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Integrating MALMATH and DESMOS in Conversational Strategic Intervention Material (CSIM) to Enhance Students' Achievement in Mathematics

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Abstract: ***This study determined the efficacy of integrating MALMATH and DESMOS in Conversational Strategic Intervention Material (CSIM) on students' achievement of Grade 9 students of Pedro "Oloy" N. Roa Sr. High School, Cagayan de Oro City. It employed a combination of pre-test posttest quasi-experimental control group and qualitative research design using a 17-item teacher made test to assess students achievement and retention in mathematics and structured interview questionnaire to determine their perception in using CSIM. Three (3) intact Grade 9 classes were randomly assigned as the control group and the other two as experimental groups. The data collected was analyzed analysis of covariance (ANCOVA). Results of the analysis revealed that students who were exposed to CSIM with MALMATH and DESMOS have significantly higher achievement as compared to students who were exposed to conventional teaching method. Hence, the researcher concludes that CSIM with MALMATH and DESMOS integration is effective in improving students' achievement. The researcher then recommended that mathematics teachers may adopt Conversational Strategic Intervention Materials (CSIM) teaching method in their K to 12 mathematics classes and may use this method as a basis for future studies for more insights on instruction that use CSIM with technology integration.***

Keywords: Conversational Strategic Intervention Material (CSIM), Achievement, DESMOS, MALMATH

1. Introduction

Stimulating the interest of today's learners is the most challenging task of being a teacher, most especially in mathematics, which is perceived by many as the most thought-provoking course. However, teachers tend to innovate instructional materials that can capture the interests and engage the students. Choosing the appropriate instructional material is very crucial in preparing the lesson because it plays a very important role in the teaching-learning process. Adebanjo (2007) affirmed that the use of instructional materials in teaching and learning of Mathematics makes students to learn more and retain better what they have been taught and that it also promotes and sustains students' interest. It also allows the learners to discover themselves and their abilities. Availability and adequacy of a wide variety of instructional resources can stimulate the interest and actively engage learners with learning disabilities in mathematics (Herward, 2009). The use of instructional strategies and techniques to integrate the learning of subject matter is essential in helping the students to think and learn. Instructional techniques are important, but the use of instructional materials also influences students' achievement, use of process skills and other outcomes. Instructional materials offer a tangible means through which the intents of curriculum are experienced.

In the lives of today's learners, digital media and connectedness are integral part of it. It is often claimed that these learners are millennial or digital natives, who have different expectations about education. It has been observed that students' interests are into the use of technology. Their curiosity drives them to explore these technologies and even give ample time engaging with it. Considering their interests, the teacher makes use of technology when appropriate in delivering her lessons. Since most students have their own cellphones, the teacher utilizes the use of it by integrating some android application in selected lessons. The choice of applications depends upon the support it can provide to the students in understanding the lessons. Through this, the students can have an idea on the educational purpose of cellphones. In fact, there are plenty of free downloadable applications that works offline that can be used in teaching and learning process and among those are MALMATH and DESMOS. These applications are timely for the lessons on quadratic functions and variations in the second quarter of Mathematics 9. It is envisioned that as many people using mobile technologies as there are opinions on how mobile technologies will impact on education.

In a public school like Pedro "Oloy" N. Roa Sr. High School that caters students whom majority came from the marginalized families, who were victims of flood, fire and other calamities, residing in relocation sites, it might be of help to create an instructional material that they can review at home and made them think that learning mathematics is not as boring as they have thought. Since few of the learners were working students, the Conversational Strategic Intervention Material (CSIM) might helped them to cope up the lessons they have missed.

Thus, this study was set to collaborate the inclination of students in the use of mobile phones and their comfort to use their own language in learning mathematics into an instructional material that will capture their interests. This study was designed to determine the effectiveness of CSIM as a medium of instruction, to help improve retention and to alleviate students' mathematics achievement.

2. Review of Related Studies

2.1 Strategic Intervention Materials (SIM)

Strategic Intervention Materials, popularly known as SIM in Philippine Education (Bunagan, 2012) is an instructional material meant to reteach concepts or topics which are considered least mastered by the students. It is composed of six parts: Title Card, Guide Card, Activity Card, Assessment Card, Enrichment Card and Reference Card. It is a material given to students to aid in mastering the competency-based skills which they were not able to develop in regular classroom instructions. SIM is a multifaceted approach to aid the students, especially those who are non-performing to become independent and successful learners.

Instructional materials are learning tools that helps the learners to learn faster and better. According to Dahar (2011), the use of appropriate instructional materials has a strong relationship to the academic performance of secondary students. Barlis (2015) added that instructional materials play a vital role in improving students' mathematics achievement. Togonon (2011) explained that SIM is a type of instructional material that develops students' skills in manipulation, thinking, understanding and observing. He also added that it is a user-friendly instructional material that can be utilized inside the four corners of the classroom or it can be given as a take home activity of students. It can be answered solely by a student or by a group of students through cooperative learning. A recommendation to use SIM not only for remediation but in teaching large classes as well was given by the Department of Science and Technology (DOST). The Department of Education (DepEd) also suggests the utilization of SIM in enhancing the academic achievement of students who are performing low in Science and Technology including Mathematics.

SIM has been known to improve the performance level of students in various schools and learning areas. Gultiano (2012) stated that the SIM are effective in mastering the competency-based skills and concluded that intervention materials contributed to better learning of concepts among students. Diaz and Dio (2016) revealed that when students are exposed to Tri-in-1 SIM, their Mathematics achievements are better and higher. IMs that are tailored based on the actual students' aptitude could be more effective than the materials that are designed for the national level. Lagata (2008) concluded that SIM is an effective instructional tool in solving word problems. Doctama (2012) confirmed that there was a definite transfer of knowledge in simplifying rational algebraic expressions using her SIM. Gatdula (2015) developed and validated a SIM on rational algebraic expressions. Her study attested that the SIM is effective in improving the performance of students at Castillejos National High School, San Roque Castillejos Zambales.

This study is similar to the studies of Gatdula (2015), Dahar (2011) and Barlis (2015), respectively, that test the effectiveness of SIM in improving the performance of students. In this study, SIM was called CSIM because it did not only serve as an instructional material but also as a medium of instruction.

2.2. Technology Integration

The world today is inundated with data that communicate important mathematical ideas in a variety of representational forms. Technological advances have given rise to nontraditional, multi-dimensional graphical representations that could not be displayed on a two dimensional sheet of paper (Angotti, 2017).

According to the National Council of Teachers of Mathematics (NCTM, 2008), technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that all their students have access to technology. Effective teachers maximize the potential of technology to develop students‟ understanding, stimulate their interest, and increase their proficiency in mathematics. When technology is used strategically, it can provide access to mathematics for all students.

Findings from a number of studies have shown that the strategic use of technological tools can support both the learning of mathematical procedures and skills as well as the development of advanced mathematical proficiencies, such as problem solving, reasoning, and justifying (Gadanidis & Geiger,; Pierce & Stacey, 2010). Watson (2015) stated that the integration of technology into secondary education mathematics classes has been shown to increase student motivation and performance. Gaskell & Mills (2010) concluded that there is much evidence that mobile technologies are playing an increasing role in education and the use of mobile technologies is increasing in the developed world in a number of areas, for instance in context related education, and how handheld devices can be used for basic language, skills, numeracy and health and safety training and some aspects of teaching and learning across the developing and developed world. The use of handheld technologies provides a major opportunity to enhance access to learning and will enable many institutions to develop learner and administrative support and learning opportunities in ways which will build on current methods.

Mobile learning in the form of mobile applications shows promise for enabling student learning across a variety of contexts, including science education. Previously published work suggests that technology such as mobile phones, Personal Digital Assistant (PDAs), tablets, and other electronic tools can successfully be utilized both inside and outside the classroom to achieve a variety of learning outcomes, while allowing users to benefit from the flexibility and individualized learning experience that it provides (Teri, Acai, Griffith, Mahmound, Ma, Newton, 2013). In their study, they concluded that the use of mobile applications in education and in science education has been shown to be: 1) effective in enhancing students' learning experience; 2) relevant and important as an emergent method of learning given modern pressures facing higher education; and, 3) met with positive student attitudes and perceptions in terms of adopting and using such technology for educational purposes. However, continuing to enhance the knowledge base surrounding the use of mobile applications to facilitate learning in science is important both in the advancement of science education and the enhancement of student learning in a modern context.

Thomas (2015) asserted that DESMOS addresses many of the shortcomings of handheld graphing calculators. This online graphing utility is free, runs in a web browser with no additional downloads or installation required, and can be used as an application on many smartphones and tablets. Many of the features of DESMOS are very intuitive; for example, zooming can be accomplished by mouse scrolling on a computer, or by the familiar pinch-zoom method on a tablet or smartphone. Intuitive design choices such as this make using DESMOS more relatable for students, in turn greatly reducing the "learning to use technology" component of instruction and allowing for greater focus on developing skills, strategies, and mathematical concepts. Orr (2017) states that the DESMOS calculator has been a game-changer for student understanding of relationships between graphs and algebraic representations of functions. It allows students to explore these function transformation. Beigie (2014) argues that these features provide "immediate visual feedback that is ideal for informal experimentation". Recent updates allow users to perform regression on a table of data and import an image into Desmos, then overlay a curve to match the real-world phenomenon depicted (Ebert, 2014). Ultimately, Desmos is a powerful tool for calculation that has intuitive design features, is free to use and highly accessible, and "gets out of the way" of the mathematics. For these reasons, it could represent a significant improvement over handheld graphing calculators as a tool for teaching and learning mathematics.

The related studies mentioned above is similar to the present study because it made use of DESMOS as a tool for teaching and learning mathematics. It addressed the shortcomings and availability of handheld graphing calculators.

3. Methodology

3.1 Design, Setting and Participants of the Study

This study used a quasi-experimental Pre-test-Posttest Control Group design. This study was conducted at Pedro "Oloy" N. Roa Sr. High School where majority of the students came from the marginalized families of the nearby relocation sites. Two (2) out of Grade 9 sections were considered as the participants of the study. One section was randomly assigned as the control group and the other one as the experimental group. The experimental group was taught using CSIM with MALMATH and DESMOS integration.

3.2 Statistical Treatment

The achievement of the students in both the control and experimental group was described using mean and standard deviation. The significant effect of the treatment was determined using the one-way of Analysis of Covariance (ANCOVA) through the 17 item multiple choice test.

4. Results and Discussions

Table 1: Mean and Standard Deviation of Students' Achievement Scores

	Control Group (n=41)		Experimental Group (n=41)	
	Pretest	Posttest	Pretest	Posttest
Mean	4.46	4.95	4.29	6.37
SD	1.93	1.88	1.47	1.66
Verbal Description	D	D	D	D

Perfect score: 17

Legend: 15-17--Advanced (A)
11-14--Proficient (P)
7-10---Approaching Proficiency (AP)
4-6---Developing (D)
3 and below--Beginning (B)

Table 1 above presents almost the same pretest mean scores of both groups before the start of the experiment. This indicates that both groups had a little knowledge about the lessons. At the end of the treatment, there was an evident increase in their posttest mean scores. The control group had an increase of 0.49 while the experimental group had an increase of 2.08, a greater increase in mean compared to the group that was taught using the conventional method of teaching. The exposure of students in CSIM led them to score better in the posttest. It has been shown that both groups were in the developing level in the pretest and posttest.

As to variability, it shows that the control group had a more dispersed scores of 1.93 than the 1.47 of the experimental group in the pretest. The difference indicates that the experimental group scores were closer to each other than that of the control group. Moreover, the standard deviation of the scores of the experimental group in the posttest is 1.66 while that of the control group is 1.88. This implies that after the treatment, the scores of the students in the control group were still more dispersed compared to that of the experimental group. This means that the adaptation of students in using CSIM varied from learner to learner. There are those who got high scores while the others remain low.

Table 2: One-way ANCOVA Summary for Students' Achievement Scores (Control Group and Experimental Group)

Source	Adj. SS	DF	Mean Square	F	p-value
Treatment within	40.659	1	40.66	12.89	.001*
Error	249.271	79	3.16		
Total	289.930	80			

**Significant at .05 level*

Table 2 shows the result of the analysis of covariance on students' pretest and posttest scores in the control group and the experimental group. It can be observed that the analysis yields an F- value of 12.89 and a probability value of 0.001 which is less than the critical value of 0.05 level of significance. This led to the rejection of the null hypothesis.

This implies that there is a significant difference in the students' performance in favor of the experimental group. This indicates that students who were exposed to CSIM with technology integration do better that those who were exposed to the conventional method of teaching. Thus, in this study, it was found that students who used CSIM have a greater achievement in their posttest scores because they could easily remember the concepts they have learned through the self-engaging CSIM. The result concurred to the studies of Togonon (2011), Gultiano (2012), Lagata (2008), Gatdula (2015) that the SIM improved the performance level of the students.

5. Conclusions and Recommendations

The researchers concluded that Conversational Strategic Intervention Materials (CSIM) is an effective strategy in teaching mathematics to improve students' achievement and to enhance retention and the students who were exposed to CSIM performed better than those who were exposed to the conventional method of teaching. Based on the findings and conclusions of the study, the researcher recommended that teachers may adopt Conversational Strategic Intervention Materials (CSIM) teaching method in their K to 12 mathematics classes, teachers and researchers may use this method as a basis for future studies for more insights on instruction that use CSIM with technology integration and school administrators may include a seminar-workshop on creating CSIM and using it as a teaching strategy during in-service trainings. Similar studies may be conducted to wider scope using different population in different institutions for better generalization.

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