Development and Evaluation of Computer-Assisted Instructional Package for Teaching and Learning Selected Mathematics Concepts in Secondary Schools in Osun State

Mariam Adenike Lasisi [1], Keji Sakiru Sulaimon [2]
[1,2] Curriculum and Instruction Department,
Federal College of Education, Iwo, Osun State, Nigeria
shomoyema@fceiwo.edu.ng; sulaimonks@fceiwo.edu.ng
Corresponding Email: shomoyema@fceiwo.edu.ng
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Abstract
The greatest contribution of technology is the development of the computer and its uses in teaching and learning. Pertinent to the above statement on computers, there has not been more use of Computer Assisted Instruction (CAI) in treating topics like plane shapes, geometry, money, angles, and so on, in the mathematics curriculum. The study examined the development and evaluation of a computer-assisted instructional package for teaching and learning selected mathematics in secondary schools in Osun State. This study was design-based research of the model type using the Analysis Design Development Implementation and Evaluation (ADDIE) model. A computer-instructional package was designed and developed. Five Educational Technology experts and five Mathematics teachers in secondary schools were purposively selected for validation of the video package. A total of 63 students were selected through the purposive sampling technique, with 29 from the experimental group and 34 from the control group schools that participated in the study in Iwo, Osun State. The computer instructional package was rated by the experts using Experts Rating Scales, while a reliability coefficient of 0.97 was obtained on the Instrument after validation by experts in Educational Technology. Percentage, mean, and the t-test were used for data analyses. The study revealed that a computer-assisted instructional package on numeracy was designed and developed for secondary school students using the ADDIE model. The result also indicated that the quality of the instructional package for teaching mathematics in secondary schools was rated suitable and high for teaching secondary school students. There was a difference in the performance of students taught using the package and those taught with the conventional method, with a mean difference of 2.13, and based on gender, with a mean gain of 0.03. The study equally reported that there was no significant difference in the performance of male and female students exposed to the package. It recommended, among other that the use of the computer-assisted instructional package for teaching mathematics to enhance teaching of secondary school students should be encouraged as it enhances effective learning.

Keywords: *Computer-assisted instruction; Mathematics education; Instructional package; Secondary schools; Student performance.*

Introduction

Teaching methods and instructional techniques continue to evolve in response to technological advancements and changing educational needs. Technology has transformed various aspects of human life, including education, where computers have become important tools for teaching, learning, and knowledge acquisition. The integration of computers into information and communication technology (ICT) has expanded opportunities for presenting educational content, accessing learning resources, and improving instructional delivery. Onasanya et al. (2007) highlighted the transformative role of computers in education, while Chaudhari (2023) observed that supplementing conventional chalkboard instruction with computer-based teaching can improve the teaching and learning process. Similarly, Adelakun (2022) emphasised the importance of digital technology and periodic curriculum review in Nigerian tertiary institutions, while Adelakun et al. (2022) examined the benefits, challenges, and prospects of electronic learning systems. These developments underscore the relevance of technology-supported instructional approaches in contemporary education.

Computer-assisted instruction (CAI) involves using computer-based programmes to present educational content and facilitate learning through tutorials, demonstrations, simulations, instructional exercises, games, and assessments. Olafare (2021) described CAI as the presentation of written and visual information to learners in a logical sequence through a computer. CAI may incorporate tutorials, drill-and-practice exercises, learning games, simulations, problem-solving activities, assessments, and demonstrations (Çepni et al., 2006; Yusuf & Afolabi, 2010). These techniques can provide learners with opportunities to interact with instructional materials, practise procedures, receive feedback, and revisit difficult concepts. Mishra (2023) discussed the potential of computer-based instruction to improve learning efficiency and retention, while Opara et al. (2015) highlighted its contribution to developing communication, data-processing, decision-making, and critical-thinking skills. Furthermore, Shomoye et al. (2023) examined the use of electronic resources for undergraduate learning at the National Open University of Nigeria in Kwara State, illustrating the relevance of digital resources within the Nigerian educational context. The effective integration of educational technology requires appropriate instructional planning, teacher preparedness, implementation, and evaluation. Adebayo et al. (2026) examined the importance of effective monitoring and supervision in Nigerian colleges of education, highlighting the institutional dimension of maintaining teaching quality. In addition, Adelakun et al. (2026) proposed a conceptual governance model for artificial intelligence adoption in Nigerian tertiary education, addressing learning, academic integrity, and equity. Although these studies focus on broader educational technology and institutional practices rather than computer-assisted mathematics instruction, they highlight the importance of integrating technology in ways that support educational objectives and equitable learning opportunities. Educational psychology also provides a useful perspective for understanding learners' needs, motivation, and responses to instructional experiences (Agbaje & Adelakun, 2024; Hadi, 2024). These considerations are relevant to developing instructional materials that are pedagogically appropriate and responsive to students' learning requirements.

Mathematics is a fundamental subject for scientific inquiry, engineering, technological advancement, and many other fields of human endeavour. It provides learners with the knowledge and skills required for logical reasoning, problem-solving, critical thinking, quantitative analysis, and creativity. Odogwu (2022) emphasised the importance of mathematics in developing learners' reasoning and creative abilities, while Odili (2022) highlighted its applications in solving problems, formulating theories, and predicting outcomes. Mathematics comprises interconnected

branches, including arithmetic, algebra, and geometry, which provide essential foundations for scientific and technological development. Consequently, mathematics occupies a prominent position in the Nigerian secondary school curriculum and serves as an important prerequisite for admission into many higher education programmes. Its relevance to everyday activities and professional practice makes effective mathematics instruction essential for preparing learners to participate meaningfully in an increasingly technology-driven society.

Despite its importance, mathematics remains challenging for many secondary school students. Reported areas of difficulty include simplifying surds and indices, applying logarithmic laws, selecting appropriate scales for plotting graphs, performing geometrical constructions, and distinguishing between plane and solid shapes (Abiodun et al., 2022; Abiodun & Asanre, 2025; Adam & Babatunde, 2020). These difficulties may be compounded by instructional approaches that emphasise theoretical explanations and memorisation without sufficient practical illustration or active learner participation. Odili (2022) identified difficulties in retaining previously learned mathematical concepts as a concern in mathematics education. When students have limited opportunities to visualise mathematical relationships, practise procedures, and receive appropriate feedback, their understanding of abstract concepts may be constrained. These challenges highlight the need to examine instructional approaches that facilitate conceptual understanding, encourage participation, and support knowledge retention.

Computer-assisted instruction offers a potential approach to addressing some of these challenges by presenting mathematical concepts through visual representations, interactive demonstrations, guided exercises, and repeated practice. Such features can help learners explore abstract concepts and apply mathematical principles in structured learning activities. Adamu and Babatunde (2020) reported that a software application package was effective in teaching matrices and found a significant difference in students' mathematics achievement. Similarly, Abiodun and Asanre (2025) investigated the effects of CAI on senior secondary school students' mathematics learning outcomes in Ogun State, Nigeria, using a quasi-experimental pre-test, post-test, non-randomised control-group design. Their findings indicated that students taught using CAI achieved significantly different outcomes from those taught through the lecture method. These findings provide a basis for further investigating the development and evaluation of computer-assisted instructional materials for secondary school mathematics. However, the effectiveness of a particular instructional package must be established through systematic evaluation rather than assumed from the general benefits associated with educational technology.

The development of an effective computer-assisted instructional package requires a systematic instructional design process that connects learners' needs, instructional objectives, content, learning activities, implementation, and evaluation. The Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model provides a structured framework for these activities. Its five phases guide instructional developers in identifying learning needs, designing instructional experiences, producing appropriate materials, implementing the intervention, and evaluating its quality and effectiveness (Allen, 2006; Spatioti et al., 2022).

Applying the ADDIE model to mathematics instruction can help ensure that the developed package aligns with intended learning outcomes and the needs of secondary school students. Expert assessment can further establish the instructional quality, content suitability, and overall appropriateness of the package.

Evaluating a computer-assisted instructional package also requires examining students' academic performance and considering whether outcomes differ according to relevant learner characteristics. Gender is one variable that may be investigated when assessing the effectiveness of instructional

interventions. Fakomogbon et al. (2014) reported no significant difference between the performances of male and female students taught mathematics using a computer-assisted instructional package. Nevertheless, this finding should not automatically be generalised to other instructional materials, populations, or educational settings.

The effectiveness of a newly developed package should therefore be assessed within its intended context, using appropriate measures of instructional quality and student performance. Similarly, credible assessment practices are necessary when determining whether observed performance reflects students' learning. Abdulkareem et al. (2024), in their study of examination malpractice in senior secondary schools in Iwo Local Government Area, Osun State, addressed a broader issue of assessment integrity within the local educational context. Although examination malpractice is distinct from instructional design, the study provides relevant contextual evidence of the importance of credible assessment in secondary education.

Against this background, the development and evaluation of a computer-assisted instructional package for teaching selected mathematics concepts in secondary schools in Osun State, Nigeria, is warranted. Although previous studies have examined the effectiveness of computer-assisted instruction in mathematics, there remains a need to assess the quality and classroom performance of instructional packages developed for specific learning contexts. Accordingly, the present study employs the ADDIE model to guide the design and development of a computer-assisted instructional package, examines its quality through expert ratings, and investigates differences in the academic performance of students taught using the package and those taught through the conventional method. The study seeks to provide evidence on the suitability and educational value of the package and contribute to improving the teaching and learning of selected mathematics concepts in secondary schools.

Statement of the Problem

The secondary school mathematics curriculum is often plagued by inadequate teaching methods and limited access to personalized learning resources, leading to poor academic performance and decreased interest in STEM fields among students. Many students struggle to grasp mathematics concepts due to large class sizes, ineffective traditional teaching approaches, and a lack of interactive learning resources. This can result in mathematics anxiety, phobia, and a general disinterest in the subject.

A computer-assisted instructional package can potentially address these issues by providing interactive and engaging learning experiences, offering personalized learning paths, and supplementing traditional teaching methods. Such a package can cater to diverse learning styles, provide real-time feedback, and enhance students' understanding and retention of mathematics concepts. The development and evaluation of a computer-assisted instructional package can therefore provide individualized attention and support to students, offer interactive and immersive learning experiences, enhance teacher-student interaction and collaboration, improve academic performance and interest in mathematics, and also prepare students for a technology-rich world. Moreover, a well-designed package can reach a wider audience, including students with disabilities, remote or rural students, and those with limited access to quality education; it can potentially bridge the gap in mathematics achievement and equip students with the skills and knowledge needed to succeed in an increasingly technological world. The proposed computer-assisted instructional package has the potential to revolutionize mathematics education in secondary schools, making it more engaging, effective, and accessible to all. Its development

and evaluation can contribute to the improvement of mathematics education and the achievement of educational goals.

Objectives of the Study

The main objective of this study was to develop and evaluate a computer-assisted instructional package for teaching selected mathematics concepts in secondary schools in Osun State. Specifically, the study designed and developed a computer-assisted instructional package for teaching mathematics concepts in secondary schools, evaluated the effectiveness of the package in improving students' understanding in mathematics, identified the strengths and weaknesses of the package, and provided recommendations for improvement in Osun State, Nigeria.

Research Questions

The study answered the following research questions:

1. What are the processes involved in designing and developing a computer-assisted instructional package for teaching Mathematics concepts in secondary schools, Osun State, Nigeria?
2. What is the quality of the computer-assisted instructional package for teaching Mathematics in secondary schools as rated by experts?
3. Is there any difference in the performance of students taught using the computer-assisted instructional package for teaching Mathematics and those taught with the conventional method in secondary schools?

Methodology

This study is a qualitative and quantitative design-based research of a pre–test– post-test quasi-experimental design. It involved the design and development of a computer-assisted instructional package. The development involved the use of the ADDIE instructional model for the development of the computer-assisted instructional package. Two groups were compared, comprising samples drawn from two different schools within Iwo, Osun State. Each of the two groups was associated with selected schools and made up of one group of students per school. The groups are the experimental and control groups. The groups are Junior Secondary School Two (2) students from the selected schools. The activities of the groups are shown in Table 1.

Table 1: Activities of the Experimental and Control Groups

S/N	Group Name	Activities
1	Experimental Group	It involves the pupils being taught with the Computer Instructional Package for teaching Mathematics. The students are given a pre-test and a post-test.
2	Control Group	It involves the pupils being taught without the Computer Instructional Package for teaching Mathematics. The students are given a pre-test and post-test.

Table 2: Research Design Layout

Groups	Pretest	Treatment	Posttest
Experimental Group	O_1	CAIPM (X_1)	O_2
Control Group	O_3	Conventional (X_2)	O_4

The population consists of all junior secondary school two in Osun State, Nigeria. However, the purposive sampling technique was used to sample Junior Secondary School Two (JSS 2) students in Iwo, Osun State, because they have at least one more session to spend while JSS 3 and JSS 1 are in terminal classes and a new class, respectively. The JSS 2 students do offer the subject because of its compulsory status at the level. The same curriculum is used for secondary schools nationwide. Intact classes for each of the groups were employed. The study was conducted in two Junior Secondary Schools that were purposively sampled in the same setting, and took place simultaneously with the researcher and assisted by the class teachers.

The researcher developed four research instruments for data collection. The instruments are the treatment instrument (Computer Instructional Package for Teaching Mathematics (CIPTM)) and the test instrument tagged the Mathematics Performance Test (MPT), which serves as the pre-test-post-test. The second research instrument, the Mathematics Achievement Test (MAT), is the pre-test and post-test of participating students in each group; the third and fourth instruments are researcher-designed questionnaires for teachers and educational technology experts to evaluate the appropriateness and quality of the package.

The CIPTM was subjected to a validation exercise with experts made up of seven (7) educational technology experts and five (5) Mathematics teachers. The reliability of the instruments was determined using Cronbach's Alpha. The values were 0.856 for lecturers' evaluation of the content; 0.746 for lecturers' design factors; and 0.806 for lecturers' screen design, feedback, and technical. Moreover, the Cronbach's alpha on the teachers' component of CAI was 0.971. These proved the reliability of the research instruments, while descriptive statistics were used to answer all research questions.

Result Presentation and Discussion

Research Question one: what are the processes involved for designed and developing computer assisted instructional package for teaching Mathematics concepts in secondary schools, Osun State, Nigeria?

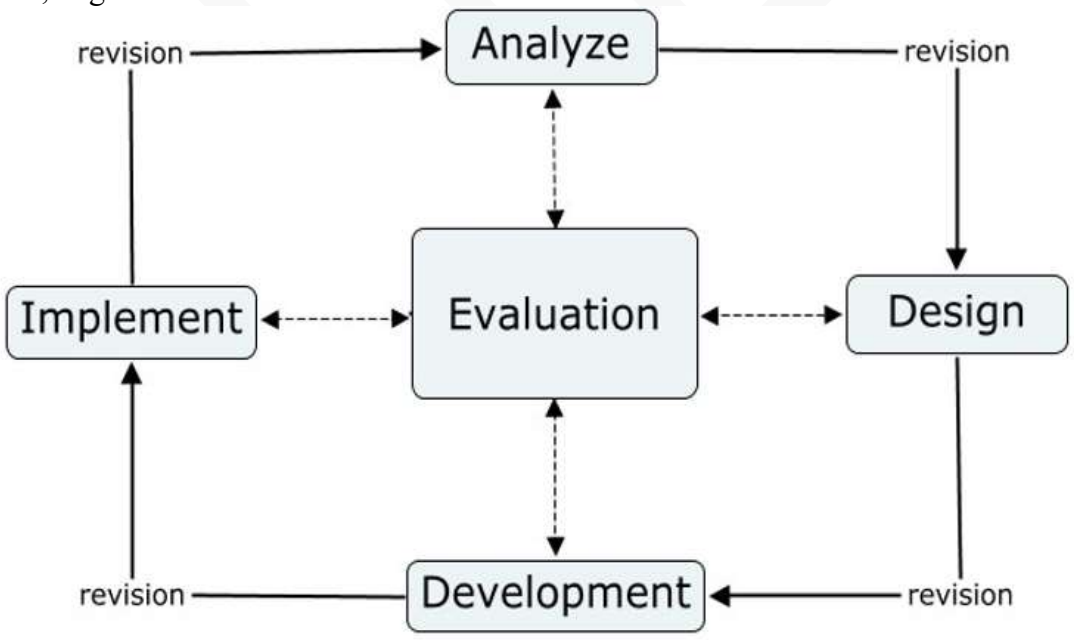


Figure 1: ADDIE MODEL

The design of the instructional content for the computer-assisted instructional package for teaching Mathematics in junior secondary schools was based on the processes of the ADDIE model. ADDIE is an acronym for analysis, design, development, implementation, and evaluation. The stage in the ADDIE instructional design model is adopted in this study. The activities carried out under the ADDIE model are outlined as follows:

Analysis: This is the stage where needs assessment, audience assessment, content/objectives specification, selection of authoring/delivery systems, and planning of evaluation strategies were determined by the researcher. The needs assessment was based on the fact that teaching is enhanced with the use of a computer-assisted instructional package; hence, it was concluded by the researcher that instructional content should be designed for the students using a computer-assisted instructional package for teaching Mathematics. On the learners' assessment, the researcher determined who the users of the instructional content are, and in this case, it is the secondary school students in Osun State. The content selection is mathematics, and the objective is to provide an alternative platform for instructional delivery other than the conventional classroom medium of teaching and learning. The authoring tools for the design of the mathematics instruction are Microsoft PowerPoint (2010), CorelDRAW (4x), and Adobe® Dreamweaver. This connotes that learners who participated in this study used a computer and disc, which were used to design instructional content.

1. **Design:** This is the stage where treatment specification was created, in which how the instructional content was delivered to the selected samples. A prototype of the computer-assisted instructional package for teaching Mathematics in primary schools was designed to ascertain its operation on devices like computers in terms of aesthetics and balancing of text and visuals. The script for the development stage was then written, and screens were formatted based on the medium to be used.

2. **Development:** The design process above was developed through the prototype approach**,** so that the instructional content for the computer-assisted instructional package for teaching Mathematics in primary schools can be subjected to evaluation through implementation. The development of the instructional content was done by the utilization of Microsoft PowerPoint (2010), CorelDRAW (4x), and Adobe® Dreamweaver. The computer-assisted instructional package for teaching Mathematics in primary schools was created with Microsoft PowerPoint (2010). CorelDRAW (4x) was used to create the images, which were exported as JPEG pictures. Each JPEG picture was imported into each slide of the MS PowerPoint.

3. **Implementation:** with the completion of the design and development of the instructional content for a computer-assisted instructional package for teaching Mathematics in secondary schools. At this stage, students were taught using the package on the computer in their schools. Students were assigned to the experimental and control groups based on their schools. The experimental groups were taught using the computer-assisted instructional package for teaching Mathematics in secondary schools, while the control groups were taught using the conventional teaching methods.

4. **Evaluation:** At this stage, the effectiveness and efficiency of the computer-assisted instructional package for teaching Mathematics in secondary schools was determined. Evaluation was also carried out at each stage of the procedures.
However, the authoring tools for the design of the package are Microsoft PowerPoint (2010), CorelDRAW (4x), and Adobe® Dreamweaver. Each of these authoring tools was used to design and develop the instructional content for its delivery through DVD on a computer. The design stage activities included treatment specification, the aesthetic, text, audio, and prototype, and script writing for the computer-assisted instructional package. Finally, the design review was carried out before the actual development of the instructional content for the computer-assisted instructional package. Experts' rating was based on the qualitative and quantitative aspects of the developed computer-assisted instructional Package for teaching mathematics in secondary school, indicating that they are of good quality for the learners. This is in line with Olafare (2021), who reported the computer assisted instructional packages are good for good and suitable for instruction.

Research Question 2: What is the quality of the computer-assisted instructional package for teaching Mathematics in secondary schools as rated by experts?

Table 3: Mean Rating of the Quality of the Computer-Assisted Instructional Package for Teaching Mathematics by Teachers

S/N	Items	Mean
1.	The content is reliable for teaching Mathematics	3.21
2.	Balanced presentation of information on each topic	3.44
3.	Bias-free viewpoints in relation to Mathematics	3.01
4.	Correct use of grammar and Mathematics terms	3.23
5.	Current and error-free information about Mathematics	3.20
6.	Concepts and vocabulary relevant to learners' abilities	3.41
7.	Information relevant to age of target groups' curriculum	3.01
8.	Information of sufficient scope and depth on Mathematics	3.59
9.	Relevant to curriculum needs	3.67
10.	Design of the package is based on reliable learning and instructional theories and is directly related with the content of the curriculum.	3.21
11.	The application of the package is possible in various topics in the curriculum	3.52
12.	The application of the package is possible on issues related with the curriculum	3.21
13.	The package can be used by learners alone, without the need of other instructional objects (i.e book)	3.64
	Grand Mean	3.33

Note: High-2.50-4.00, Low -below 2.50

Table 3 showed a grand mean of 3.33 for the mathematics teachers' rating of the computer-assisted instructional package, which is above the threshold of 2.5. This indicated a positive rating of the instructional package quality on the part of the teachers, which confirmed that the instructional package for teaching mathematics in secondary schools was rated suitable and high for teaching secondary school students when considering the grand mean of 3.70 and mean value of each item.

Data in the table also indicated that all responses to items showed a high level of quality of the computer-assisted instructional package for teaching Mathematics in secondary schools. Addo et al. (2023) examined instructional design models for promoting inclusive, participatory learning in Nigeria. Grounded in constructivism, the paper discussed ADDIE, Rapid, Gagné's Nine Events, and Isman models, highlighting their benefits, implementation challenges, and strategies for improving learner engagement and educational outcomes. Similarly, Umoke et al. (2025) investigated modelling-based instruction among 260 junior secondary students in Ebonyi State, Nigeria. Their quasi-experimental study found significantly higher computer studies interest among students receiving modelling-based instruction than conventional teaching, with a large effect size and no significant gender differences. This is also tantamount to the submission of Adam & Babatunde (2020) who indicated that, the software application package was effective in learning Matrices.

Research Question 3: Is there any difference in the performance of students taught using the computer assisted instructional package for teaching Mathematics and those taught with conventional method in secondary schools?

Table 4: Description of the Performance of students taught using the Computer Assisted Instructional Package for teaching Mathematics and those taught with conventional method in secondary schools

Groups	N	Pre-test Mean	Post-test Mean	Mean Gain Scores
Control	34	12.19	13.55	1.36
Experimental	29	12.23	17.11	4.88

Table 4 showed that the control group had mean performance scores of 12.19 before the treatment and 13.55 after the treatment. The experimental group also had mean performance scores of 12.23 before the treatment and 17.11 after the treatment. It revealed that the control group had a mean difference of 1.36 while the experimental group had a mean difference of 4.88. This implies that the experimental group benefited from the treatment; hence, the computer-assisted instructional package was effective. The finding of this study is in line with the results of Abiodun and Asanre (2025), who found that students' academic achievement in mathematics was significantly impacted by the Computer Assisted Instruction (CAI) approach compared to the lecture method of teaching. The report of this study aligns with the findings of Adamu & Babatunde (2020), who confirmed that there is a significant difference in the mean performance of students taught matrices with Computer Aided Software (CAS) package over those taught with the traditional teaching method, and there is a significant difference in the mean performance of Pretest and Posttest students taught matrices with CAS package. There is also a significant difference between the pretest and posttest mean performance of students taught matrices using the traditional teaching method.

Research Question 4: Is there any difference in the performance of students taught using the computer-assisted instructional package for teaching Mathematics in secondary schools based on gender?

Table 5: Description of the performance of students taught using the Computer-Assisted Instructional Package for teaching Mathematics in secondary schools based on gender

Gender	N	Pre-test Mean	Post-test Mean	Mean Gain Scores
Male	18	9.25	17.72	8.47
Female	11	9.16	17.36	8.02

Table 5 presents the pre-test and post-test mean differences for the experimental group (those exposed to CAI) by gender. Mean gain scores of 8.47 and 8.02 were obtained for males and females, respectively. This indicated a slight difference, with male students performing better than female students. The result of this study disagrees with submission of Abiodun and Asanre (2025), who claimed that there is no discernible difference in the mean accomplishment scores of male and female students in math classes that use computer-assisted instruction. The result of this study contradicts the finding of Fakomogbon et al. (2014) who found that, there was no significant difference between the mean achievement scores of male and female students taught Mathematics with CAI package.

Conclusion

From the findings of this study, it was concluded that the design and development of instructional content for the computer assisted instructional package adequately followed the ADDIE model. The package was of good quality and useful for the learners. It is also worth mentioning that gender has no significant influence on the use of the computer assisted instructional package for teaching mathematics in secondary schools as the package is effective for teaching.

Recommendations

Based on the major findings of this study, the following recommendations are made;
Effort should be put in place by government of the state to recommend computer assisted instructional package for teaching and learning mathematics in secondary schools in the State. This would enhance qualitative and effective teaching and learning experience among secondary school students. The use of the computer assisted instructional package for teaching mathematics among the teachers should be encouraged in secondary schools as it enhances effective learning. More so, gender is not a determinant of the performance of secondary school students when taught using computer assisted instructional package for teaching mathematics. Therefore, teachers should put in more effort on equal distribution of attention to both male and female students.

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