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Improving Teaching and Learning of Agricultural Science Education Using Augmented Learning in Bayelsa State

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Abstract

This study reviewed ways to improve teaching and learning in Agricultural Science Education through the integration of augmented learning in Bayelsa State. Agricultural Science Education was recognized as a vital discipline for fostering food security, environmental sustainability, and socio-economic development in Nigeria. However, the teaching of the subject has remained largely theoretical, constrained by inadequate instructional resources and limited use of technology. Drawing on the Constructivist Learning Theory, the study emphasized that knowledge construction occurs through experiential and interactive engagement, principles that align with augmented learning approaches. Augmented learning, which combines digital simulations and real-world experiences, was identified as a transformative instructional strategy that enhances learners' motivation, comprehension, and participation. The conceptual analysis demonstrated that augmented learning fosters an immersive, technology-supported environment where abstract agricultural concepts become tangible and practical. Its integration empowers teachers to adopt learner-centered methods while enabling students to engage with realistic agricultural scenarios in virtual contexts. The theoretical and practical implications suggested that augmented learning promotes pedagogical innovation, technological competence, and experiential understanding, thereby addressing long-standing instructional challenges in Agricultural Science Education. The study recommended capacity-building programmes for teachers, inclusion of augmented learning in educational curricula, and provision of requisite digital infrastructure by policymakers. In light of these findings, it was concluded that augmented learning serves as a viable pedagogical innovation capable of transforming Agricultural Science Education in Bayelsa State, equipping learners with twenty-first-century competencies and advancing sustainable educational development.

Keywords: Agricultural Science Education, Augmented Learning, Constructivist Theory, Teaching and Learning

Introduction

The term Agricultural Science Education is defined as the academic discipline that integrates the scientific principles of agriculture, such as crop and animal production, soil science, agribusiness, and environmental sustainability, with pedagogical strategies for teaching and learning (Naudé et al., 2024). Within this field, learners are equipped not only with theoretical knowledge but also with practical competencies that enable productive engagement in agricultural systems and sustainable food production (Naudé et al., 2024). In the Nigerian context, particularly Agricultural Science Education has been regarded as pivotal to national development, given the significance of agriculture to employment, food security and economic growth (Ibironke, 2024).As such, it has become essential to explore innovations that can strengthen how the subject is taught and learned, particularly in under-resourced regions.

The concept of teaching and learning in Agricultural Science Education encompasses the systematic process by which educators design, implement and assess instructional experiences that facilitate student understanding, skills acquisition, and attitudinal change towards agriculture (Emeya & Eyorokumoh, 2024).Teaching involves the deployment of appropriate methods, resources and assessments, while learning reflects how students internalize, apply and transfer agricultural knowledge and skills (Okeke, 2007).

In many Nigerian settings, teaching has remained predominantly theoretical, with limited practical exposure, thus constraining student engagement and competency development (Okeke, 2007). In Bayelsa State in particular, empirical studies have indicated that school environmental and instructional resource factors significantly determine students' academic outcomes in Agricultural Science (Ikpaikpai & Obiyai, 2025). These findings underscore the imperative to explore pedagogical innovations that could improve or restructure instructional delivery within the discipline.

The term Augmented Learning denotes the use of digital technologies such as augmented reality (AR), simulations, and overlaying virtual elements onto real-world settings to enrich instructional environments and learner engagement (Al-Ansi, 2023). In educational research, augmented learning has been shown to enhance visualization, interactivity and contextualization of complex concepts, thereby promoting deeper understanding and motivation (Al-Ansi, 2023; Namkoong et al., 2023). Within Agricultural Science Education, augmented learning tools can simulate farm environments, crop growth processes or soil-nutrient interactions in a safe, repeatable and engaging format, which may compensate for limited physical infrastructure in schools (Kumar, 2023). The integration of augmented learning thus holds promise for transforming how students experience agricultural concepts, making instruction more immersive and practice-oriented. The regional context of this study is Bayelsa State, Nigeria, a state characterized by substantial agricultural potential but facing instructional constraints in its secondary education sector.

Empirical investigations within Bayelsa State have revealed that teacher competence, instructional methods and school environmental factors significantly influence effective teaching of Agricultural Science (Obiyai & Olisa, 2022; Ikpaikpai & Obiyai, 2025). Despite the instructional challenges, few studies have addressed how advanced educational technology, particularly augmented learning, could be utilized effectively within the Agricultural Science classrooms of the region.

Hence, there is a research gap regarding how this pedagogical innovation may contribute to improved teaching and learning outcomes in the Bayelsa State context. In light of this context, the goal of this study is to investigate the improvement of teaching and learning of Agricultural Science Education Using Augmented Learning in Bayelsa State.

Statement of the Problem

Agricultural Science Education in Bayelsa State continues to face instructional and infrastructural challenges that hinder effective teaching and learning despite its strategic relevance to sustainable food production and national development (Ibironke, 2024). Most classroom instruction in the subject has remained largely theoretical, with limited use of interactive technologies or practical field experiences, which has resulted in low learner engagement and poor mastery of core agricultural competencies (Ikpaikpai & Obiyai, 2025). The absence of technologically enriched instructional environments, coupled with inadequate teacher training in modern pedagogical tools, has further widened the gap between conceptual knowledge and practical application (Obiyai & Olisa, 2022).

Consequently, students often demonstrate poor problem-solve skills and limited motivation towards agricultural careers. Although augmented learning has been globally recognized as a transformative educational innovation capable of enhancing experiential learning and student participation (Namkoong et al., 2023; Al-Ansi, 2023), its potential remains largely unexplored within the context of Agricultural Science Education in Bayelsa State. This neglect raises critical questions about how augmented learning could be systematically integrated to improve instructional delivery and learner outcomes in the subject. In light of this situation, this study aims to investigate how teaching and learning of Agricultural Science Education could be improved through the adoption of augmented learning technologies in Bayelsa State.

Theoretical Review

Constructivist Learning Theory by Piaget (1972)

This study was anchored on the Constructivist Learning Theory propounded by Piaget (1972) and later advanced by Vygotsky (1978), which posited that learners actively construct knowledge through meaningful interaction with their environment and by engaging in hands-on experiences that promote cognitive development. The theory emphasized that learning becomes more effective when learners are provided with opportunities to explore, manipulate, and reflect on real-world phenomena rather than passively receiving information from the teacher (Fosnot & Perry, 2019). In the context of Agricultural Science Education, constructivism supports the use of augmented learning technologies, as these digital tools create immersive, interactive environments where students can virtually engage in farming processes, soil analysis, and crop management, thereby bridging the gap between theory and practice (Naudé et al., 2024). Augmented learning aligns with the constructivist notion of experiential and discovery-based learning by allowing students to visualize and interact with agricultural concepts that are otherwise difficult to demonstrate in traditional classrooms (Kumar, 2023). Thus, the theory provided a suitable framework for this study by explaining how technology-mediated experiences can improve the teaching and learning of Agricultural Science Education in Bayelsa State through active learner participation, contextual understanding, and cognitive engagement. In light of this theoretical alignment, the study investigated how the integration of augmented learning could foster constructivist-oriented teaching and enhance learning outcomes among students in Agricultural Science Education.

Conceptual Review

Agricultural Science Education

Agricultural Science Education was broadly defined as the structured instructional discipline that integrated scientific principles of agriculture with pedagogical strategies aimed at developing learners' knowledge, competencies, and attitudes necessary for agricultural productivity and sustainability (Naudé et al., 2024). It combined theoretical understanding of agricultural processes such as crop production, animal husbandry, soil management, and agribusiness, with practical applications designed to prepare students for professional or entrepreneurial participation in agricultural systems (Ibironke, 2024). In Nigeria, the field occupied a central role in advancing national food security, rural development, and youth empowerment, particularly in states such as Bayelsa, where agriculture remained an underexploited economic sector (Ikpaikpai & Obiyai, 2025). Despite this importance, the effectiveness of Agricultural Science Education was undermined by inadequate instructional materials, limited field demonstration opportunities, and insufficient integration of technology into teaching practices (Obiyai & Olisa, 2022). The traditional approach relied heavily on rote learning and teacher-centered methods, which restricted the development of problem-solving and practical competencies among learners. As such, there was a growing need to innovate in instructional delivery through modern technological interventions, such as augmented learning, to bridge the gap between theoretical content and experiential understanding. By leveraging digital simulations and interactive environments, Agricultural Science Education could be repositioned to produce graduates equipped for modern agricultural practice and sustainable development in Bayelsa State.

Concept of Teaching

Teaching was widely recognized as an intentional, systematic, and interactive process through which a teacher facilitates learning by transmitting knowledge, guiding inquiry, and nurturing intellectual development (Knight, 2022). It transcended mere content delivery and instead involved designing learning environments that promoted curiosity, reflection, and application of concepts. In educational theory, teaching was conceived as both an art and a science, requiring the integration of pedagogical knowledge, technological awareness, and subject expertise to promote meaningful learning outcomes (Shulman, 2018). Within the Nigerian context, teaching in Agricultural Science Education remained constrained by teacher-centered approaches, where instructors dominated classroom discourse, and learners functioned as passive recipients of knowledge (Ikpaikpai & Obiyai, 2025). This instructional imbalance limited the development of critical thinking and experiential engagement that Agricultural Science inherently required. The advancement of technology-driven pedagogies, such as augmented learning, therefore, provided an opportunity to reposition teaching as an active, student-centered process where instructors assumed the role of facilitators guiding learners through discovery and simulation (Naudé et al., 2024). Hence, effective teaching was increasingly viewed as a dynamic activity that leveraged digital tools and interactive strategies to enhance comprehension, collaboration, and real-world application within the agricultural classroom setting.

Concept of Learning

Learning, in contemporary educational psychology, was defined as a relatively permanent change in behaviour, knowledge, or disposition resulting from experience and practice (Illeris, 2018). It involved the cognitive, affective, and psychomotor domains, each contributing to the holistic development of the learner. The constructivist perspective maintained that learning occurred most effectively when individuals actively constructed meaning based on their prior experiences and contextual interactions (Fosnot & Perry, 2019). Within Agricultural Science Education, learning entailed not only understanding theoretical concepts such as crop production or soil science but also applying them through practical experiences that

enhanced retention and transferability (Ibironke, 2024). However, many students in Bayelsa State were reportedly unable to achieve these outcomes due to limited exposure to fieldwork and inadequate instructional resources (Obiyai & Olisa, 2022). The introduction of augmented learning into this educational process provided an alternative mechanism for experiential engagement, allowing students to visualize, manipulate, and interact with agricultural phenomena in a virtual environment. This approach aligned with modern learning theories that emphasized participation, self-regulation, and technological interactivity as essential to the learning process (Namkoong et al., 2023). Consequently, the integration of augmented learning was conceptualized as a means of transforming learning from a passive absorption of content to an active construction of knowledge within a technologically enriched context.

Concept of Augmented Learning

Augmented learning refers to the application of digital technologies, especially augmented reality (AR), to enrich educational experiences by superimposing interactive, computer-generated content onto real-world environments (Al-Ansi, 2023). This pedagogical innovation sought to enhance learners' perception and engagement by allowing them to visualize and manipulate complex concepts that were otherwise abstract or difficult to access within traditional classrooms (Namkoong et al., 2023). In practice, augmented learning blends physical and virtual realities, enabling students to interact with digital representations of objects, processes, or systems relevant to their field of study. Within Agricultural Science Education, this meant that learners could engage with virtual farm environments, crop growth simulations, or soil-composition visualizations, fostering deeper conceptual understanding and practical insight (Kumar, 2023). The incorporation of augmented learning tools corresponded with the principles of constructivist and experiential learning theories, which emphasized active exploration, reflection, and learner participation (Fosnot & Perry, 2019). Beyond improving comprehension, augmented learning has been associated with heightened motivation, self-efficacy, and retention of knowledge, as it transformed abstract content into interactive, contextually meaningful experiences (Naudé et al., 2024). In the context of Bayelsa State, where infrastructural limitations constrained traditional agricultural instruction, the integration of augmented learning presented a transformative avenue for improving both teaching and learning outcomes. Therefore, understanding its potential within Agricultural Science Education was vital for developing a more technology-driven, participatory, and competency-oriented educational framework in the region.

Augmented learning was further understood as a pedagogical framework that expanded traditional classroom instruction by merging physical reality with digital enhancement to create an adaptive, immersive, and personalized learning environment (Cheng et al., 2020). Unlike conventional e-learning, which relied primarily on static online resources, augmented learning dynamically integrated three-dimensional visuals, simulations, and real-time feedback that engaged multiple sensory modalities to strengthen cognition and memory retention (Lee & Wong, 2021). This technology facilitated experiential understanding by allowing learners to interact directly with augmented objects and environments, which encouraged exploratory thinking, experimentation, and reflection processes central to meaningful learning (Wu et al., 2023). In agricultural contexts, such as soil testing, crop rotation, or animal nutrition, students could use augmented applications to visualize complex biological or chemical interactions that were otherwise invisible or difficult to reproduce in physical classrooms (Naudé et al., 2024). These immersive experiences helped overcome constraints posed by limited laboratory infrastructure and inadequate access to experimental farms that characterized many schools in Bayelsa State (Ikpaikpai & Obiyai, 2025).

Moreover, augmented learning embodied adaptive learning principles by customizing content delivery to match the learner's pace, interests, and performance feedback (Namkoong et al., 2023). This personalized

approach promoted inclusivity by accommodating different learning styles and abilities, particularly among students who struggled with traditional, text-based instruction (Al-Ansi, 2023). Empirical evidence suggested that such environments cultivated greater student motivation, collaboration, and creative problem-solving abilities through interactive group simulations and gamified agricultural scenarios (Kumar, 2023). In the broader educational ecosystem, augmented learning supported teacher professional development by enabling instructors to design and deliver visually enriched lessons that aligned with curriculum standards while fostering digital competence (Cheng et al., 2020). From an institutional perspective, it contributed to sustainable educational transformation by integrating technology into pedagogy in ways that strengthened instructional quality, resource utilization, and learner outcomes (Lee & Wong, 2021).

Within the scope of Agricultural Science Education in Bayelsa State, the potential of augmented learning was particularly significant. The technology could address perennial challenges such as inadequate instructional resources, low student engagement, and poor academic achievement in practical subjects. By facilitating virtual farm tours, crop management simulations, and pest-control demonstrations, augmented learning offered a realistic yet safe environment where learners could observe cause-and-effect relationships and test hypotheses (Wu et al., 2023). Teachers, on the other hand, could use augmented tools to demonstrate abstract agricultural principles with greater clarity, thereby enhancing instructional efficiency and learner comprehension. When contextualized within constructivist and experiential learning paradigms, augmented learning served as a catalyst for bridging the gap between theoretical instruction and real-world agricultural practice.

In light of these perspectives, augmented learning represented a powerful instructional innovation capable of transforming Agricultural Science Education into a more interactive, engaging, and technology-driven discipline. Its integration in Bayelsa State schools, therefore, held the potential to revolutionize how teachers taught and how students learned laying the foundation for improved educational outcomes, sustainable agricultural literacy, and the development of a technologically empowered generation of agricultural professionals.

Implications for Teaching and Learning

The integration of augmented learning into Agricultural Science Education presented profound implications for both teaching and learning processes in Bayelsa State and similar educational contexts. For teaching, augmented learning redefined the educator's role from a transmitter of information to a facilitator of discovery and innovation. Teachers were expected to adopt more learner-centered instructional strategies that leveraged augmented tools to create immersive experiences that encouraged inquiry, collaboration, and reflection (Cheng et al., 2020). This transition required a paradigm shift in pedagogical practice, emphasizing digital literacy, creativity, and adaptability among teachers (Lee & Wong, 2021). By utilizing augmented reality simulations, educators could demonstrate abstract agricultural processes such as soil nutrient cycles, crop physiology, or pest management in visually engaging ways that transcended the limitations of textbooks and conventional laboratories (Naudé et al., 2024). Consequently, augmented learning offered a practical means to revitalize Agricultural Science instruction, aligning it with twenty-first-century pedagogical standards and enhancing curriculum delivery within resource-constrained educational settings.

For learners, the implications were equally transformative. Augmented learning facilitated experiential and participatory learning by allowing students to actively engage with digital representations of agricultural environments, thereby fostering deeper conceptual understanding and long-term retention (Namkoong et

al., 2023). Through interactive simulations and problem-based learning activities, students could visualize complex agricultural phenomena, test hypotheses, and apply theoretical principles in a virtual setting that mirrored real-world contexts (Kumar, 2023). This active engagement promoted higher-order thinking, critical analysis, and self-directed learning competencies that were essential for success in modern agricultural practice. Moreover, the gamified and visually stimulating nature of augmented learning increased learner motivation, reduced cognitive overload, and enhanced collaborative learning as students worked together to solve virtual agricultural challenges (Al-Ansi, 2023). In essence, augmented learning transformed the traditional passive learning environment into a dynamic ecosystem of exploration, creativity, and innovation.

At the institutional and policy levels, the adoption of augmented learning carried implications for curriculum design, infrastructure development, and teacher professional training. Educational authorities and policymakers were encouraged to integrate augmented learning into teacher education programmes and secondary school curricula, ensuring that instructors acquired the necessary digital competencies to design, implement, and evaluate augmented lessons effectively (Wu et al., 2023). Furthermore, schools needed to invest in digital infrastructure, such as reliable internet connectivity, smart devices, and augmented reality software, to sustain this innovation (Lee & Wong, 2021). The incorporation of augmented learning also supported national education policies aimed at promoting science, technology, and innovation-driven teaching methods to prepare students for the demands of the digital economy (Ibironke, 2024).

Overall, the implications of augmented learning for teaching and learning in Agricultural Science Education were extensive. It promoted a pedagogical culture that valued creativity, technological integration, and experiential engagement, thereby bridging the gap between knowledge acquisition and practical application. For Bayelsa State, where Agricultural Science instruction faced significant challenges due to limited physical and instructional resources, the adoption of augmented learning provided an evidence-based, scalable solution for improving educational outcomes. In light of these implications, educational stakeholders were urged to embrace augmented learning as a strategic innovation for transforming Agricultural Science Education, enhancing teacher effectiveness, and empowering learners with the technological and practical competencies necessary for sustainable agricultural advancement.

Conclusion

The study concluded that the integration of augmented learning into Agricultural Science Education represented a transformative step toward revitalizing the teaching and learning process in Bayelsa State. Agricultural Science, as a discipline central to national food security and sustainable development, had long been hindered by inadequate instructional materials, teacher-centered methodologies, and insufficient exposure to practical experiences (Ikpaikpai & Obiyai, 2025). These challenges restricted students' engagement and hindered the effective transfer of theoretical knowledge into applicable competencies. The introduction of augmented learning, however, provided a viable and innovative solution that redefined traditional instructional boundaries by merging physical and digital realities to create a more interactive, experiential, and learner-driven educational environment (Naudé et al., 2024). Grounded in the constructivist learning theory, this innovation allowed learners to explore complex agricultural processes virtually, thereby improving comprehension, retention, and problem-solving abilities (Cheng et al., 2020).

Furthermore, augmented learning was shown to empower teachers by providing them with advanced pedagogical tools to enhance instructional delivery and assessment. The approach shifted the focus of education from passive knowledge transmission to active construction of meaning, thus aligning with

global trends in twenty-first-century education that emphasized technological integration and experiential learning (Lee & Wong, 2021). The theoretical and practical implications of this transformation were significant, as they highlighted the necessity of adopting technology-enhanced pedagogies to foster innovation, motivation, and self-directed learning among students in Agricultural Science Education. Hence, the study established that augmented learning held great potential for improving educational quality, bridging instructional gaps, and developing a digitally competent generation of agricultural learners capable of contributing meaningfully to Nigeria's socio-economic development.

Suggestions

Based on the findings and discussions of this study, several suggestions were advanced for effective implementation of augmented learning in Agricultural Science Education. First, teachers of Agricultural Science should be provided with systematic training and professional development programmes on the use of augmented learning technologies, ensuring they possess the requisite pedagogical and technological competencies to integrate digital tools into classroom instruction effectively (Namkoong et al., 2023). Educational institutions, particularly in Bayelsa State, should incorporate augmented learning frameworks into their instructional design and curriculum development processes to promote learner-centered and inquiry-based education (Wu et al., 2023). In addition, policymakers and government agencies should prioritize the provision of technological infrastructure such as reliable internet connectivity, smart devices, and augmented reality software to support the practical adoption of this innovation in schools (Al-Ansi, 2023).

Moreover, universities and teacher education faculties should embed augmented learning pedagogy within their training curricula, ensuring that pre-service teachers are adequately prepared for technology-driven teaching environments (Kumar, 2023). Collaborative partnerships between educational institutions, agricultural agencies, and technology firms were also recommended to facilitate resource sharing, content development, and innovation in teaching Agricultural Science. Finally, further research should be undertaken to evaluate the long-term impact of augmented learning on student performance, teacher competence, and curriculum effectiveness within Agricultural Science Education across different educational levels and regions in Nigeria. In light of these suggestions, stakeholders in education and agriculture were encouraged to embrace augmented learning as a sustainable strategy for improving teaching and learning outcomes, enhancing digital inclusion, and fostering agricultural literacy necessary for the nation's growth and resilience.

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