PROBLEM POSING STRATEGY: EFFECT ON STUDENTS' MATHEMATICAL PERFORMANCE AND ANXIETY

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Abstract

Mathematics is a fundamental part of school curricula but many students struggle with it due to instructional factors and cognitive limitations in comprehension and problem-solving. Hence, the study aims to investigate the effectiveness of problem posing strategy as an alternative method for teaching problem-solving in mathematics. The study involved two groups of Grade 7 students, a control group and an experimental group. The experimental group was taught using problem posing while the control group was taught using traditional methods. The study used a quasi-experimental pre-test-post-test control group design methods and data was collected using the Modified Abbreviated Math Anxiety Survey (mAMAS) to determine the level of anxiety of the students. The results showed that there is a significant difference in the two-teaching strategy, that is, students who were exposed to problem posing strategy had higher scores and lower levels of anxiety compared to those taught using traditional methods. The study suggests that problem posing can be an effective approach to teaching problem-solving in mathematics.

Keywords: *mAMAS, problem solving, word problems, quasi-experiment*

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1.0 Introduction

Mathematics is a vital subject and it is a fundamental part in every school curriculum. However, there is a common belief that most of the students find it a dilemma due to factors related to instructions and learners' cognitive attributes like poor comprehension and analysis especially in problem solving (Alsaleh, 2020). This often leads to fear and withdrawal from problem-solving activities although most solutions are typically offered at hand. Hence, it is seen most wanting that an intervention be properly made with the use of problem posing (Akay & Boz, 2010; Rosli *et al.*, 2014).

Various studies claimed that problem posing methods significantly produces positive results in students' attitudes toward mathematics word problems and mathematics achievement. For instance, the integration of problem-posing activities into students in mathematics instruction can develop mathematical creativity (Bicer *et al.*, 2020). The study of Cai and Leikin (2020) 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 & Semana, 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, 2011). 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 study use the Problem Posing Strategy as an alternative way of teaching problem-solving to the students. The evaluation of the effectiveness of this method was carried out by comparing the post-test scores of two teaching methods. Furthermore, the study intends to explore whether there exists an interaction between math anxiety and teaching techniques that affects the academic performance of students.

2.0 Methodology

The 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.

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 like validation from the experts of the field, and reliability testing. 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.

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 Two-Way Analysis of Variance (Two-way ANOVA) for the comparison of the two-teaching method

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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 your self	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 a math lesson	4.13	MA	3.93	MA	-.20	VLD	4.23	HA	2.87	NA	-1.37	LD
9.	Staring a new topic in math.	2.77	NA	2.70	NA	-.07	VLD	2.77	NA	1.83	FA	-.93	VLD
	Weighted Mean	**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)

and interaction effect of teaching method and math anxiety to the performance of the students. The assumptions of Two-way ANOVA were examined and satisfied before applying.

3.0 Results and Discussion

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 as supported in the study of Milovanović and Branovački (2021). 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 provide more considerable benefits (Akay & Boz, 2010; Rosli *et al.*, 2014). Cai and Leikin (2020) suggested that the research community must consider affective aspects in mathematical problem-posing research and da Ponte *et al.* (2013) highlighted the investigation task to promote problem posing. While Passolunghi *et al.* (2020) suggested that math strategy training can reduce the math anxiety level as well as on the improvement of math achievement. search show that when students pose problems, they tend to be more motivated and improve their problem-solving skills (Calabrese, 2022).

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

As depicted in Table 2, it can be gleaned from the result that the two-way ANOVA F value is 6.010 and p-value = 0.017 (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 result 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

Table 2. Two-way analysis of variance of students' Mathematics performance

Source	Type III Sum of Squares	df	Mean Square	F	*p*-Value	Decision	Conclusion
Intercept	60535.455	1	60535.455	2860.49	0.000		
Teaching Method	127.188	1	127.188	6.010	0.017	Reject Ho	There is sig. difference
Math Anxiety	19.282	2	9.641	0.456	0.636	Fail to Reject Ho	There is no sig. difference
Teaching Method * Math Anxiety	57.650	2	28.825	1.36	0.265	Fail to Reject Ho	There is no interaction effect
Corrected Total	1381.733	59					

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 1.36 and *p*-value=0.265 in the two-teaching methods and math anxiety. It is concluded that there is no an interaction effect between the teaching method and mathematical anxiety in the performance of the students. This means that the mathematics performance of the students is independent on the anxiety and strategy being applied to Mathematics instructions. Although there was a positive relationship between math anxiety and approach to learning among students, but this association was not statistically significant according to the study of Rozgonjuk *et al.* (2020). Furthermore, the *p*-value of 0.636 indicate that there is no significant difference of mathematical anxiety on the students' performance. In the study of Hung *et al.* (2014), the mathematics anxiety ratings did not show significant differences among the three comparable groups.

4.0 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 result 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.

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