

The Impact of Digital Learning Tools on the Academic Performance of Secondary School Students in Nigeria: An Empirical Review

Aliyu Sahabi

Department of General Education
Federal College of Education, Keana, Nasarawa State.
<https://doi.org/10.56201/ijee.v12.no.3.2026.pg294.304>

Abstract

Nigeria's National Digital Learning Policy promises inclusive digital learning for all, yet it remains unclear what digital tools actually do for secondary school students' academic performance. This study reviewed empirical evidence on the impact of digital learning tools on the academic performance of secondary school students in Nigeria. A narrative, thematic review design was adopted. Twelve Nigerian studies published between 2011 and 2024 and covering eight states, comprising five experiments, two meta-analyses, one programme evaluation, three surveys and one national panel survey, were identified through Google Scholar, DOAJ, RePEc/IDEAS and university repositories, and synthesised under six themes. The review found that teacher-led computer-assisted instruction and computer animation generally improved achievement in mathematics and the sciences, although the gains varied by subject, with a mean effect size of 0.52 across science subjects but only 0.05 in Chemistry, and were sometimes smaller than those of non-digital methods such as problem-solving. By contrast, Osun State's Opon-imo tablet programme was associated with lower English Language performance, and findings on social media use were mixed. Limited ICT facilities, low teacher competence, poor connectivity and unstable electricity restricted the benefits of digital learning, while gender made no significant difference. The study concludes that the value of digital tools depends less on the devices themselves than on how teachers use them and whether students can access them. It recommends teacher-led integration rather than device distribution alone, continuous teacher training, investment in power and connectivity, and more rigorous research, particularly in Northern Nigeria.

Keywords: *digital learning tools, computer-assisted instruction, academic performance, secondary school students, empirical review, Nigeria*

1.1 Introduction

This paper reviews empirical studies that bear on the impact of digital learning tools on the academic performance of secondary school students in Nigeria. For each study, the purpose, design, setting, sample, instruments, method of analysis and main findings are presented. The study is then related to the present investigation, and the point at which it differs or leaves a gap is noted. The review covers Nigerian studies published between 2011 and 2024. They are grouped into six themes: computer-assisted instruction; computer animation and multimedia; meta-analytic evidence; large-scale device programmes; students' use of social media and personal technology; and teachers' ICT capacity and students' access to digital learning. The objectives of the study and the method used for the review are presented first. The section closes with a summary of the reviewed studies and the gaps the present study seeks to fill, after which the findings of the review, a conclusion and recommendations are presented.

Throughout, “the present study” refers to an investigation of how digital learning tools affect the academic performance of secondary school students in Nigeria. It is set against the background of the National Digital Learning Policy, which commits government to “inclusive and ubiquitous digital learning for all Nigerians” (Federal Ministry of Education [FME], 2023).

1.2 Objectives of the Study

The main objective of this study is to review empirical evidence on the impact of digital learning tools on the academic performance of secondary school students in Nigeria. Specifically, the study seeks to:

1. examine the effect of teacher-led digital instructional tools, such as computer-assisted instruction, computer animation and multimedia, on students’ academic achievement;
2. assess the impact of large-scale device programmes and students’ personal use of technology, including social media, on their academic performance;
3. determine how teachers’ ICT capacity and students’ access to digital learning facilities shape the effect of digital tools on academic performance; and
4. identify gaps in the existing Nigerian literature to guide future research, policy and practice on digital learning in secondary schools.

1.3 Methodology

This paper adopted a narrative, thematic review design. Pooling the studies statistically was not appropriate because they differ widely in design, subject, outcome measure and the statistics they report, and several give no effect sizes. Instead, each study was described in a consistent way, and the evidence was then compared and synthesised by theme.

Search and sources. Studies were identified through searches of Google Scholar, the Directory of Open Access Journals (DOAJ), RePEc/IDEAS and the institutional repositories of Nigerian universities, including the University of Ilorin (UILSpace) and Lead City University. Search terms combined “computer-assisted instruction”, “digital learning tools”, “ICT”, “e-learning”, “computer animation”, “tablet” and “social media” with “academic performance”, “achievement”, “secondary school” and “Nigeria”. The reference lists of the studies retrieved were also checked for further sources.

Inclusion criteria. A study was included if it (a) was conducted in Nigeria; (b) involved secondary school students or the teachers who teach them; (c) examined a digital learning tool, students’ use of personal technology, or the conditions under which digital learning takes place; (d) reported empirical data or a synthesis of empirical studies; and (e) was published between 2011 and 2024. Opinion papers and studies of tertiary institutions were excluded.

Studies reviewed. Twelve studies met these criteria (Table 1). They comprise five experimental or quasi-experimental studies, two meta-analyses, one ex-post facto programme evaluation, three descriptive or correlational surveys and one national panel survey conducted during the COVID-19 school closures. Together they cover eight states (Akwa Ibom, Anambra, Delta, Kwara, Niger, Osun, Oyo and Rivers) as well as national samples.

Data extraction and synthesis. For each study, the purpose, design, setting, sample, instruments, method of analysis and main findings were extracted using a common template. The studies were then grouped into six themes, and findings were compared within and across themes, with effect sizes and test statistics reported wherever the original authors provided them. Each study was also appraised for the strength of its design, the size and spread of its sample and the completeness of its reporting; these appraisals inform the gaps identified in

Section 2.7. The National Digital Learning Policy (FME, 2023) served as the policy reference point for interpreting the evidence.

2.1 Computer-Assisted Instruction and Students' Academic Achievement

The effect of computer-assisted instruction (CAI) on secondary school students' achievement in ecological concepts was examined in the Aguata Education Zone of Anambra State (Nkemdilim & Okeke, 2014). The researchers adopted a quasi-experimental, pretest-posttest non-equivalent control group design. The sample was 66 Senior Secondary Two (SS2) biology students drawn from two randomly selected co-educational schools. One group was taught ecology with CAI, and the other was taught with a modified lecture method. Achievement was measured with the Biology Achievement Test on Ecology (BATEC). The results showed that students taught with CAI achieved significantly higher scores than those taught by the lecture method. Male students scored slightly higher than female students in both groups, but the gender difference was not significant. The study relates to the present work because it tests a digital tool against conventional teaching at senior secondary level. However, it was limited to one biology topic in one education zone, and the abstract does not report effect sizes, so the size of the benefit cannot be judged.

In Rivers State, the effect of CAI on mathematics achievement was investigated among senior secondary students in Kpor, Gokana Local Government Area (Ukaigwe & Goi-tanen, 2022). The study used a quasi-experimental design. From a population of 215 students, 35 were selected by simple random sampling. Data were collected with a multiple-choice mathematics achievement test; whose reliability coefficient was 0.81. Students taught with CAI performed better than those taught with traditional methods, and the CAI group showed a significant gain from pretest to posttest. The authors recommended that computers and educational software be built into the mathematics curriculum from junior secondary level. This study supports the view that digital tools can raise achievement in a core subject. Its very small sample from a single school, however, limits how far its results can be generalised, which the present study seeks to address by drawing on wider evidence.

A related study in Oluyole Local Government Area of Oyo State examined the effect of CAI on senior secondary students' achievement in geometry, together with the roles of motivation and attitude (Turabia, 2024). A quasi-experimental design was adopted, and 150 students were assigned to a CAI group or a control group taught by conventional methods. The instruments were a Geometric Achievement Test ($KR-20 = 0.81$) and questionnaires on motivation ($\alpha = 0.73$) and attitude ($\alpha = 0.76$). Data were analysed using analysis of covariance (ANCOVA). The CAI group significantly outperformed the control group, $F(1,145) = 54.58$, $p < .05$. Motivation, $F(1,145) = 5.58$, and attitude, $F(1,145) = 6.22$, each had a significant effect on achievement, and together they moderated the effect of CAI, $F(1,134) = 6.35$, $p < .05$. This study is closely related to the present one because it shows that the benefit of a digital tool depends partly on learner characteristics. It differs in that it focused on a single topic in one local government area and did not consider teacher or infrastructure factors.

Not every study has found CAI beneficial. In Osun State, the effect of CAI on junior secondary school students' achievement in Social Studies was examined (Adeyemi, 2012). The study adopted a 2×2 factorial design, with teaching method (CAI versus conventional) and academic ability (high versus low) as factors. The sample consisted of 160 students selected by simple random sampling from four co-educational public secondary schools in Osogbo and Ife Central Local Government Areas. Data were analysed with analysis of variance. Unlike most other studies in this group, the study found no significant main effect of CAI on achievement, $F(1,153) = 0.42$, $p > .05$. Academic ability had a significant effect, $F(1,153) = 7.85$, $p < .05$, with high-ability students scoring higher, while the interaction between method and ability was not significant. The author recommended that schools be given adequate facilities for CAI to

be used effectively. This study is important to the present review because it shows that CAI does not always improve achievement. It differs from the present study in focusing on junior secondary students and on a humanities subject rather than science or mathematics.

2.2 Computer Animation, Multimedia and Students' Learning Outcomes

The effect of computer animation instruction on senior school students' learning outcomes in atomic and nuclear physics was investigated in Kwara State (Shehu et al., 2024). The researchers used a pretest-posttest, non-randomised, non-equivalent control group design. Multi-stage sampling was used to select two of the state's sixteen local government areas and two co-educational public senior secondary schools within them. The sample was two intact classes with a total of 177 SS3 physics students. The experimental group was taught with computer animation, while the control group was taught conventionally. Students' performance and retention were measured after teaching. The experimental group scored significantly higher than the control group on both performance and retention, and neither gender nor score level had a significant effect. The authors recommended that federal and state ministries of education train teachers in the use of computer animation through workshops and seminars.

This study is relevant to the present work because it shows that a well-matched digital tool can improve both immediate performance and longer-term retention in an abstract science topic. Retention matters because external examinations such as WAEC and NECO are written months after the topic is taught. The study, however, used intact classes rather than random assignment, so pre-existing differences between the two schools may have influenced the results. It also did not examine whether teachers could sustain the approach without researcher support, which is one of the concerns of the present study.

2.3 Meta-Analytic Evidence on Computer-Assisted Instruction

A meta-analysis of effect sizes from CAI studies in science education gives a broader picture of the evidence (Idris et al., 2018). From 545 research projects completed between 2006 and 2015 in the Department of Science Education, Federal University of Technology, Minna, the authors purposively selected 78 reports that dealt with CAI. Effect sizes were calculated for each study and compared across subjects and years. The overall mean effect size across five subjects was 0.52, which the authors described as large. By subject, the effect sizes were 0.57 for Physics, 0.48 for Geography, 0.46 for Biology, 0.40 for Mathematics and only 0.05 for Chemistry. Neither subject nor year of study produced a significant difference in effect sizes. The authors recommended wider use of CAI in science teaching and urged researchers to report effect sizes in experimental studies. This work is valuable to the present study because it pulls together a large body of local experiments. Its main limitation is that all the studies came from one university department, which may have shared supervisors, instruments and methods, so the pooled estimate may not represent Nigerian research as a whole.

A second meta-analytic review compared the effect of different teaching methods on students' academic performance in chemistry in Nigeria (Okwuduba & Okigbo, 2018). They included 51 Nigerian studies published between 1990 and 2010 and used a random-effects model to deal with variation between studies. The overall effect size across methods was 0.147. Computer-assisted instruction produced an effect size of 0.146, and games, simulations and animations produced 0.173. These were smaller than the effects of problem-solving (0.315), cooperative learning or student grouping (0.218) and the use of instructional materials (0.208). Mastery learning (-0.013) and constructivist or concept-mapping approaches (-0.203) showed negligible or negative effects. This review relates to the present study because it places digital tools alongside other teaching methods rather than only against the lecture method. It shows that CAI helps in chemistry, but less than some approaches that need no technology. It differs

from the present study in covering only one subject, and its studies end in 2010, before smartphones and tablets became common among Nigerian students.

2.4 Large-Scale Device Programmes

The impact of Opon-imo, the tablet programme introduced by the Osun State Government in 2013, on senior secondary students' academic performance has also been assessed (Daramola et al., 2015). The tablets were preloaded with e-textbooks, past questions and other learning materials. The study adopted an ex-post facto design. Using multi-stage stratified and purposive sampling, the researchers drew 440 Senior Secondary Three (SS3) students from across the state. The focus was on performance in English Language. The results showed that students' performance in English Language was below average and that use of the tablet had a significant negative impact on that performance. The impact did not differ by gender or senatorial district, but it did differ by students' subject combination.

This is one of very few Nigerian studies to evaluate a state-wide digital learning programme rather than a single classroom experiment, which makes it central to the present study. Its finding runs against the generally positive results of the CAI experiments reviewed above. It suggests that giving students devices without structured classroom use and teacher support may not improve, and may even harm, achievement. Because the design was ex-post facto, the study cannot prove that the tablets caused the lower scores, as students who relied heavily on the device may have differed in other ways. The study also examined only one subject. The present study builds on it by comparing tool-based programmes with teacher-led uses of technology.

2.5 Social Media, Smartphones and Students' Academic Performance

In Uyo, Akwa Ibom State, researchers examined how social media use affects the academic performance of senior secondary school students (Asanga et al., 2023). The study adopted a descriptive survey design. The population was about 2,500 SS2 students studying Government in Uyo in the 2020/2021 session. Two hundred students were sampled from four schools, and 168 questionnaires (84%) were returned and used. Data were collected with a self-developed four-point Likert questionnaire, validated by experts and with a split-half reliability of $r = 0.85$, together with an achievement test. Data were analysed using frequencies, percentages, means, standard deviations, chi-square, t-test and Pearson correlation at the 0.05 level. About 84.5% of respondents agreed that they owned a social media account, and 82.1% agreed that they spent at least two hours online each day. Students agreed that social media distracted them from their studies. On the achievement test, the mean score was 24.1%, below the 40% pass mark. Social media use was found to be significant ($\chi^2 = 59.85$, critical value = 7.82), with no significant difference between male and female students ($t = 0.08$). The authors reported a significant relationship between social media use and academic performance.

This study is related to the present one because it looks at the most common form of digital technology in students' hands. However, the reported correlation coefficient is not given, and some tables are internally inconsistent, so the strength of the relationship should be treated with caution. The sample was also limited to one subject group in one city.

In Delta State, the influence of social media usage on science students' academic achievement and behaviour was investigated in public and private schools (Atomatofa et al., 2024). The sample comprised 180 junior secondary students who used Android phones for social media after school. Data were collected with a Social Media Time Questionnaire, and students' 2020/2021 academic results were used as the achievement measure. Data were analysed with descriptive statistics, t-test and two-way analysis of variance. Students in private schools had slightly higher Basic Science achievement, while those in public schools had slightly better behaviour ratings, but neither difference was significant ($p = .242$ and $p = .656$). There was no significant interaction between time spent on social media and school type for either

achievement ($p = .549$) or behaviour ($p = .470$). The authors nevertheless recommended that students reduce social media use and increase study time.

Taken together, the two studies show that the link between social media and performance is not settled. The Uyo study points to harm from heavy use, while the Delta study found no clear effect. Both are correlational and rely on self-reported use, so neither can establish cause. The present study differs by considering personal technology use alongside planned, school-based digital tools.

2.6 Teachers' ICT Capacity and Students' Access to Digital Learning

Secondary school teachers' use of information and communication technology (ICT) was assessed in Oyo Metropolis, Oyo State (Obakhume, 2011). The study adopted a descriptive survey design. The population consisted of 120 secondary school teachers, and data were collected with a questionnaire and analysed using frequency counts and simple percentages. The findings showed that ICT facilities were not available in most of the schools covered and that most of the teachers sampled were not competent in the use of ICT. This study relates to the present investigation because teachers are the main channel through which digital tools reach students. If facilities are absent and teachers lack the skills, positive results from controlled experiments are unlikely to be repeated in ordinary classrooms. The study is now more than a decade old, and it did not link teachers' competence to students' performance, which the present study considers. A study for the Research on Improving Systems of Education (RISE) programme examined how Nigerian students continued learning during the COVID-19 school closures of 2020 and the role of parental investment (Ogenyi, 2022). The study drew on survey data collected monthly from March to July 2020. After the first closures, about 38% of students were not involved in any educational activity, and only 19% had contact with their teachers. Students relied mainly on radio educational programmes (up to 51.1% in June), television programmes (up to 46.7%) and sessions with tutors (up to 60.0%). Mobile learning apps peaked at 23.7% in June and fell to 16.0% by July. Radio and television were adopted especially by children from relatively wealthy homes, and low-income households lacked the digital tools and connectivity needed for distance learning. Unstable electricity made the situation worse. This study is relevant because it shows how far digital learning actually reached students when it was most needed. It suggests that access, not only the quality of tools, limits their effect on performance. It differs from the present study in focusing on a period of emergency remote learning rather than regular classroom use, and it did not measure academic achievement directly. The reviewed studies show that teacher-led digital tools, especially CAI and animation, usually improved achievement in mathematics and the sciences when compared with conventional teaching (Nkemdilim & Okeke, 2014; Shehu et al., 2024; Turabia, 2024; Ukaigwe & Goi-tanen, 2022). The size of that improvement varied widely by subject, and in chemistry CAI was less effective than problem-solving and cooperative learning (Idris et al., 2018; Okwuduba & Okigbo, 2018). In contrast, the only large-scale device programme evaluated was associated with lower performance (Daramola et al., 2015). Findings on social media were mixed (Asanga et al., 2023; Atomatofa et al., 2024), and evidence on teachers' capacity and students' access suggests that many students and teachers lack the facilities needed to benefit (Obakhume, 2011; Ogenyi, 2022).

2.7 Gaps in the Literature

The review reveals several gaps that the present study seeks to fill:

1. Narrow scope of experiments. Most studies tested one tool on one topic in one or two schools over a few weeks. Few compared different types of digital tools within the same study.
2. Weak designs and incomplete reporting. Most experiments used intact classes rather than

random assignment, and several did not report effect sizes, which makes it difficult to compare results.

3. Little evaluation of large programmes. Apart from the Opon-imo study, no peer-reviewed evaluation of a state-wide digital learning programme was found.

4. Limited attention to mediating conditions. Teacher competence, electricity and internet access was studied separately from achievement rather than as factors that shape the effect of digital tools.

5. Geographical imbalance. No reviewed study was conducted in the North-East or North-West, where access to digital tools is likely to be lowest.

6. Reliance on researcher-made tests. Achievement was rarely measured with standardised external examinations such as WAEC or NECO.

The present study addresses these gaps by examining the impact of digital learning tools on the academic performance of secondary school students in Nigeria. It considers both the type of tool and the conditions, including teacher capacity and access, under which tools are used.

3.0 Findings of the Review

The synthesis of the twelve studies summarised in Table 1 yields six main findings.

Table 1

Summary of the Nigerian Studies Reviewed (2011–2024)

Author(s) (year)	State	Design	Sample	Tool / focus	Main finding
Nkemdilim & Okeke (2014)	Anambra	Quasi-experimental	66 SS2	CAI; Biology (ecology)	CAI > lecture method; no gender difference
Ukaigwe & Goitanen (2022)	Rivers	Quasi-experimental	35 SS students	CAI; Mathematics	CAI > traditional method; significant gain
Turabia (2024)	Oyo	Quasi-experimental	150 SS students	CAI; Geometry	CAI > control, $F(1,145) = 54.58$; motivation and attitude moderated effect
Adeyemi (2012)	Osun	2 × 2 factorial	160 JSS	CAI; Social Studies	No significant CAI effect, $F(1,153) = 0.42$; ability significant
Shehu et al. (2024)	Kwara	Quasi-experimental	177 SS3	Animation; Physics	Higher performance and retention; no gender effect
Idris et al. (2018)	Niger	Meta-analysis	78 studies	CAI; science subjects	Mean ES = 0.52; Chemistry ES = 0.05
Okwuduba & Okigbo (2018)	National	Meta-analysis	51 studies	Teaching methods; Chemistry	CAI ES = 0.146, below problem-solving (0.315)
Daramola et al. (2015)	Osun	Ex-post facto	440 SS3	Opon-imo tablets; English	Significant negative impact on performance
Asanga et al. (2023)	Akwa Ibom	Descriptive survey	168 SS2	Social media; Government	Significant relationship; mean score 24.1%, below pass mark

Author(s) (year)	State	Design	Sample	Tool / focus	Main finding
Atomatofa et al. (2024)	Delta	Survey (ANOVA)	180 JSS	Social media; Basic Science	No significant effect on achievement
Obakhume (2011)	Oyo	Descriptive survey	120 teachers	Teachers' ICT use	Facilities lacking; most teachers not ICT-competent
Ogenyi (2022)	Nationa l	Panel survey	Monthly survey, 2020	Remote learning, COVID-19	38% in no learning activity; apps peaked at 23.7%

Note. CAI = computer-assisted instruction; ES = effect size; SS = senior secondary; JSS = junior secondary.

Finding 1: Teacher-led digital instruction usually improves achievement in mathematics and the sciences. Four of the five experimental studies found that students taught with computer-assisted instruction or computer animation outperformed those taught by conventional methods, in Biology, Mathematics, Geometry and Physics (Nkemdilim & Okeke, 2014; Shehu et al., 2024; Turabia, 2024; Ukaigwe & Goi-tanen, 2022). In Physics, the benefit extended to retention, which matters for external examinations written months after a topic is taught (Shehu et al., 2024).

Finding 2: The benefit is real but uneven, and it is not guaranteed. The one experiment outside mathematics and science, on junior secondary Social Studies, found no significant effect of CAI (Adeyemi, 2012). The meta-analytic evidence shows a large average effect of 0.52 across science subjects, but only 0.05 in Chemistry (Idris et al., 2018). In Chemistry, CAI (0.146) was also less effective than problem-solving (0.315), cooperative learning (0.218) and the use of instructional materials (0.208), approaches that need no technology (Okwuduba & Okigbo, 2018). Digital tools are therefore one effective option among several, not a replacement for good teaching.

Finding 3: Supplying devices without structured classroom use has not improved performance. The only evaluation of a state-wide device programme, Osun State's Opon-imo tablets, found a significant negative impact on students' English Language performance (Daramola et al., 2015). Although the ex-post facto design cannot prove cause, the contrast with the positive classroom experiments is striking: the tools that worked were used by teachers within planned lessons, while the tool that did not was placed in students' hands with little guidance.

Finding 4: Evidence on social media and personal technology is mixed. In Uyo, heavy social media use was linked to distraction and to low achievement, with a mean test score of 24.1%, below the 40% pass mark (Asanga et al., 2023). In Delta State, time spent on social media had no significant effect on Basic Science achievement (Atomatofa et al., 2024). Because both studies were correlational and relied on self-reported use, neither establishes that personal technology helps or harms learning.

Finding 5: Access and teacher capacity limit what digital tools can achieve. Most schools in the Oyo study lacked ICT facilities, and most teachers were not competent in their use (Obakhume, 2011). During the COVID-19 closures, about 38% of students took part in no educational activity, only 19% had contact with their teachers, and mobile learning apps reached at most 23.7% of students; low-income households lacked devices and connectivity,

and unstable electricity made matters worse (Ogenyi, 2022). These conditions help explain why gains seen in controlled experiments may not appear in ordinary classrooms.

Finding 6: Learner characteristics shape the effect, while gender generally does not. Motivation and attitude moderated the effect of CAI on geometry achievement (Turabia, 2024), and academic ability affected Social Studies achievement (Adeyemi, 2012). By contrast, no significant gender differences were found in any of the studies that tested for them (Asanga et al., 2023; Daramola et al., 2015; Nkemdilim & Okeke, 2014; Shehu et al., 2024), suggesting that well-designed digital instruction benefits male and female students alike.

4.0 Conclusion

This review set out to establish what Nigerian research reveals about the impact of digital learning tools on the academic performance of secondary school students. The evidence shows that digital tools can raise achievement, particularly in mathematics and the sciences, when teachers use them deliberately within well-planned lessons. The same evidence shows that the benefit varies by subject, is sometimes smaller than that of good non-digital teaching methods, and disappears, or even reverses, when devices are distributed without structured classroom use. Students' personal use of social media has no consistent relationship with performance.

The deciding factors are therefore not the tools themselves, but how they are used, who guides their use and whether students and teachers have the electricity, connectivity, facilities and skills to use them at all. The evidence base is also narrow: it rests largely on short experiments in single schools, it seldom reports effect sizes or uses external examination results, and it contains no study from the North-East or North-West. For Nigeria to realise the goal of "inclusive and ubiquitous digital learning for all Nigerians" (FME, 2023), investment in devices must be matched by investment in teachers, infrastructure and rigorous evaluation.

4.1 Recommendations

Based on the findings of this review, the following recommendations are made:

1. Prioritise teacher-led integration over device distribution. The Federal Ministry of Education and state ministries of education should implement the National Digital Learning Policy through programmes that build digital tools into planned lessons, schemes of work and assessment, rather than through the distribution of devices alone. Any new device programme should include curriculum-aligned content and clear guidance on classroom use.
2. Train teachers to teach with digital tools. Ministries of education, the Teachers Registration Council of Nigeria and Colleges of Education, such as the Federal College of Education, Keana, should provide continuous, practical professional development in computer-assisted instruction, animation and simulation, focused on lesson design and assessment rather than on basic computer operation.
3. Close the access gap in schools and homes. Government and development partners should equip schools with functional ICT facilities and alternative power sources such as solar energy, negotiate affordable educational data, and provide offline digital content, so that students in rural and low-income communities are not left behind.
4. Strengthen the evidence base. Researchers and research funders should prioritise randomised or well-controlled studies that report effect sizes, use external examination results such as WAEC and NECO as outcomes, evaluate state-wide digital learning programmes, and include schools in the North-East and North-West, where access to digital tools is likely to be lowest.

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