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Strategic Questioning as Formative Assessment in Teaching Mathematics Grade 9 Learners

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Abstract- *Use of strategic questioning as the formative assessment is one of the strategies that advocates the improvement of learners' performance in Mathematics. The study assessed the contribution of strategic questioning to the improvement and development of the foundation of knowledge of learners to come up with improved performance and developed a plan of strategic questioning. The experimental evaluation design-posttest only was used with Posttest for both control and experimental groups. The experimental groups were exposed to the treatment. Data gathered through a checklist and plan for strategic questioning were developed. Two hundred twenty-five students under the researcher were randomly selected as control and experimental groups. Data were statistically treated with percentage, mean, standard deviation, t-test, and p-test. It was found out that there was a significant difference between the performance of students in the controlled and experimental groups after instruction/intervention. This meant that strategic questioning as formative assessment contributes to the effective performance of the learners in mathematics. It can be inferred further that categorizing questioning to the lower level and higher level can really increase the learners' performance in math. The research revealed then that using contextualized problems/lessons as one form of strategic questioning in every quarter contributed to improving the learners' competence in solving math problems.*

Keywords: ***S****trategic questioning, evaluation design-posttest only, Posttest, formative assessment improving learners competence, contextualized problems.*

INTRODUCTION

Learning of students is a shared experience with their mentors. Students must be given opportunities to be involved and be responsible for all aspects of their learning to perform well in the class. The educators' art of questioning plays a vital role in the process of formative or summative assessments of each engagement with the students.

DepEd Order No 8, s. 2015 states that there are two types of classroom assessment: Formative assessment is an assessment for learning, may be given at any time during the teaching and learning process (before the lesson, during the lesson, and after the lesson. Formative Assessment results are not included in the computation of summative assessment and should not be used as a basis for grading. The other type of classroom assessment is the summative test which occurs at the end of a particular unit/lesson. It measures whether the learners have met the content and performance standard. The result of SA is recorded and used to report on the learner's achievement. From the descriptions, what the concern of the present research is the Formative Assessment.

Furthermore, Formative assessments are those activities and exercises that are used by the teachers to help students learn concepts in Mathematics. To be considered formative, the evidence must be elicited, interpreted and used both teachers and learners (Williams, 2011). Formative assessment is a crucial tool for simultaneously improving classroom practice and students' performance" (Petit & Zawojewski, 2011). There are different processes of Formative Assessment. These include strategic questioning, short test, and quizzes, question and answer in the lesson, homework, assignments, and others. Brandsfort, et. al. (2000) suggested that the learning environment must consider centralization, in particular, the value formative assessment. It was noted that formative assessment design should be able to engage student attention and engender student learning commitment to self-evaluation (Wang, et al. 2004). A learning environment with formative assessment has many benefits to learners. Darling Hammond (2000), states that teachers who are able to use various instructional strategies have been shown to be more effective than those who just use single teaching strategies.

Uses of strategic questioning are one of the processes in formative assessment. According to Fran Peavey (1998), a strategic questioning process is an approach to creating personal and social change. This is the skill of asking the question that will make the difference. This phenomena according to her create knowledge by synthesizing new information from what

is already known. It can create motion, options, digs deeper, avoids "whys", avoids "yes" or "no" answers, empowering, and ask the un-askable questions. Furthermore, according to her, there are two levels of the questioning process. The first level is describing the issue and the second level id digging deeper. The concern of this research is to adapt to the different levels in the context of mathematics. The lower level concerns the contents evaluating students what they already know, diagnosing student's strengths and weaknesses, reviewing and summarizing its contents. The higher level deals on encouraging the learners to think deeply, critically involve problem-solving, encourage discussion on the activity presented and stimulating students to seek information or contextualize items related to the topic."

Strategic Questioning is a process which is considered formative in nature. Teachers can use this to determine if further classes are needed (Crochett, 2018). William (2011) suggests only two reasons to ask questions in a classroom: "one, to cause thinking and two, to provide information for the teacher what to do next". In this kind of approach, the teacher tries to reveal the thinking and understanding of the students on the concepts discussed in mathematics. This not just listening to the right answer from students, but listening to evidence about student thinking to inform the next instructional steps. Students are engaged when they are absorbed in the activities, task, and discussions using techniques, rather than just waiting for their projects and result of their tests. For student engagement, there is a need to use simply-worded questions. Alber on her blog in the 2013 states process of questioning to be effective: ' 1) What do you think?;) Why do you think that?; 3) How do you know this?; 4) Can you tell me more?; and, 5) What questions do you still have?' According to her varying tone is also important.

Questioning strategies may be used by individuals, small groups, or the entire class. Effective formative assessment strategies involve asking students to answer well-thought-out, higher-order questions. Higher-order questions require more in-depth thinking from the students and help the teacher discern the level and extent of the students' understanding. Studies have found that most students become more engaged in classroom dialogue when higher-order questions are combined with a waiting period.

The research concerns the improvement of classroom pedagogy and improved performance of students in Mathematics. The uses of strategic questioning processes in Mathematics has not been extensively reported. Thus, this action research would like to address the quality of performance through strategic questioning as a formative assessment of Mathematics teachers.

METHODOLOGY

The study used the Experimental Design or the Evaluation Design-Posttest Only. According to Mcleod, Salil in 2007, Experimental Designs refer to how participants are allocated to the different conditions in an experiment, divide the participants into two groups, the experimental group, and the control group, and then introduce a change to the experimental group. Merriam-Webster states that Posttest is a test given to students after completion of an instructional program or segment and often used in conjunction with a pretest to measure their achievement and the effectiveness of the program. Thus, this posttest only design is administered to two groups, the control and experimental groups to look at the effectiveness of using strategic questioning as formative assessment in teaching mathematics. One group comprises of three sections called the comparison or control group, who do not participate in the program that the researcher, aimed to conduct Another group, the experimental group, which composed of another three sections are participants in the use of strategic questioning as formative assessment, Both group took the posttest on the second quarter. The scores in the posttest were compared to see if using the strategic questioning as formative assessment had an impact on the performance of Grade 9 students in Mathematics. To describe the manner of questioning, qualitative will be used, these questions were clustered and categorized from the lower level to higher level questions.

RESULTS and DISCUSSION

Grade-9 respondents in terms of age. Table 1 shows the age of the respondents. In the controlled group, there were ninety-nine (99) respondents or 44%. Composed of: one (1) nineteen year old (1%), two (2) eighteen years old (2%), four (4) seventeen years old (4%), nine (9) sixteen years old (16%), sixty (60) fourteen years old (61%), and seven (7) thirteen years old (7%). The experimental group had one hundred twenty-seven (126) students or 56%. Composed of one (1) nineteen year old (1%), one (1) eighteen year old (1%), three (3) seventeen years old (2%), nine (9) sixteen years old (7%), fifteen (15) fifteen years old (12%), eighty-one (81) fourteen years old (64%). and seventeen (17) thirteen years old (13%). Most of the respondents were in the bracket of fourteen (14) years old.

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Table 1
Grade-9 learners in terms of age

Age	Control Group	%	Exptl. Group	%
19	1	1	1	1
18	2	2	1	1
17	4	4	3	2
16	9	9	9	7
15	16	16	15	12
14	60	61	81	64
13	7	7	16	13
Total	**99**	**100**	**126**	**100**

Posttest performance of learners in Grade-9 Mathematics for the second quarter. Table 2 provides the average score on the Posttest Performance of Grade-9 respondents in mathematics for the second quarter. There were twenty-six (26) item test for the Module 3 on Variation and fourteen (14) item test for Module 4 on Zero, Negative, Rational Exponent and Radicals. It has two groups, namely, controlled group and experimental group. The three sections in the controlled group, namely, Sapphire, Carnelian, and Zircon have score mean of 12.61, 16.74, 1.65, respectively and with an average mean of 17.00. For the experimental group, namely, Amethyst, Topaz, and Garnet, has a Score Mean of 17.64, 2.02, 23.10, 23.10, and 20.92, respectively. The Average Mean is 20.92 which is higher than the controlled group.

Table 2
Posttest performance of learners in Grade-9 Mathematics for the second quarter

Posttest	Module 3	Module 4	Overall
Controlled Groups			
A	12.61	11.37	11.99
B	16.74	12.55	14.65
C	21.65	12.30	16.98
Ave.	**17.00**	**12.07**	**14.54**
SD	**4.6**	**1.69**	**2.925**
Exptl. Group			
A	17.64	13.04	15.34
B	22.02	13.20	17.61
C	23.10	13.48	18.29
Ave.	**20.92**	**13.24**	**17.08**
SD	**2.89**	**1.05**	**1.97**
Ave. Score	**26**	**14**	**40**

The Posttest for Module 4 of the controlled group, namely, Sapphire, Carnelian, and Zircon has a Score Mean of 11.37, 12.07, and 12.30, respectively. The average mean is 12.07. In the experimental group which was composed of Amethyst, Topaz, and Garnet, the score mean were 13.04, 13.20, and 13.48, respectively. The average mean was 13.24 which was 1.17 higher than the controlled group. This showed that students who were exposed to strategic questioning as formative assessment performed well in class. Rebecca Alber's post on 5 Powerful Can Ask Students. In it, she shared her experience learning the importance of asking questions that 'strategic, well designed and that lead students to questions of their own, as quoted by Kathy Dyer in 2013.

Standard Deviation of Grade-9 learners in Mathematics for the second quarter. Table 2 further shows the standard deviation of the posttest scores of the students for Module 3 on Variations and Module 4 on Zero/Negative Exponents, Rational Exponent, and Radicals of the controlled and experimental groups. The Standard Deviation of posttest scores of the controlled group in Module 3, namely Sapphire, Carnelian, and Zircon was 2.48, 6.12, and 3.87, respectively, had an overall average SD of 4.6. Carnelian had the highest deviation of 6.12. This showed that the spread of the scores is extremely high or extremely too low. The Standard Deviation of the experimental group, namely Amethyst, Topaz, and Garnet were 4.06, 2.51, and 2.10, respectively, with an overall average SD of 2.89. This is lower than the controlled group. Meanwhile, for Module 4 standard deviation of posttest scores in the controlled group, Sapphire, Carnelian, and Zircon has 2.15, 3.87, and 2.77, respectively and had an overall average SD of 2.93. For the experimental group, Amethyst, Topaz, and Garnet, the SD of Posttest Score are 2.77, 1.66, and 1.48, respectively and has an Overall Average SD of 1.97. This was lower than the control group. A high standard deviation was influenced by the extremeness of scores in Module 3 represented by Grade-9 Carnelian. Likewise, the SD of the experimental group was lower which meant that numbers were mostly clustered about the mean.

Significant difference between the posttest performance of the controlled and the experimental groups. Table 3 reveals the significant difference between the Posttest Performances of the Controlled and the Experimental Groups after the use of strategic questioning. For Module 3, it had a mean of 16.02. The standard deviation was 5.58. The degrees of freedom was 223. The t-value was 7.58 and the p-values of 0.00. This showed that the value was significant and the hypothesis was rejected. For Module 4, it had a mean of 12.01. The standard deviation was 1.78. The degrees of freedom of 223, t-value of 6.30, p-values of 0.00. This showed that the value was significant and the hypothesis was rejected. There was a significant difference in the posttest performances of the students in the controlled

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and experimental groups of Modules 3 and 4. Using strategic questioning as formative assessment significantly increased the performance of learners in Grade-9 Mathematics classes.

Table 3
Significant difference between the posttest performance of the controlled and the experimental groups

	X_1	X_2	df	t-val.	p-val.	Decision
Module 3	16.02	30.80	223	7.58	0.00	Reject Ho
Module 4	12.01	13.23	223	6.30	0.00	Reject Ho

Controlled Group (N=99); Experimental Group (N= 126)

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings teacher must categorize the art of questioning to lower and higher level and have a reservoir of contextualized problems to help students improve/develop their academic competence. Thus, the research revealed a good point that the use of strategic questioning as formative assessment contributed to improving the learners' ability in solving math problems and had a significant effect. However, the result may not be conclusive since this study was employed to one group of subject. There might be other significant variables which influenced the result of the posttests. Thus, there is a need to encourage teachers to modify instruction for the whole class according to the needs of the students. The teacher should provide feedback for the learning and communicate this to the students or to the class to know and for them to develop further; developed a contextualized problem in every quarter math lessons and validate its effectiveness; and the questions should be categorized to lower and higher category to facilitate learning of the fast and slow learners and to address the multiple intelligence of the students which leads to the used of differentiated instruction. There is also a need to plan strategic questions for every quarter to validate its effectiveness, create more contextualized problems for the students to work on to challenge their thinking and to understand better the concepts of Mathematics related to their lives. The teacher should let the students create their own problem related to variations, exponents, and radicals to allow internalization of the learning; and replication of this study is recommended on other strategies of formative assessment in teaching mathematics to prove the veracity of the claims of this research, correlating to the level of learning, IQ, motivation, learners' self-awareness and attitudes towards mathematics.

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