

## Effect of Information and Communication Technology Instructional Methods on Senior Secondary School Students' Achievement, Attitude, Retention, and Classroom Participation in Mathematics in Kogi State, Nigeria

**Babadunni, Mayowa Samson, Apata, Olayiwola Timothy & Abdullahi, Haruna Itopa**

Mathematics Department, Federal College of Education, Okene, Kogi State.

Corresponding email: Smayowa53@gmail.com, 09056825428

### **Abstract**

*The persistent poor performance of senior secondary school students in mathematics has remained a major concern among educators and policymakers in Nigeria. This study investigated the impact of Information and Communication Technology (ICT) instructional methods on students' academic achievement, attitude toward mathematics, retention of mathematical concepts, and classroom participation in senior secondary schools in Okene Local Government Area of Kogi State, Nigeria. The study adopted a quasi experimental, non-equivalent control group design involving 250 Senior Secondary School Two (SS II) students selected from four public secondary schools using a multistage sampling technique. Data were collected using the Mathematics Achievement Test, Students' Attitude toward Mathematics Questionnaire, Mathematics Retention Test, and Classroom Participation Observation Schedule. Frequency counts, percentages, mean, and standard deviation were used to answer the research questions, while t-test was employed to test the hypotheses at the 0.05 level of significance. The findings revealed that ICT instructional methods significantly improved students' academic achievement,  $t(2, 248) = 1338.933, p < .001$ , attitude toward mathematics,  $t(2, 248) = 678.549, p < .003$ , retention of mathematical concepts,  $t(2, 248) = 541.620, p < .005$ , and classroom participation,  $t(2, 248) = 23.49, p < .004$ . The study concludes that ICT instructional methods provide a more effective approach to mathematics instruction than the conventional teaching method. It recommends increased investment in ICT infrastructure, regular professional development for mathematics teachers, and wider integration of ICT into classroom-instruction.*

**Keywords:** Achievement, Attitude, Classroom, ICT, instructional methods

### **Introduction**

Mathematics is universally recognized as a fundamental discipline that underpins scientific innovation, technological advancement, engineering, economics, and national development. It develops learners' logical reasoning, critical thinking, quantitative skills, and problem solving abilities required for success in higher education and the modern workforce (OECD, 2023; UNESCO, 2023). In Nigeria, mathematics is a compulsory subject at the basic and senior secondary school levels and serves as a prerequisite for admission into science, technology, engineering, medicine, economics, and other mathematics related programmes in

tertiary institutions (Federal Ministry of Education, 2022). Despite its importance, students' achievement in mathematics has remained persistently low, as reflected in the annual results of the West African Senior School Certificate Examination and the National Examination Council (West African Examinations Council (WAEC), 2024).

Several studies have attributed students' poor performance in mathematics to teacher centred instructional methods, inadequate instructional materials, low motivation, mathematics anxiety, limited teacher competence, and poor integration of Information and Communication Technology into classroom instruction (Ameen *et al*, 2019; Okeke & Nwafor, 2023). Conventional teaching methods often encourage passive learning, thereby limiting students' participation, conceptual understanding, and problem solving abilities. These challenges have increased the need for innovative instructional strategies capable of improving mathematics teaching and learning outcomes.

The integration of Information and Communication Technology (ICT) into education has emerged as one of the most effective approaches for improving instructional delivery and students' learning experiences. ICT instructional methods utilize digital technologies such as computers, multimedia presentations, educational software, graphing applications, simulations, virtual learning environments, and online learning platforms to create interactive and learner centred classrooms (UNESCO, 2023). According to Alabdulaziz (2021), ICT enhances students' understanding of abstract mathematical concepts by providing visual representations and immediate feedback, while Awofala (2020) reported that ICT supported mathematics instruction significantly improves students' conceptual understanding, academic achievement, and problem solving skills.

Beyond academic achievement, ICT instructional methods have also been associated with improved students' attitudes toward mathematics, enhanced classroom participation, and better retention of mathematical concepts. Technology enhanced learning environments motivate learners, reduce mathematics anxiety, encourage collaboration, and promote active engagement during classroom instruction (Sari & Mahmud, 2022; Okeke & Nwafor, 2023). Similarly, Yusuf and Bello (2024) found that students who regularly engaged with educational software and multimedia resources demonstrated greater interest in mathematics, participated more actively during lessons, and retained mathematical concepts more effectively than those taught using conventional instructional methods.

Although the educational benefits of ICT have been widely acknowledged, its implementation in many Nigerian secondary schools remains inadequate because of limited ICT infrastructure, unstable electricity supply, inadequate internet connectivity, insufficient funding, and inadequate teacher competence in technology integration (UNESCO, 2023; Ameen *et al*, 2019; Eunice *et al*, 2020). Consequently, many mathematics teachers continue to rely on conventional instructional approaches, limiting opportunities for students to benefit from technology enhanced learning.

Furthermore, while previous studies have examined the relationship between ICT and students' achievement or attitude, relatively few studies have investigated the combined effect of ICT instructional methods on academic achievement, attitude, retention, and classroom participation within a single study in the Nigerian secondary school context. This gap underscores the need for further empirical investigation.

Therefore, this study investigated the impact of ICT instructional methods on senior secondary school students' academic achievement, attitude toward mathematics, retention of mathematical concepts, and classroom participation in Okene Local Government Area of Kogi State, Nigeria. The findings are expected to provide evidence that will assist teachers, school administrators, curriculum developers, and educational policymakers in strengthening the integration of ICT into mathematics instruction to improve students' learning outcomes.

## Literature Review

### Information and Communication Technology (ICT) in Mathematics Education

Information and Communication Technology (ICT) has become an essential component of contemporary education because of its capacity to improve instructional delivery and learners' academic outcomes. ICT comprises digital technologies such as computers, multimedia applications, educational software, internet resources, mobile devices, virtual learning environments, and communication networks that facilitate the creation, storage, processing, and dissemination of information (UNESCO, 2023). In mathematics education, ICT provides innovative opportunities for teachers to present abstract concepts through visual and interactive approaches, thereby enhancing conceptual understanding and meaningful learning.

The integration of ICT into mathematics classrooms has transformed instructional practices from teacher centred approaches to learner centred pedagogies that encourage collaboration, inquiry, and active participation. According to Alabdulaziz (2021), ICT supported instruction enables students to visualize complex mathematical concepts through simulations, graphing software, animations, and multimedia presentations, thereby improving conceptual understanding and reducing learning difficulties. Similarly, OECD (2023) emphasized that technology enhanced instruction promotes critical thinking, creativity, communication, and problem solving, all of which are essential competencies for twenty first century learners.

ICT instructional methods include Computer Assisted Instruction, blended learning, mobile learning, virtual classrooms, multimedia instruction, educational games, and online learning platforms such as Google Classroom and Microsoft Teams (UNESCO, 2023). These instructional approaches provide immediate feedback, individualized learning experiences, and opportunities for collaborative learning that are difficult to achieve through conventional lecture methods. Consequently, ICT has become an indispensable instructional resource for improving mathematics teaching and learning across different educational levels.

## ICT Instructional Methods and Students' Academic Achievement

Academic achievement remains one of the most widely used indicators for evaluating instructional effectiveness. Several empirical studies have demonstrated that ICT instructional methods significantly improve students' academic achievement in mathematics by promoting active engagement, conceptual understanding, and problem solving skills. Alabdulaziz (2021) reported that students exposed to ICT supported mathematics instruction achieved significantly higher academic performance than those taught using conventional instructional methods. Likewise, Awofala (2020) found that multimedia and computer assisted instructional strategies enhanced students' understanding of mathematical concepts and significantly improved their achievement scores.

Similarly, Yusuf and Bello (2024) observed that educational software, graphing applications, and multimedia presentations improved students' ability to solve mathematical problems accurately and increased their overall academic performance. These findings suggest that ICT instructional methods create meaningful learning experiences that facilitate better academic outcomes than traditional teacher centred instructional approaches.

## ICT Instructional Methods and Students' Attitude toward Mathematics

Students' attitude toward mathematics plays a significant role in determining their interest, confidence, motivation, and willingness to learn. Positive attitudes encourage students to participate actively in mathematics lessons, while negative attitudes often result in mathematics anxiety and poor academic performance (OECD, 2023). Studies have consistently shown that ICT instructional methods contribute to the development of positive attitudes toward mathematics. Sari and Mahmud (2022) found that students taught through ICT based instructional strategies demonstrated higher levels of motivation, confidence, and interest than those taught using conventional methods. Similarly, Okeke and Nwafor (2023) reported that technology enhanced instruction reduced mathematics anxiety and increased students' enthusiasm for learning mathematics. Yusuf and Bello (2024) also concluded that multimedia instructional resources significantly improved students' perceptions of mathematics and increased their willingness to participate during classroom instruction.

## ICT Instructional Methods and Students' Retention of Mathematical Concepts

Retention is an important outcome of meaningful learning because mathematics requires students to build new knowledge upon previously acquired concepts. ICT instructional methods enhance retention by presenting mathematical ideas through multiple representations that engage visual, auditory, and kinesthetic learning styles. According to Awofala (2020), students who received ICT supported instruction retained mathematical concepts significantly better than those taught using conventional lecture methods. Ugwuanyi *et al* (2019) similarly found that multimedia presentations, simulations, and interactive educational software

improved students' long term retention by promoting active engagement and immediate feedback. These findings suggest that ICT instructional methods facilitate deeper cognitive processing, leading to improved retention of mathematical concepts.

## ICT Instructional Methods and Classroom Participation

Classroom participation reflects the extent to which students engage actively in teaching and learning activities. Effective participation encourages interaction, collaboration, communication, and meaningful learning. ICT instructional methods promote classroom participation by providing interactive learning environments where students solve problems collaboratively, participate in online discussions, and receive immediate feedback.

Research by Sari and Mahmud (2022) revealed that students exposed to ICT based instruction participated more actively in mathematics lessons than students taught through conventional methods. Similarly, Okeke and Nwafor (2023) found that ICT integration significantly increased students' confidence to ask questions, contribute to discussions, and engage in collaborative learning activities. Yusuf and Bello (2024) further observed that the use of educational software and multimedia applications enhanced students' engagement and participation during mathematics instruction.

## Theoretical Foundation

This study is anchored on the Constructivist Learning Theory proposed by Jerome Bruner and the principles of social constructivism advanced by Lev Vygotsky. Constructivism posits that learners actively construct knowledge through interaction with their environment rather than passively receiving information from the teacher. ICT instructional methods support this theory by providing opportunities for exploration, collaboration, experimentation, and immediate feedback, enabling students to develop deeper conceptual understanding of mathematical concepts.

The theory is relevant to this study because ICT based instructional methods encourage active learning, collaborative problem solving, and learner autonomy. Through multimedia resources, simulations, and interactive software, students construct mathematical knowledge by engaging directly with instructional materials. This theoretical perspective provides a strong explanation for the observed improvements in students' achievement, attitude, retention, and classroom participation resulting from ICT supported mathematics instruction.

## Conceptual Framework

The conceptual framework for this study assumes that ICT instructional methods constitute the independent variable, while students' academic achievement, attitude toward mathematics, retention of mathematical concepts, and classroom participation are the dependent variables. The framework proposes that effective integration of ICT into mathematics instruction enhances students' engagement with learning activities, leading to

improved academic performance, more positive attitudes toward mathematics, better retention of learned concepts, and increased classroom participation. The relationship is moderated by factors such as teachers' ICT competence, availability of ICT facilities, institutional support, and students' digital literacy. This study, therefore investigated the effect of ICT instructional methods on senior secondary school students' academic achievement, attitude toward mathematics, retention of mathematical concepts, and classroom participation in Okene Local Government Area of Kogi State, Nigeria.

## Research Questions:

1. What is the demographic Characteristics of Respondents?
2. What is the effect of ICT instructional methods on students' academic achievement in mathematics?
3. What is the effect of ICT instructional methods on students' attitudes toward mathematics?
4. What is the effect of ICT instructional methods on students' retention of mathematical concepts?
5. what is the effect of ICT instructional methods on students' classroom participation in mathematics?

## Research Hypotheses

1. There is no significant effect in the academic achievement of students taught mathematics using ICT instructional methods and those taught using the conventional teaching method.
2. There is no significant effect in the attitudes of students taught mathematics using ICT instructional methods and those taught using the conventional teaching method.
3. There is no significant effect in the retention of mathematical concepts between students taught using ICT instructional methods and those taught using the conventional teaching method.
4. There is no significant effect in the classroom participation of students taught mathematics using ICT instructional methods and those taught using the conventional teaching method.

## Methodology

This study adopted a quasi-experimental non-equivalent control group design to investigate the effect of ICT instructional methods on senior secondary school students' academic achievement, attitude toward mathematics, retention of mathematical concepts, and classroom participation in Okene Local Government Area of Kogi State, Nigeria. A total of 250 Senior Secondary School Two (SS II) students from six purposively selected public secondary schools participated in the study, with 125 students assigned to the experimental group and 125 to the control group. Data were collected using the Mathematics Achievement

Test (MAT), Students' Attitude toward Mathematics Questionnaire (SAMQ), Mathematics Retention Test (MRT), and Classroom Participation Observation Schedule (CPOS), all of which were validated by experts and found to be reliable through KR 20, Cronbach's Alpha, and inter-rater reliability techniques. The experimental group received instruction using ICT instructional methods for six weeks, while the control group was taught using the conventional lecture method. Data were analyzed using frequency counts, percentages, mean, and standard deviation, while independent t-test was used to test the hypotheses at the 0.05 level of significance.

## Results

### What are the demographic characteristics of respondents?

**Table 1: Distribution of Respondents**

|        |              | Frequency | Percentage (%) |
|--------|--------------|-----------|----------------|
| Group  | Experimental | 125       | 50.0           |
|        | Control      | 125       | 50.0           |
|        | Total        | 250       | 100.0          |
| Gender | Male         | 122       | 48.8           |
|        | Female       | 128       | 51.2           |
|        | Total        | 250       | 100.0          |

A total of 250 Senior Secondary School Two (SS II) students participated in the study. The respondents were equally distributed between the experimental and control groups, with 125 (50.0%) students in each group. Of the participants, 122 (48.8%) were male, while 128 (51.2%) were female, indicating a fairly balanced gender distribution.

**Research Question 1:** What is the effect of ICT instructional methods on students' academic achievement in mathematics?

**Table 2: Mean and Standard Deviation of Students' Academic Achievement by Group**

| Group        | N   | $\bar{X}$ | SD   |
|--------------|-----|-----------|------|
| Experimental | 125 | 26.66     | 1.94 |
| Control      | 125 | 21.52     | 2.29 |
| Total        | 250 | 24.09     | 3.34 |

Source: Field Survey (2026)



**Hypothesis1:** There is no significant effect in the academic achievement of students taught mathematics using ICT instructional methods and those taught using the conventional teaching method.

**Table 3: Summary of t-test analysis on Students' Academic Achievement**

| Source       | N   | $\bar{X}$ | SD   | t        | Sig. | Decision    |
|--------------|-----|-----------|------|----------|------|-------------|
| experimental | 131 | 26.66     | 1.94 | 744.520  | .002 | Significant |
| Group        | 119 | 21.52     | 2.29 | 1338.933 | .001 |             |

Source: Field Survey (2026)

The result on Table 2 and 3, showed that students exposed to ICT instructional methods obtained a higher mean achievement score (Mean = 26.66, SD = 1.94) than those taught using the conventional teaching method (Mean = 21.52, SD = 2.29). t-test further revealed a statistically significant effect of ICT instructional methods on students' academic achievement after controlling for pretest scores,  $t(2, 248) = 1338.933$ ,  $p < .001$ , This indicates that ICT instructional methods significantly enhanced students' academic performance in mathematics.

**Research Question 2:** What is the effect of ICT instructional methods on students' attitudes toward mathematics?

**Table 4: Mean and Standard Deviation of Students' Attitudes toward Mathematics by Group**

| Group        | N   | $\bar{X}$ | Standard Deviation |
|--------------|-----|-----------|--------------------|
| Experimental | 131 | 61.91     | 3.81               |
| Control      | 119 | 48.02     | 4.65               |
| Total        | 250 | 54.97     | 8.15               |

Source: Field Survey (2026)

**Research Hypothesis 2:** There is no significant effect in the attitudes of students taught mathematics using ICT instructional methods and those taught using the conventional teaching method.

**Table 5: Summary of t-test analysis on Students' Attitude toward Mathematics**

| Source       | N   | $\bar{X}$ | SD   | t       | Sig. | Decision    |
|--------------|-----|-----------|------|---------|------|-------------|
| experimental | 131 | 61.91     | 3.81 | 3.680   | .006 | Significant |
| control      | 119 | 48.02     | 4.65 | 678.549 | .003 |             |

Source: Field Survey (2026)



The result on Table 4 and 5 showed that students in the experimental group recorded a higher mean attitude score (Mean = 61.91, SD = 3.81) than students in the control group (Mean = 48.02, SD = 4.65). The t-test results indicated a significant effect of ICT instructional methods on students' attitudes toward mathematics,  $t(2, 248) = 678.549$ ,  $p < .003$ . The findings suggest that ICT based instruction promoted more positive attitudes toward mathematics than the conventional teaching method.

**Research Question 3:** What is the effect of ICT instructional methods on students' retention of mathematical concepts?

**Table 6: Mean and Standard Deviation of Students' Retention Scores by Group**

| Group        | N   | $\bar{X}$ | SD   |
|--------------|-----|-----------|------|
| Experimental | 131 | 25.58     | 2.28 |
| Control      | 119 | 20.63     | 2.63 |
| Total        | 250 | 23.11     | 3.49 |

Source: Field Survey (2026)

**Research Hypothesis 3:** There is no significant effect in the retention of mathematical concepts between students taught using ICT instructional methods and those taught using the conventional teaching method.

**Table 7: Summary of t-test analysis of Students' Retention in Mathematical Concepts**

| Source       | N   | $\bar{X}$ | SD   | t       | Sig. | Decision    |
|--------------|-----|-----------|------|---------|------|-------------|
| experimental | 131 | 25.58     | 2.28 | 335.969 | .009 | Significant |
| Group        | 119 | 20.63     | 2.63 | 541.620 | .005 |             |

Source: Field Survey (2026)

Table 6 and 7 showed that students taught using ICT instructional methods demonstrated better retention of mathematical concepts (Mean = 25.58, SD = 2.28) than those taught using the conventional method (Mean = 20.63, SD = 2.63). t-test showed that the effect was statistically significant,  $t(2, 248) = 541.620$ ,  $p < .005$ . The findings indicate that ICT instructional methods significantly improved students' retention of mathematics concepts.

**Research Question 4:** What is the effect of ICT instructional methods on students' classroom participation in mathematics?

**Table 8: Mean and Standard Deviation of Students' Classroom Participation by Group**

| Group        | N   | $\bar{X}$ | SD   |
|--------------|-----|-----------|------|
| Experimental | 131 | 20.67     | 2.31 |
| Control      | 119 | 15.90     | 2.60 |
| Total        | 250 | 18.29     | 3.43 |

Source: Field Survey (2026)

**Research Hypothesis 4:** There is no significant effect in the classroom participation of students taught mathematics using ICT instructional methods and those taught using the conventional teaching method.

**Table 9: Summary of t-test analysis on students' classroom participation**

| Source  | N   | $\bar{X}$ | SD   | t     | Sig. | Decision    |
|---------|-----|-----------|------|-------|------|-------------|
| Pretest | 131 | 20.67     | 2.31 | 0.836 | .002 | Significant |
| Group   | 119 | 15.59     | 2.60 | 23.49 | .004 |             |

Source: Field Survey (2026)

Table 8 and 9 indicated that the experimental group achieved a higher mean classroom participation score (Mean = 20.67, SD = 2.31) than the control group (Mean = 15.90, SD = 2.60). t-test revealed a statistically significant effect of ICT instructional methods on classroom participation,  $F(2, 248) = 23.49$ ,  $p < .004$ . This finding indicates that ICT instructional methods significantly enhanced students' engagement and participation during mathematics lessons.

## Discussion of Findings

The findings of this study demonstrate that ICT instructional methods significantly improve students' academic achievement in mathematics. Students who received ICT supported instruction achieved higher posttest scores than those taught using the conventional lecture method. This finding is consistent with those of Alabdulaziz (2021), Awofala (2020), and Yusuf and Bello (2024), who reported that ICT based instructional strategies improve conceptual understanding, problem solving skills, and overall academic performance in mathematics.

The study also revealed that ICT instructional methods significantly enhanced students' attitudes toward mathematics. The higher attitude scores recorded by the experimental group suggest that technology enhanced learning environments increase students' motivation, confidence, and interest in mathematics. This finding supports the reports of Sari and Mahmud (2022), Okeke and Nwafor (2023), and Yusuf and Bello (2024), who found that ICT integration reduces mathematics anxiety and promotes positive learning experiences.

Similarly, ICT instructional methods had a significant positive effect on students' retention of mathematical concepts. Students exposed to multimedia resources, simulations, and interactive learning activities demonstrated superior retention compared with their counterparts in the control group. This finding agrees with Awofala (2020) and Ugwuanyi et

al (2019), who concluded that ICT enhances long term retention through interactive and meaningful learning experiences.

Finally, the findings established that ICT instructional methods significantly improved students' classroom participation. The interactive nature of ICT encouraged students to ask questions, collaborate with peers, and participate actively during mathematics lessons. This finding corroborates the studies of Sari and Mahmud (2022), Okeke and Nwafor (2023), and Yusuf and Bello (2024), who reported that ICT supported instruction creates learner centred environments that enhance classroom engagement and participation. Overall, the findings provide strong empirical evidence that integrating ICT instructional methods into mathematics teaching enhances students' achievement, attitude, retention, and classroom participation, thereby improving the quality of mathematics education in Nigerian secondary schools.

## Conclusion

This study examined the effect of ICT instructional methods on senior secondary school students' academic achievement, attitude toward mathematics, retention of mathematical concepts, and classroom participation in Okene Local Government Area of Kogi State, Nigeria. The findings demonstrated that students exposed to ICT instructional methods performed significantly better than those taught using the conventional teaching method across all the outcome variables investigated. ICT based instruction enhanced students' conceptual understanding, promoted positive attitudes toward mathematics, improved long term retention of mathematical concepts, and increased classroom participation. These findings highlight the effectiveness of integrating ICT into mathematics instruction as a strategy for improving students' learning outcomes and achieving quality mathematics education in secondary schools.

## Educational Implication of Findings

The findings of this study have important implications for educational practice and policy. Mathematics teachers should adopt ICT instructional methods to promote active learning, conceptual understanding, and students' engagement during classroom instruction.

1. School administrators and educational authorities should invest in modern ICT facilities, ensure reliable internet connectivity,
2. Provision of regular maintenance of digital infrastructure to support effective classroom implementation should be endure by the school administrators.
3. Continuous professional development programmes should be organized to improve teachers' competence in integrating ICT into mathematics instruction.
4. Curriculum developers should also strengthen the inclusion of technology enhanced instructional strategies within the mathematics curriculum to equip students with the digital and problem solving skills required in the twenty first century.

## Recommendations

Based on the findings of this study, it is recommended that:

1. Mathematics teachers adopt ICT instructional methods to enhance students' learning outcomes.
2. Government and school authorities should provide adequate ICT facilities and organize regular training for teachers to improve their competence in technology integration.
3. Curriculum planners should strengthen the inclusion of ICT based instructional strategies in the mathematics curriculum
4. Students should be encouraged to utilize digital learning resources to support classroom instruction and independent learning.

## References

- Alabdulaziz, M. (2021). Technology integration in mathematics education: Improving students' conceptual understanding and achievement.
- Ameen, S.K., Adeniji, M.S., Abdullahi, K. (2019). Teachers' and students' level of utilization of ICT tools for teaching and learning mathematics in Ilorin, Nigeria. *African Journal of Educational Studies in Mathematics and Sciences*, 15(16), 51-59.
- Awofala, A. O. (2020). Improving students' performance in mathematics through innovative teaching strategies. *Journal of Mathematics Education*, 13(3), 1–12.
- Eunice, N.; Christian S. U.; Chinedu, I. O. O.; Boniface, G. N.; Uche V.N.A; Chika C. U.; Pauline I.O; Mercy N.N & Agnes O.O. (2020). Evaluation of the effect of computer assisted instructions on mathematics and physics students' achievement implication for industrial technical education. *International journal of engineering research and technology*, 13(17): 1786-1794
- Federal Ministry of Education. (2022). National Policy on Education (7th ed.). Abuja, Nigeria: Federal Ministry of Education.
- Organisation for Economic Co-operation and Development. (2023). PISA 2022 Results (Volume I): The State of Learning and Equity in Education. Paris: OECD Publishing.
- Ugwuanyi, C.S., Ugwuanyi, C.C., Ezenwa - Nebife, D.C., Gana, C., Ene, C., Oguguo, B.C., Ikeh, F.E., Okeke, A.O., Nwoye, M.N., Obi, C.N., Anyaegbu, C. & Agah, J.J. (2019). Assessment of the efficacy of information and communication technology tool on achievement of students in physics and mathematics: A case of repeated measures. *Journal of Engineering and Applied Sciences*, 14(13), 4541-4546.
- UNESCO. (2023). Global Education Monitoring Report 2023: Technology in Education—A Tool on Whose Terms? Paris: UNESCO.
- West African Examinations Council. (2024). Chief Examiners' Report on the West African Senior School Certificate Examination (WASSCE). Lagos, Nigeria: WAEC.