

# TEACHING MATHEMATICS THROUGH PROBLEM-SOLVING WITH SEQUENTIAL QUESTIONING TECHNIQUE: IT'S INFLUENCE ON PUPILS' ACHIEVEMENT AND ANXIETY TOWARDS MATHEMATICS

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**ABSTRACT:** *This study was designed to explore if the sequential questioning technique of teaching-learning problem solving influence the learners' mathematical achievement and reduce anxiety. The study was conducted during the third and fourth quarters of the school year 2018-2019. The two sections in grade six in each participating school, Mimbalot Elementary School and Sgt. Miguel Canoy Memorial Central School of west II District in Iligan City, were the participants of the study. The experimental groups were taught using problem-solving with the Sequential Questioning Technique (SQT) and the researcher-written SQT manual as the teachers' guide. The control group pupils were taught using the 5E's. A quasi-experimental pretest-posttest control group design was employed with the 40-item teacher-made achievement test as the main instrument of the study. One-way analysis of covariance (ANCOVA) was used to analyze data gathered. The result of the analysis revealed that the use of the sequential questioning method has a better effect on the academic performance of the learners compare to those under conventional teaching. Moreover, it lessened the anxiety level of the participants. The researchers recommended that mathematics teachers may apply the sequential questioning method of teaching mathematics since it gives the chance to learners to develop their critical thinking skills, become problem solvers, and able to express and share their ideas with their co-learners.*

**Keywords:** mathematics achievement, sequential questioning technique, mathematics anxiety

## 1. INTRODUCTION

Mathematics is an essential subject in general education and is important in daily living as well as in the study of other fields. Despite of its importance in daily life, it has not become an interesting subject for learners [1]. One of the reasons of the learners' dislike of mathematics was related to the difficulty in understanding the subject matter, as shown in the reciprocal relationship that exists between every attitudinal measure and mathematics achievement [2]. In addition, mathematics is considered a difficult subject by most of the learners because of the aversive teaching style and poor instruction in which the learners had difficulty in following instructions, and in remembering its equation.

Furthermore, researches had shown that mathematics achievement is influenced by psychological factors such as mathematics anxiety especially in problem-solving [3]. Hence, anxiety level may be remedied by teaching word problem solving through sequential questioning because this approach provides learners a way to learn mathematics with understanding by dissecting information into bits through sequential questions that serve as clues for the solution of the given problem tasks [4]. The relevance of questioning as a teaching technique contributes to engage learners and to promote a deeper-level of thinking [5]. Thus, questioning is a very useful classroom practice process [6].

Mathematics influencers who are teachers play a critical role in drawing the interests of learners to learn. Low interest in mathematics is due to teachers' teaching techniques [7]. Since teachers are the crucial agents for bringing changes in their classrooms, they should be equipped with innovative approaches in teaching. Teaching problem solving with sequential questioning techniques can be seen as a solution to the pupils' ineptness in mathematics since it can develop critical thinking, creativity, communication, and collaboration, hence the reason for this study.

## 2. OBJECTIVE OF THE STUDY

This research study sought to determine the effect of teaching mathematics problem solving with sequential questioning techniques on the pupils' achievement and mathematics

anxiety. Specifically, learners' scores in the problem-solving achievement test and anxiety towards mathematics will be measured and compared as influenced by the teaching models.

## 3. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

This study is anchored on the following educational and psychological theories. First, the theory of constructivism [8], which believed that pupils construct their own ideas through the concepts they have understood. Second, the zone of proximal development (ZPD) which gave importance to the development of pupils' potential under adult guidance and collaboration with more capable peers [9]. Third, is the assimilation and accommodation theory which stated that assimilation and accommodation require active participation of the learner because problem-solving skills cannot be learned by following the pattern of processes [10]. Finally, the teaching process which anchored on the Revised Bloom's Taxonomy of Learning Domains. The revised taxonomy arranges skills from most basic to the most complex.

The National Council of Teachers of Mathematics (NCTM) recommended that problem-solving be the focus of mathematics teaching because it encompasses skills and functions which are an important part of everyday life [11]. In support of the NCTM's recommendation, a paper, An Analysis of a Problem-Solving Activity in a High School Mathematics II Class, recommended that problem-solving should be the focus of teaching because it is an effective way to enhance the problem-solving ability of the pupils [12]. An article, Teaching Mathematics through Problem Solving (TtPS), described teaching through problem-solving as a way to achieve equity in mathematics classrooms. The study, "Effects of Teaching Mathematics through Problem-Solving Contexts on Sixth-Grade Pupils' Problem-Solving Performance and Representation Use," revealed that within the experimental group, the intervention had a positive effect on pupils' problem-solving performance whereas the comparison group experienced no changes [13].

Cai and Lester posited in their article in NCTM journal entitled, "Why is Teaching with Problem Solving Important to Student Learning?" that focusing on problem-solving in the classroom not only impacts the development of students' higher-order thinking skills but also reinforces positive attitudes [14]. Ruff and Susan cited the belief of Geist (2010) that mathematical anxiety is one of the barriers to mathematics achievement as it has a widespread impact on pupils' everyday life and career choices [15]. Mathematics anxiety is experienced by most pupils who lack basic skills in mathematics. A study entitled "The Influence of Mathematics Anxiety in Middle and High School Students Mathematics Achievement", also found correlations between the level of mathematics anxiety and achievement [16]. In fact, Fulya-Yuksel-Sahin cited the study of Gresham (2005) that group work and collaborative learning alleviate mathematics anxiety and have a positive impact on students cognitively, emotionally, and socially [17]. Moreover, Lomibao stated that situational and environmental factors of mathematics anxiety are influenced by the teaching methods and the teaching-learning environment [18].

**4. MATERIALS AND METHODS**

This study used the quasi-experimental research design in exploring the effect of sequential questioning in problem-solving on the topics of measurement. One hundred eighty-four (184) grade six pupils with different learning abilities, who are officially enrolled in Mimbalot Elementary School (MES) and Sgt. Miguel Canoy Memorial Central School (SMCMCS) for the school year 2018-2019, were participants of the study. Each school has a pair of control and experimental groups. One of the two sections was randomly assigned as the experimental group, the other was the control group. Before the start of the implementation, both groups were given the self-test for mathematics anxiety and achievement test. The participants in the experimental group were exposed to teaching method with sequential questioning techniques while the control group was exposed to the 5E's following Polya's approach in problem-solving. A researcher-written teachers' manuals were used in teaching both groups to ensure impartiality in the implementation of the study. The 40-item researcher-made achievement test with a reliability index of 0.87, served as the main instrument of the study. To compare the achievement scores of the two groups, the mean and standard deviation were computed. To determine the effect of teaching math problem solving with sequential questioning techniques one-way analysis of covariance (ANCOVA) was used to analyze data gathered. The hypothesis was tested at 0.05 level of significance.

**5. RESULTS AND FINDINGS**

**Table 1. Mean, Standard Deviation, Mastery Qualitative Equivalent, and Descriptive Level of Pupils' Achievement Scores in Grade 6 Mathematics**

|                                | Experimental Group<br>N=184 |                         | Control Group<br>N=184 |            |
|--------------------------------|-----------------------------|-------------------------|------------------------|------------|
|                                | Pretest                     | Posttest                | Pretest                | Posttest   |
| Mean                           | 31.60                       | 79.16                   | 22.40                  | 59.31      |
| SD                             | 9.10                        | 14.30                   | 14.23                  | 21.04      |
| Mastery Qualitative Equivalent | Low                         | Moving Towards Mastery  | Low                    | Average    |
| Descriptive Level              | Beginning                   | Approaching Proficiency | Beginning              | Developing |

Table 1 shows the pretest and posttest mean scores, standard deviation, mastery qualitative equivalent, and descriptive level. It can be seen in the pretest that the learners from both groups were in the beginning level, which is an indication that they had an inadequate foundation in measurement. Although the experimental group is slightly higher yet the two groups are shown to have a similar ability in the learning content needed to understand the concept before the treatment, which means that all had low mastery levels described as beginning level.

In the posttest, pupils in the control group obtained a mean score of 59.31 with a descriptive rating of **Developing Level** and the mastery qualitative description as **Average Level**. The result is within the range of 35%-65%, an indication that it is 10% lower than the 75% standard passing level of mean percentage score set by the DepEd. Meanwhile, the mean score of the experimental group was 79.16, with the descriptive rating of **Approaching Proficiency** and the mastery qualitative description was **Moving Towards Mastery** with a percentage range of 66%-85%. The mean values of the posttest scores indicate that both groups have increased their mean score from their pretest scores.

To determine if there was a significant difference on the pupils' mean achievement scores in Measurement, further analysis was done using Analysis of Covariance.

**Table 2. One-way ANCOVA Summary for Pupils' Achievement Score**

| Sources         | df  | Adjusted Sum of Squares | Adjusted Mean Square | F ratio | P value |
|-----------------|-----|-------------------------|----------------------|---------|---------|
| Treatment Group | 1   | 6595.48                 | 6595.48              | 27.54   | 0.001*  |
| Error           | 182 | 43821.48                | 239.46               |         |         |
| Total           | 183 | 971870.68               |                      |         |         |

\*Significant at .05 level

Table 2 shows a summary of the analysis of the covariance of the participants' pretest and posttest achievement scores. The analysis yielded an F-ratio of 27.54 with a probability value of .001 which is less than the 0.05 level of significance. This led the researcher to reject the null hypothesis. This implies that the posttest score of the experimental group which is 79.16 is significantly higher than the control group where the mean score is 59.31. Furthermore, the result reveals that the use of sequential questioning as a technique in teaching problem solving provided pupils with the opportunity to recall concepts and discussed with each other as they answered information-seeking questions. Thus, the use of sequential questioning posed a positive effect on the pupils' performance because it gave pupils opportunities to express ideas, draw inferences, and contribute their own opinions during scaffolding, information-seeking questions, explaining, and transforming knowledge. Furthermore, students' participation, explaining their reasoning, and teachers who use their time efficiently in asking questions, compelling information, and listening are all ways in which critical thinking skills can be developed [19].

**Table 3. Mean and Standard Deviation of Pupils' Self-Test for Mathematics Anxiety**

|      | Experimental Group<br>N=184 |          | Control Group<br>N=184 |          |
|------|-----------------------------|----------|------------------------|----------|
|      | Pretest                     | Posttest | Pretest                | Posttest |
| Mean | 45.93                       | 36.86    | 45.32                  | 39.88    |
| SD   | 7.71                        | 7.39     | 8.08                   | 6.64     |

Table 3 shows the pretest and posttest mean scores and standard deviation of pupils' self-test for mathematics anxiety. It can be observed that the learners in both groups have mean scores in the pretest of 45.32 and 45.93, respectively, where they could not determine if they were anxious or not or they were undecided of their emotion. These results reveal that both groups had the same mathematics anxiety level before the implementation of the study. The experimental group became less anxious while the control group's anxiety level remained the same. This is an indication that pupils exposed to sequential questioning in the teaching-learning process had somehow lessened their fear towards mathematics enough to grasp the concept taught. This finding supports the statement that molding critical thinking skills by asking questions strengthened their proficiency and confidence [20]. The group discussion in classrooms and cooperative learning as a strategy might have more or less lessened their anxiety.

To determine if there was a significant difference in the pupils' mean scores in the self-test for mathematics anxiety, further analysis was done using Analysis of Covariance.

**Table 4. One-way ANCOVA Summary for the Pupils' Mean Scores in the Self- test for Mathematics Anxiety**

| Sources         | df  | Adjusted Sum of Squares | Adjusted Mean Square | F ratio | P value |
|-----------------|-----|-------------------------|----------------------|---------|---------|
| Treatment Group | 1   | 493.96                  | 493.96               | 12.43   | 0.001*  |
| Error           | 182 | 7270.67                 | 39.73                |         |         |
| Total           | 183 | 283138.00               |                      |         |         |

\*Significant at .05 level

Table 4 shows a summary of the analysis of the covariance of the self-test for mathematics' anxiety scores. The analysis yielded an F-ratio of 12.43 with a probability value of 0.001 which is less than the critical value 0.05 level of significance. This led to the rejection of the null hypothesis that there is no significant difference in the participants' anxiety level as influenced by using the sequential questioning technique. This implies that when the class promoted pupil-teacher discourse and pupil-pupil discourse, as exhibited in sequential questioning, the process reduced fear or difficulty in understanding the subject. This result is similar to the result of the study of Lomibao which revealed that situational and environmental factors of mathematics anxiety are influenced by the teaching methods and the teaching-learning environment.

### 6. CONCLUDING STATEMENTS

The sequential questioning technique in teaching problem solving is effective in fostering pupils' achievement. The sequential questioning technique can reduce pupils' mathematics anxiety. Hence, the researchers recommended

that teachers may use and indorse sequential questioning techniques in teaching mathematics in addition to the 5Es of DepEd mathematics lesson guide and teachers may be given training and workshops to gain mastery in using the sequential questioning techniques and develop confidence in teaching mathematics. School administrators may support the implementation of using the sequential questioning technique in teaching mathematics. The sequential questioning technique may be used in other subjects taught in school. Similar studies may be conducted to a wider scope using different populations in different learning institutions to promote the generalizability of the results.

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