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Integration of Technology - Aided Instruction in Teaching Mathematics for Grade 10 Students

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Abstract

This study was conducted to evaluate if there is a significant contribution of technology aided instruction to the performance of the students in topic circle.

The score of the students came from five secondary schools in Bongao, Tawi-Tawi under Deped-ARMM, on the researcher-made test served as the performance of the students and were analyzed. The researcher-made test was validated by the experts and item analyzed using Rasch Model. ANOVA and t-Test were employed as statistical treatment of the data.

This study found that there is a significant difference on the performance of students between technology- aided instruction and traditional methods. Apparently, the technology-aided instruction was better than traditional teaching in terms of increasing academic achievement of Grade 10 students; it can be that technology such as power point presentation can enhance student's learning, prolong their attention span, and memory retention. These conform to the findings of Clark[6], Apperson *et. al.*[1], Pearson *et. al.*[20], and Sazabo and Hasting[27];

Moreover, out of five high schools only BSTHS did not have enough learning in mathematics particularly on the concept of circle.

Key words: Technology-aided instruction, performance in mathematics, and circle

Mathematics Subject Classification (2000) MSC: 97D10, 97D40, 97C40

Introduction

The importance of integrating technology into Mathematics teaching pedagogy has long been established. But the helpfulness and competence of that integration is the more pertinent question.

Coherently, underachievement in mathematics is a continuing issue in schools across Bongao, Tawi-Tawi. Part of the reason for this problem may be poor attitudes towards mathematics and poor teaching strategies in mathematics. In order to begin the remedy of this problem of poor mathematics motivation and achievement, secondary teachers need to be aware and implement the best teaching-learning process of the students. According to Moore[18], integrating technology into mathematics instruction is one of the remedies. In a qualitative study by Clark[6], out of the 46 students surveyed, 89.13% indicated they believed PowerPoint enhanced their learning when it is use as a tool in lecture because of the visual stimuli provided in a PowerPoint presentation helped to gain and maintain the attention of the students.

Along the challenge of K-12 curriculum and problem cites earlier, the researcher had come up with the rationale of this study to address these problems. And this is to integrate the technology - aided instruction in teaching Mathematics to address the constraints of both parties, the teachers and the learners. On the teacher's side, this design of power point presentation may lessen the load of the teacher's preparations for lectures. Furthermore, it addresses the teacher's problem of classroom management. On the student's side, the attention and interest will rise due to its realistic examples, impact of the images and entertaining visual presentation that the power point could serve.

This study may also be beneficial to curriculum making-bodies of colleges and universities offering Education courses. They may integrate Basic Computer subjects to gradually minimize and ultimately eliminate traditional lectures for the education students to be ready to teach using technology such as power point presentation.

This study aimed to establish integration of technology-aided instruction in teaching Mathematics for Grade 10 students in five secondary schools in Bongao, Tawi-Tawi.

Specifically it tried to answer the following questions: First, what is the performance of the concerned Grade 10 students of Tawi-Tawi School of Arts and Trades, Tawi-Tawi School of Fisheries, Pagasinan National High School, Sanga-Sanga National High School and Bolobok Science and Technology High School in geometry, particularly on circle? Second, is there a significant difference between the performance of students using technology-aided instruction and the performance of students using traditional instruction? And lastly, is there a significant difference in the performance of the students in geometry by school?

The following diagram shows that the performance of the students in geometry is related to the two independent variables which are the technology-aided instruction and traditional method which are both demonstrated in teaching Mathematics by the researcher. The output of the two independent variables would be the performance in Geometry of the respondents selected in this study.

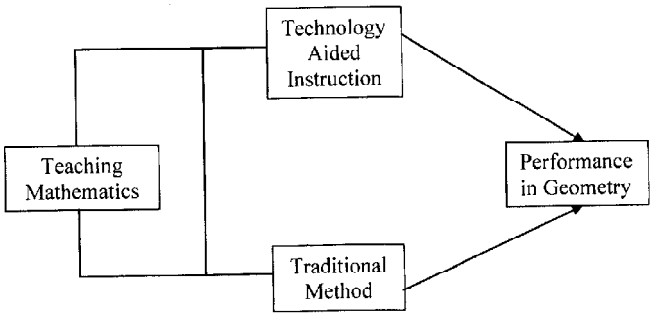

Figure 1. Conceptual Framework of the Study

Literature Review :

Since the use of computers is one of the appropriate tools, the researcher enthusiastically include some findings of the related literature of integration of technology-aided instruction in teaching Mathematics to support the effectiveness of technology use in the subject of Mathematics. And these are the findings:

Based on the study of Bochniak[3], data analysis using one-way analysis of variance revealed that computer aided instruction—specifically, Fluency and Automaticity through Systematic Teaching and Technology (FASTT) Math—was more effective than the other classroom's mathematics instruction in developing multiplication fluency.

According to Moore[18] alternative strategy to improve student achievement and motivation in Mathematics is integrating technology into Mathematics instruction. He quoted the findings of Gargiulo and Metcalf (2010) and Cavanagh (2007). First, suggests that many students experience anxiety with Mathematics which blocks initial learning and makes transfer of skills difficult and the latter, stress that this emotional response hinders working memory and subsequently the ability to recall basic facts. Integrating technology into a Mathematics classroom will increase the transfer of skills, lower anxiety, promote automaticity of basic math computational skills, and will help develop higher order Mathematical skills.

Moreover, the research of Main and Rourke[16] demonstrates the effectiveness of technology in a twenty-first century Mathematics class. Technology can serve a number of roles in increasing knowledge of basic skills in Mathematics. For example, the use of calculators can increase a student's ability to problem solving.

Bowes[4] explores technology's place in the Mathematics Curriculum. He states that technology supports achievement, enabling learners to be independent, competent and creative thinkers, as well as effective communicators and problem solvers.

In support of the statement of Bowes[4], Hudson *et. al.*[12] conduct a study using power points, web-based games, the internet, projectors, Smart boards, Elmos, calculators, videos, DVDs, and music as tools for instruction and targeted students in the fourth, fifth, sixth, and ninth grades. Their post intervention test scores indicated a noticeable increase in student mastery of basic mathematics. More students earned scores of 70% or higher when compared to the pre-assessment scores. This study really demonstrates that technology improves achievement, enabling learners to be independent problem solvers, competent and creative thinkers, as well as effective communicators.

Interactive white boards are one of the most common pieces of technology found in a classroom today. Developed and introduced by SMART in 1991, the interactive whiteboard is connected to an LCD projector and computer, and provides touch control of computer applications. Marr[17] found out interactive white board creates a connection between the user and the application that personalizes the learning experience.

There is abundance of research and evidence that supports the effectiveness of integrating technology into a mathematics classroom to increase student achievement and it is apparent that technology should be utilized by mathematics teachers at all academic levels.

Back to the researcher's general objective on integrating technology-aided instruction in teaching Mathematics for Grade 10, the researcher used the power point presentation as a tool in achieving the goal. Here are some related studies for power point presentation as a tool for integration of technology in teaching Mathematics.

Research suggests that purposeful and well-designed use of presentation software can enhance student learning since it can allow teachers to vary their method of delivery and appeal to students with a variety of learning styles. In a qualitative study, Clark[6] surveyed 46 college students to explore the impact of the use of PowerPoint in lectures and found that students preferred PowerPoint when used as a tool in the lecture.

Of the students surveyed, 89.13% indicated they believed PowerPoint enhanced their learning.

The study of Pearson *et al*.[20] indicates that knowledge retention of material by students was greater with the use of presentation software than in traditional lecture classes. Additionally, 94% of the students reported they enjoyed the course and two-thirds reported they learned more when PowerPoint was used. Szabo and Hastings[27] reported that presentation software would increase students' grades, improve class attendance, and reduce some disruptive behaviours during lectures. Furthermore, they concluded that PowerPoint lectures might benefit memory retention better than traditional lectures and there were no significant differences in grades but students believed PowerPoint facilitated their learning.

Apperson, Laws, and Scepansky (2006) investigate the benefits and effectiveness of instructional technology and they surmised that using PowerPoint made for a better class experience for students from their point of view.

While student engagement is increased with focus, instructors should be sure to design presentation software slides in a manner that allows them to communicate concepts and engage students in the material being taught[6,26]. Students need to realize they cannot understand mathematics by observation alone; therefore, how the slides are designed and how much information they contain is critical when incorporating them into the lecture[26]. Mathematical content and pedagogy should not be compromised.

According to Fieldkamp[7], the most beneficial aspect in having teacher lessons on PowerPoint is sending electronic copies home for student use. He believed that the number one reason why student grades improved during the course his study. Although creating the lessons are very time committing, he believed that they are a critical resource in student learning. He found his initial hypothesis, that the use of PowerPoint lesson would help students learn, to be correct. From personal documentation, student and teacher surveys, and student grades, there is clear evidence that these tools are beneficial in the high school mathematics classroom. His thesis demonstrates what resources a school should begin using today, and be prepared to utilize heading into the 21st century.

The concern of this study is to address the underachievement of students of this generation. The computer generation of today is offering the wide-range way of ease to every transaction. Acquiring accessibility to research and learn more innovations, the computer-based tools are the appropriate solution in the problem. Hence the researcher aimed to study the impact of integration of technology-aided instruction in teaching Mathematics to provide solutions for those underachiever and advancement for those students who are fast learners.

Research Methodology :

The researcher used a descriptive quantitative method of research as it evaluated the performance of students on geometry and analyzed the scores of the students obtained from the test administered by the researcher would serve as basis of their performance.

This research was conducted in five (5) public secondary schools under DepED-ARMM in Bongao, namely: Tawi-Tawi School of Arts and Trade (TTSAT), Tawi-Tawi School of Fisheries (TTSOF), which are both located at downtown Bongao, Pag-asinan National High School (PNHS), Bolobok Science and Technology High School (BSTHS) which are located at Sanga-Sanga Island; and the Sanga-Sanga National High School (SSNHS) which is found in Barangay Pahut.

The respondents of this study were the 182 students of Grade 10 Section A of the above mentioned secondary schools in Bongao who are officially enrolled during school year 2015-2016. They were purposely selected because these schools are operated under DepEd Division of Tawi-Tawi, applying the core curriculum in Mathematics for Grade 10 students. Standard lesson planning is common among these five schools.

Permission from the school Principals and mathematics teachers was sought by the researcher to

lecture to the target students. The researcher conducted a series of lectures to the students on the field of geometry specifically on the topic circle consisting of the subtopics diameter, circumference and area of the circle. The students were assigned into two groups randomly. The traditional group was taught using the traditional way (chalk-and-board method) and the other group, which is the experimental group, was taught using the computer-aided instruction; both groups had the same topic which is circle. The two groups of students were taught separately by the researcher at separate room and time. In a day, one hour was spent on the traditional teaching and another one hour was spent on the technology-aided instruction (based on the required hours of the curriculum). The lecture lasted for two weeks. At the end of the lecture, the researcher administered the test to the respondents. The test was answered by the two groups of Grade 10 students with strict supervision.

The tool used to gather data in this experiment was a researcher-made test. It is constructed based on the coverage of the lecture. The questions involved the computation of diameter, circumference and the area of the circle. Initially, the test consisted of 60 items. This was made by the researcher with the close supervision of the adviser. It was validated by a panel of experts from the College of Science and Mathematics of Mindanao State University-Tawi-Tawi College of Technology and Oceanography, Sanga-Sanga Bongao, Tawi-Tawi. For the reliability of the test Rasch Model was used.

The scores obtained by the students serve as data of this study were tabulated, organized, and analyzed using R statistical software. t-Test was used to determine any significant difference between students exposed to traditional teaching and students exposed to computer-aided teaching. To determine the significant difference of the performance of students by school, the Analysis of Variance was employed.

The following table gives the guide in interpreting the mean score of the performance of the students in circle.

Table 1. Hypothetical mean ranges

Scale Range	Remark
48 - 60.00	Outstanding
36 - 47.99	Very Satisfactory
24 - 35.99	Average
12 - 23.99	Below average
0 - 11.99	Poor

Result and Discussion

The analysis of test items was carried out using the responses from 182 students from the five secondary schools used as research locale. To judge the acceptability of the items, the residual-based fit statistics were used. The Infit Weighted Mean Square (IWMS) and t-statistics (t) were particularly employed to indicate whether or not an item conforms to the Rasch Model. As a test, a range of 0.80 to 1.20 [15] for IWMS and -2.0 to 2.0 for t [28] were used to indicate acceptable item fit.

The results of item analysis using the Rasch Model indicated that all the 60 items of the researcher-made test on Circle with subtopics on diameter, circumference and area of a circle were acceptable. Initially, the analysis for the overall 60-item test was carried out and the results were all in the acceptable level. Then, analysis for every subtopic on circle was performed and similarly the results were all acceptable[2,9,10]. The reliability index based on the Rasch model was 0.964, which indicated that the test was very reliable.

At the end of couple of weeks lecture on each secondary school, the researcher administered an examination to the students to evaluate how far they learned on the discussed lecture. Presented in Table 2 are the levels of performance in geometry of the students in the five high schools concerned.

Table 2. Mean Distribution of the Performance in Geometry of Five Secondary Schools

School	Technology-Aided Instruction		Traditional Teaching		Overall	
	Mean	Interpretation	Mean	Interpretation	Mean	Interpretation
TTSF	28.45	Average	22.52	Below average	25.56	Average
TTSAT	28.36	Average	23.64	Below average	26.00	Average
PNHS	25.96	Average	22.18	Below average	24.11	Average
BSTHS	19.15	Below average	17.61	Below average	18.38	Below Average
SSNHS	26.30	Average	17.64	Below average	21.76	Below Average
Overall	26.28	Average	21.47	Below average	23.89	Below Average

Legend: TTSF- Tawi-Tawi School of Fisheries
TTSAT- Tawi-Tawi School of Arts and Trades
PNHS - Pagasinan National High School
BSTHS – Bolobok Science and Technology High School
SSNHS – Sanga-Sanga National High School

Table 2 shows that students exposed to technology-aided instruction got better mean score than the students taught using the traditional method. All schools were marked average except for Bolobok Science and Technology High School (BSTHS) under technology-aided instruction method. The Tawi-Tawi School of Arts and Trades (TTSAT) performed best in geometry using traditional instruction and for overall performance among the secondary schools under this study. Bolobok Science and Technology High School (BSTHS) performed lowest in all aspects.

The main interest of this study was to determine if the performance in geometry of the students improved using the intervention of technology in teaching mathematics. The scores of the students were treated statistically to find out if there was a significant difference between students exposed to technology-aided instruction and students exposed thru traditional instruction.

The succeeding table shows the t-Test results comparison of the two teaching methodologies in the five different secondary schools. The results revealed that there were three schools where the performance of the students on geometry differed significantly. The Tawi-Tawi School of Fisheries (TTSF) has the t-Test value of 2.5 with a p-value of 0.017, Tawi-Tawi School of Arts and Trades (TTSAT) obtained t-Test value 2.95 with p-value 0.005, and Sanga-Sanga National High School (SSNHS) gained a t-Test value 2.17 with corresponding p-value 0.047. The p-values of these three high schools are less than 0.05 and they are considered as

Table 3. t-Test Results in Testing the Significant Difference Between Technology-Aided Instruction and Traditional Instruction

School	Mean Differences	t-Test	p-value	Remark
TTSF	5.93	2.5	0.017	Significant
TTSAT	4.72	2.95	0.005	Significant
PNHS	3.77	1.81	0.079	Not significant
BSTHS	1.54	0.948	0.353	Not significant
SSNHS	8.66	2.17	0.047	Significant
Overall	4.81	4.56	0.000	Significant

significant. On the other hand, Pagasinan National High School (PNHS) and Bolobok Science and Technology

High School (BSTHS) exhibit insignificant differe nce on the two teaching methodologies. Considering the overall learning of the students coming from the five high schools, there is a significant difference between student expose to technology-aided instruction and students exposed to traditional teaching.

As stated in the statement of the problems, the researcher wanted to investigate if the performance of the students on geometry differed by school. The following table shows the summarized ANOVA results in testing the significant difference by school.

Table 4. ANOVA Results in Testing the Significant Difference by School

Group	F-Test	p-value	Remark
Technology-Aided Instruction	3.597	0.009	Significant
Traditional Method	44.02	0.005	Significant
Overall	5.93	0.000	Significant

The analysis exhibit that the technology-aided instruction group had a F-test value 3.597 with p-value 0.009. This implies that there is a significant difference. On the traditional method group, the F-test 44.02 exhibits a highly significant p-value. This means that the performance on geometry differed significantly by school as the students learned thru traditional instruction.

The results in Table 5 show that in Technology aided instruction group of Bolobok Science and Technology High School (BSTHS) differs significantly from that of Tawi-Tawi School of Fisheries (TTSF) and Tawi-Tawi School of Arts and Trades (TTSAT). On the traditional method group, Tawi-Tawi School of Arts and Trades (TTSAT) differs significantly from Bolobok Science and Technology High School (BSTHS) and Sanga-Sanga National High School (SSNHS). Taking the overall performance on geometry, BSTHS differs significantly from the three schools, namely: TTSF, TTSAT, and PNHS.

Table 5. Tukey Multiple Comparison Test Results

Comparison	Technology Aided		Traditional methods		Overall	
	p-value	Remark	p-value	Remark	p-value	Remark
TTSF and TTSAT	1.0	NS	0.962	NS	0.998	NS
TTSF and PNHS	0.82	NS	1.00	NS	0.88	NS
TTSF and BSTHS	0.009	S	0.106	NS	0.001	S
TTSF and SSNHS	0.95	NS	0.143	NS	0.279	NS
TTSAT and PNHS	0.823	NS	0.901	NS	0.705	NS
TTSAT and BSTHS	0.007	S	0.019	S	0.000	S
TTSAT and SSNHS	0.955	NS	0.032	S	0.161	NS
PNHS and BSTHS	0.097	NS	0.147	NS	0.013	S
PNHS and SSNHS	1.00	NS	0.193	NS	0.731	NS
BSTHSand SSNHS	0.197	NS	1.00	NS	0.50	NS

Legend : NS=Not significant
S= Significant

In summary, Bolobok Science and Technology High School (BSTHS) consistently low mean scores in the two methods of teaching and the overall.

Conclusion

In totality, the overall performance in geometry of the five high schools under study was below

average. The Tawi-Tawi School of Arts and Trades ranked first but only an average performance. The experimental group had a mean of 28. 45, average performance, while the control group had the overall mean score of 23.89, below average. The highest mean score in the experimental group is TTSF, with 28.45, average. And the highest mean score the control group is TTSAT with 23.64, below average. In consonance, Bolobok Science and Technology High School (BSTHS) consistently had low mean scores in the two methods of teaching and the overall. It had the lowest performance level of all the five high schools tested.

Meanwhile, in testing the significant difference between technology-aided instruction and traditional teaching, the t-Test shows a significant difference in overall. Further, TTSF, TTSAT and Sanga-Sanga had a significant difference but for Pagasinan and Boloboc there was no significant difference. Moreover, the performance in geometry of students are same in TTSAT, TTSF and Pag-asinan while Bolobok Science and Technology High School students had similar performance in geometry with Sanga-Sanga National High School. Technology-aided instruction was better than traditional teaching in terms of increasing academic achievement of Grade 10 students; it can be that technology such as power point presentation can enhance student's learning, prolong their attention span, and memory retention. These conform to the findings of Clark[6], Apperson *et. al.*[1], Pearson *et. al.*[20], and Sazabo and Hasting[27];

In addition, the ANOVA result in testing the significant difference by school was found out that overall, technology-aided instruction shows a significant difference. Grade 10 students of TTSF, TTSAT and PNHS had better learning than those of BSTHS while others under similar comparison had more or less than the same level of learning on the concept of circle. These differences can be attributed to the location and exposure of the students. Schools located within the town of Bongao such as TTSF, TTSAT, and PNHS had better access to services such as electricity, transportation facilities, and infrastructures. These schools have always been accessible to improvement projects, materials such as books, and facilities such as library and computers. Schools located in the far-flung area such as BSTHS and SSNHS are not lucky. Moreover, BSTHS is a newly built school and SSNHS had been transferred more than once since its establishment. Thus, their students had less advanced amenities.

Coherently, grade 10 students of TTSF, TTSAT, PNHS, and SSNHS had sufficient learning in mathematics, particularly on the concept of circle. Perhaps these students were adequately taught and were exposed to technology-aided instruction in mathematics;

Lastly, grade 10 students of BSTHS did not have enough learning in mathematics, particularly on the concept of circle. Possibly, these students were not adequately taught and were exposed to traditional teaching in mathematics; it could be that these students were not properly and fully motivated, and had poor study habits in mathematics; and

From the above output of this study here are some remedies in order to meet the standard quality of learning. Students should be taught adequately by all means. Study habits of the students should be improved. Use technology-aided instruction instead of traditional instruction. Moreover, teachers should be exposed to seminars and workshops to be abreast with innovations in strategies and methods of teaching Mathematics. Considerably, students in the far-flung areas should be monitored and given equal opportunities in terms of basic services such as transportation facilities, infrastructures and electricity and it is highly sought that similar studies should be conducted.

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