the comments and suggestions of the students and teachers involved in the study.

2.3 Statistical Treatment

The following statistical tools were used to analyze and interpret the data gathered in this study:

Mean. This was used to present the average score of the peer tutored and non-peer tutored group in the periodic examination and the average scores gathered from the evaluated research instruments.

Below is the formula for the mean:

$$\bar{x} = \frac{\sum fx}{n} \quad (1)$$

where \bar{x} is the mean, f is the frequency of each score, x is the weight of each score, and n is the number of respondents.

Performance Level. Percentage is used to determine the performance level of the students in the periodic examination. Performance level can be computed as follows:

$$\text{Performance Level} = \frac{\text{mean score}}{\text{highest possible score}} \times 100 \quad (2)$$

Performance Level	Mastery Level Descriptive Equivalence
92% and above	Full Mastery
83% to 91%	Near Full Mastery
75% to 82%	Mastery
51% to 74%	Near Mastery
25% to 50%	Low Mastery
24% and below	No Mastery

Levene's test. This test was used to determine the homogeneity of variances. If the assumption was satisfied, then Analysis of Variance can be employed. Otherwise, it cannot be utilized.

Analysis of Variance (ANOVA). A single factor ANOVA was used to determine whether there is a significant difference among the mean score of peer tutored and non-peer tutored groups.

Post hoc analysis. When the ANOVA resulted in a significant difference, post hoc analysis was used to find where the difference lies. Specifically, the researcher utilized Contrasts. The process was to compare the peer tutored group, pairwise, to each of the other four (4) groups using contrast coefficient of 1 or -1 , respectively. Likewise, to compare the peer tutored group to the average of the non-peer tutored groups, a contrast coefficient of 1 for the first group and -0.25 for each of the other four groups were utilized. An alpha correction called Bonferroni correction factor was employed during the process in order to control family-wise error.

3. Results and Discussion

3.1 Developed Session Plans with Learning Activities for Peer Tutoring

Nine session plans with learning activities for peer tutoring were developed to meet the learning competencies in Grade 9 Mathematics Module 1 on the topic Quadratic Equations. The session plans for peer tutoring contain seven (7) parts namely: learning objectives, time frame, learning activities, materials, references, preliminary activity (teacher), and the activity proper (peer tutoring session). The learning objectives serve as a guide for both peer tutors and peer tutees on what is their goal for every peer tutoring session. The time frame helps them to be more time-conscious so that the students can achieve their goals at the specified time. The materials needed and the references in the peer tutoring session were also included. The preliminary activity served as an opener in a usual lesson

plan. It included the guidelines in doing the activity in peer tutoring. The researcher is the one who explains this part. Moreover, the peer tutoring session occurs in the activity proper.

Table 1 shows the developed session plans with learning activities for peer tutoring. Moreover, the learning competencies, the title of the developed session plans, and the learning activities used in every session plans were also presented.

Table 1: *Developed Session Plans with Learning Activities for Peer Tutoring*

Learning Competencies	Session Plan No. and Title	Learning Activities used in the Session Plans
The students should be able to:	1.	
▪ illustrates quadratic equations.	Illustrations of Quadratic Equations	▪ Sort Me ▪ Make Me Standard ▪ Is It Quadratic or Not?
▪ solves quadratic equations by:	2.	
(a) extracting square root;	Solving Quadratic Equations by Extracting Square Roots	▪ Use of game entitled Let's Spin It!
(b) factoring;	3.	
	Solving Quadratic Equations by Factoring	▪ Use of worksheet with the use of bamboo algebra tiles which entitled Factor Me!
(c) completing the square	4.	
	Solving Quadratic Equations by Completing the Square	▪ Use of worksheet and bamboo algebra tiles which entitled Complete Me!
(d) using the quadratic formula	5.	
	Solving Quadratic Equations using Quadratic Formula	▪ Use of worksheet which entitled Find My Roots!
Learning Competencies	Session Plan No. and Title	Learning Activities used in the Session Plans
▪ characterizes the roots of a quadratic equation using the discriminant	6.	
	Characteristics of Roots of Quadratic Equations	▪ Use of worksheet which entitled What's My Nature?
▪ describes the relationship	7.	
	Sum and Product of Roots of Quadratic	▪ Pentagonal Dice Game and the

between the coefficients and the roots of a quadratic equation	Equations	Task Card.
<ul style="list-style-type: none"> ▪ solves equations transformable to quadratic equations (including rational algebraic equations) 	8. Equations Transformable to Quadratic Equations	<ul style="list-style-type: none"> ▪ Use of board game entitled Transform and Solve Me! and the Task Card.
<ul style="list-style-type: none"> ▪ solves problems involving quadratic equations and rational algebraic expressions 	9. Problems Involving Quadratic Equations	<ul style="list-style-type: none"> ▪ Team Competition

3.1.1 Features of the Developed Session Plans with Learning Activities for Peer Tutoring

Two features were incorporated in the developed session plans with learning activities for peer tutoring. These features were cooperative learning and the contextualized learning approach.

a. Cooperative Learning Approach

Cooperative learning is a student-centered, instructor-facilitated instructional strategy in which a small group of students is responsible for their learning and the learning of all group members (Li & Lam, 2013). This approach was integrated into the developed session plans with learning activities for peer tutoring.

The cooperative learning approach was applied since the class was divided into groups and each group has peer tutor/s and peer tutees. The session plan started with peer tutors assigning the specific roles of their peer tutees. Every member of the group also understands that cooperation among them is essential to achieve the learning objectives in the peer tutoring session. Likewise, the assignment of roles to every student in the peer tutoring activity was also emphasized since these components are a fundamental component of a cooperative group (Pesci, n.d.). The rotation of roles of the peer tutees in every peer tutoring session was also observed so that each one of them could experience the different duties to accomplish in doing the different learning activities. Moreover, the role of the researcher was to facilitate, supervise, and give clarifications to the queries of the students during the peer tutoring sessions. The main purpose of incorporating cooperative learning in the developed session plans is because the study is all about peer tutoring that requires cooperation.

b. Contextualized Learning Approach

The contextualized learning approach is a learning approach that helps learners to relate the subject matter to real-world situations and problems. It motivates students to take charge of their learning and to make connections between knowledge and its applications to the various contexts of their lives (Sears, 2003).

Moreover, contextual learning is an approach that involves students in the learning process to discover the concepts learned through the knowledge and experience of students. When the students can connect Mathematics with real-life contexts or situations, the students can look between a conceptual to be learned with a concept that has been studied (Selvianiresa & Prabawanto, 2017).

The developed session plans with learning activities for peer tutoring in this study employed the integration of real-life contexts or situations. As well as, four (4) of the session plans with learning activities involved the use of locally available materials.

3.2 Significant Learning Experiences of Peer Tutors and Peer Tutees

The key quality of educational programs is for teachers to change from presenters of information to facilitators of significant learning experiences. This kind of experience has both a process and an outcome dimension. In terms of the process, the students are engaged in their own learning and the class has a high energy level. In addition, outcome dimension results to significant and lasting change that is significant changes in the students happen, changes that continue after the course is over and even after they graduated and ultimately they give value in life that is enhancing their individual lives by preparing them to participate in multiple communities and preparing them for the world of work (Fink, 2003).

In this study, significant learning experiences refer to the benefits acquired by being peer tutors and peer tutees during the conduct of the peer tutoring sessions. To determine this, the peer tutors and peer tutees were asked to express their thoughts and experiences on the reflection guide given to them every after the peer tutoring session. Moreover, to support the reflection entries of the students involved in peer tutoring, there were three teacher observers invited to observed the peer tutoring sessions. Then, the researcher transcribed the reflection entries of the peer tutors and peer tutees, observation notes of the teacher observers, and the results of the focus group discussions, thus three themes were generated. The three themes that emerged were classified as cognitive skills, social skills, and interest.

In terms of cognitive skills, peer tutors were able to master the lessons since they have the opportunity to study it again and revise what they have learned. They were able to share their knowledge with their peer tutees. On the left photo on Figure 1, it depicted a peer tutor explaining the activity to his peer tutees during one of the peer tutoring sessions.



Figure 1: *A Peer Tutor Explaining to his Peer Tutees (left) and a Peer Tutee asking help to her Peer Tutor about their Activity (right)*

On the other hand, during the peer tutoring sessions, the peer tutees grasp the lessons because their peer tutor gives immediate feedback to them. This was shown in the right photo in Figure 1. As one of the teacher-observers wrote, *“The peer tutees asked their peer tutors whenever they are confused about their given task. Also, they were not hesitant to clarify their queries about their assigned task to their peer tutors since they are comfortable with them.”* With this, the peer tutees were able to better understand the topic and the activity given to them since they can ask without hesitation to their peer tutor on what to do and immediately teaches them.

Furthermore, the peer tutoring sessions also improved the social skills of both the peer tutors and peer tutees. Through peer tutoring, the peer tutors gain more friends and boosted their confidence while teaching their peer tutees. Also, their communication skills and interpersonal skills were also enhanced. All throughout the peer tutoring sessions, it was observed that peer tutors were able to socialize with their other classmates (peer tutees). This was based on the observation notes of the teacher-observers, *“The peer tutors were confident in teaching their peer tutees and they were able to gain more friends through peer tutoring.”* Meanwhile, the peer tutees learned how to cooperate and participate with their group to achieve their goals. Their sense of responsibility was also observed

since they have to do their assigned task to meet the objectives of their activity. Through peer tutoring, the social skills of both the peer tutors and peer tutees were enhanced.

Moreover, in terms of interest, peer tutors were very glad and enthusiastic about teaching their peer tutees. With the use of the session plans and learning activities, they were more interested in learning Mathematics and glad to share them with their peer tutees. In addition, peer tutees were very much engaged and eager to learn Mathematics during peer tutoring.

3.3 Performance of the Peer Tutored and Non-Peer Tutored Groups

The performance of the students exposed to the conduct of session plans with learning activities for peer tutoring and those students who were not exposed was assessed by using the results of their periodic examination in quadratic equations. The examination was a 50-item test, which involve the topics in (a) illustrations of quadratic equations, (b) solving quadratic equations by extracting square roots, factoring, completing the square, using quadratic formula, (c) characteristics of roots of quadratic equations, (d) sum and product of roots of quadratic equations, (e) equations transformable to quadratic equations, and (f) problems involving quadratic equations.

By providing an opportunity for peer tutors and peer tutees to interact directly with each other, the students utilized their knowledge and experiences in a meaningful way. As a result, the conduct of the session plans with learning activities for peer tutoring had an impact on the process of learning and the performance of students. Table 2 presents the results of the periodic examination of the peer tutored and non-peer tutored groups.

Table 2: Periodic Examination of Peer Tutored and Non-Peer Tutored Group Summary Statistics

Group	Mean	Standard Deviation	Performance Level		p-value*	Significance*
			%	Description		
Peer Tutored	38.76 ^a	5.9244	78	Mastery	1.5422 x 10 ⁻³⁶	Highly Significant
Non-Peer Tutored						
A	23.26 ^b	4.6544	47	Low Mastery		
B	25.26 ^b	6.1947	51	Near Mastery		
C	24.06 ^b	5.2850	48	Low Mastery		
D	23.96 ^b	5.3632	48	Low Mastery		

*Test for significance using Analysis of Variance (ANOVA) among the peer tutored and non-peer tutored groups

**Means with different letters are significantly different using planned comparison with Bonferroni correction

Table 2 depicts that the peer tutored group had a mean score of 38.76 with a standard deviation of 5.9244 in the periodic examination. On the other hand, the non-peer tutored group, which includes four sections of Grade 9 students, obtained a mean score of 23.26, 25.26, 24.06, and 23.96,

respectively. Analyzing their performance level, the peer-tutored group was under the “mastery” level, which means that they had mastered the competencies in quadratic equations. However, one non-peer tutored group had only achieved up to “near mastery” performance level, while the other three were under the “low mastery” level.

The difference among the performance level of the groups denotes that the peer tutored group had a better performance than those that were not exposed to peer tutoring sessions which are the non-peer tutored group. However, to test whether this difference is significant, a single factor Analysis of Variance (ANOVA) was employed among the means. But before conducting this statistical treatment, homogeneity of variances was checked first as one of the requirements of the analysis. Using Levene’s test (use of mean), a *p*-value of 0.1823 was obtained, suggesting that the homogeneity of variances assumption was satisfied and an ANOVA can be employed.

With $\alpha = 0.05$, the single factor ANOVA resulted in a *p*-value of 1.5422×10^{-36} that demonstrates a highly significant difference between the mean scores of the peer-tutored group and four (4) non-peer tutored groups. To determine where the difference lies, post hoc analysis was performed. The post hoc analysis used was a planned comparison, specifically Contrasts with Bonferroni correction. Comparing the peer-tutored group, pairwise, with each of the other four (4) groups, all revealed significantly higher mean scores as shown in Table 3. This means that the peer-tutored group had performed better in the periodic examination compared to each of the non-peer tutored groups.

Table 3: Pairwise Comparison of Mean Scores of Peer-Tutored and Non-Peer Tutored Groups

Group 1	Group 2	<i>p</i>-value	Significant?*
Peer-Tutored	Non-Peer Tutored		
	A	1.1625×10^{-30}	yes
	B	4.7968×10^{-25}	yes
	C	7.9121×10^{-29}	yes
	D	3.9922×10^{-29}	yes

**The level of significance turned into $\alpha = 0.0125$ due to Bonferroni correction and a contrast coefficient of 1 or -1 was used*

Further comparative analysis also shows that the peer-tutored group had a significantly higher mean score against the average of the four (4) non-peer tutored groups. This was done by using contrast coefficient of 1 for the peer-tutored group and -0.25 for each of the other four (4) groups that resulted to a *p*-value 3.8841×10^{-39} . It is also noted that the four (4) non-peer tutored classes did not differ in terms of their performance in the periodic examination. The aforementioned findings revealed

that the peer-tutored group had performed better than those students who were not exposed to peer tutoring sessions which were the non-peer tutored group.

4. Conclusion

Nine session plans with learning activities for peer tutoring about quadratic equations were developed. These were embedded with two features such as cooperative and contextualized learning approaches. Moreover, the significant learning experiences showed the benefits acquired of being the peer tutors and peer tutees during the conduct of peer tutoring sessions. Also, it further enhanced the performance in the periodic examination of the peer tutored group. This showed that the peer tutored group performed better than those classes that were not peer tutored. Therefore, the session plans with learning activities for peer tutoring were then concluded to give benefits in the learning experiences and enhanced the Mathematics performance of the learners.

4.1 Research Limitations

This study focused on peer tutoring in Grade 9 Mathematics with the topic quadratic equations that served as intervention strategy during Independent/Cooperative Learning (ICL). Also, this study aimed to develop session plans with learning activities for peer tutoring with the integration of cooperative and contextualized learning approaches. The study was conducted on the First Quarter from June to August 2018. Draw lots was employed since the Grade 9 classes were heterogeneously divided. This was done to determine the peer tutored group. The peer tutored group was the class who undergone peer tutoring sessions. This class utilized the session plans with learning activities for peer tutoring. On the other hand, the four remaining sections in the Grade 9 level were considered as the non-peer tutored group. They were the classes who were not exposed to peer tutoring sessions. Moreover, the researcher was the one who conducted the peer tutoring sessions during the Independent/Cooperative Learning (ICL) schedule of the peer tutored group.

4.2 Scope of Future Research

The researcher recommends further research on the development and validation of session plans and learning activities for peer tutoring on different areas of Mathematics. Moreover, longer duration on the conduct of peer tutoring is encouraged to determine the effects on students' conceptual understanding, process skills, and problem solving skills.

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