

A REVIEW OF EDUCATIONAL TECHNOLOGY FOR LOW-PERFORMING AGRICULTURAL SCIENCE STUDENTS IN SENIOR SECONDARY SCHOOLS IN JOS NORTH LGA, PLATEAU STATE

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ARTICLE INFO

Article No.: 0644

Accepted Date: 02/09/2026

Published Date: 18/10/2026

Type: Research

ABSTRACT

This paper reviews the use of educational technology for supporting low-performing Agricultural Science students in senior secondary schools, with particular attention to the context of Jos North Local Government Area (LGA), Plateau State. It adopts a narrative review approach rather than reporting new field data. Literature was identified from peer-reviewed journal articles, institutional repositories, official education sources and a major international education report, with emphasis on Nigerian secondary education, Agricultural Science, educational technology, student achievement, practical learning and the local context of Jos North. The review finds consistent evidence from three Nigerian Agricultural Science studies that multimedia or simulation-supported instruction can improve achievement, although these studies did not specifically sample low-performing students. A 2025 meta-analysis covering 72 experimental and quasi-experimental studies also found a small positive overall effect of educational technology on less-advantaged students, with computer-assisted learning more promising than simple access to devices. Local Jos North evidence from related science subjects indicates that computer animation and simulation can support achievement, while local studies also identify infrastructure and teacher-preparation constraints. The review therefore concludes that technology is best treated as a support for teacher-led explanation, formative assessment and practical Agricultural Science rather than as a substitute for practical work. The major evidence gap is the absence of a directly verified study testing technology-supported remediation among low-performing Agricultural Science students in Jos North. Further local research should therefore identify low-performing learners and test targeted interventions.

Keywords: Educational technology; Agricultural Science; Low-performing students; Academic achievement; multimedia; Jos North

1.0 INTRODUCTION

Educational technology includes digital devices, multimedia materials, educational applications, simulations, digital assessment tools, electronic curriculum resources and communication technologies used deliberately to support teaching and learning. Its educational value does not arise simply from placing devices in classrooms. UNESCO (2023) emphasizes that technology should be selected according to learning needs, evidence, equity, sustainability and the capacity of teachers and learners to use it. Systematic evidence is also mixed: technology can support learning, but effects depend on how it is integrated with teaching, the quality of the learning activity and the context in which it is used.

Agricultural Science is especially suitable for carefully selected educational technologies because it combines conceptual knowledge with practical activities. Students are expected to understand crops, livestock, soils, farm tools, production systems, environmental processes and agricultural economics. Some processes are difficult to observe at the exact time they are taught. Multimedia can provide photographs, diagrams, animations and video demonstrations that complement classroom explanation. However, Agricultural Science also requires direct observation and practical work. Recent Nigerian research on practical Agricultural Science has identified inadequate teaching tools and insufficient farmland as constraints on hands-on learning, reinforcing the need for technology to supplement rather than eliminate practical experiences (Belonwu, 2026; Nwambe, 2024).

The focus of this review is low-performing students. In this paper, the term refers operationally to students whose demonstrated achievement in Agricultural Science is persistently below the level expected for their class or below the learning standard set by the school, as established through classroom or formative assessment. The term is not treated as a statement about fixed ability. Rather, low performance is treated as evidence that a learner may need additional explanation, practice, feedback, prerequisite knowledge or another instructional approach. This distinction is important because the available Agricultural Science studies located for this review generally examine secondary students as a whole, rather than deliberately selecting low-performing learners.

The empirical evidence nevertheless provides a reasonable basis for examining the issue. Olori and Igbosanu (2016), using 80 SS II students in Ijebu-Ode, reported higher achievement for students taught Agricultural Science with a computer-based multimedia presentation than for students taught conventionally. Lawal et al. (2025) reported significant differences in achievement and retention among SS II Agricultural Science students in Katsina State who received an explicit multimedia learning strategy. Ugwuoke et al. (2023) likewise reported higher achievement among students taught Agricultural Science with multimedia in Enugu State, while identifying unreliable electricity, poor network connectivity and inadequate computers as barriers. More recent Nigerian evidence also supports simulation as a potentially useful strategy: Ezea and Ezea (2026) found that simulation-based instruction significantly improved Agricultural Science achievement in public secondary schools in Abia State.

Evidence relevant to disadvantaged or lower-performing learners is broader than Agricultural Science. Di Pietro and Castaño Muñoz (2025) synthesized 740 estimates from 72 experimental and quasi-experimental studies and found a small positive, statistically significant overall effect of educational technology on the achievement of less-advantaged students. Their analysis found computer-assisted learning and behavioural interventions more effective than simple access to technology. This is important for the present review because it suggests that technology should be embedded in an instructional strategy rather than treated as an end in itself.

Jos North is a particularly relevant setting for a contextual review. Local studies have examined technology-supported learning in related science subjects. Piwuna et al. (2025), for example, studied 214 SS I Biology students in Jos North and found that students taught cell division through computer animation performed better than those taught through lecture. Nakargo et al. (2026) similarly studied computer simulation in Basic Science and Technology in Jos North. These studies do not establish an Agricultural Science effect, but they provide local evidence that technology-supported instruction is being investigated within the same educational environment.

There is also evidence concerning the local implementation environment. Mathew (2026), in a University of Jos B.Ed. project on educational applications for science subjects in Jos North, reported awareness of educational apps but identified limited infrastructure, inadequate teacher training and concerns about the relevance of available applications to the Nigerian curriculum. Nnamdi and Busa (2023) examined ICT and secondary-school administrative effectiveness in Jos North and identified ICT-related issues within the local school system. These studies are contextual rather than direct evidence of Agricultural Science achievement, and they should not be presented as proof that technology has already improved Agricultural Science performance in Jos North.

A further limitation concerns evidence of the problem itself. The sources reviewed for this revision do not provide a verified public dataset showing Agricultural Science examination failure specifically among senior secondary students in Jos North. For that reason, this paper does not invent WAEC or NECO figures. Instead, it treats low performance as the instructional problem addressed by the proposed review and identifies the absence of local, subject-specific evidence as a research gap.

2.0 OBJECTIVES OF THE REVIEW

The main objective is to review how educational technology may support low-performing Agricultural Science students in senior secondary schools, with attention to the context of Jos North LGA, Plateau State.

Describe the role of educational technology in Agricultural Science teaching and learning.

Review Nigerian and relevant international evidence on technology-supported achievement, including evidence concerning less-advantaged or lower-performing learners.

Examine contextual opportunities and constraints affecting technology-supported Agricultural Science teaching in Jos North LGA.

Identify practical implications for targeted support of low-performing Agricultural Science students and areas requiring further local research.

REVIEW QUESTIONS

What roles can educational technology play in the teaching and learning of Agricultural Science?

What does the available evidence indicate about the effect of technology-supported instruction on achievement, particularly among less-advantaged or lower-performing learners?

What opportunities and constraints are relevant to educational technology use in Jos North LGA?

What practical approaches and research priorities follow from the reviewed evidence?

3.0 METHOD OF THE REVIEW

This paper used a narrative literature-review design. The purpose was to synthesize available evidence rather than to collect new responses from teachers or students. Searches were

conducted across accessible journal websites, institutional repositories and official education websites using combinations of terms including educational technology, multimedia learning, computer-assisted instruction, simulation, Agricultural Science, academic achievement, low-performing students, secondary schools, Nigeria and Jos North. Priority was given to peer-reviewed studies and official sources; institutional project reports were used only where they provided local contextual information not available in journal literature.

The review emphasized studies published from 2016 to 2026, while allowing established theoretical sources and major policy reports where necessary. Sources were considered relevant when they addressed at least one of the following: technology-supported learning; Agricultural Science achievement; practical Agricultural Science; educational technology and less-advantaged learners; technology integration in Nigerian secondary schools; or technology-supported science learning in Jos North. Studies from subjects other than Agricultural Science were used only as contextual evidence and are clearly identified as such.

The final synthesis was organized around five themes: (1) achievement evidence in Agricultural Science; (2) support for low-performing or less-advantaged learners; (3) technology and practical Agricultural Science; (4) the Jos North implementation context; and (5) implications for classroom practice and future research. The review does not claim to be a systematic review or meta-analysis, and no effect size was calculated by the present author.

4.0 REVIEW OF LITERATURE AND DISCUSSION

4.1 Educational Technology and Agricultural Science Achievement

The most direct Nigerian evidence located concerns multimedia and simulation. Olori and Igboanu (2016) conducted a quasi-experimental study involving 80 SS II students in two secondary schools in Ijebu-Ode. The experimental group was taught Agricultural Science using a computer-based multimedia maize-breeding package, while the control group received conventional instruction. The authors reported a significant difference in achievement in favour of the multimedia group. The study therefore provides direct Nigerian evidence that multimedia representation can support achievement in an Agricultural Science topic.

Lawal et al. (2025) provide more recent evidence. Their quasi-experimental study examined 142 SS II Agricultural Science students in Katsina State using pre-test, post-test and post-post-test measures. The study reported significant improvement in academic performance and retention among students exposed to an explicit multimedia learning strategy. The retention result is relevant because it suggests that the benefit was not limited to immediate post-test performance.

Ugwuoke et al. (2023) also reported higher achievement among Agricultural Science students exposed to multimedia application than among students receiving conventional instruction. Importantly, the study identified practical barriers including inconsistent electricity, poor network connectivity and inadequate computers. This combination of evidence supports a cautious interpretation: multimedia may improve achievement when used appropriately, but infrastructure determines whether the strategy can be implemented consistently.

Ezea and Ezea (2026) extend the evidence to simulation-based learning. Their study of SS II Agricultural Science students in public secondary schools in Abia State used a non-equivalent pre-test/post-test design with 96 students and reported significantly higher achievement for the simulation group than for the conventional lecture group. Simulation is therefore a promising technology-supported approach, although the study was conducted outside Plateau State and did not specifically target low-performing learners.

The important limitation across these four Agricultural Science studies is their population. None of the studies located for this review deliberately selected students who were already low-performing. Their results therefore justify the proposition that technology-supported instruction can improve achievement among secondary Agricultural Science students, but they do not prove that the same effect will occur among low-performing students in Jos North. That distinction should be retained throughout the paper.

4.2 Educational Technology and Low-Performing Learners

Evidence specifically focused on lower-performing Agricultural Science learners is limited. The strongest broader evidence located is the meta-analysis by Di Pietro and Castaño Muñoz (2025). The authors synthesized 740 estimates from 72 experimental and quasi-experimental studies and found a small positive statistically significant overall effect of educational technology on the achievement of less-advantaged students. Computer-assisted learning and behavioural interventions were more effective than simple access to technology. This finding supports a central principle for Jos North: providing devices is not itself the intervention; the educational activity delivered through the device matters.

UNESCO (2023) reaches a compatible conclusion at the system level. The Global Education Monitoring Report notes that digital technology can improve instruction by increasing opportunities to practise, expanding available learning time and supporting personalized instruction. It also cautions that evidence is uneven, technology can create distraction and unequal access, and implementation requires teacher preparation and sustainable infrastructure. The report therefore recommends evidence-based, equitable and human-centred technology use rather than technology adoption for its own sake.

For low-performing Agricultural Science students, the practical implication is targeted support. A teacher can use a short diagnostic quiz to identify whether a learner has difficulty with soil fertility, crop identification, animal nutrition or farm management. The teacher can then provide a focused digital explanation, guided practice and a follow-up assessment. This approach is consistent with the evidence favouring computer-assisted learning over mere access to technology (Di Pietro & Castaño Muñoz, 2025).

Multimedia design also matters. Mayer (2021) explains that multimedia learning is based on the coordinated processing of words and pictures, but learners have limited processing capacity. Unnecessary text, sound, animation or decorative material can therefore interfere with learning. For struggling learners, digital materials should be short, clearly signposted and focused on the learning objective. A five-minute video showing a sequence in seed selection may be more useful than a long video containing unrelated agricultural content.

4.3 Technology, Practical Work and Agricultural Science

Technology should not be used as a substitute for Agricultural Science practical work where direct experience is possible and safe. Nigerian research continues to identify practical resources as important. Nwambe (2024) reported that factors such as teaching resources and conditions of practical lesson delivery affect Agricultural Science practical teaching. Belonwu (2026) likewise reported inadequate teaching tools and insufficient farmland as constraints in practical agriculture. These findings reinforce the need for a blended approach.

Technology can strengthen practical teaching before, during and after field activities. Before practical work, the teacher can use a short video or labelled image to demonstrate safe handling of a tool. During practical work, students can use photographs or teacher-provided digital guides to identify specimens. After the activity, students can review photographs, answer

a short digital quiz or record observations. In this model, technology extends practical learning rather than replacing it.

Simulation is particularly useful when direct practice is expensive, risky or temporarily unavailable. Ezea and Ezea (2026) provide Agricultural Science evidence that simulation can improve achievement. However, a simulation of farm budgeting, crop growth or livestock management cannot provide every sensory and procedural experience of actual farming. Teachers should therefore use simulation as preparation, reinforcement or an alternative where direct experience is genuinely unavailable.

4.4 The Jos North Context

Local evidence is essential because the infrastructure and school conditions of Jos North may differ from the settings in which the Agricultural Science experiments were conducted. Piwuna et al. (2025) studied 214 SS I Biology students in Jos North and found that students taught cell division using computer animation achieved better than students taught using lecture instruction. Because Biology is not Agricultural Science, this result should be treated as contextual evidence rather than direct proof of an Agricultural Science effect.

Nakargo et al. (2026) examined computer simulation in Basic Science and Technology in Jos North using 75 students from the public secondary-school population. The study provides additional local evidence that computer-supported instruction is being tested in Jos North. Again, the subject differs from Agricultural Science, so the appropriate conclusion is that technology-supported science teaching is locally feasible enough to warrant further subject-specific research, not that Agricultural Science achievement has already been established.

Mathew (2026), a University of Jos B.Ed. project, investigated the adoption and use of educational applications for science subjects by secondary-school teachers and students in Jos North. The project used a mixed-method approach with 200 teachers and students and reported awareness of educational apps alongside constraints involving limited infrastructure, inadequate teacher training and perceived lack of relevance of some apps to the Nigerian curriculum. This evidence is useful for planning but is not a test of Agricultural Science achievement.

Nnamdi and Busa (2023) examined ICT and secondary-school administrative effectiveness in Jos North. Although the study was not about student achievement, it provides additional evidence that ICT should be understood within the wider organizational capacity of schools. Technology-supported Agricultural Science teaching requires not only devices but also staff capacity, maintenance, connectivity and school-level support.

The available local evidence therefore suggests both opportunity and constraint. The opportunity is that computer animation, simulation and educational applications are already being investigated in Jos North. The constraints include infrastructure, teacher preparation and curriculum alignment. These factors should shape any intervention for low-performing Agricultural Science students.

4.5 Teacher Competence and Instructional Design

Teachers remain central to educational technology integration. Nigerian studies of ICT implementation repeatedly identify teacher knowledge and readiness as important conditions. Wordu and Njoku (2023), for example, identified infrastructure, internet access and capacity-building among barriers to ICT integration in Nigerian secondary schools. Solomon and Ogbonnaya-Ngwu (2023) also found that Nigerian teachers recognize the relevance of digital literacy but that implementation requires teacher capacity.

For Agricultural Science, professional development should therefore be subject-specific. Teachers should learn how to select curriculum-aligned videos, create short digital quizzes, use

photographs for crop and livestock identification, organize offline materials and interpret assessment results. The aim should not be to make every teacher an ICT specialist. The aim should be to give teachers enough competence to solve specific learning problems.

NERDC's e-Curriculum platform provides an official digital route for accessing curriculum and learning resources, including Agricultural Science at senior secondary level (NERDC, 2025). This provides an important starting point for curriculum alignment. Schools can supplement official resources with locally relevant photographs, demonstrations and practical materials.

4.6 Access, Equity and Sustainability

Technology can widen rather than reduce inequality if access depends entirely on students' private devices and internet subscriptions. UNESCO (2023) warns that disadvantaged learners can be excluded when digital access is unequal. Wang et al. (2024) likewise found that the relationship between device use and academic performance varies according to where and how devices are used, with educational-purpose use more positively related to academic performance than undifferentiated use.

For Jos North schools, equity therefore requires school-based access. Important materials should be available during school hours and should not depend entirely on students owning smartphones or purchasing data. Where devices are limited, pair or small-group activities can be used. Offline videos, downloaded resources and teacher-controlled projector lessons may be more sustainable than internet-dependent platforms where connectivity is unreliable.

Sustainability also requires attention to electricity, maintenance and replacement. Ugwuoke et al. (2023) identified electricity, connectivity and computer availability as barriers in Agricultural Science. UNESCO (2023) similarly emphasizes the financial and maintenance costs of technology. Schools should therefore begin with technologies that can be maintained locally and expand only when there is evidence that the intervention improves learning.

4.7 A Practical Model for Supporting Low-Performing Students

On the basis of the reviewed evidence, the following model is proposed as an application of the literature rather than as a tested model. The cycle is: diagnose, explain, practise, assess, analyse and reteach.

Diagnose: use a short Agricultural Science test to identify the concepts on which students are performing below the expected level.

Explain: provide a concise teacher explanation supported by a suitable image, diagram, animation or video.

Practise: give students guided questions, identification tasks or short digital exercises.

Assess: use a short formative assessment to determine whether the specific misconception has been corrected.

Analyse: review individual or group responses to identify students who still require support.

Reteach: use another representation, teacher demonstration or practical activity and reassess.

This model is consistent with the broader evidence that technology is most useful when it supports active learning, feedback and targeted instruction rather than simply providing access to devices. It also keeps the teacher and practical Agricultural Science at the centre of the intervention.

5.0 CONCLUSION

The reviewed evidence indicates that educational technology has potential to support achievement in Agricultural Science, particularly through multimedia, simulation and computer-assisted learning. Four Nigerian Agricultural Science studies reviewed in this paper reported positive achievement outcomes from multimedia or simulation-supported instruction. Broader evidence from a 2025 meta-analysis also indicates a small positive effect of educational technology among less-advantaged learners. However, the direct evidence has an important limitation: the Agricultural Science studies did not specifically focus on low-performing students in Jos North.

The evidence therefore supports a cautious conclusion. Technology should be used as part of a planned instructional strategy that includes diagnosis, teacher guidance, practice, feedback and practical work. In Jos North, local science studies suggest that computer-supported learning is feasible, while local contextual evidence points to infrastructure, teacher training and curriculum alignment as important constraints. The most important research gap is a subject-specific study that identifies low-performing Agricultural Science students in Jos North and tests whether a targeted, technology-supported intervention improves their achievement and retention.

RECOMMENDATIONS

Agricultural Science teachers: Use short, curriculum-aligned videos, diagrams, photographs, animations and digital quizzes when they directly address a learning difficulty.

Agricultural Science teachers: Use formative assessment to identify low-performing students and provide targeted technology-supported remediation rather than applying the same intervention to every learner.

School management: Prioritize maintainable equipment, electricity, secure storage and offline digital resources before adopting expensive internet-dependent platforms.

Education authorities and school leaders: Provide practical professional development that combines basic technology skills with Agricultural Science pedagogy and assessment.

Schools and teachers: Ensure that technology complements school-farm and other practical activities rather than replacing direct agricultural experience.

Researchers: Conduct a quasi-experimental or mixed-method study in Jos North that identifies low-performing Agricultural Science students, establishes a baseline and tests a technology-supported intervention against an appropriate comparison group.

7.0 LIMITATIONS OF THE REVIEW AND AREAS FOR FURTHER RESEARCH

This is a narrative review, not a systematic review or meta-analysis. The available literature on technology-supported Agricultural Science in Nigeria is relatively small, and the studies located were conducted mainly outside Plateau State. The review also found no verified study specifically testing educational technology among low-performing Agricultural Science students in Jos North. Some local evidence comes from Biology, Basic Science and Technology, or general ICT studies and is therefore contextual rather than directly transferable.

Future research should address this gap through a local study involving senior secondary Agricultural Science students in Jos North. The study should identify low-performing students using a clearly defined baseline assessment, use a technology intervention linked to specific Agricultural Science topics, measure post-test and retention outcomes, and document implementation conditions such as electricity, device availability, teacher competence and student access. Qualitative evidence from teachers and students would also help explain why an intervention succeeds or fails.

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