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The Impact of Problem Posing Strategies on Mathematical Performance, Ability, and Anxiety in Grade 7 Students: A Quasi-Experimental Study

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A B S T R A C T

This study aims to investigate the impact of the problem-posing strategy on the mathematical performance, skills, and anxiety levels of Grade 7 students. Two groups with an equal number of participants were subjected to different instructional strategies: the control group received traditional guided practice, while the experimental group experienced an integrated problem-posing approach. Employing a quasi-experimental design, the study utilized a teacher-made test as both a pre-test and post-test to assess students' academic achievement in mathematics. Additionally, the Modified Abbreviated Math Anxiety Survey (mAMAS) was employed to gauge students' anxiety levels. The experimental group received instruction through the problem-posing method, whereas the control group was taught using traditional guided practice. The findings indicate a significant difference between the two teaching methods, demonstrating that students' mathematics performance is influenced by the instructional strategy used.

INTRODUCTION

Mathematics plays a crucial role in every school curriculum. However, many students struggle with it due to factors such as poor comprehension and analysis, especially in problem solving, which leads to fear and withdrawal from such activities. Despite solutions being available, there is a need for intervention, and one promising approach is problem posing. This involves generating new problems, re-formulating existing ones, or modifying them. In light of this, a study aims to utilize the Problem Posing Strategy as an alternative approach to teaching problem-solving to students.

Various studies claimed that problem posing methods significantly produces positive results in students' attitudes toward mathematics word problems and mathematics achievement. For instance, Pittalis et. al (2004) pointed out that students could solve mathematical word problems as a result of using problem posing as an instructional strategy. The study of Cai and Hwang (2003) showed that problem posing instruction emphasizes students' active involvement in learning. Thus, problem posing teaching frequently expresses that the students learn by connecting new knowledge to the real world. It can illuminate what can be learned from studying how students solve problems and vice versa (Brown & Walter, 2005) and can affect students' positive attitude towards mathematics (Akay & Boz, 2010). Because having a fear or dread of mathematics results to distancing themselves from the lesson, it is the student's preferred reaction, but doing so worsens their lack of mathematical confidence and competency (Santos, et al. 2015).

Despite of the education systems high regard to Mathematics curriculum, there are still certain issues and difficulties arising in teaching and learning the subject. It was reported that during 2003 Trends in International Mathematics and Science Study, the Philippines ranked near the bottom (Culaste, 2011). With the many questions and anxieties related to Mathematics teaching and learning, the most common is the problem-solving performance of students and the math anxiety level of students (Corrective Math, n.d; Hewson, n.d.). In the Philippines, a study made by Dela Cruz and Lapinid (2014) has shown that 40% of learners are below the satisfactory level in solving and

translating worded problems because of lack of comprehension, carelessness, unfamiliar words, and anxiety. In fact, for the school year 2016 – 2017 in Jacinto P. Elpa National High School, results showed that Mathematics subject obtained the least mean percentage score among other subjects with the mean score of 35.84% which was far below the standard passing rate of 75%. Hence, incorporating problem posing in mathematics problem-solving activities is the main aim of this present study.

The implementation of problem posing in classrooms is very significant for both teachers and students. The NCTM's Principles and Standards for School Mathematics (2000) stated that teachers are responsible for creating a learning environment that promotes student discourse and provokes their critical thinking through problem posing activities and eventually achieved academic success. Problem posing activities not only help to reduce students' anxiety and foster flexible thinking (Brown & Walter 1990) but may also develop and enhance students' understanding and problem-solving skills (Stanoya,1999). Also, English (1997) assert that problem posing afforded teachers the chance to grasp students‟ thinking about concepts and developments in mathematics and similarly, it is a potential option for pre-service teachers to acquire professional aptitude in mathematics (Ticha and Hospesova, 2006).

METHODS AND MATERIALS

Scope of Research

The research study was conducted at Jacinto P. Elpa National High School (JPENHS), located in Capitol Hills, Telaje, Tandag City, Province of Surigao del Sur, Philippines. JPENHS is the biggest secondary school in the entire Province of Surigao del Sur. The subjects of the study were the Grade-7 students under the Science Technology and Engineering (STE) Curriculum for the school year 2017 – 2018. Out of this number, only sixty (60) were considered as the subjects of the study. There were thirty (30) subjects in each group and were grouped according to their Mathematics grades from first quarter period to ensure that the two groups will be comparable.

Research design

The purpose of the study is to gain an "authentic understanding" of the changes that occurred as a result of problem posing strategy. Thus, this study used the quasi-experimental pre-test-post-test control group design method to determine the effectiveness of problem posing strategy in teaching Grade 7 Mathematics on the mathematical performance and anxiety of the students. In this design, two groups of students have involved: the experimental group and the control group. Two intact classes were utilized in the study.

Research Instrument

In the descriptive survey, the study used the adapted Modified Abbreviated Math Anxiety Survey (mAMAS). The mAMAS contained a 9-item survey questionnaire items responded to using a 5-point Likert-type scale, ranging from 1 (low anxiety) to 5 (high anxiety), with the total score representing a summation of the nine items.

Another research instrument used in this study was the Second Periodical test questionnaire. The test questionnaire was a teacher-researcher made questionnaire which was subjected to series of validation procedures from the experts in the field. The content of the said questionnaire were the competencies provided under the K-12 Grade 7 Math Curriculum; it was used to get the pre-test and posttest scores of the subjects in the control and experimental group.

Data Collection and Data Analysis

Two sections were randomly chosen using the "fishbowl technique" to determine the respondents of the study. Between these two sections, a coin was tossed to determine which among the sections will be the control group or the experimental group.

Both groups took the pretest to gauge their problem-solving performance and math anxiety level using the teacher-researcher- made questionnaire and mathematics anxiety test. For the data analysis, the researcher used Mann-Whitney Test for the comparison of the two-teaching method and Two-Way Analysis of Variance (Two-way ANOVA) for the interaction effect. The assumptions of Two-way ANOVA were examined and satisfied before applying.

RESULTS AND DISCUSSIONS

Hypotheses Testing

H_{00}: There is no significant difference on the performance of the student using the two-teaching method.
H_{01}: There is no interaction effect on the students performance to the mathematical ability and mathematics anxiety.

Pre-test and Post-test of Math Anxiety in Experimental and Control Groups.

As it can be seen in Table 1, the arithmetic mean of the Mathematics Anxiety scale pretest scores revealed by the experimental group students was found 3.35 and the respected figure for the control group students was found 3.04. The figures show only a small difference between the pre-math anxiety scores of the research group and control group. In the same table, the arithmetic mean of the post-math anxiety scores revealed by the experimental group students was found 2.46 and the respected figure for the control group students was found 3.14. In this respect, there is a difference between the post-attitude scores of the experimental group and control group on behalf of the

former group. Hence, it is observed that there is a decrease in the anxiety level of the experimental group students towards Mathematics class.

It can be gleaned from Table 1 that item no. 8 "Finding out that you are going to have a surprise quiz when you start your math lesson" obtained the highest anxiety level in the pre-test for control group with the mean average of 4.13 and 4.23 for the experimental group. This only means that students really had fear on giving of unannounced quiz to them. On the other hand, item no. 7 "Listening to another student in your class explain a math problem" got the lowest anxiety level with the mean average of 2.07 for the control group and 2.50 for the experimental group. After the conduct of the study, it can be seen from the result of the post-test in experimental group that the anxiety level of students in all the items from pre-test to post-test declined especially in item no.8 that obtained a greatest dropped from 4.23 (High Anxiety) to 2.87 (Normal Anxiety) with a gain of -1.37(Low Decrease) compared to the control group that nearly all the items increased except for items 4, 8 and 9 that showed only a slight reduction. The negative gain in the post-test results implies a decrease in the anxiety level of students, while the positive gain means increase in the level of anxiety.

There is no improvement in the control groups to which traditional teaching methods were applied. Yet, problem posing type of education employed in the experimental group brought about positive improvements in the conceptual development of the students. In the experimental group in which problem posing activities are applied, the students could find the opportunity to discuss and share their ideas since they communicate with their group members and other groups. In this way, information transfer among students is accomplished

This result supports the researches that showed problem posing reduces mathematics anxiety. Additionally, it is reported that problem posing activities improve students' attitudes toward mathematics and give more responsibility to them for their own learning (Brown & Walter, 1983). Since problem posing requires active involvement of students it reduces anxiety and increases optimism and motivation. Problem posing encourages academic independency and increases possessiveness, emphasizes students' responsibility in solving and posing problems. All of these as a result increase inner control (Kliman and Richards, 1992; Silver, 1994). Research show that when students pose problems, they tend to be more motivated and keener on searching answers to their problems (Silverman et. al, 1992).

Significant difference in students' Mathematics Performance in the Two-Teaching Strategy

As depicted from the Table 2, it can be gleaned from the result that the Mann-Whitney Test Z value is -2.097 and p-value= 0.036 ($p<0.050$), thus, we reject the null hypothesis that states "there is no significant difference in students' Mathematics performance when taught using problem posing strategy and those who were taught without problem posing strategy". This implies that there is a significant difference in the performance of the students in conventional and experimental group. The problem posing strategy in teaching Mathematics is more effective than teaching Mathematics without problem posing strategy.

This results conforms to the study of Akay and Boz (2010) that emphasize that problem posing approach is more effective in increasing academic success than teacher-centered traditional teaching approach. Furthermore, this finding corroborates with the study of Guvercin and Verbovskiy (2014) on the effect of problem posing tasks used in mathematics instruction to mathematics academic achievement and attitudes toward mathematics their study poses that problem posing method of instruction has significantly increased students' mathematical academic achievement.

Significant Interaction Effects on the Students Performance to Two-Teaching Method and Mathematical Anxiety

Results of Two-Way ANOVA gives a F value of 0.022 and p-value=0.979 in the two-teaching methods and math anxiety. It is concluded that there is no an interaction effect between the teaching method and mathematical ability in the performance of the students. This means that the mathematics performance of the students is independent on the strategy and anxiety being applied to Mathematics instructions. Furthermore, the p-value of 0.029 indicate that the teaching methods has an effect on the students' performance. And p-value of 0.002 implies that there is an effect of mathematical anxiety on the students' performance. This result means that the presence of anxiety in mathematics effects the performance in mathematics class.

Table 1. Mean Scores of the Pre-Test and Post Test of Math Anxiety

STATEMENT	CONTROL						EXPERIMENTAL					
	PRE-TEST		POST TEST				PRE-TEST		POST TEST			
	Mean	VI	Mean	VI	GAINED	VI	Mean	VI	Mean	VI	GAINED	VI
1. Having to complete a math worksheet by yourself	3.10	NA	3.10	NA	.00	ND	3.43	MA	2.77	NA	-.67	VLD
2. Thinking about a math test the day before you take it.	3.43	MA	3.73	MA	.30	VLI	3.70	MA	2.73	NA	-.97	VLD
3. Watching the teacher work out a math problem on the board	2.70	NA	3.00	NA	.30	VLI	3.00	NA	2.20	FA	-.80	VLD
4. Taking a math test	3.83	MA	3.70	MA	-.13	VLD	4.17	MA	3.00	NA	-1.17	VLD
5. Being given math homework with lots of difficult questions that you have to hand in the next day	3.00	NA	3.57	MA	.57	VLI	3.83	MA	2.67	NA	-1.17	VLD
6. Listening to the teacher talk for a long time in math	2.37	FA	2.40	FA	.03	VLI	2.53	FA	2.13	FA	-.40	VLD
7. Listening to another student in your class explain a math problem	2.07	FA	2.10	FA	.03	VLI	2.50	FA	1.90	FA	-.60	VLD
8. Finding out that you are going to have a surprise math quiz when you start your math lesson	4.13	MA	3.93	MA	-.20	VLD	4.23	HA	2.87	NA	-1.37	LD
9. Starting a new topic in math	2.77	NA	2.70	NA	-.07	VLD	2.77	NA	1.83	FA	-.93	VLD
AVERAGE	**3.04**	**NA**	**3.14**	**NA**	**.09**	**VLI**	**3.35**	**NA**	**2.46**	**FA**	**-.90**	**VLD**

INTERVAL: 1.00 – 1.80 - Low Anxiety (LA); 1.81 – 2.60 - Fair Anxiety (FA); 2.61 – 3.40 - Normal Anxiety (NA); 3.41 – 4.20 - Moderate Anxiety (MA); 4.21 – 5.00 - High Anxiety (HA). INTERVAL FOR GAIN 0.00 – No increase/decrease (NI/ND); (POSITIVE) +0.01 – 1.20 – Very Low Increase (VLI); +1.21 – 2.40 – Low Increase(LI); +2.41 – 3.60 – Moderate Increase (MI); +3.61 – 4.80 – High Increase (HI); +4.81 – 5.00 – Very High Increase (VHI). (NEGATIVE) – 0.01 – 1.20 – Very Low Decrease (VLD); -1.21 – 2.40 – Low Decrease (LD); - 2.41 – 3.60 – Moderate Decrease (MD); -3.61 – 4.80 – High Decrease (HD); -4.81 – 5.00 – Very High Decrease (VHD)

Table 2. Comparison of Students' Mathematics Performance in the Two-Teaching Method

	Mean	Z	p-value	Decision	Conclusion
Conventional	29.97	-2.097	0.036	Reject H_{o1}	There is a significant difference
Experimental	34.57				

Table 3. Two-Way Analysis of Variance of Students' Mathematics Performance

Source	Type III Sum of Squares	df	Mean Square	F	P-Value	Decision	Conclusion
Teaching Method	90.252	1	90.25	5.033	0.029	Reject Ho	There is an effect
Math Anxiety	247.821	2	123.911	6.910	0.002	Reject Ho	There is an effect
Teaching Method * Math Anxiety	0.806	2	0.403	0.022	0.978	Fail to Reject Ho	There is no interaction effect
Corrected Total	1381.73	59					

CONCLUSION

Students who were exposed to Problem Posing Strategy have a higher score compared to those who were just exposed to traditional method. The results shows that there is a significant difference in the performance of the students when teaching using Problem Posing Strategy and without problem posing strategy. Mathematics anxiety and the two-teaching methods does affect the mathematics performance of the students in mathematics subject. The results also reveals that the performance of the students in Mathematics is independent on the strategy and being applied to Mathematics instruction and math anxiety. Furthermore, the result implies that applying Problem Posing Strategy in teaching Mathematics is more effective than teaching without using Problem Posing Strategy, thereby facilitating deeper learning and improved achievements and performance in Mathematics.

Recommendation

1. Students can be trained and encouraged to become skilled problem solvers with the ability to conduct qualitative analysis of problems before they perform quantitative solutions.
2. Administrators can exhibit more support for teachers who will engage in researches and future researchers, another experimental study can be conducted in other fields of mathematics to determine the effect of the strategy on the performance of the students.

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