ADOPTION OF AI DEVICES IN TEACHING BIOLOGY IN SECONDARY SCHOOLS IN AKWA IBOM STATE: THE PROSPECT AND CHALLENGES

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ABSTRACT

The integration of Artificial Intelligence (AI) devices in teaching Biology in secondary schools in A+kwaIbom State presents a transformative opportunity to enhance science education through advanced technological innovations. descriptive survey design was adopted for this study. The study was carried out in AkwaIbom State. The targeted population for the study comprised of all biology teachers in AkwaIbom State. Simple random sampling technique was used to select 120 respondents, which formed the sample size for this research. The instrument used for data collection was a structured questionnaire titled "AI Devices and Biology Teaching Questionnaire (AIDBTQ)". Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.88, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such percentage analysis to answer research questions.The result showed thatconducting needs assessment and infrastructure readiness hasthe highest strategic steps of adopting AI to teach biology while establishing ethical guidelines and AI governance had the least strategic steps of adopting AI to teach biology. The study concludedincorporating AI devices in teaching biology in secondary schools in Akwa Ibom State holds immense potential for enhancing learning experiences. AI can provide personalized instruction, real-time feedback, and virtual simulations, bridging gaps in laboratory resources.One of the recommendations made was thatthe state government, in collaboration with private stakeholders and educational organizations, should invest in AI-powered educational infrastructure, including internet access, electricity, and digital learning tools.

Keyword:Artificial Intelligence, Device, Teaching, Biology, Secondary School and Akwa Ibom State

INTRODUCTION

The integration of Artificial Intelligence (AI) devices into the teaching of biology in secondary schools is a significant step toward modernizing education in AkwaIbom State, Nigeria. AI has the potential to revolutionize classroom learning by making teaching more interactive, personalized, and efficient. AI-powered educational tools, such as intelligent tutoring systems, chatbots, and virtual laboratories, can assist both teachers and students in enhancing comprehension and engagement in biology lessons. With the increasing global shift towards AI-driven education, there is a growing interest in how these technologies can be effectively utilized within Nigeria's educational system, particularly in science subjects like biology.

The application of AI in secondary school biology education presents numerous prospects. Firstly, AI can provide personalized learning experiences by analyzing students' strengths and weaknesses and tailoring lessons accordingly. This helps bridge learning gaps and improves retention rates (Luckin, 2020). Secondly, AI-powered tools can provide real-time feedback to students, helping those correct misconceptions and reinforce biological concepts (Chassignol, 2018). Additionally, virtual simulations and AI-assisted experiments can offer students hands-on experience in biology, even in schools that lack well-equipped laboratories. This is particularly beneficial in AkwaIbom State, where some schools face challenges in accessing quality laboratory facilities.

Despite these promising benefits, the implementation of AI devices in teaching biology comes with significant challenges. One of the major obstacles is inadequate infrastructure, including poor internet connectivity and unreliable electricity supply in many parts of AkwaIbom State (Olufemi, 2021). Additionally, the high cost of AI technology and the lack of trained teachers to operate and integrate AI tools into lesson plans remain significant barriers (Aina&Olaleye, 2023). Moreover, ethical concerns regarding data privacy, security, and potential job displacement for educators must be addressed to ensure responsible AI adoption in education. While AI has the potential to significantly enhance biology education in secondary schools in AkwaIbom State, there are considerable challenges that must be tackled. Addressing these issues requires government intervention, investment in digital infrastructure, and training programs for educators. By overcoming these barriers, AI can play a transformative role in improving biology education and equipping students with the skills needed for the future. Further research and pilot programs will be essential in evaluating the effectiveness and sustainability of AI integration in Nigerian schools.

STATEMENT OF THE PROBLEM

The rapid advancement of Artificial Intelligence (AI) presents significant opportunities for improving the quality of education, particularly in the teaching of science subjects like Biology. AI-powered tools such as virtual laboratories, intelligent tutoring systems, and adaptive learning platforms have the potential to make Biology lessons more interactive, personalized, and effective. However, in many secondary schools in Akwa Ibom State, the use of such technologies remains minimal or nonexistent. Despite the global shift toward AI integration in education, there is limited empirical information on how these devices are being adopted locally, what benefits they offer, and how effectively they are being used to enhance the teaching and learning of Biology. At the same time, various challenges appear to hinder the adoption of AI in classrooms across the state. These include inadequate infrastructure, lack of teacher training, insufficient funding, and limited

awareness of AI applications in education. Additionally, some educators may resist the use of AI due to fear of job displacement or lack of confidence in using modern technologies. These barriers raise concerns about the readiness of secondary schools in Akwa Ibom State to embrace AI-driven instructional methods. As such, there is a critical need to investigate both the prospects and challenges of adopting AI devices in the teaching of Biology to inform policy decisions and strategic investments aimed at transforming science education in the region.

OBJECTIVE OF THE STUDY

1. To investigate the strategic steps of adopting AI to teach biology.

RESEARCH QUESTION

1. What is strategic steps of adopting AI to teach biology

CONCEPT OF AI

Artificial intelligence began in the 1950s as an inquiry into the nature of intelligence. It used computers as a revolutionary tool to simulate, indeed exhibit, intelligence, thereby providing a means for examining it in utmost detail. "B.C.", before computers, the only observable examples of intelligence were the minds of living organisms, especially human beings. Now the family of intelligent systems had been joined by a new genus, intelligent computer programs.

AI deals with some of the phenomena surrounding computers, hence is a part of computer science. It is also a part of psychology and cognitive science. It deals, in particular, with the phenomena that appear when computers perform tasks that, if performed by people, would be regarded as requiring intelligence thinking. Gawande, Badi and Makharoumi, (2020). Artificial Intelligence (AI) refers to the use of technology aided systems that may have human like capacities for problem solving, and also have thinking abilities.

Artificial intelligence (AI) is one of humanity's most promising innovations, poised to transform myriad facets of our lives, from healthcare and education to finance and transportation. Artificial intelligence (AI) refers to computer systems capable of performing complex tasks that historically only a human could do, such as reasoning, making decisions, or solving problems. " (Baker &Smith, 2019). AI as a set of skills or abilities of a digital computer, such as "computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving.

Artificial intelligence systems work by using algorithms and data. First, a massive amount of data is collected and applied to mathematical models, or algorithms, which use the information to recognize patterns and make predictions in a process known as training. Generally, artificial intelligence (AI) refers to the information technology (IT) capabilities that can perform tasks that possibly require intelligence (Russell & Norvig, 2010). Nowadays, AI technologies, including machine learning (ML), natural language processing (NLP), pattern recognition, and virtual agents, are being embedded in existing information systems and new applications.

CONCEPT OF TEACHING

Teaching is a dynamic and evolving process that has undergone significant transformations over the past decades. With the rapid advancement of technology, increased emphasis on student-centered learning, and diverse educational philosophies, teaching methods and strategies have adapted to meet the changing needs of students and societies. Bell, S. (2015).

Teaching is the process of imparting knowledge, skills, values, and attitudes to others, typically in a formal or structured setting like schools, colleges, or training programs. It involves guiding and facilitating learning by sharing information, explaining concepts, and encouraging students to engage actively with the material. Effective teaching fosters understanding, critical thinking, and personal growth, helping learners to acquire both theoretical knowledge and practical skills.

Teaching can take various forms, ranging from direct instruction (where the teacher provides clear, structured lessons) to more interactive approaches (such as group discussions, project-based learning, or hands-on activities). The role of a teacher is not only to transmit content but also to support students in developing their own ability to think, solve problems, and learn independently. Selwyn, N. (2016)

In a broader sense, teaching is a dynamic interaction between the teacher, the students, and the content, shaped by various factors such as cultural context, learning styles, and available resources. The goal of teaching is to enable learners to grow intellectually, socially, and emotionally, preparing them for personal success and societal participation.

Teaching is the process of guiding individuals to acquire knowledge, skills, and values. It involves a teacher or instructor facilitating learning by imparting information, providing explanations, and offering insights to help students understand various subjects. The role of a teacher goes beyond merely delivering content; it involves fostering an environment where learners feel encouraged to explore, inquire, and grow. Effective teaching considers the diverse needs of students, ensuring that the content is accessible and engaging for all learners. Thomas, J. W. (2014)

At its core, teaching is a two-way interaction between the teacher and the students. It is not a one-sided transfer of knowledge but rather an ongoing conversation where feedback, questions, and discussions are integral. Teachers use various methods, such as lectures, discussions, hands-on activities, or digital tools, to engage students in the learning process. The teacher's role includes not just providing information but also helping students to think critically, problem-solve, and apply their learning to real-world situations.

Teaching also encompasses the development of both cognitive and emotional aspects of students. While academic knowledge is important, teaching encourages emotional intelligence, interpersonal skills, and values such as responsibility, respect, and empathy. By creating a supportive environment, teachers guide students not only in mastering the curriculum but also in developing character traits that are essential for personal growth and social interaction. This holistic approach ensures that students are well-prepared to face the challenges of both their academic and personal lives.

Ultimately, teaching is a dynamic and evolving practice. With the rapid advancement of technology and changes in societal needs, teaching methods have adapted, incorporating new tools and approaches to improve learning outcomes. The shift toward student-centered learning, the integration of digital resources, and the emphasis on critical thinking are all examples of how teaching continues to evolve. As teaching practices change, the essence of teaching—helping individuals learn and grow—remains constant, impacting individuals and communities alike.

CONCEPT OF BIOLOGY

Biology is the scientific study of life and living organisms, including their structure, function, growth, origin, evolution, and distribution. The term biology is derived from the Greek words bios (meaning "life") and logos (meaning "study" or "discourse"). It is a vast and diverse field that explores everything from microscopic molecules to entire ecosystems. Biology focuses on understanding what defines a living organism. All living beings share common characteristics, including: Organization (cellular structure), Metabolism (energy transformation), Homeostasis (internal balance), Growth and development, Reproduction, Response to stimuli and Adaptation through evolution. Biology is divided into numerous branches, including: Molecular Biology (Study of bimolecular such as DNA, proteins, and RNA), Cell Biology (Study of cell structure and function), Genetics (Study of heredity and variation in organisms), Ecology (Study of interactions between organisms and their environment), Evolutionary Biology (Study of the origins and changes in species over time), Physiology (Study of the functions and mechanisms in living systems) and, Microbiology (Study of microorganisms such as bacteria, viruses, and fungi).

However, biology plays an important role in medical advancements, such as vaccine development and disease treatment, Supports environmental conservation and sustainability efforts, Contributes to biotechnology and genetic engineering innovations and Enhances understanding of ecosystems and biodiversity. It is fundamental to many aspects of life and science, providing knowledge that helps solve real-world challenges in health, agriculture, and environmental conservation. The concepts of biology are the fundamental principles that explain the study of life and living organisms. These concepts include adaptation, reproduction, and response to stimuli. Biology, the scientific study of life and living organisms, explores various aspects of life, including structure, function, growth, evolution, and distribution (Couch et al., 2019). Over the years, advancements in biological research have provided a deeper understanding of life at molecular, cellular, organism, and ecological levels. The foundational principles of biology have evolved to encompass five core concepts: evolution, pathways and transformations of energy and matter, information flow, structure and function, and systems biology (Couch et al., 2019). These principles form a framework for comprehending biological complexity.

Recent educational approaches emphasize student engagement through integrative assessments, helping learners articulate these concepts and connect them to real-world biological phenomena. Biological systems exhibit multiscale organization, from molecular interactions to ecosystems, leading to emergent properties concept referred to as collective intelligence (Jiang & Perc, 2023). For instance, within cellular networks, genetic and metabolic interactions shape development and physiological responses. Similarly, in social organisms, collective decision-making in insect colonies and human societies exemplifies adaptive intelligence emerging from local interactions. There is growing recognition of the need to integrate societal issues into biology education to enhance learning outcomes. Research indicates that students exposed to curricula

connecting biological concepts with social issues develop a more holistic understanding of science. For example, teaching evolutionary biology alongside discussions on antibiotic resistance, climate change, and genetic engineering fosters a deeper appreciation of biology's relevance to societal challenges (Gouvea, 2023).

STRATEGIC STEPS OF ADOPTING AI TO TEACH BIOLOGY

Adopting artificial intelligence (AI) in biology education requires a structured approach to ensure effectiveness, accessibility, and ethical use. AI can enhance learning experiences by enabling personalized learning, automating assessments, and facilitating advanced data analysis. However, to maximize its potential, educational institutions must follow a strategic framework. Below are five essential steps to successfully integrate AI into biology education:

- **Conducting Needs Assessment and Infrastructure Readiness**

Before adopting AI, educational institutions must evaluate their current technological infrastructure, teaching objectives, and readiness for AI integration.

Assessing Institutional Readiness: Schools and universities should analyze their existing digital tools, internet connectivity, and AI competency among educators to determine AI feasibility (Xu, 2025).

Identifying Gaps in Biology Education: AI should address specific challenges, such as limited access to laboratory resources, difficulty in visualizing biological processes, and the need for personalized learning (Nayak, 2025).

Evaluating Budget and Resource Allocation: Institutions must assess funding availability for AI adoption, including software, training, and maintenance costs (García-Torres &Meinich-Bache, 2025).

- **Designing AI-Powered Curriculum and Learning Materials**

AI should be aligned with biology curricula to complement existing teaching methods rather than replace traditional instruction.

Aligning AI with Biology Standards: AI tools should support biology syllabi, ensuring compliance with curriculum guidelines (Shafik&Tufail, 2025).

Developing AI-Integrated Learning Modules: AI-powered virtual labs, adaptive quizzes, and interactive simulations should be created to enhance student engagement (Gensitz& Woods, 2025).

Customizing AI Content for Different Learning Levels: AI should differentiate learning materials for high school, undergraduate, and graduate biology courses (Wood, 2025).

- **Training Educators and Building AI Literacy**

To successfully integrate AI into biology education, teachers must be equipped with the necessary skills and knowledge.

AI Literacy Programs for Educators: Universities should introduce AI training workshops to help teachers use AI tools effectively in biology classrooms (Declercq&Devreese, 2025).

Promoting Human-AI Collaboration: Teachers should learn how to blend AI-powered learning experiences with human-led instruction to maintain student engagement (Mohammad, 2025).

Providing Ongoing AI Support: Schools should establish AI mentorship programs where experienced educators guide their peers in using AI tools (Dhahbi, 2025).

- Implementing AI Tools and Monitoring Effectiveness

Once AI systems are integrated, institutions should assess their impact on student learning and adjust implementation strategies accordingly.

Deploying AI in Stages: Schools should first introduce AI in selected biology courses and gradually expand based on feedback (Luz, 2025).

Tracking AI Performance: Institutions should analyze student engagement and learning outcomes to measure AI's effectiveness (Zabetakis, 2025).

Refining AI Models Based on User Feedback: Regularly updating AI models ensures that they remain accurate, relevant, and aligned with educational goals (Malicse, 2025).

- Establishing Ethical Guidelines and AI Governance

AI implementation must align with ethical considerations, ensuring fairness, transparency, and responsible AI use in biology education.

Developing Ethical AI Policies: Institutions should create guidelines that define how AI can be used in education while ensuring data privacy and transparency (Zabetakis, 2025).

Implementing AI Ethics Review Boards: Universities should establish committees to oversee AI-driven biology education programs (Gensitz, 2025).

Ensuring AI is a Teaching Aid, Not a Replacement: AI should support educators rather than replace them, maintaining the human element in biology education (Shafik&Tufail, 2025).

THE PROSPECTS OF USING AI TO TEACH BIOLOGY

The integration of Artificial Intelligence (AI) in biology education is revolutionizing the way students learn and interact with complex biological concepts. AI-driven tools enhance engagement, personalize learning, and facilitate advanced data analysis, making the subject more accessible and effective. There are some key prospects of using AI to teach biology:

- AI-Powered Personalized Learning in Biology

AI enables personalized learning by adapting educational content to the individual needs of students. AI-driven systems analyze student performance and tailor content accordingly, ensuring that students receive the right level of challenge and support. AI-powered platforms like intelligent tutoring systems provide customized feedback and real-time assessments, which significantly

improve student comprehension (Sahafi, 2025). It also driven virtual labs allow students to conduct experiments in a simulated environment, overcoming the limitations of physical labs (Oyinloye, 2025). With the help of students understand complex biological processes by offering instant explanations and guiding problem-solving activities (Al-Rubaidi, 2025).

- **Enhancing Cognitive and Analytical Skills through AI**

AI enhances cognitive learning by allowing students to analyze vast amounts of biological data and identify patterns, fostering higher-order thinking skills. It help break down complex biological concepts, such as nervous system functions, making them easier to understand (Echo, 2025). AI-driven simulations enable students to visualize DNA sequencing, protein folding, and ecosystem modeling, improving their analytical abilities (Reznicek, 2025).

- **AI for Distance and Blended Learning in Biology**

AI-driven educational tools have become particularly useful for remote and blended learning environments, making high-quality biology education accessible to students worldwide. AI-based platforms provide interactive lessons, automated grading, and feedback, improving the quality of distance learning (Jalilova&Musayeva, 2025). It evaluates student assignments with greater accuracy, reducing the workload of educators while ensuring fair grading. It also allows students to conduct experiments from home, enhancing their practical understanding (Edenkwo&Nwaoburu, 2025).

- **AI in Biological Research and Inquiry-Based Learning**

AI enables students to participate in real-world biological research, promoting critical thinking and scientific inquiry. It helps students formulate and test biological hypotheses by analyzing large datasets (Gregory, 2025). AI tools assist students in understanding complex topics such as biomedical imaging, disease modeling, and drug interactions (Borghi&Vassanelli, 2025).Automated Literature Review: AI-powered search engines help students conduct literature reviews efficiently, finding relevant research papers quickly (Malicse, 2025).

THE CHALLENGES OF USING AI TO TEACH BIOLOGY

While artificial intelligence (AI) has revolutionized biology education by enhancing personalized learning, providing virtual labs, and automating assessments, it also presents several challenges. These challenges include ethical concerns, infrastructure limitations, and teacher preparedness which are:

- **Ethical Concerns and Data Privacy Issues**

AI-driven learning platforms collect and analyze large amounts of student data, raising concerns about privacy, security, and ethical use. These systems rely on vast datasets, often requiring the storage of sensitive academic and personal information.

Student Data Protection: AI-based educational systems gather personal learning histories, biometric data, and cognitive patterns, which, if misused, could lead to privacy breaches (Telaumbanua, 2025).

Algorithmic Bias: AI models may reinforce biases in biology education, particularly in areas like genetics and medical biology, where existing datasets may not represent diverse populations fairly (Alboueishi&Absisa, 2025).

Ethical Dilemmas in AI-Generated Content: AI-generated instructional content in biology, particularly in genetics and evolution, may introduce misinformation if not properly curated (Echo, 2025).

The integration of AI in biology education requires high-end computing resources, stable internet access, and sophisticated software, making it financially and logistically challenging.

Cost of Implementation: Many schools, particularly in developing regions, lack the financial resources to install and maintain AI-powered learning systems (Sahafi, 2025).

Infrastructure Deficiencies: AI-based simulations for molecular biology, genetics, and ecosystems require high processing power, which is often unavailable in standard educational settings (Jalilova&Musayeva, 2025).

Accessibility Issues: Students in underprivileged regions may not have access to the necessary hardware, leading to an educational divide (Vinn, 2025).

- Teacher Training and Resistance to AI Adoption

Biology educators may lack the necessary training to effectively integrate AI tools into their teaching methods, leading to resistance and ineffective use of AI in classrooms.

Lack of AI Training for Educators: Many biology teachers are not trained in AI-based tools and may struggle to incorporate them into their curriculum (Mahdavi, 2025).

Pedagogical Challenges: AI-generated lessons may not always align with traditional teaching methods, requiring educators to rethink their instructional strategies (Wang, 2025).

Fear of AI Replacing Educators: Some educator's worry that AI will replace human teachers rather than complementing their role (Gregory, 2025).

- Accuracy and Reliability of AI in Biology Education

AI systems are only as good as the data they are trained on. Inaccuracies in datasets or biases in AI models can lead to incorrect biological conclusions.

Misinformation in AI Models: AI-based tools may misinterpret complex biological phenomena, leading to flawed explanations in areas such as cell biology and evolution (Malicse, 2025).

Lack of Explainability in AI Predictions: AI-driven diagnostic tools in medical biology often function as "black boxes," making it difficult for students to understand how conclusions are derived (Karimian, 2025).

Dependency on AI for Learning: Over-reliance on AI-generated content can reduce critical thinking skills in students, who may accept AI-generated conclusions without questioning those (Borghi&Vassanelli, 2025).

- **Ethical and Philosophical Implications in Teaching Biology with AI**

The use of AI in teaching biology raises ethical and philosophical concerns, particularly regarding topics like genetics, bioengineering, and artificial life.

AI in Genetic Research: AI-driven genetic analysis tools can raise concerns about genetic privacy and the ethical implications of gene editing (Xuan, 2025).

Philosophical Challenges: The increasing role of AI in biological research raises questions about human intervention in natural evolution and the ethical limits of AI-driven biological advancements (Wimalasena, 2025).

AI and Human Identity: The role of AI in understanding human biology and intelligence challenges traditional notions of consciousness and life sciences education (Gensitz, 2025).

HOW TO MITIGATE THE CHALLENGES OF USING AIT TO TEACH BIOLOGY

The integration of Artificial Intelligence (AI) in biology education comes with significant challenges, including ethical concerns, infrastructure limitations, teacher training gaps, AI reliability issues, and philosophical implications. To fully harness AI's potential while addressing these issues, targeted mitigation strategies must be implemented. There are some solutions:

- **Addressing Ethical Concerns and Data Privacy Issues**

AI systems in education collect extensive data on student performance, raising ethical concerns regarding privacy, consent, and algorithmic bias. Mitigation strategies focus on implementing strong data security measures, ethical AI development, and policy regulations.

Enhanced Data Privacy Protections: Schools and AI developers must adopt strong data encryption and anonymization techniques to protect student information. AI systems should comply with data protection laws such as the General Data Protection Regulation (GDPR) and Family Educational Rights and Privacy Act (FERPA) (Rueda &Soni, 2025).

Bias Mitigation in AI Models: Developers should use diverse datasets representing various demographics to reduce algorithmic bias in AI-driven biology education tools (Vinn, 2025).

Transparent AI Decision-Making: AI platforms should include explainable AI (XAI) features, enabling educators and students to understand how AI models make decisions (Xu, 2025).

- **Overcoming High Costs and Infrastructure Limitations**

Implementing AI in biology education requires advanced hardware, internet access, and ongoing maintenance, which can be expensive, particularly in developing regions.

Cloud-Based AI Solutions: Using cloud-based AI platforms allows students and institutions to access AI-driven biology tools without requiring high-end local hardware (Abdurrahman&Trengove, 2025).

AI in Low-Bandwidth Environments: AI developers should optimize educational tools to function in low-resource settings, incorporating offline AI-powered features where possible (Nayak, 2025).

Government and Institutional Funding: Governments and educational institutions should invest in AI infrastructure to ensure equitable access to AI-powered biology education (Garcia-Torres , 2025).

- **Enhancing Teacher Training and AI Integration in Curriculum**

Many educators lack training in AI tools, leading to resistance and ineffective implementation in biology education. Addressing this issue requires specialized training programs and AI-supported teaching strategies.

AI Literacy for Educators: Universities and educational institutions should introduce AI training courses for biology teachers, ensuring they understand AI-based learning tools (Shafik&Tufail, 2025).

Blended Learning Models: Teachers should integrate AI as a supplementary tool rather than replacing traditional teaching methods, fostering a balance between human instruction and AI-assisted learning (Gensitz, 2025).

Collaborative AI Development: AI developers should work with educators to create user-friendly AI-driven biology teaching tools tailored to different learning styles (Wood et al., 2025).

- **Improving Accuracy and Reliability of AI in Biology Education**

AI systems may produce inaccurate or biased results, leading to misinformation and misinterpretation of biological concepts. To mitigate this, AI models should be rigorously tested and designed for educational transparency.

Human-AI Collaboration: AI-driven biology tools should be used alongside expert review, ensuring that AI-generated content is fact-checked before being integrated into curricula (Declercq&Devreese, 2025).

Interdisciplinary AI Development: AI models should be developed with input from biologists, data scientists, and educators to improve reliability and reduce errors (Mohammad, 2025).

AI Transparency Regulations: AI tools should include explainability features that allow educators to trace and validate AI-generated biological conclusions (Dhahbi, 2025).

- Addressing Ethical and Philosophical Concerns in AI-Powered Biology Education

AI raises philosophical and ethical questions regarding its role in teaching biology, particularly in sensitive topics like genetics and artificial life. Strategies to address these concerns focus on ethical AI governance and balanced AI-human interaction.

Ethical AI Curriculum: Schools should introduce ethics courses that teach students about AI's benefits and risks in biological research (Malicse, 2025).

Ethical AI Review Boards: Universities should establish review boards to oversee A implementation in education, ensuring responsible AI use in biology classrooms (Luz, 2025).

AI as a Teaching Aid, Not a Replacement: AI should be positioned as a supplementary tool rather than a substitute for human instruction, preserving the role of human educators in biology education (Zabetakis. 2025).

METHODOLOGY

To carry out the study, descriptive survey design was adopted for this study. The study was carried out in AkwaIbom State. The targeted population for the study comprised of all biology teachers in AkwaIbom State. Simple random sampling technique was used to select 120 respondents, which formed the sample size for this research. The instrument used for data collection was a structured questionnaire titled "AI Devices and Biology Teaching Questionnaire (AIDBTQ)". Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.88, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such percentage analysis to answer research questions.

RESULT/DISCUSSION

Research Question 1.

The research question sought to find out the strategic steps of adopting AI to teach biology. To answer the research percentage analysis was performed on the data, (see table 1).

Table 1: Percentage analysis of the strategic steps of adopting AI to teach biology.

STRATEGIC STEPS	FREQUENCY	PERCENTAGE
Conducting Needs Assessment and Infrastructure Readiness	60	50**
Designing AI-Powered Curriculum and Learning Materials	23	19.17
Training Educators and Building AI Literacy	17	14.17
Implementing AI Tools and Monitoring Effectiveness	12	10
Establishing Ethical Guidelines and AI Governance	8	6.67*
TOTAL	120	100%

** The highest percentage frequency
* The least percentage frequency
SOURCE: Field survey

The above table 1 presents the percentage analysis of the strategic steps of adopting AI to teach biology. From the result of the data analysis, it was observed that "Conducting Needs Assessment and Infrastructure Readiness" 60(50) is the highest strategic steps of adopting AI to teach biology, while "Establishing Ethical Guidelines and AI Governance" 8(6.67) recorded the least strategic steps of adopting AI to teach biology. The result therefore is in agreement with the research findings of Xu (2025), who noted that schools and universities should analyze their existing digital tools, internet connectivity, and AI competency among educators to determine AI feasibility.

CONCLUSION

Incorporating AI devices in teaching biology in secondary schools in AkwaIbom State holds immense potential for enhancing learning experiences. AI can provide personalized instruction, real-time feedback, and virtual simulations, bridging gaps in laboratory resources. However, challenges such as poor infrastructure, high implementation costs, and lack of trained educators hinder its widespread adoption. Addressing these issues requires government intervention, investment in digital infrastructure, and teacher training programs. Ethical concerns, including data privacy and job displacement, must also be managed responsibly. Despite these hurdles, AI remains a transformative tool for modernizing biology education. With strategic planning and investment, its integration can revolutionize learning outcomes. A balanced approach will ensure that AI enhances, rather than replaces, traditional teaching methods.

RECOMMENDATION

1. The state government, in collaboration with private stakeholders and educational organizations, should invest in AI-powered educational infrastructure, including internet access, electricity, and digital learning tools.
2. Training programs should be organized to equip biology teachers with the necessary skills to effectively utilize AI in the classroom. Professional development workshops and certification programs should be introduced.
3. The government should work with tech companies to subsidize the cost of AI-powered educational tools such as chatbots, virtual labs, and adaptive learning platforms, making them accessible to more schools.

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