

Computer-Aided Instruction (CAI): Does It Uplift the Mathematical Attitude and Performance of Students?

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ABSTRACT

This quasi-experimental study examined the impact of Computer-Aided Instruction (CAI) on the mathematical attitude and academic performance of Grade 7 students at Hinunangan National High School in Southern Leyte, Philippines. Against a backdrop of persistently low national achievement in mathematics, this research was motivated by the need to explore technology-driven pedagogies that resonate with 21st-century learners. The study was grounded in Vygotsky's Zone of Proximal Development and Skinner's Operant Conditioning theories, positing that interactive, technology-mediated learning could provide enhanced scaffolding and positive reinforcement. A descriptive comparative design was employed with

111 participants, divided into an experimental group ($n=53$) that received instruction via researcher-developed Computer-Aided Instructional Materials (CAIMs) and a control group ($n=58$) taught using conventional lecture methods. Data were collected using a validated 40-item Mathematics Achievement Test and the Silance and Remmers standardized attitude scale, administered in pre-test and post-test phases.

Quantitative analysis revealed a statistically significant advantage for the CAI group. The experimental group achieved a Mean Percentage Score (MPS) of 61.13%, classified as "Average," which was substantially and significantly higher than the control group's MPS of 41.29% ($t=5.183$, $p=0.000$). In terms of attitude, both groups showed improvement, but the gain was markedly greater for the experimental group. Their average attitude score increased significantly from 3.60 ("Likes Math") to 4.45 ("Likes Math"), representing a more positive shift than that observed in the control group. However, Pearson correlation analyses found no significant relationship between post-intervention attitude scores and academic performance within either group, suggesting these constructs improved independently under the CAI intervention. Complementing these findings, a qualitative interview with the implementing teacher affirmed the positive impact on student engagement and attentiveness but concurrently identified critical logistical barriers to implementation, including unreliable electric power, insufficient computer units, time constraints, and limited teacher training in CAI development.

The study concludes that CAI is a potent pedagogical tool for simultaneously uplifting both the performance and disposition of students toward mathematics in a public secondary school setting. The findings strongly support the integration of CAI into the mathematics curriculum. However, the successful and sustainable

adoption of this approach necessitates that educational administrators proactively address the accompanying infrastructural, technical, and professional development challenges to fully realize its transformative potential in the classroom.

Keywords: *Computer-Aided Instruction (CAI), Mathematics Performance, Student Attitude, Educational Technology, Quasi-Experimental Study, Grade 7, Pedagogical Intervention, Philippines, Academic Achievement, Technology Integration*

INTRODUCTION

The knowledge and use of Mathematics affect every area of life. It plays a vital role in the lives of every individual, in scientific and technological innovation and even in the development of a nation. The knowledge of mathematics is an essential tool in our society. It is a tool that can be used in our daily life to overcome the difficulties that are faced. In the contemporary world, it is a gateway to many well-respected, well-rewarded and prestigious occupations. As such, everyone must have an equal opportunity to learn mathematics and to achieve higher learning outcomes with his or her personal potentials, capabilities, needs and desires.

Despite the significance of Mathematics in various fields of study, researches show that students' performance and attitude to mathematics are low (Grotenboer & Kay, 2011). Students often lack motivation when it comes to learning mathematics and this, in turn, can affect their achievement. Likewise, the decline in mathematics achievement is shown in Trends in Mathematics and Science Survey (TIMSS) where the Philippines ranked 41st in Math and 42nd in Science out of 45 countries that were tested as published by Manila Times 2004. This clearly manifests that majority of the Filipino learners have performed low in all national achievement tests, and below the levels of most students from other countries in the international tests.

For that reason, teachers should take note of the needs of individual students. Children of today are called millennials or technology lovers, which view technology as a way of life, as means of learning, and extension of themselves, rather than a simple tool (Government House, 2008). They learn easily with the aid of technology and most likely, they indulge more time in gadgets rather than studying. Therefore, they should be addressed accordingly so that the teaching and learning is effective. Thus, it is a very challenging task for Mathematics teachers and school heads to use a variety of techniques to deal with students with different learning styles.

Nevertheless, it is highly important that teachers must be able to identify students' skills and conceptual understanding levels in mathematics to be able to make an early intervention (Atma Sahu, 2011). In the context of education, the teachers are the facilitators of learning. Other than the school, teacher and parent would be the single most important factor in determining the child's achievement. They are one of the direct responsible persons in the student's educational performance. Their duty is to see to it that a total personal development of the student will take place.

The rapid change and advancement in science and technology challenges the present education system to develop a program that can cope with the demands of an ever-changing society. The advent of computers in a new breed of students, whose interests, and abilities greatly influenced by technology, creates new knowledge, insights and skills require to a more significant education. Research indicates that

the use of Computer-Aided Instruction (CAI) is better to traditional methods of instruction alone. It brings with it several potential benefits as a teaching / learning medium. The students feel more successful, motivated to learn, have increased self-confidence and self-esteem. Likewise, teachers and administrators need to use computers and information technologies to improve their roles and performances in the education process.

Recently, our school is lucky enough to have been provided with new fifty (50) units of computers under the DepEd Computerization Program (DCP). The School Plan for Professional Development (SPPD) through the National Competency-Based Teacher Standards – Teacher’s Strengths and Needs Assessment (NCBTS-TSNA) conducted last October 2015 at Hinunangan NHS reveals that the priority training needs of the teachers fall on this competency; Strand 4.7. Demonstrates skills in the use of ICT in teaching and learning. Teachers of the 21st century should possess or acquire skills on ICT or technologies which are tools that can facilitate learning. They must undergo trainings on ICT to meet the demand of today’s educational system where students need technology-driven activities to revitalize their performance as revealed by their very low score in the School Achievement Test (SAT) last second quarter exam for School year 2016-2017, which is clearly reflected also in our Enhanced School Improvement Plan (E-SIP). Thus, the researcher wanted to apply CAI through CAIM’s as teaching strategy to the Grade 7 students of the school to have a baseline data about the effects on the students’ attitude and performance, as basis also for the implementation of Computer-Aided Instruction in other mathematics class or in the other subjects and for the adaptation of computer-aided instruction to the school curriculum.

It is in this light that the researcher wanted to find out the attitude and performance in Mathematics of the Grade 7 students of Hinunangan National High School, as basis for the development and implementation of CAI.

Theoretical Background

This study is supported and anchored by the following theories, concepts and legal bases: Vgotsky’s Theory (Zone of Proximal Development), Skinner Theory (Operant Conditioning), K to 12 Law and DepEd Order 78 s. 2010.

Vgotsky’s Theory of Zone of Proximal Development or ZPD considers that each child is capable of further development if supported and guided by experienced others. In school, the teacher is the experienced other who will provide a vital role in guiding the child, making suggestions and offering strategies. These others can help the child’s development and enhance their achievements.

Fernandez (2006) recommends that mathematics teachers, who play a vital responsibility in molding the students to like the subject should unceasingly seek for more innovations and new strategies of teaching. They should properly encourage and challenge the learners to become interested in mathematics and strive to make the learning of the subject enjoyable not boring, simple, and comprehensible, not difficult and complicated.

Skinner’s Theory on Operant Conditioning pointed out individuals act to meet the demands of their environment. Boerie (2006) supported Skinner’s theory on conditioning that the behavior of an individual is followed by a consequence, and the nature of the consequence modifies the person’s tendency to repeat the behavior in the future. In this manner, implementing CAI to the classroom will greatly motivate and condition the attitude of the students to learn and love mathematics. Much of the research that examines the

effects of CAI and other microcomputer applications on student learning outcomes also investigates effects upon student attitudes. This line of inquiry has brought most researchers to the conclusion that the use of CAI leads to more positive student attitudes than the use of conventional instruction. Multimedia uses text, graphics, sound, animation, video, and pictures to present information and encourage students to actively engage with the learning process (Mahmood, 2006).

As part of the implementation of the K to 12 law, particularly in line with media and technology skills, the Department of Education has issued DepEd Order 78, s. 2010 - Guidelines on the Implementation of the DepEd Computerization Program (DCP) - with the legal mandate of promoting the right of all citizens to take appropriate steps in making education accessible to all. The Department of Education (DepEd) is geared towards the transformation of education through the DepEd Computerization Program (DCP).

DCP aims to provide public schools with appropriate technologies that would enhance the teaching-learning process and meet the challenges of the 21st century. This program shall respond to the computer backlog of public schools by providing them hardware and software, and training on simple trouble shooting.

In line with this, the Technology Principle states that "Technology is essential in teaching and learning mathematics, it influences the mathematics that is taught and enhances students' learning" (p.3). Computers, when used effectively, can support fundamental characteristics of learning, active engagement, participation in groups, frequent interaction and feedback, and connections to real-world contexts (Roschelle, et.al, 2000).

The implementation of CAI to the classroom setting is very much essential. CAI captures the students' attention because the programs are interactive and engage the students' spirit of alertness and competitiveness. Math computer programs demonstrate concepts, instruct, and remediate student errors and misunderstandings. Many entertaining computer math games encourage students to learn while enjoying the experience. Other programs are useful for instruction or remediation because they present problems that the student answers (ICT and Math, 2006).

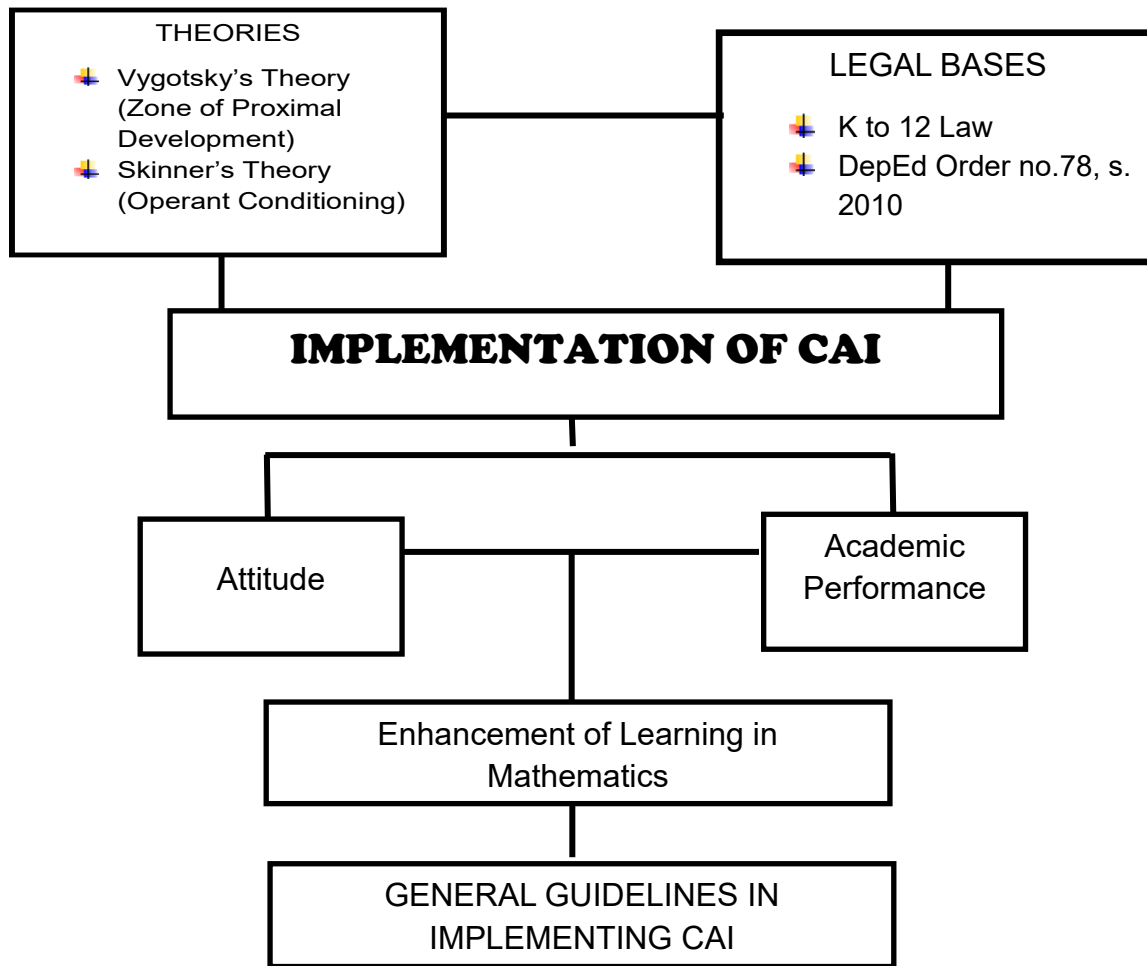
CAI has the following principles namely; learning experience has a clear purpose with tightly focused outcomes and objectives, the learner is engaged actively, learning environment makes appropriate use of variety of media, and learning environments include problem-based as well as knowledge-based learning.

Moreover, characteristics of quality CAI are the following: fosters meaning-making discourse, moves from knowledge transmission to learner-controlled system, provides reciprocal teaching, learner-centered, encourages active participation and knowledge construction, based on higher level thinking skills, promotes active learning, allows group collaboration and cooperative learning, provides multiple levels of interaction, and focuses on real-world problem solving (CAI Manual, 2007).

Moreover, CAI can uplift the attitude and performance of the students. Lupdag (1984) stated that a learner who has a positive attitude towards his subject, teacher or schooling as a whole strives to study harder than one with negative attitude. This will enable the learner to improve his academic performance and profit more from education.

The output of the study which is based on the findings, conclusions and recommendations is the general guidelines in implementing CAI.

THE THEORETICAL AND CONCEPTUAL FRAMEWORK OF THE STUDY



Statement of the Problem

This study aimed to measure the effectiveness of CAI and its effects to the student’s attitude and academic performance in Mathematics of the Grade 7 students of Hinunangan National High School. Specifically, the study sought to answer the following questions:

1. What is the profile of the following group of students in terms of their academic performance?
 - a. controlled group
 - b. experimental group
2. What is the profile of the following group of students in terms of their attitude?
 - a. controlled group

- b. experimental group
3. Is there a significant difference in the academic performance of the controlled and experimental groups in Mathematics?
 4. Is there a significant difference between the attitude of the students in the controlled and experimental group before and after the implementation of the CAI?
 5. Is there a significant relationship in the attitude and academic performance of the students in the controlled and experimental group?
 6. What are the problems encountered during the implementation of CAI as perceived by the teacher?
 7. What would be the output of the study?

METHODOLOGY

Research Design

A descriptive comparative survey was used in this study to evaluate the effectiveness of CAI and its effects to the attitude and academic performance of the students. On the other hand, an interview was done to the subject teacher to find out if there are problems encountered during the implementation of CAI.

Research Respondents

The school where the study was conducted has four sections. Two sections out of four sections of Grade 7 students of Hinunangan National High School were considered in the study. The controlled group was taught Mathematics using the traditional teaching method while the experimental group was taught using CAI. Both groups were taught by the same teacher.

The respondents of the study are presented in Table 1.

Table 1. The Distribution of Research Respondents

Sections of Grade 7	Research subject	Remarks
Bonifacio	53 (experimental group)	With CAI implementation
Mabini	58 (controlled group)	Without CAI implementation
Total	111	

Research Environment

The study was conducted at Hinunangan National High School, located at Bangcas A, Hinunangan Southern Leyte, a third class municipality of Southern Leyte Province. The school is near the Hinunangan Community Hospital which is almost 4 kilometers away from the town proper. It is one of the secondary schools of the municipality of Hinunangan that supported the computer literacy program of the Division of Southern Leyte. The School offers Junior and Senior High School with a total population of 1,200 students. It was headed by a school principal with 52 teachers, and 3 administrative staff. Most of the respondents reside at mountainous areas and some are at the coastal areas.



Map of the municipality of Hinunangan depicting Hinunangan National High School

Research Instruments

There were two research instruments used in the collection of data for the study. A standardized questionnaire based on Silance and Remmers: A scale to measure attitudes towards Mathematics subject which is composed of 45 items. Second, a teacher-made 40-item questionnaire with table of specification of the 40-item test is prepared. Checking of the test was done by the researcher to ensure validity. The result will reflect the knowledge acquired by the students after the implementation.

Data Gathering Procedure

After the approval of the research proposal by the Research Committee of the Graduate School Department of Saint Joseph College, the researcher secured permission from the School Head of

Hinunangan NHS and Nava Elementary School for the conduct of the study and validation purposes of the achievement test questionnaire.

The researcher conducted the Mathematics Achievement Test to Grade 8 students and Grade 6 pupils to validate if the teacher-made test is really fitted to the learning competency of the Grade 7 students-the research respondents. An item-analysis was made to determine the items with low score which needs to be revised. To avoid bias and to achieve its purpose the researcher personally ask the assistance of the Grade 7 Mathematics teacher to explain to the students the objective of the study before the dissemination of the attitudinal questionnaire for them to comprehend on what they are going to respond to before the teaching method is being introduced to both group. The Mathematics 7 teacher conducted the two classes: one with CAI implementation and the other with the traditional method of teaching. CAIM's, table of specification and lessons were prepared by the researcher. The researcher's-made test-the Mathematics Achievement Test was conducted to both groups and an item analysis was made afterwards. The teacher conducted again the attitudinal questionnaire to the two group to determine if there is really a difference of their attitude before and after the implementation of CAIM's. An interview was conducted to the subject teacher regarding the problems met during the implementation of CAI.

Upon the retrieval of the questionnaires the data gathered were tabulated, analyzed and interpreted. Statistical Package for Social Sciences (SPSS) software, using the t-test formula was utilized to determine the significant difference between attitude and performance of the controlled and experimental group.

Statement of Hypotheses

The following null hypotheses are formulated to subject the foregoing sub-problems to statistical treatment for more objective interpretation of the presented data.

H₀1. There is no significant difference in the academic performance of the controlled and experimental groups.

H₀2. There is no statistically significant difference on the attitude of the students in the controlled and experimental groups before and after the implementation of the CAI.

H₀3. There is no significant relationship between the attitude and academic performance in Mathematics of the students in the controlled and experimental groups.

RESULTS AND DISCUSSIONS

A. Profile of the Academic Performance in Mathematics 7 of the Controlled and Experimental Groups

A forty-item test was given to the controlled and experimental groups after the period of the study. The results are summarized on the following table.

Table 2. Achievement Scores of the Controlled and Experimental Groups

	Controlled Group (N = 58)	Experimental Group (N = 53)
MEAN PERCENTAGE SCORE (MPS)	41.293	61.132
STANDARD DEVIATION (SD)	20.944	19.225
PROFICIENCY LEVEL	AVERAGE	AVERAGE

Legend:

MPS	Proficiency Level	Description
0-4	ANM	Absolutely No Mastery
5-14	VL	Very Low
15-34	L	Low
35-65	A	Average
66-85	MTM	Moving Towards Mastery
86-94	CAM	Closely Approximating Mastery
95-100	M	Mastered

The table above shows that the MPS of 61.132% of the experimental group is higher than the MPS of 41.29% of the controlled group. However, the standard deviations, which show the variations in the scores of the experimental group was 19.225 which is slightly lower compared to the value of 20.944 of the controlled group. This implied that the individual scores of the students of the experimental group are more concentrated towards the mean as compared to that of the students of the controlled group. As to the proficiency level, the two groups are classified to be both of the average (A) level. This finding was supported by Johari (1998) that a relationship exists between the use of Computer-aided instruction and a higher level of academic achievement.

Numerous studies indicate that computer use has a positive impact on student achievement, attitudes, learning rates and other variables. A meta-analysis of 254 studies comparing outcomes in computer instructed and traditional classes found small positive changes in student attitudes towards learning, a reduction amount of time needed for instruction, and an increase in exam scores of 0.3 standard

deviations (Kulik & Kulik, 1991). In 81% of the studies, Computer-Aided Instruction (CAI) classes had a higher end-of-course exam scores, and in 19% the traditional classes had the higher average.

Thus, through the application of CAI the learners got a higher score of their achievement test than the learners without CAI implementation.

B. Profile of the Attitude in Mathematics of the Controlled and Experimental Groups Before and After the Implementation of CAI

The controlled and experimental group was given the Attitude Questionnaire before and after the research period. The results are summarized in the tables below.

Table 3.1 Attitude of the Students of the Controlled Group

DESCRIPTION	BEFORE			AFTER		
	Frequency	Percentage	Weighted Mean	Frequency	Percentage	Weighted Mean
DMVM	0	0	0	0	0	0
DM	1	1.72	2.01	0	0	0
U	29	50.00	3.13	25	43.10	3.24
LM	28	48.28	3.87	32	55.17	3.86
LMVM	0	0	0	1	1.72	4.60
Overall	58	100%	3.47	58	100	3.60

Legend:

Weighted Mean	Description
0.00 – 15.0	DMVM - Dislikes Math Very Much
1.51 – 2.50	DM - Dislikes Math
2.51 – 3.50	U - Undecided
3.50 – 4.50	LM - Likes Math
4.51 – 5.00	LMVM - Likes Math Very Much

No respondents in the controlled group manifested dislikes math very much (DMVM) before and after the research period. Only 1 student or 1.72% of them showed dislikes math (DM) with an average weighted mean of (AWM) of 2.01 at the start of the study and eventually increase his attitude towards the subject after the study. Twenty-nine or 50.00% of the students were undecided (U) on their attitude towards Math, with an AWM of 3.13, and this decreases to 25 or 43.10% afterwards with AWM of 3.24. Twenty-eight or 48.23% with AWM of 3.87 said that they like Math (LM) and it increased to 32 or 55.17% with AWM of 3.87 at the end of the research period. Though, none likes Math very much at the start, 1 or 1.72% the pupils with an AWM of 4.60, showed this attitude at the end of the study. Overall, the students had an overall average weighted mean of 3.47 at the beginning. They were still at the undecided (U) level of attitude towards Math. After the research period, their overall average weighted mean increased to 3.60. This group at the end of the research, are now classified at the like Math (LM) level.

Table 3.2 Attitude of the Students of the Experimental Group

DESCRIPTION	BEFORE			AFTER		
	Frequency	Percentage	Weighted Mean	Frequency	Percentage	Weighted Mean
DMVM	0	0.00	0.00	0	0.00	0
DM	0	0.00	0.00	0	0.00	0
U	18	33.96	3.21	2	3.77	3.25
LM	32	60.38	3.74	24	45.28	4.33
LMVM	3	5.66	4.52	27	50.94	4.66
Overall	53	100%	3.60	53	100%	4.45

Legend

Weighted Mean	Description
0.00 – 15.0	DMVM - Dislikes Math Very Much
1.51 – 2.50	DM - Dislikes Math
2.51 – 3.50	U - Undecided
3.50 – 4.50	LM - Likes Math
4.51 – 5.00	LMVM - Likes Math Very Much

No student of the experimental group showed dislikes Math (DM) and dislikes Math very much (DMVM) at the start of the research period. Eighteen students or 33.96% were undecided (U) of their attitude towards Math at the start of the experiment with AWM 3.21 and this number reduced to 2 or 3.77% after the study with AWM of 3.25. Majority of them, 32 or 60.38% with AWM of 3.74 likes Math (LM) before the start of the experiment and this reduced to 24 or 45.28% at the end of the study with AWM of 4.33. Three or 5.66% manifested likes Math very much (LMVM) before with AWM of 4.52 and this increased to 27 or 50.94 % with AWM of 4.66 after the study. There was a decrease in the number of students who are undecided (U) after the implementation of CAI. On the other hand, there was an increase in the number of students who like Math very much (LMVM). Almost all of the students, 45.28% and 50.94%, have developed a more positive attitude towards mathematics after they have been taught using CAI. The overall average weighted mean before the use of the CAI was 3.60 which categorized the students at the likes Math (LM) level. This overall average weighted mean was 4.45 which classify the students at the likes Math (LM) level after the implementation of the CAI.

C. Mean Difference in the Achievement Test Scores of the Controlled and Experimental Groups

The mean percentage scores (MPS) of the control and experimental groups in the achievement test in Mathematics were compared to determine the extent of the difference. Table 4 shows the results.

Table 4. Mean difference in the Achievement Test Scores of the Controlled and Experimental Groups

Mean Percentage Score (MPS)						
Experimental Group (N=53)	Controlled Group (N=58)	Mean Difference	T-test Value	*Critical Value	p-value	Decision
61.132	41.293	19.839	5.183	2.000	0.000	Reject H ₀

*level of significance (α) = 0.05; df = 55

The two groups had a mean difference of 19.839% on their achievement test scores in favor of the experimental group with an MPS of 61.132 as compared to the control group with an MPS of 41.293. The computed t-test of 5.183 is greater than the tabulated t value of 2.000 at a level of significance, α of 0.05 and degrees of freedom, df of 55. Also the p-value was less than $\alpha = 0.05$. The null hypothesis of no significant mean difference is therefore rejected. The mean difference was significant which implied 'that the experimental group obtained a significantly higher mean percentage score than the control group. They performed better in the achievement test after being exposed to the CAI. This finding was supported by Fine (2003), that there was a significant gain in the test scores of the students on special education programs, after their preferred learning style was incorporated into the instruction. Students' performance were

significantly better when they were instructed through learning style approaches rather than traditional method.

Some studies suggest positive results are in part related to students' increased motivation to learn when technology is included in the curriculum (Roschelle, et.al., 2000;Tillman, 2004). Others indicate that gains are experienced because CAI allows students to work more comfortably at their own pace and convenience, in addition to providing access to superior learning materials, customized tutors, as well as, automated measures of progress (Soe,et.al,2000).When used appropriately, CAI can transform the learning environment (ChanLinto, et.al,2006; Richardson Kemp,2005).

Thus, the students of the experimental group performed better in the achievement test than the students of the controlled group. Their exposure to CAI made them to perform better.

D. Mean Difference in the Attitude Scores of the Controlled and Experimental Group

The attitude towards Mathematics of the students in the controlled and experimental group was measured before and after subjecting to the instruction using CAI. The scores were statistically treated to determine any difference after the experiment. Following tables summarize the results.

Table 5.1 Mean Difference in the Attitude Scores of the Controlled Group

Average Weighted Mean		Mean Difference	T-test Value	*Critical Value	p-value	Decision
Before	After					
3.467	3.604	0.137	4.026	2.000	0.000	Reject H ₀

*level of significance (α) = 0.05; df = 57

The controlled group had an average weighted mean (AWM) of 3.47 at the start of the experiment. This increased to 3.60 at the end of the experiment, or an increased in mean of 0.137. T-test of this difference gave a value of 4.026 which was greater than the tabulated value of 2.000 and the p-value of 0.000 was less than $\alpha = 0.05$. The null hypothesis of no significant mean difference is therefore rejected. The controlled registered a significant increase in level attitude towards mathematics after exposure to traditional approach of learning Math. They look Math at a much better angle after the study.

Table 5.2 Mean difference in the Attitude Scores of the Experimental Group

Average Weighted Mean		Mean Difference	T-test Value	*Critical Value	p-value	Decision
Before	After					

3.60	4.45	0.85	16.234	2.010	0.000	Reject H ₀
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*level of significance (α) = 0.05; df = 52

The 53 students in the experimental group registered an increase in the average attitude scores of 0.85. This mean difference in the average weighted means registered a t-test value of 16.234 which is greater than the tabled value of 2.010 and a p-value of 0.000 which is less than 0.05. Hence, the null hypothesis of no significant mean difference is rejected. The difference was significant. Though gauged in the same descriptive level, the mean attitude scores were significantly different. The students scored higher attitude scores after being exposed to CAI. They had better attitude towards learning Mathematics with the intervention of the CAI.

Table 5.3. Mean Difference in the Attitude Scores of the Controlled and Experimental Group

Average Weighted Mean		Mean Difference	T-test Value	*Critical Value	p-value	Decision
Controlled	Experimental					
3.60	4.45	0.85	11.945	2.010	0.000	Reject H ₀

*level of significance (α) = 0.05; df = 53

How the students progressed on their attitude towards Math were compared at the end of the study. The experimental group's AWM of 4.45 was 0.85 points greater than the AWM of 3.60 of the controlled group. T-test of this mean difference resulted to a computed value of 11.945 which was greater than the tabulated value of 2.010. Also the p-value of 0.000 was less than 0.05. The null hypothesis of no significant difference is therefore rejected. The students of the experimental group had a much better attitude towards the subject after they were exposed to the instruction with CAI.

E. Relationship of the Attitude and Performance of the Students

The attitude scores of the students were correlated to their performance in Mathematics after the end of the research period. Table 6.1 and 6.2 tabulate the results.

Table 6.1 Relationship of the Attitude and Performance in Mathematics of the Controlled Group

No. of Students	**r	Description	t-test		Decision
			*Computed	Tabled	

			Value	Value	
58	0.126	Very weak Positive	0.950	2.000	Accept H ₀

*level of significance (α) = 0.05; degrees of freedom (df) = 52

** Pearson product moment correlation coefficient

.00-.19 “very weak” • .20-.39 “weak” • .40-.59 “moderate” • .60-.79 “strong” • .80-1.0 “very strong”

The 58 students of the controlled group had a Pearson product moment correlation coefficient r value of 0.126 for their attitude and performance in Math. This is indicative of a very weak positive linear correlation of the two variables. T-test of this r value yielded a computed value of 0.950 which was less than the critical value of 2.000. Thus the null hypothesis of no significant relationship is accepted. The very weak positive linear correlation is not significant. The students’ manifestation of attitude towards the subject is not parallel with their performance in Math. Those with high attitude in the subject does necessarily mean will have high performance in Math, and those with low attitude in Math will not imply that they will have low performance in Math.

Table 6.2. Relationship of the Attitude and Performance in Mathematics of the Experimental Group

No. of Students	** r	Description	t-test		Decision
			*Computed Value	Tabled Value	
53	-0.071	Negligible Negative	-0.058	2.010	Accept H ₀

*level of significance (α) = 0.05; degrees of freedom (df) = 52

** Pearson product moment correlation coefficient

.00-.19 “very weak” • .20-.39 “weak” • .40-.59 “moderate” • .60-.79 “strong” • .80-1.0 “very strong”

The correlation value, r of -0.071 indicated a negligible negative correlation between the attitude and performance in Mathematics of the students in the experimental group. The computed t-test of -0.058 is within the critical values of ± 2.010 , thus null hypothesis of no significant relationship is accepted. The value of r is no different from 0 or no relationship. The negligible negative correlation is indicative of no

relationship between the attitude and academic performance in Mathematics. How the students performed in Mathematics were independent of their attitude towards the subject.

Rosello (2009), pointed that the improved performance of the students after exposure to CAI program was associated with students' greater interest. The CAI program has definitely enhanced the students' motivation, enjoyment, value, self-confidence and innovation in dealing with different Mathematics activities and ultimately resulted to a better academic performance. If the students have positive attitude towards learning thus it will lead to a greater performance.

F. Problems in the implementation of the CAI

To contextualize the quantitative findings and understand the practical realities of integrating technology into the classroom, a qualitative interview was conducted with the Grade 7 mathematics teacher. The teacher identified several significant challenges encountered during the creation and implementation of the Computer-Aided Instructional Materials (CAIMs), which provide crucial insight for future adoption.

The primary barriers were infrastructural and logistical. During implementation, the class faced intermittent electric power, a constrained time frame within the school schedule, an insufficient number of computers for all students, and a lack of essential equipment like a school projector. These limitations likely impacted the consistency and depth of the CAI exposure. The development phase presented its own set of obstacles, including unreliable internet connectivity, the time-consuming nature of creating effective digital materials, limited resources for software or content, and the teacher's own limited foundational knowledge about CAIMs. These challenges underscore the need for institutional support beyond merely providing hardware.

Despite these hurdles, the teacher's perception of CAI's effectiveness was overwhelmingly positive, aligning directly with the study's statistical results. When asked about efficacy, the teacher confirmed, "Yes, it is. Based on their achievement test result, the class with CAIM's got a higher MPS than the other class using the traditional way of teaching." This observation corroborates the significant difference in Mean Percentage Scores (MPS) where the experimental group (61.13%) outperformed the control group (41.29%).

The teacher also noted marked behavioral differences between the two groups. In comparing the classes, they reported a divergence "in terms of their attitude and academic performance," explicitly stating that "students with CAIM's show much better attitude towards learning in Mathematics. They are more attentive than students without CAIM's." This qualitative assessment supports the quantitative data showing a more substantial and statistically significant improvement in the attitude scores of the experimental group (from an AWM of 3.60 to 4.45) compared to the control group.

While the implementation of CAI was fraught with practical challenges related to infrastructure, time, and teacher preparation, the teacher's firsthand account strongly affirms its positive impact on both student engagement and academic outcomes, as measured in this study. These findings highlight that the successful integration of CAI requires addressing both technical/logistical barriers and providing professional development to maximize its educational benefits.

Summary of Findings

1. Profile of the Academic Performance in Mathematics of the Controlled and Experimental Group:
The controlled group had a mean percentage score (MPS) of 41.293% on their achievement test in Mathematics. They were classified on the Average (A) level for their performance in Mathematics. Likewise, the experimental group had an MPS of 61.132% classified as Average on their performance in Mathematics.
2. Profile of the attitude in Mathematics of the Controlled and Experimental Group:
The students of the controlled were either on the undecided (U) (48.28%) or likes Math (LM) (50.00%) level of attitude towards Mathematics. Only one student (1.72%) was classified on the dislikes Math (DM). After the study majority of them (55.17%) likes Math (LM), 43.10% were undecided and 1.72% improved likes Math very much (LMVM). Their average weighted mean was 3.467, categorized them at the likes Math (LM) level.
On the other hand, more students in the experimental group, 60.38%, were at the likes Math (LM) level on their attitude towards Mathematics before the conduct of the experiment. Their average weighted mean was 3.60, classified in likes Math (LM) level. After being exposed to the CAI majority of the students, 50.94%, fell on the likes Math very much (LMVM) level, while the rest was at the likes Math (LM) (45.28%) and undecided (U) (3.77%). Their average weighted was 4.45 which was in the likes Math (LM) level.
3. Mean Difference in the Achievement Test Scores of the Controlled and Experimental group:
The greater mean difference of 19.839% in the achievement test in Mathematics of the experimental group with that of the controlled group is significant for a t-test of 5.183 which was greater than the critical value of 2.000. The experimental group scored significantly higher MPS than the control group.
4. Mean difference in the attitude scores of the controlled and experimental groups:
The mean difference of 0.137 of the controlled group on their attitude scores was significant. The t-test was 4.026 which was greater than the critical value of 2.000.
The 0.85 difference in the average weighted mean of the attitude scores of the experimental group was significant. The computed t-test was 16.234 was greater than the critical value of 2.010. The students scored significantly higher attitude scores in Mathematics after being exposed to CAI.
Moreover, the mean difference of 0.85 of the attitudes scores of the controlled and experimental groups was significant. The computed t-test value was 11.945 and greater than the tabulated value of 2.010. The experimental scored better than the controlled group.
5. Relationship of the attitude to the academic performance in mathematics:
The correlation r value of 0.126 of the attitude and performance of the students was not significant. There is no relationship on the attitude and performance of the students.
Furthermore, the correlation r value of the attitude and performance of the students in Mathematics was -0.071. This was negligible negative correlation. The computed t-test of -0.058 was within the region of acceptance. The attitude of the students in Mathematics is not related to their performance in the subject.

Conclusions

1. The students of the experimental group performed better on their achievement test in Mathematics than the students of the controlled group. Their exposure to CAI made them performed better on their achievement test.

2. The attitudes of the students improved after being exposed to traditional approach of instruction.
3. The students' attitude Mathematics improved after being exposed to instruction with CAI. CAI contributed on the improvement of their attitude towards learning Mathematics.
4. The attitude of the students exposed to Math instruction with CAI was better than those with the students not exposed to instruction with CAI.
5. Though achievement and attitude towards Mathematics improved after the exposure to instruction with CAI, yet there was no evidence to suggest that attitude is related to the performance of the students in Mathematics.

Recommendations

1. Teachers, administrators and stakeholders need to support the implementation of the CAI in teaching mathematics to boost the students' achievement, as well as their attitude towards the subject. They need to address the problems associated with the implementation of the CAI in teaching the subject.
2. Teachers and administrators should strongly consider using CAI, not only in teaching Mathematics, but also other academic subjects so as to effective teachers of the 21st century. Further they should allocate budgets for preparation of the needed materials as well as training of the teachers.
3. Conduct related studies on the following:
 - a. The Effect of Using CAI in Teaching other Academic Subjects
 - b. The Relationships of Academic Performance, Emotional Quotient and Attitude in CAI Assisted Academic Instruction

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