INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH
2025, Vol. 6, No. 6, 2928 – 2934
http://dx.doi.org/10.11594/ijmaber.06.06.23

Research Article

Electronic Learning System in Teaching Mathematics Enhancing Achievement among Students

Charlotte S. Tamayo-Urbina*, Reynaldo H. Dalayap

Graduate School, Sultan Kudarate State University, 9800, Philippines

Article history:
Submission 03 May 2025
Revised 31 May 2025
Accepted 23 June 2025

**Corresponding author:*
E-mail:
charlotte.tamayo@deped.gov.ph

ABSTRACT

This study investigates the effectiveness of Computer-Aided Instruction (CAI) in improving mathematics achievement among 70 Grade 7 students over an eight-week period at Bacongco National High School. Using a quasi-experimental design, it compares CAI with traditional lecture-based teaching through pretest and posttest assessments. Grounded in Constructivist, Behaviorist, and Cognitive Load theories, the research explores how CAI may enhance active learning, reduce cognitive overload, and increase engagement.

Participants were split into two groups: one received CAI-based instruction, while the other followed traditional methods. Pretest results showed both groups performed at a "weak" level with nearly identical scores (CAI: 14.34%, traditional: 14.29%), indicating similar academic baselines. After the intervention, both improved to a "developing" level (CAI: 20.06%, traditional: 20.86%). However, statistical analysis found no significant difference in posttest scores or mean gain scores (CAI: 5.71%, traditional: 6.57%, $p > 0.05$). While both approaches were equally effective in enhancing performance, the short duration of the study (eight weeks) may have limited CAI's impact. The findings suggest CAI should be seen as a complementary tool rather than a replacement for traditional instruction.

The study recommends longer-term implementation, development of localized CAI materials, and teacher training to maximize benefits. It contributes to the broader discourse on educational technology by affirming the comparable effectiveness of CAI and traditional methods, while emphasizing the need for strategic planning, contextual adaptation, and institutional support to optimize technology integration in education.

Keywords: *Computer-Aided Instruction (CAI), Mathematics Achievement*

How to cite:
Tamayo-Urbina, C. S. & Dalayap, R. H. (2025). Electronic Learning System in Teaching Mathematics Enhancing Achievement among Students . *International Journal of Multidisciplinary: Applied Business and Education Research*. *6*(6), 2928 – 2934. doi: 10.11594/ijmaber.06.06.23

Background

In recent years, the use of technology in classrooms has become an important part of teaching and learning. One such innovation is Computer-Aided Instruction (CAI)—a method that uses computers and software to support the learning process. CAI is designed to make learning more interactive and tailored to individual students, and it has been increasingly used in various subjects, including mathematics (Abusomwan & Osaigbovo, 2020).

Mathematics is a subject that often challenges students, especially those in early secondary school. Grade 7 students, for example, are at a key stage in their education where they are introduced to more complex and abstract mathematical concepts. Many students find this transition difficult, which can affect their confidence and performance. CAI offers a potential solution by using visual aids, interactive tools, and personalized feedback to help students understand difficult topics in a more engaging way (Lai et al., 2015; Bulman & Fairlie, 2016).

Several studies have shown that students who learn using CAI often perform better than those who rely only on traditional classroom teaching. For instance, Chekour (2017) found that students using computer-assisted math programs improved significantly in developmental math courses. De Witte, Haelermans, and Rogge (2015) also reported better results among students using technology-supported instruction. These tools not only improve academic performance but also seem to increase students' interest and motivation in the subject (Harandi, 2015; Lepper & Malone, 2021).

For Grade 7 learners, this technology can be especially helpful. At this stage, students are developing the foundational skills they will need in higher-level mathematics. The adaptability of CAI—allowing students to learn at their own pace and receive immediate feedback—can support a deeper understanding of mathematical concepts and improve overall academic success (Tokac et al., 2019; Van der Kleij, Feskens, & Eggen, 2015).

This study explores whether CAI can improve the math performance of Grade 7 students. Specifically, it examines how students who use CAI compare with those who are taught using traditional methods. By doing so, the research aims to contribute to a broader understanding of how technology can enhance learning, building on earlier work by Muralidharan, Singh, and Ganimian (2019) and Gongden & Gongden (2019), who found positive results using CAI in other educational contexts.

In this study, we report on the outcomes of a study assessing the impact of Computer-Aided Instruction on Grade 7 mathematics performance. The findings are intended to inform educators and policymakers about the potential of CAI as a tool for improving student achievement in mathematics.

This study addresses the question: Does Computer-Aided Instruction significantly improve the mathematics achievement of Grade 7 students compared to traditional teaching methods?

Methods

This chapter presents the research design, locale of the study, respondents, sampling technique, data gathering instruments, data gathering procedure, and statistical tools used in the study.

Research Design

This study employed a quasi-experimental research design to examine the effect of the Electronic Learning System (Computer-Aided Instruction or CAI) compared to the conventional teaching method on the academic achievement in mathematics of Year 7 high school students at Bacongco National High School. Specifically, the design used was a Pretest-Posttest Non-Equivalent Groups Design, where pre-existing classes were assigned as experimental or control groups through cluster sampling.

The quasi-experimental approach is appropriate for educational research settings where random assignment is impractical or impossible (Muralidharan, Singh, & Ganimian, 2019; Abusomwan & Osaigbovo, 2020). This design has been widely utilized to evaluate the effectiveness of CAI versus traditional teaching, particularly in secondary education contexts (Bulman & Fairlie, 2016; De Witte, Haelermans, & Rogge, 2015).

The selection of CAI as the experimental condition is supported by evidence of its positive influence on student motivation and achievement in mathematics (Cao, 2022; Suson & Ermac, 2020; Harandi, 2015). Several studies demonstrate statistically significant improvements in academic performance when CAI is implemented effectively (Chekour, 2017; Gongden & Gongden, 2019; Lashley, 2017). Moreover, CAI's impact has been observed across varied learner demographics and educational settings (Ige & Hlalele, 2017; Munyakazi et al., 2022).

Respondents of the Study

The study involved two naturally occurring Grade 7 classes from Bacongco National High School, selected from five available sections. The sample included all seventy (70) students from these two sections: 7 – Callalily and 7 – Sampaguita. These classes represent heterogeneous groups to reflect typical learner diversity.

Utilizing pre-existing classes aligns with prior CAI research practices aimed at maintaining ecological validity and real-world applicability (Abusomwan & Osaigbovo, 2020; Bippert & Harmon, 2017; Gongden & Gongden, 2019). Selecting heterogeneous groups also supports the generalizability of findings across varied learner profiles (Munyakazi et al., 2022; Ordeniza & Ramber, 2024).

Locale of the Study

The study was conducted at Bacongco National High School, located in Barangay San Isidro, City of Koronadal. The school is a public secondary institution under the Department of Education implementing the K-12 curriculum. It houses a computer laboratory equipped with sixty (60) desktop computers connected to the internet, facilitating the delivery of CAI to the experimental group.

Sampling Size and Sampling Technique

The study involved two groups: one received CAI-based instruction, and the other followed conventional teaching methods. Two pre-existing Grade 7 classes were randomly selected from the available pool. To ensure unbiased group assignment, a coin toss was used to randomly assign one class to the experimental group and the other to the control group. This method maintains fairness while preserving the natural classroom setup.

The use of intact classes rather than individual students reflects a cluster sampling approach, which is commonly employed in educational research due to administrative and practical constraints (Han, Capraro, & Capraro, 2015; Muralidharan, Singh, & Ganimian, 2019; Lai et al., 2015). Cluster sampling allows for comparability between groups while respecting school policies on class organization and minimizing disruptions to regular instruction.

Research Instruments

The instruments used to assess academic achievement in this study included the pretest and posttest, the 3rd Quarter Grade 7 Mathematics module, and the Computer-Aided Instruction (CAI) software. The pretest and posttest consisted of the 3rd Periodical Exam in Grade 7 Mathematics, which is aligned with the Department of Education's (DepEd) Table of Specifications and comprised of 40 multiple-choice items. These exams were validated by the Koronadal City Division Office and administered before and after the instructional intervention to measure student performance. The 3rd Quarter Grade 7 Mathematics module, issued by DepEd, primarily covered Geometry topics for the third quarter of the school year and was used as the core instructional material. Additionally, the experimental group utilized specially developed CAI software for lessons, quizzes, and online readings, which required user authentication through login credentials to ensure secure access and proper tracking of usage.

Validity and Reliability of Instruments

The pretest and posttest were standardized assessments developed and validated by the DepEd Division Office of Koronadal City, ensuring content validity as they reflect the prescribed mathematics curriculum (Chekour, 2017; Abusomwan & Osaigbovo, 2020). These tests have been routinely administered across public schools, reinforcing their construct validity in measuring students' mathematical competencies (De Witte, Haelermans, & Rogge, 2015).

Data Gathering Procedure

Data collection followed a systematic sequence. First, consent and permissions were obtained from school authorities. Then, a pretest was administered to both the experimental and control groups to establish baseline performance. Over the following eight weeks, the experimental group received instruction using Computer-Aided Instruction (CAI), while the control group was taught using traditional methods. After the instructional period, a post test was conducted to measure learning gains. All collected data were anonymized and securely stored for analysis.

Statistical Treatment

The data were evaluated using several statistical analyses to determine the effectiveness of the interventions. A T-test for independent samples was employed to compare the pretest scores between the experimental and control groups, establishing baseline equivalence between the two groups (Abusomwan & Osaigbovo, 2020; Muralidharan, Singh, & Ganimian, 2019). To assess the impact of the instructional methods within each group, a T-test for paired samples was conducted to compare pretest and posttest scores, measuring the effect of the interventions over time (Guo, 2018; Ekpenyong & Akwagiobe, 2018). Additionally, a Z-test for the difference in mean gain scores was utilized to determine whether the average improvement between the experimental and control groups was statistically significant (Lai et al., 2015; De Witte, Haelermans, & Rogge, 2015; Owede, 2024). These statistical procedures align with established practices in experimental education research focused on the effectiveness of computer-assisted instruction.

Results and Discussion

This chapter presents and discusses the results of the study on the effect of Computer-Assisted Instruction (CAI) on the academic achievement of Grade 7 students in mathematics.

Pre-test Results

Table I. Mean Score and Descriptive Rating of Respondents in the Pre-test.

Group	Standard Deviation	N	CV	Mean Percentage Score	Interpretation
Computer – Aided Instruction (Experimental)	3.03	35	21.13	14.34	Weak
Conventional Method (Control)	2.92	35	20.43	14.29	Weak

Both the CAI (experimental) and conventional (control) groups recorded low pre-test scores (M = 14.34% and 14.29%, respectively), with "Weak" interpretations. Statistical analysis using the T-test showed no significant difference ($p = 0.94 > 0.05$), indicating comparable starting competencies. This baseline equivalence strengthens the validity of subsequent comparisons.

Post-test Results

Table II. Mean Score and Descriptive Rating of Respondents in the Post-test.

Group	Standard Deviation	N	CV	Mean Percentage Score	Interpretation
Computer – Aided Instruction (Experimental)	6.02	35	30	20.06	Developing
Conventional Method (Control)	5.35	35	25.65	20.86	Developing

After the intervention, both groups improved to a "Developing" level. The control group had a slightly higher mean (20.86%) than the experimental group (20.06%). However, a T-test showed no statistically significant difference (p = 0.56 > 0.05), suggesting similar learning gains regardless of instructional method.

Mean Gain Scores

Table III. Difference in the Mean Gain Scores of the Experimental Group and Control Group

Group	Number of Students	Mean	Standard Deviation	Test Stat	P – Value	Remarks
Computer – Assisted Instruction (Experimental)	35	5.71	5.04	0.67	0.51	Not Significant
Conventional Method (Control)	35	6.57	5.66			

x= 0.05 level of significance

Although the experimental group showed a mean gain of 5.71 points and the control group 6.57 points, a Z-test revealed no significant difference (p = 0.51 > 0.05). The effect size, measured by Cohen's *d*, was small (d = 0.12), indicating a negligible practical difference between the two groups. This outcome implies that CAI was as effective as the traditional method over the 8-week period.

Interpretation and Implications

Despite the potential of CAI, the findings indicate no significant advantage over conventional instruction in this context. One possible explanation is the short duration of CAI implementation, which may not have been sufficient for students and teachers to fully adapt to the new method. Additionally, low levels of digital literacy among students could have hindered their ability to engage effectively with the technology, limiting the instructional benefits. Similarly, limited teacher familiarity or confidence with CAI tools might have affected the quality and consistency of implementation. Student engagement levels may also have varied, with some learners potentially finding the digital format less motivating or interactive than intended. These factors suggest that the success of CAI depends not only on its presence in the classroom but also on how well it is integrated, supported, and aligned with student needs and curricular goals.

The results showed that CAI and conventional teaching methods yielded comparable outcomes in student achievement. This suggests that while CAI holds promise, its effectiveness may be contingent on broader contextual factors. Further research is recommended to investigate the long-term effects of CAI, explore professional development strategies for teachers, and identify best practices for integrating CAI into the mathematics curriculum in a way that maximizes student engagement and learning outcomes.

Conclusion

This study examined the effect of Computer-Assisted Instruction (CAI) on the academic achievement of Grade 7 students in Mathematics at Bacongco National High School. The results revealed that while both the experimental (CAI) and control (conventional) groups showed improvement from pre-test to post-test, there was no statistically significant difference in their performance outcomes. The mean gain scores also showed no substantial advantage in favor of CAI.

The findings indicate that CAI, within the scope and duration of this study, is equally as effective as traditional teaching methods. This suggests that CAI can serve as a viable alternative instructional approach, particularly in environments exploring digital integration. However, its lack of significant superiority underscores the need for thoughtful implementation. Factors such as the short duration of the intervention, variability in digital literacy among students, and instructional fidelity may have limited the potential impact of CAI.

From an educational management and policy perspective, the study emphasizes that the effectiveness of technology in education—such as CAI—depends not solely on its availability, but on strategic integration, sustained implementation, and support infrastructure. For school administrators and decision-makers, this highlights the importance of teacher training, curriculum alignment, and access to digital tools if CAI is to produce measurable improvements in learning outcomes.

In conclusion, CAI holds promise as a complementary tool in mathematics instruction, but further studies are needed to explore its full potential. Future research should consider: (1) the longitudinal effects of CAI to determine its sustained impact over time; (2) the use of gamification within CAI platforms to enhance engagement and motivation; and (3) the differential impact of CAI on various types of learners, including struggling students, average performers, and advanced learners. Investigating these areas will provide deeper insights into how CAI can be more effectively tailored and integrated into diverse educational settings.

Acknowledgement

I first thank my parents, Papang Felino and Mamang Nelia, my siblings, and my children Renzo Ceb and Rhian Cassandra for their unfailing love and prayers. Deepest gratitude goes to my husband, Rushty B. Urbina, whose constant support made this work possible.

Academic guidance from Dr. Reynaldo H. Dalayap was indispensable. I likewise appreciate Dr. Allan Jay S. Cajandig and Dr. Efren C. Flores for their insightful advice, Ms. Evora H. Dioneza for meticulous editing, and Dr. Ernie C. Cerano for expert statistical assistance. My thanks also to evaluators Mr. Dexter R. Afon, Mr. Rushty B. Urbina, Ms. Sandra S. Gazo, and Mr. Benedict Sambo.

Institutional appreciation is extended to Dr. Samson L. Molao, SKSU President, and Dr. Mildred F. Accad, Dean of the Graduate School, as well as to the Grade 7 students and mathematics teachers of Bacongco National High School for their vital participation.

Above all, I thank the Almighty for guidance and strength throughout this endeavor.

CHARLOTTE S. TAMAYO-URBINA

References

Abusomwan, S. B., & Osaigbovo, L. (2020). Effect of Computer Aided Instruction on Students Academic Achievement in Technical Drawing in Secondary Schools in Edo State. NIU Journal of Social Sciences, 6(2), 367-374.

Bippert, K., & Harmon, J. (2017). Middle school teachers' perceptions of computer-assisted reading intervention programs. Reading Psychology, 38(2), 203-230.

Bulman, G., & Fairlie, R. W. (2016). Technology and education: Computers, software, and the internet. In Handbook of the Economics of Education (Vol. 5, pp. 239-280). Elsevier.

Cao, H. (2022). Entrepreneurship education-infiltrated computer-aided instruction system for college Music Majors using convolutional neural network. Frontiers in psychology, 13, 900195.

Chekour, A. (2017). The effectiveness of computer-assisted math instruction in developmental classes. AURCO Journal, 23(Spring), 21-30.

De Witte, K., Haelermans, C., & Rogge, N. (2015). The effectiveness of a computer-assisted math learning program. Journal of Computer Assisted Learning, 31(4), 314-329.

De Witte, K., Haelermans, C., & Rogge, N. (2015). The effectiveness of a computer-assisted math learning program. Journal of Computer Assisted Learning, 31(4), 314-329.

Ekpenyong, E. E., & Akwagiobe, A. B. (2018). Unmasking the effectiveness of computer assisted instruction in the teaching and learning of social studies in Cross River State College of Education Akamkpa, Cross River State, Nigeria. Global Journal of Arts, Humanities and Social Sciences, 6(7), 45-52.

Gongden, E. J., & Gongden, E. E. (2019). Effects of computer assisted instruction on male and female students' achievement in basic science in Jos metropolis, Plateau State, Nigeria

Guo, H. (2018). Application of a Computer-Assisted Instruction System Based on Constructivism. International Journal of Emerging Technologies in Learning, 13(4).

Harandi, S. R. (2015). Effects of e-learning on Students' Motivation. Procedia-Social and Behavioral Sciences, 181, 423-430.

Lai, F., Luo, R., Zhang, L., Huang, X., & Rozelle, S. (2015). Does computer-assisted learning improve learning outcomes? Evidence from a randomized experiment in migrant schools in Beijing. Economics of Education Review, 47, 34-48.

Lepper, M. R., & Malone, T. W. (2021). Intrinsic motivation and instructional effectiveness in computer-based education. In Aptitude, learning, and instruction (pp. 255-286). Routledge

Muralidharan, K., Singh, A., & Ganimian, A. J. (2019). Disrupting education? Experimental evidence on technology-aided instruction in India. American Economic Review, 109(4), 1426-1460.

Owede, K. (2024). Effects of Use of Computer Aided Instructions (CAI) at Secondary School on Academic Performance Undergraduates in Bayelsa State. Fuo-Journal of Educational Research, 3(1).

Tokac, U., Novak, E., & Thompson, C. G. (2019). Effects of game-based learning on students' mathematics achievement: A meta-analysis. Journal of computer assisted learning, 35(3), 407-420.

Van der Kleij, F. M., Feskens, R. C., & Eggen, T. J. (2015). Effects of feedback in a computer-based learning environment on students' learning outcomes: A meta-analysis. Review of educational research, 85(4), 475-511.