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Struggling Learners' Mathematics Achievement Level using Quick Response Embedded Strategic Intervention Material

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Abstract

This study focused on the effect of a QR-embedded Strategic Intervention Material (QRSIM) on the achievement level of 11th Grade Students in General Mathematics via Solomon-four group research design, focusing on the least mastered competencies in solving exponential equations. A total of 120 students participated in the experiment at Dolores National High School during the school year 2019-2020. Findings revealed that; the students were unable to reach the expected level of achievement based on the pretest; the experimental and control groups with pretest performed better in the posttest assessment; no significant difference was observed between the pretest achievement level of the students; the pretest and posttest achievement levels of the experimental and control group shows a significant achievement; and that the achievement levels among the four groups significantly improved in the posttest. The findings of this study highlight the use of an innovative SIM based instruction and its counterpart in teaching frequently least mastered competencies in the subject, General Mathematics that paves the way in developing mathematical competencies among 11th grade learners. Furthermore, the researcher recommends that; assessing the learners' level of achievement prior to instruction will aid teachers in developing instructional tools and approaches suited to their scholastic needs; Mathematics teachers should be geared with appropriate knowledge on the use of 21st century teaching and learning resources such as Strategic Intervention Material to help a student who finds mathematics concepts difficult to comprehend; and that a similar study be conducted to cover other least learned competencies in the Eastern Samar division to further probe and enrich the findings of this study.

Keywords: Least Mastered Competencies, Solomon Four Group Design, Achievement Level, Pretest, Posttest

INTRODUCTION

Mathematics is considered a vital subject in the world today. The navigation towards a more technological society is made possible through inventions following mathematical paths, logic and human undertakings. However,

many students nowadays fail in completing necessary requirements and get low performances in both academics and logical reasoning skills especially in disciplines like mathematics and sciences (Salveijo, Aranes, & Espinosa, 2014). Dahar (2011) opined that mathematics education has always faced challenges as a great number of learners complained of the difficulties in the subject and that of students' laziness based on a survey retrieved from StudyPool.com, stipulating that 70% of the students do not like mathematics.

Ten years ago, the Department of Education released its National Achievement Test (NAT) passing rate of 47.40%, a decreased achievement rate was seen the next school year, with an average rate of 46.38%. The 2003 Trends in International Mathematics and Science Studies (TIMSS) assessment placed the Philippines 34th out of 38 countries in High School Mathematics. Meanwhile, the Philippines Science High School ranked lowest among 10 countries in an advanced Mathematics program evaluation (Baldomar, 2018). The DepEd Eastern Samar division posted an alarming 65.31% Mathematics MPS for the school year 2018-2019. This figure suggests that there is a gap between the instructions provided to the students and that of the learner's interest in the subject as they cannot meet the acceptable learners' mastery and competence set by the academe. This problematic scene is also true in the researchers' classrooms at Dolores National High School, where students find mathematical concepts too abstract and difficult to solve due to a lack of skills on the basic competencies required to understand higher mathematics. Apparent to the result of the midterm and final assessments conducted among Grade 11 students of all tracks, in which mean percentage scores (MPS) of 80.10% and 78.40% respectively, during the said school year showed a declining path of overall performance. Based on the item analyses conducted for school years 2016-2017 and 2017-2018, a consistent least learned competencies were reported under conceptual and applied understanding in solving exponential equations in the course, General Mathematics.

The K to 12 Enhanced Basic Education envisions Filipino learners with necessary learning experiences towards the context-based transfer of learning through a 13 year-spiral progression-based curriculum. However, studies of Antigua (2015) and Salviejo et al. (2014) stated loopholes of the said program including lack of learning facilities and unprepared learning materials to name a few. Over the years, poor performances are correlated with the poor and wrong choice of teaching materials and methods (Selçuk, Çalışkan, & Erol, 2008). This forces teachers to purchase materials out of their own pocket to sustain productivity inside the classroom (Umil, 2017).

QR Code stands for Quick Response, is usually used in giving ease to students in visiting web addresses and for some educators for checking of learners' attendance, since most classrooms use smart devices. Most instructional setting here in the Philippines and abroad applies QR code technology due to its ability to enhance self-directed learning (Walsh, 2014). The Strategic Intervention Material (SIM) is a remedial tool that aims to reteach concepts and skills to students to help them master competency-based skills which they were not able to develop during regular classroom teaching. With the release of DepEd Order No. 39 series of 2012, teachers in the country are encouraged to use Strategic Intervention Materials along with tutorials and summer camps or classes to address learning gaps that vary across students and different subject areas. This intervention requires posttest, pretest, and fun learning activities. According to Dy (2011) stimulate the increase of learners' acquisition of factual knowledge and mastery competence on certain topics. Instructional tools such as SIMs were proven effective educational involvement practices when applied to low achieving learners. The good results were evident through countless researches done both locally and abroad.

Multitudes of educators have a different viewpoint on the use of instructional tools, henceforth adhering to the concept of no two persons are the same. There had been a roaster of academicians who conducted multivariate analyses on the efficacy of remediation materials and related instructional approaches. Aggabao (2002) uncovered respondent's high regards and positive attitude towards the use of teacher developed-instructional materials as a mode of instruction in teaching Basic Mathematics. Rastogi (2003) expressed that more concept retention among the subjects was displayed using self-made instructional material and concluded that it was more effective than the traditional classroom teaching strategy. On one hand, it was revealed in the study of Arora and Singh (2005) that in as much as most of the respondents preferred Self-Learned Modules, it cannot totally replace teacher lectures and instructional textbooks. Six years after, Togonon (2011) sheds light on the understanding of SIM as a mode of instruction, as it displayed a high validity showing a significant difference in students' achievement before and after being exposed to the material. In addition, he clarified that strategic intervention material deepens students' skills in manipulation, thinking, understanding and observing. Moreover, Salviejo et al. (2014) showcased the comparison of how surface and deep learners navigated the material concluding that both the types of learners performed equally through the use of a Strategic Intervention Material (SIM). The positive result of the survey suggested that the SIM was appreciated and appealed to both the subject of the study.

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Given the aforementioned reasons and underlying concerns on learners' declining academic performance in General Mathematics and difficulty in solving exponential equations, the researchers came up with Expocamp, a QR-based Strategic Intervention Material aimed at increasing students' achievement level on General Mathematics. Furthermore, this study; (1) determined the pretest achievement levels of students in the experimental group and control group, (2) determined the posttest achievement level of students of the four groups, (3) tested the difference between the pretest achievement levels of the control and experimental group, (4) tested the difference between the pretest and posttest achievement levels of the control and experimental group, and (5) tested the difference among the posttest achievement levels of the four groups.

RESEARCH DESIGNS AND METHODS

This study employed quasi-experimental research in determining the treatment/testing effect of the teacher-devised QR-based Strategic Intervention Material (QRSIM) on the achievement level of struggling math learners at Dolores National High School. Furthermore, the researcher used Solomon four-group design to overcome the problem of pretest sensitization. Participants were assigned to either receive or not receive a pretest and then randomly assigned to either a treatment or a comparison group. A total of 120 students comprised the four groups, with 30 subjects each who were enrolled at Dolores National High School for the school year 2018-2019 as shown in Table 1 below. The experiment-subjects were pre-identified but were not excluded from their original classes. The researcher made use of a 20-item validated Pre/Posttest instrument and a QR-based Strategic Intervention Material (QRSIM) as research instruments. Two instructional approaches in measuring learners' achievement levels because of the many literature reviews that bind the relevance of SIM in enhancing the competence of the students in all disciplines. Furthermore, the achievement level based on National Achievement Test was used in interpreting the results as shown in Table 2 below, while t-test for paired samples, between independent samples and Scheffe's test, was used to analyze the treatment and testing effect of the QR-based Strategic Intervention Material (QRSIM) on the achievement level of 11th grade struggling math learners.

Table 1.

Distribution of Subjects

Equivalent Mean Scores	Descriptive Equivalent
19.20–20.00	Achieved
17.20–19.00	Closely Approaching Achievement
13.20-17.00	Moving Toward Achievement
7.00-13.00	Average Achievement
3.00-6.80	Low Achievement
1.00 - 2.80	Very Low Achievement
0.00 – 0.80	Absolutely No Achievement

Table 2.

Mastery/Achievement Descriptive Equivalence

Groups	*f*	Classes	Instructional Material Used
EG_1	30	11- HUMSS Cassiopeia	QR-SIM
EG_2	30	11- HUMSS Pandora	QR-SIM
CG_1	30	11 –HUMSS Pisces	Mathematics LM* 11
CG_2	30	11 – HUMSS Gemini	Mathematics LM* 11

*Learner's Material

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RESULTS AND DISCUSSION

Table 3.

Pretest Achievement Levels of Experimental and Control Groups

Groups	*Mean Scores*	Interpretation
EG_1	5.75	Low Achievement
CG_1	4.60	Low Achievement

Table 4.

Posttest Achievement Level of the Four Groups

Groups	*Mean Scores*	Interpretation
EG_1	16.3	Moving Towards Achievement
EG_2	15	Moving Towards Achievement
CG_1	9.85	Average Achievement
CG_2	3.1	Low Achievement

Table 5.

Difference between the Pretest Achievement Levels of the Experimental and Control Groups

Groups	SD	Computed t - value	P-value	Interpretation
EG_1	2.4	1.41	0.08*	Not Significant
CG_1	2.1			

*α = 0.05

Table 6.

Difference between the Pretest and Posttest Achievement Levels of the Experimental and Control Groups

Groups	Mean Difference	Computed t - value	P-value	Interpretation
EG_1	10.55	24.41	0.000*	Significant
CG_1	5.25	8.46	0.000*	Significant
CG_1Pretest/ CG_2Posttest	1.5	2.19	0.020*	Significant

*α = 0.05

Table 7.

Scheffe's Test Comparison of the Posttest Achievement Levels of the Four Groups

Groups	F-Value	P-Value	Interpretation
Between the four groups	133.04	0.000*	Significant
EG1 - CG1	77.01**		Significant
EG1 - EG2	3.13		Not Significant
CG1 - EG2	49.02**		Significant
CG1 – CG2	262.122**		Significant

Source: Department of Education Memorandum No. 160 Series of 2012

Pretest Achievement Levels of the Experimental and Control Groups

Table 3 presents the pretest achievement levels of the experimental and control group. The experimental group got a mean score of 5.75, while the control group obtained 4.60 mean score. These results were both interpreted as "Low Achievement" The data signify that the subjects in both groups belong to struggling learners and poorly performing in class. Overall, these results are similar to the findings of Abuda (2019) who found that both the control and experimental groups performed poorly in the pretest.

Posttest Achievement of the Four Groups

Table 4 showcases the posttest achievement levels of the four groups namely: (1) experimental group with pretest, (2) experimental group without pretest, (3) control group with pretest, and (4) control group without pretest. The table shows that both the experimental group with pretest and without pretest gained mean scores of 16.3 and 15, respectively of which are interpreted as "Moving towards achievement". On the other hand, the control group with pretest gained a mean score of 9.85 interpreted as "Average achievement" while the control group without pretest got the lowest achievement score of 3.1 interpreted as with "Low achievement". Based on the table, both the experimental group with pretest (EG1) and without pretest (EG2) acquired the highest achievement mean scores. These findings were confirmed in the study of Diaz and Dio (2017) and Lazaro (2018) who both proved that students exposed to a strategic intervention material performed better compared to a learner's textbook.

Difference between the Pretest Achievement Levels of the Experimental and Control Groups

Table 5 discloses that the experimental and control groups who were pretested prior to exposing to treatments via QRSIM got almost the same scores deviation. Since the computed P-value is higher than the level of significance, there is no ample evidence to reject the null hypothesis. Therefore, the pretest achievement levels of the experimental and control groups do not have a significant difference. This amplifies that the learning achievement of the subjects was homogenous as opined by Fajardo (2004). A similar mastery level resulted due to the pairing made by the researcher to ensure that the two groups were made equal.

Difference between the Pretest and Posttest Achievement Levels of the Experimental and Control Groups

Table 6 shows the difference between the achievement levels in the Pretest and Posttest results of the experimental group, the control group, and the pretest sensitization of the pretest of the control group (CG1) and posttest score of the control group without pretest (CG2). All the computed P-values were less than the level of significance. The results suggest, that there are significant differences between the pretest and posttest scores of the experimental group, the control group, and the pretest sensitization of the pretest of the control group (CG1) and posttest score of the control group without pretest (CG2). Furthermore, it can be gleaned from the table that the experimental group got the highest mean difference and computed t-value of 10.55 and 24.41, respectively. This clearly suggests that the use of a QR-based Strategic Intervention Material enhances the achievement level of struggling math learners in the 11th grade curriculum. It was also observed that there is a significant difference in achievement levels of students who were exposed to pretest and those who were not pretested as at-value of 2.19 with a critical P-value of 0.02 is still less than the unprecedented level of significance. Barles (2015) and Guevara (2016) both believed that the use of instructional materials can positively improve the scholastic performance of students.

Posttest Achievement Levels of the Four Groups

Table 7 presents the comparison of the posttest achievement levels of the four groups. Since the F-value of 133.04 with a computed P-value of 0.000 is less than the alpha level, it is safe to say that there is a significant difference among the posttest achievement levels of the four groups. Furthermore, the researcher looked into the differences of these groups to determine which truly shows a significant difference, using Scheffe's test. It can be observed that only the experimental groups do not significantly differ. This entails the use of a QR-based Strategic Intervention Material that improves the achievement levels of students exposed to it. This result is supported by the findings shown in Table 4 revealing that the experimental groups move towards the expected achievement level. This result however was opposite to the findings of Bruma (2016) as cited by Diaz (2017) who found out that there was no significant difference among the mean scores of the groups. Hence, using the QR-based is more effective than using the Learners' material.

Summing up, the findings of this study show that the use of a QR-based Strategic Intervention Material (QRSIM) has significantly improved the posttest mean score performance of Grade 11 Students. Also, the SIM improved students understanding of the least mastered competencies. The SIM developed by the researcher does not only provide related concepts and information about the competencies being studied but also meaningful activities that encourage students to think and concretize abstract knowledge enabling them to reflect on their learning, related to the subject. Dacumos (2016) opined that the use of SIM developed learners' dependency on their capability and less from the teacher–autonomous learning.

With regards to the use of QRSIM to improve performance, it was observed that direct instruction was on par with discovery learning since learners could easily manipulate and interpret variables through guided practice compared to asking them to conduct the given task on their own. It can be attributed to the deductive nature of the subject as it requires both mastery and memorization. Vanlehn (2007) remarked that explicit training in solving problems is found out to be successful when there is assistance provided to the students. In addition to that, Sweller (2010) wrapped up that the superior effectiveness of direct instruction is supported by empirical findings and cognitive theories most especially when dealing with concept development.

This study revealed that the QRSIM can be used in a self-paced manner which is highly suggested by the Department of Education specially designed to assist learners in improving their performance and understanding in the least mastered topic in the subject even with minimal intervention coming from the teacher and that there is a need for SIM developers to integrate simulation activities that would help students improve their performance on the least learned competencies. On an overall scale, the Strategic Intervention Material can be utilized in improving learners' achievement level and understanding of the least mastered competencies in Grade 11 General Mathematics class.

CONCLUSIONS

Based on the results of the study, the following conclusions were drawn: The pretest achievement levels prior to exposing the learners to a QR-based Strategic Intervention Material ((QRSIM)) heightened the academic struggles of the students as they were unable to reach the expected level of achievement; the experimental and control groups with pretest performed better in the posttest assessment, while the control group without pretest shown the least achievement; no significant difference was observed between the pretest achievement level of the students; the pretest and posttest achievement levels of the experimental and control groups show a significant achievement; the achievement levels among the groups significantly improved in the posttest, of which no significant difference between the posttests of the experimental with and without pretest groups. Hence, the instructional material was more effective in heightening the achievement level of students compared to exposing them to the DepEd prescribed and provided learners' material.

From the conclusions, the following are recommended; that assessing the learners' level of achievement prior to instruction will aid teachers in developing instructional tools and approaches suited to their scholastic needs; Mathematics teachers should be geared with appropriate knowledge on the use of 21st century teaching and learning resources such as Strategic Intervention Material to help a student who finds mathematics concepts difficult to comprehend; and that a similar study be conducted to cover other least learned competencies in the Eastern Samar division to further probe and enrich the findings of this study.

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