Original Research Article

EFFECTIVENESS OF STRATEGIC INTERVENTION MATERIAL IN MATHEMATICS AS REMEDIATION FOR GRADE 9 STUDENTS IN SOLVING PROBLEMS INVOLVING QUADRATIC FUNCTIONS

Abstract

This study investigated the effectiveness of Strategic Intervention Material (SIM) on solving problems involving quadratic functions. The SIM was designed as a remediation tool for students in teaching one of the least learned competencies. It was personally conducted by the researcher in Digos City NHS – Igpit HS Annex, City Schools Division of Digos, Philippines, during the school year 2016-2017. A total of 16 Grade 9 students were the participants of the study. Pretest-postest quasi-experimental design was used. The data were gathered using the researcher-made academic achievement. Mean and standard deviation were used to describe the data. One-way analysis of co-variance (ANCOVA) was utilized to test if the significant difference existed between the experimental and the control groups. Findings revealed that the academic achievement of Grade 9 students when remediated using the SIM was satisfactory; while the students remediated with the Grade 9 Learner's Material was described as did not meet expectations. A significant difference in the academic achievement of students on the topic in favor of the experimental group was noted; hence, the Strategic Intervention Material in Mathematics was found effective as a remediation tool for Grade 9 students in solving problems involving quadratic functions. Recommendations were offered.

Keywords: Strategic intervention material, Remediation, Mathematics, Quadratic functions, Problem solving

INTRODUCTION

Low performance of students poses a significant challenge to the education arena. Amidst the technology advancement in solving daily problems, basic knowledge of this technology is vital in its success. Gaining basic knowledge starts in school. Study of mathematics primarily needs conceptual understanding. Based on observation, students can read mathematical concepts but they can hardly comprehend and understand them. Hence the quality of mathematical skills being taught in schools is one of the primordial concerns of education (DepEd Report 2014).

According to Ramirez *et al.* (2013), it was common to perceive mathematics as a difficult subject and some students avoided solving mathematical problems. Many learners experienced mathematics anxiety in their school lives.

Eyed as a long term solution, a curriculum transition from 2002 Basic Education Curriculum to K to 12 Curriculum (DepEd Order No. 3, s. 2012) had been taking place starting School Year 2012-2013 and was made legal by the Republic Act 10533 or the Enhanced Basic Education Program of 2013. This curriculum reform had introduced many revisions and innovations such as the incorporation of multiple disciplines in one subject.

In 1999, 2003, and 2007, Trends in International Mathematics and Science Study (TIMSS) revealed unsatisfactory results in Science and Mathematics and they both ranked below international standards (International Association for the Evaluation Achievement 2004). The same scenario is true in the 2013 National Achievement Test (NAT) results where Mathematics had a very low MPS of 42.35% (Philippine Education for all 2015 National Review Report). In School Years 2013-2014 and 2014-2015, NAT results in Mathematics for Southern Mindanao Region (Region XI) showed an MPS of 35.67% and 38.79% respectively making Mathematics as one of the lowest performing subjects. Furthermore, Digos City Division NAT results in Science of the same school years revealed an MPS of 36.27% and 39.24% respectively (Region XI Institutional Performance Profile SY 2014-2015). The said results nailed Digos City Division as the second lowest ranking division in the whole region for Science and Mathematics and the lowest ranking division in all five core subjects at the same time. Note that the students who took the said test were in fourth year level under the old curriculum whose approach in Mathematics was not yet spiral. The National Achievement Test results for the last five years showed that mathematics got the lowest mean percentage score compared to other subjects (NETRC Report 2014).

Time for successful remediation is more difficult and more costly, making it closely impossible to be facilitated (Aguele 2010) considering that teachers and students are also pre-scheduled to regular classes (DO No. 31, s. 2012; DepEd Memorandum No. 291, s. 2008). However, this is not the case in Digos City NHS – Igpit HS Annex since one hour each day is allotted for remedial classes.

Long before the advent of K to 12 Basic Education Program, intervention materials are highly regarded as tools for remediating poor achievements of the learners. Thereafter, Strategic Intervention Materials or SIM was introduced into the teaching methods to stimulate the activity of the students and thereby increase their level of understanding (Dy 2011). It is strategically prepared and designed for teaching remediation for low achievers in the subject. The same is given after a regular classroom instruction to students who were not able to grasp the concepts of a subject matter (Barredo 2013; and Salviejo, Aranes & Espinosa 2014).

In the past three quarters of School Year 2016-2017, the researcher had observed that remediation as part of addressing learning gaps and other deficiencies in learning produced positive effects. The one hour teaching-learning interaction in the classroom is not enough for the slow learners to grasp the concept. This raises a big concern on how students can maximize learning.

The researcher is primarily interested in identifying the least learned competencies in Mathematics and finding a way to address this problem. The goal of the study is to determine the effectiveness of the SIM as a remediation tool for the Grade 9 students so as to enhance their skills in solving problems involving quadratic functions, this being one of the least mastered competencies in Grade 9 Mathematics.

LITERATURE REVIEW

Strategic Intervention Material

Strategic Intervention Material (SIM) refers to a teaching aid introduced into the teaching methods to stimulate the activity of the students and thereby increase their level of understanding (Dy 2011). It tends to reteach the lessons which are not clear to the learners and help them gain mastery of the skills (Rodrigo 2015). SIM is designed to (a) remediate the learners especially in the least learned competencies; (b) engage the learners through interesting activities; (c) capture learners' interest by making the material pleasing to the eyes; and (d) encourage the learners to think more, do more, and learn more.

Strategic Intervention Material (SIM) is an instructional material meant to re-teach concepts and topics which are considered least learned by the students who are working below national expectations but have the potential to meet national standards if given timely support and motivation (Barredo 2013; Salviejo, Aranes & Espinosa 2014). It is a teaching-learning kit devised for the benefit of both teachers and pupils. Its goals are to encourage pupils' interest; learn Mathematics concepts and skills; and apply learned skills and concepts into real life situations. SIM is believed to be an effective strategic teaching aid for teachers in carrying out objectives on least learned lessons (Dy 2011).

At present, in the Philippine education system, intervention materials are highly regarded as tools for remediating poor achievements of the learners (Salviejo, Arnanes & Espinosa 2014). It is strategically prepared and designed for teaching remediation for low achievers in the subject. The same is given after regular classroom instruction to the students who were not able to grasp the concept of the subject matter (Banugan 2012). It consists of both learning strategies (for students) and content enhancement (for teachers). It is multifaceted approach to help students to become independent and successful learners.

Furthermore, SIM is an instructional material prescribed by the Department of Education to improve students' performance in Mathematics subjects. To promote successful learning in the field of Science and Technology subjects in both elementary and secondary among public schools, DepEd Memorandum No. 117, series of 2005, provided the teachers with training and workshop on how to prepare this intervention material. As part of promoting the wide use of the material, the Department of Education included SIM making that is open to all Math teachers as one of the contests in the yearly Mathematics fair in the school, division, region, and national level competitions.

Recent studies revealed that developing SIMs can be very adequate in content accuracy, clarity, and appropriateness in presenting the Mathematics concepts (Dedace, 2014). SIM can also be very acceptable, applicable, and useful to the potential users. Regarding the use of SIM in Mathematics IV for the fourth year students, Soriano (2012) revealed that the students easily mastered the least learned topics. Furthermore, Blalock (2010) described SIM as a competency-based academic support approach that can help students in upper elementary, middle high school, and higher education become independent and successful learner.

A study conducted by Escoreal (2012) on the SIM tool to reduce least mastered skills in Grade 4 Mathematics, reveals that SIM provides baseline information and should be implemented to avoid marginalization of pupils. Her study also indicated that there is a significant reduction in the pupil's mean number of least mastered skills after SIM implementation. Furthermore, Soberano (2010) mentioned that SIMs were effective in mastering the competency based-skills in math based on the mean gain scores in the post tests of the experimental and control groups. As per result, higher mean was observed from the experimental group after the presentation of the intervention materials. This suggested that there was significance difference between their mean scores in the post test in favor of the experimental group. Also, Barredo (2013) stressed, in her study entitled "Evaluating the Effectiveness of Using Strategic Intervention Material in Improving the Academic Performance in Science", that Strategic Intervention Materials were effective in mastering the competency based-skills in science based on the mean gain scores in the posttest of the experimental and control groups.

Based on the presented information from different sources, one way to improve student performance specifically in the least mastered skills of the subject area, is the utilization of an instructional material. The use of Strategic Intervention Material (SIM) as prescribed by the Department of Education is one of the treatments to improve students' achievements and reduce least mastered skills in Mathematics subjects. Different studies have shown that the use of SIM successfully decreased the least mastered skills in Mathematics subject; thus, poor performance is addressed.

According to Dy (2013) achievement of the students who were exposed to the Strategic Intervention Materials (SIMs) is higher and better compared to the students taught in the traditional approach. The 75 percent proficiency/performance level required in any subject area has been attained in the experimental group. There is a significant difference in the achievement of the students in the control group and experimental group. This suggests that the Strategic Intervention Materials (SIMs) be adopted as instructional materials for teaching Mathematics to facilitate and improve performance.

The criteria and areas to be considered in making Strategic Intervention Materials in Mathematics is emphasized in DepEd Memorandum No. 225 series of 2009 enclosure No. 2. The parts of the SIM are title card, guide card, activity card, enrichment card, assessment card, and reference card. SIMs guarantee alignment of activities with the tasks/objectives, keep the activities short and simple, provide a variety of activities to cater to the diverse learners;

provide number of activities so that the learner can have enough practice in developing the skill and focus on the least mastered skills.

Furthermore, the SIM topics should be competency-based specifically least mastered competencies and follow the Bloom's taxonomy guidelines. Activities must be in line with the content and skills, validated before the classroom use and are easy to copy. Materials used must improve mastery level and increase students' academic achievement.

Students' Academic Performance

Student performance has dominated current discussions on educational matters and many believe that the new curriculum is not yet absorbed in schools and consequently student performance leaves much to be desired (Mahlo & Taole 2015). They further emphasized that this has resulted in finger pointing among stakeholders. However, the fact of the matter is that something should be done to improve the current status quo. Everyone has a right to basic and further education and thus all children and youth must have the entitlement to learn but they need support. This implies that every student has the potential to learn and become a responsible citizen if given a conducive atmosphere.

In accordance with Philippine national policy, Mathematics is taught in English. However, many children from poor families have little knowledge of English and it is recommended that instruction begin "with an assumption of zero knowledge." It is within this background that the investigation of student performance in the domain of word problems form an integral part of the Philippine Mathematics curriculum (Department of Education – Bureau of Elementary Education 2003). Filipino children find word problems difficult and the language factor is identified as one of the "what-else-is-new" reasons for student failure (Philippine Executive Report on the TIMSS). It is also a well-known fact that word problems in English are more difficult for children who are still in the process of learning English than for native English speakers (Martiniello 2008).

Research Questions

The study investigated the effectiveness of Strategic Intervention Material in Mathematics as a remediation for Grade 9 students of Digos City NHS – Igpit HS Annex.

Specifically, this study sought to answer the following questions:

1. What is the academic achievement in Quadratic Function of students using the SIM and the Grade 9 Learner's Material in Mathematics as remediation tool?
2. Is there a significant difference in the academic achievement in Quadratic Functions between the students with SIM as remediation tool and of the students with Grade 9 Learner's Material in Mathematics as a remediation tool?

Theoretical Framework

The theories anchored to this study are twofold. First is what Jerome Bruner (1961) as cited by David (2017) in his Discovery Learning Theory or Inquiry Method/ Theory of Instruction that posits that learning is more meaningful to learners when they have the opportunity to discover on their own the relationships among the concepts or to actively search for a solution to a problem. This theory is an approach to instruction through which the students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies or performing experiments. Furthermore, the proponents of this theory believe that discovering learning encourages active engagement, promotes motivation, promotes autonomy, responsibility and independence, develops creativity and problem solving skills, and tailors learning experiences. The idea is that students are more likely to remember concepts they discover on their own. Bruner (1961) calls his view of learning "instrumental conceptualism." Second is David Ausubel's (1963) Meaningful Verbal Theory that asserts meaning is created through some forms of representational equivalence between language and mental context. There are two processes involved: first is reception, which is employed in meaningful verbal learning; and second is discovery, which is involved in concept formation and problem solving.

METHOD

Research Design

Randomized pretest-posttest control group design was used in this study. Two groups of subjects were used, with both groups being measured twice. The first measurement served as the pretest and the second measurement served as the posttest. Random assignment was used to form the groups.

Locale of the Study

This study was conducted in Digos City National High School – Igpit HS Annex, Igpit, Digos City, Davao del Sur, Philippines. Two sections of Grade 9 in this school were involved in this study.

Respondents of the Study

Eight students from one section were selected for remediation using the Grade 9 learner's material (control group) and another eight students from the other section for remediation using the strategic intervention material developed by the researcher (experimental group). These students from both sections were those who got lowest scores in the quarterly examination.

Research Instruments

This study used a researcher-made 20-item pretest and posttest on solving problems involving quadratic function. The questions were based from the pre-assessment of the Grade 9 based on the Mathematics 9 Learner's Material which was modified for the purpose of this study. The test was administered to the control and experimental groups before and after the topic was discussed by the teacher.

Table 1: Comparative Matrix on Using SIM and DepEd's Grade 9 Learner's Material in Mathematics as Remediation Tool in Solving Problems Involving Quadratic Functions

Factors	Experimental Group	Control Group
Teacher	Teacher-researcher	Teacher-researcher
Number of Students remediated	8	8
Subject competency	Mathematics 9	Mathematics 9
Teaching tool	SIM	Grade 9 Learner's Material

RESULTS

Academic Achievement of Students under Remediation

Table 1 shows that the pretest results of both groups under remediation are generally comparable. Based on the achievement descriptions set by the Department of Education, both the control group and the experimental group did not meet expectations. However, their respective standard deviations indicated that the pretest scores of the students in the control group were more scattered compared with that of the experimental group. The frequency and percentage of pretest scores show that before the conduct of the study, the participants in both the control group and the experimental group least mastered the concepts behind quadratic functions. Pretest results indicate the students have poor academic achievement scores. The results suggest for interventions that will aid the improvement of the students' academic achievement. It can be implied that when teachers may not incorporate effective interventions in the remediation class, students' academic achievement would be on the same level, which is low.

The results indicate that Grade 9 students under remediation struggle with their understanding; prerequisite and fundamental knowledge and/or skills have not been acquired or developed adequately to aid understanding. A similar finding in the pretest scores was revealed in a study conducted by Barredo (2013) that both groups of research subjects had the same level of mastery before an intervention was introduced to the experimental group and traditional instructional material to the control group.

Table 2: Achievement Scores of Students in Mathematics

Level of Proficiency	Range of Scores	Control Group				Experimental			
		Pretest		Posttest		Pretest		Posttest	
		f	%	f	%	f	%	f	%
Outstanding	17–20	0	0%	0	0%	0	0%	1	12.5%
Very Satisfactory	16	0	0%	0	0%	0	0%	1	12.5%
Satisfactory	14–15	0	0%	0	0%	0	0%	3	37.5%
Fairly Satisfactory	12–13	0	0%	0	0%	0	0%	2	25.0%

Did Not Meet Expectations	0–11	8	100 %	8	100 %	8	100 %	1	12.5%
$\bar{x}$		3.50		9.00		3.25		13.88	
SD		2.00		1.69		1.49		2.70	

On the other hand, the posttest results of both groups showed that the experimental group had the greater posttest mean score compared with that of the control group. Based on the achievement descriptions set by the Department of Education, the experimental group met the "satisfactory" rating while the control group still obtained a "did not meet expectations" rating. Furthermore, results presented using frequencies and percentages show that in the posttest results of the two groups, a greater number of percentages of the students in the experimental group reached at least Fairly Satisfactory rate while none of the students in the control reached the same level. All students in the control group still did not meet the prescribed expectations while only little number of students in the experimental group remained at the same level. Findings suggest that students in the control group had not increased their scores compared to the students in the experimental group who had had an increased in their scores.

Results indicate that the use of SIM in remediating solving problems involving quadratic functions increases the students' achievement significantly higher than the use of Grade 9 Math Learner's Materials. SIM influence the students under remediation in the experimental group to perform better as compared to Grade 9 Math Learner's Material. The results are in consonance with the findings of the study conducted by Lusica (2015) and Barredo (2013) that more learning has been taking place during the conduct of the study and that although there was a positive transfer of learning in the two groups, a higher mean was observed from the experimental group after the use of SIM as remediation tool.

Comparison of the Academic Achievement between Groups

Table 3 shows that there is a statistically significant difference in the academic achievement between the experimental group and the control group, in favor of the experimental group. The difference must have resulted from the use of SIM. The data show that the remediation tool obtained a p-value which is lower than the significance level of 0.05; thus, the null hypothesis which states that there is no significant difference in the academic achievement in Mathematics between the groups is rejected. The use of SIM gave a significant improvement in students' academic achievement than the use of Grade 9 Math Learner's Material.

The findings are parallel to the earlier results of the researchers conducted by Auditor & Naval (2014) who found out that the SIM is an effective instructional material for least learned competencies and also for students who are academically at risk.

Table 3: One-way ANCOVA Comparing the Results of Students' Achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	117.512	2	58.756	15.773	.000

Intercept	250.446	1	250.446	67.233	.000
Pretest	22.450	1	22.450	6.027	.029
Remediation tool	101.612	1	101.612	27.278	.000
Error	48.425	13	3.725		
Total	2259.000	16			
Corrected Total	165.938	15			

R squared = 0.708 (Adjusted R squared = 0.663)

DISCUSSION

Pretest and posttest results of both groups presented in frequency and percentage distributions and the analysis of covariance showed that Grade 9 students under remediation in the experimental group had a better achievement than those in the control group.

With this, it can be inferred that there is a concrete manifestation of the Gestalt Theory wherein students learn best when they can build on past experience, relate what they are learning to things that are relevant to them, have direct "hands-on" experience, construct their own knowledge in collaboration with other students and communicate their results effectively (Webliography-Gestalt 2007). The same is true as the researcher's findings agreed with the findings of Gultiano (2012), who found out that intervention materials contributed to better learning of the concepts among students wherein students manifested better retention of concepts learned and that students who used the SIM are more superior in applying the knowledge in problem solving exercises.

This result agrees with the findings of Soriano (2012) and Tabago (2012), who found out that intervention materials contributed to better learning of the concepts among students resulting to better academic performance.

This finding however contradicts those of Bassey (2012), who reported that students taught with the conventional instructional materials had the highest achievement. The same contradiction is also found in the findings of the study of Barlis & Fajardo III (2013) that resulted to no significant difference in the mean gain scores of students who had a traditional method of instructions and students who had been given an intervention material.

The significant differences in favor of the experimental group might have been due to the nature of the instructional materials used by the experimental group (Estacio 2008). In the theory of Gamut (2014), he explained that instructional materials which do not fit in the learning levels of the students might be useless in developing skills. Hence, it is essential that teachers must use an effective and validated instructional materials and are according to the learning levels of the students so that it can improve students' academic performance.

This implies that using SIM as remediation tool brings large effect on students' performance in mathematics. Further, these point out that those students who are exposed to this intervention material have a greater chance of increasing or improving their performance in mathematics.

The same approves the claim of Marimla & Dimalanta (2015) and Soberano (2009) in their studies using instructional materials that resulted to a significant increase in the posttest mean scores as compared from the pretest mean scores of the experimental group after employing an intervening instructional materials as remediation tool.

CONCLUSIONS

Strategic Intervention Material can help improve the academic achievement of Grade 9 students in Mathematics. Incorporating SIM to the delivery of the lessons with least mastery developed the mathematical skills in solving problems involving quadratic functions. The said intervention material assists students to develop the fundamental knowledge, skills, and understanding in Mathematics and aid them in the transfer of learning.

RECOMMENDATIONS

In the light of the foregoing findings and conclusions of the study, the following are recommended:

Department of Education officials may institutionalize the use of SIM in reinforcing difficulties of learners in learning Mathematics least learned competencies. They may formulate policies that will encourage teachers to develop SIMs for their classes to maximize teachers' potential in making more effective instructional materials which can be helpful in saving students who are academically at-risk.

Principals, head teachers and master teachers can conduct seminars and in-service trainings regarding the development of SIM that may aim to enhance and maximize teachers' potential on developing instructional materials such as SIM as well as its implementation as a remediation tool.

Mathematics teachers may develop SIMs for lessons to complete the least learned competencies in all secondary level which can be as a remediation tool.

Researchers may embark similar studies on the use of SIM in Mathematics that are highly needed to provide further evidence on the effectiveness of the SIM as a remediation tool. These studies can also be extended to investigate the use of SIM as a tool for classroom-based instruction.

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