ASSESSMENT OF ARTIFICIAL INTELLIGENCE ROLES IN TEACHING AND LEARNING (ICT) FOR PROBLEM SOLVING IN SECONDARY SCHOOL IN IMO STATE: INVESTIGATING THE PROSPECT AND CHALLENGES

By

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Abstract

This study investigates the prospect and challenges of integrating Artificial Intelligence (AI) into teaching and learning practices for problem-solving in secondary schools within Imo State, Nigeria. To carry out the study, a descriptive survey design was adopted for this study and the study was carried out in Imo State. The targeted population for the study comprised all ICT teachers in secondary schools in Imo State. A stratified random sampling technique was used to select 80 ICT teachers each from the 3 senatorial districts of Imo State and this gave a total of 240 respondents used for the study. The instrument used for data collection was a structured questionnaire titled "Artificial Intelligence Roles in Teaching and Learning ICT Questionnaire (AIRTLICTQ)". 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 validity and accuracy for the study under consideration. The reliability coefficient obtained was 0.91, and this was substantially high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such as percentage analysis to answer research questions. The findings reveal that AI offers opportunities for personalized learning experiences, instant feedback, and enhanced problem-solving skills, challenges such as the digital divide, data privacy concerns, and the need for comprehensive teacher training must be addressed. It was observed that the major prospect of artificial intelligence in education is Personalized Learning. Finally, it was also found that the greatest challenge of artificial intelligence in education is data privacy and security concerns. One of the recommendations was it is quite pertinent that as a matter of necessity, teachers should be provided with comprehensive training and professional development programs to enhance their digital literacy skills and proficiency in integrating AI technologies into teaching practices effectively.

KEYWORDS: Artificial Intelligence, Teaching, Learning, Problem Solving, Secondary Schools and Imo State.

Introduction

When it comes to information and communication technology (ICT) education for problem-solving in secondary schools, artificial intelligence (AI) offers a potentially transformative path for teaching and learning. Imo State, Nigeria, stands to benefit from integrating AI into its educational system, but such integration also poses significant challenges. This assessment delves into the prospects and challenges of AI implementation in secondary schools in Imo State.

AI-powered ICT tools can provide personalized learning experiences tailored to students' individual needs and learning styles. Through adaptive learning platforms, students can engage in interactive and customized learning activities, leading to improved comprehension and retention.AI algorithms can facilitate the development of critical thinking and problem-solving skills among students. By incorporating AI-based simulations and virtual environments, students can apply theoretical knowledge to real-world scenarios, honing their problem-solving abilities in diverse contexts (UNESCO, 2020).AI can alleviate the burden of routine administrative tasks for teachers, allowing them to focus more on facilitating meaningful learning experiences and providing individualized support to students. Automated grading systems and AI-assisted lesson planning tools can enhance teacher productivity and effectiveness.

Imo State may face challenges related to inadequate ICT infrastructure and uneven access to technology across schools. Ensuring equitable access to AI-powered learning resources and reliable internet connectivity is crucial for maximizing the benefits of AI integration in education (Adekola& Adigun 2020).Effective implementation of AI in teaching and learning requires comprehensive teacher training programs to familiarize educators with AI technologies and pedagogical strategies. However, Imo State may encounter challenges in providing sufficient training and professional development opportunities for teachers to leverage AI effectively in the classroom.Aligning AI-enabled ICT education with existing curriculum frameworks poses a challenge, as it requires revising educational standards and integrating AI-related competencies into subject-specific curricula. Imo State may need to invest in curriculum development initiatives to ensure that AI education complements existing learning objectives and standards (Eke & Okwelle 2019).

Statement of Problem

In Imo State, the integration of artificial intelligence (AI) in teaching and learning processes within secondary schools presents a promising opportunity to enhance problem-solving skills among students. However, there is a lack of comprehensive understanding regarding the potential benefits and challenges associated with incorporating AI in the educational system. The current educational landscape in Imo State may not fully leverage the capabilities of AI to optimize teaching methodologies and improve learning outcomes for problem-solving skills. Therefore, there is a critical need to conduct an assessment of the roles of artificial intelligence in teaching and learning for problem-solving in secondary schools in Imo State. This investigation aims to explore the prospects and challenges of integrating AI in education, identify best practices, and address potential barriers to the effective implementation of AI technologies in the educational sector. By examining the impact of AI on teaching and learning processes, this study seeks to provide valuable insights that can inform policy decisions, curriculum development, and teacher training programs to enhance problem-solving skills among secondary school students in Imo State.

Objectives of the Study

This research seeks to find out:

1. The prospect of artificial intelligence in education
2. The challenges of artificial intelligence in education

Research Question

1. What are the prospect of artificial intelligence in education?
2. What are the challenges of artificial intelligence in education?

LITERATURE REVIEW

Concept of artificial intelligence

According to Copeland (2024), artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. Bassey and Owushi (2023) defined Artificial Intelligence (AI) as the development of computer systems that can perform tasks that typically require human intelligence. The term is

frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the advent of the digital computer in the 1940s, it has been shown that computers are capable of performing extremely difficult jobs, such as finding proofs for mathematical theorems or mastering the game of chess. Even so, no software can yet match human adaptability over a larger range of fields or in jobs requiring a great deal of common knowledge, despite ongoing advancements in computer processing speed and memory capacity. However, some programs have reached the performance levels of human experts and professionals in carrying out particular tasks. As a result, artificial intelligence in this constrained sense is used in a wide range of applications, including computer search engines, voice or handwriting recognition, medical diagnosis, and catboats.

Great Learning (2023) mentioned that artificial intelligence (AI) is currently one of the hottest buzzwords in tech, and with good reason. Over the past few years, a number of breakthroughs and technological developments that were previously limited to science fiction have begun to come true. Artificial intelligence is seen by experts as a factor in production that has the power to bring forth new growth opportunities and transform how work is done across industries.

Artificial intelligence (AI), in its broadest sense, is intelligence exhibited by machines, particularly computer systems, as opposed to the natural intelligence of living beings. As a field of research in computer science focusing on the automation of intelligent behavior through machine learning, it develops and studies methods and software that enable machines to perceive their environment and take actions that maximize their chances of achieving defined goals, with the aim of performing tasks typically associated with human intelligence. Such machines may be called AIs (Wikipedia, 2024).

Concept of information and communication technology (ICT)

ICT, or information and communications technology (or technologies), is the infrastructure and components that enable modern computing. Among the goals of IC technologies, tools, and systems is to improve the way humans create, process, and share data or information with each other. Another is to help them improve their abilities in numerous areas, including business, education, medicine, real-world problem-solving, and even leisure activities related to sports, music, and movies (Rahul A. & Mary K. P, 2024). Wikipedia (2024) stated that information and

communications technology (ICT) is an extensional term for information technology (IT) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage, and audiovisual, that enable users to access, store, transmit, understand, and manipulate information.

Information and communications technology (ICT) is an extensional term for information technology (IT) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage, and audiovisual, that enable users to access, store, transmit, understand, and manipulate information. ICT is also used to refer to the convergence of audiovisual and telephone networks with computer networks through a single cabling or link system. There are large economic incentives to merge the telephone networks with the computer network system using a single, unified system of cabling, signal distribution, and management. ICT is an umbrella term that includes any communication device, encompassing radio, television, cell phones, computer and network hardware, satellite systems, and so on, as well as the various services and appliances with them, such as video conferencing and distance learning. ICT also includes analog technology, such as paper communication, and any mode that transmits communication. ICT is a broad subject, and the concepts are evolving. It covers any product that will store, retrieve, manipulate, transmit, or receive information electronically in a digital form. The Skills Framework for the Information Age is one of many models for describing and managing competencies for ICT professionals in the 21st century (Scholarly Community Encyclopedia, 2024).

Concept of teachings

Toluwalope (2016) explained that teaching is defined as a complete process whereby the learner is made to pay attention, make observations, associate ideas, and remember previous experiencess and reasons. Teaching can equally be defined or described as a process of educating someone. Also, teaching is a process of developing the cognitive, affective, and psychomotor powers of the learner through giving the learner knowledge of facts about one subject matter, reinforcing or developing positive attitudes in the learner, and also developing certain physical or manipulative skills in the learner.

Devasis (2022) defined Teaching is a process that usually takes place in classroom situations. The process of teaching is a kind of transfer, or shearing, of knowledge from one person to another. The person who transfers his or her knowledge is known as a teacher, and the one who receives it is known as a teacher. Its special function is to impart knowledge, develop skills, and. It involves sharing, telling, and demonstrating information. Skill or knowledge that is unknown to the observer, hearer, or follower. Teaching is a relationship that is established among three focal points in education: the teacher, the student, and the subject matter. Teaching is a process by which a teacher brings the student and the subject matter together. Teaching is not only telling and testing; it is the complex art of guiding students through a variety of experiences and activities towards the attainment of goals.

In education, teaching is the concerted sharing of knowledge and experience, which is usually organized within a discipline, and, more generally, the provision of stimulus to the psychological and intellectual growth of a person by another person or artifact. Teaching is the profession of those who give instruction, especially in an elementary school, a secondary school, or a university. When a person imparts information or skills to another, it is common to describe the action as teaching. Imparting may mean sharing experiences or communicating information, for instance, through a through a lecture. Teaching is regarded as both an art and a science (IGI Global, 2014).

Teaching is one of the instruments of education, and its special function is to impart understanding and skill. The main function of teaching is to make learning effective. Teaching is a process in which one individual teaches or instructs another individual, or it can be considered the act of imparting instructions to the learners in a classroom situation. Teaching is a face-to-face encounter between two or more persons, one of whom (the teacher) intends to effect certain changes in the other participants (students). It is watching systematically (Fagge, 2022).

Concept of problem solving

Problem-solving is the process of observing what is going on in your environment, identifying things that could be changed or improved, diagnosing why the current state is the way it is and the factors and forces that influence it, developing approaches and alternatives to influence change, making decisions about which alternative to select, taking action to implement the changes, and observing the impact of those actions in the environment (Wayne,2023).

Wikipedia (2024) Problem solving refers to the process of finding solutions to problems encountered in life. Solutions to these problems are usually situation- or context-specific. The process starts with problem-finding and problem-shaping, in which the problem is discovered and simplified. The next step is to generate possible solutions and evaluate them. Finally, a solution is selected to be implemented and verified. Problems have an end goal to be reached; how you get there depends upon problem orientation (problem-solving coping style and skills) and systematic analysis.

Reid (2023) Problem solving is the process of identifying an existing problem, determining the root cause or causes of the problem, deciding the best course of action in order to solve the problem, and then finally implementing it to solve the problem. Another meaning of problem solving is that it is simply a methodology for solving everyday issues. All living things, notably humans, depend on solving problems in order to survive. In our daily lives, we use it to address both simpler problems like adjusting a light fixture on the International Space Station and more complicated ones like providing basic necessities like food and water. There are various types of problem solving that are used in countless ways and in countless fields of study, such as mathematics and physics, to determine how to solve complex equations and theoretical issues. It is also widely used in a variety of professional fields, such as construction and plumbing, where workers must be able to adapt to meet the needs of specific clients. There are many ways to solve problems. The countless numbers of everyday solutions are as diverse and specialized as the problems themselves.

Prospect of Artificial Intelligence in Education

The prospect of integrating artificial intelligence (AI) into education holds significant promise, revolutionizing the way students learn, educators teach, and institutions operate. This fusion of technology and education brings forth a multitude of benefits while also posing challenges that need careful consideration. Here's an exploration of the prospects of AI in education:

Personalized Learning: Large volumes of data can be analyzed by AI algorithms to customize learning programs to meet the needs of each unique student. With the help of adaptive learning

systems, students' engagement and comprehension can be improved by customizing the pace, material, and style of education to suit their individual learning preferences and skills.

Efficiency and Automation: AI-powered solutions can automate grading, lesson planning, and other repetitive administrative work, freeing up teachers to concentrate more on giving students individualized advice and mentoring. Teachers are able to dedicate more time to the creative and critical thinking components of teaching due to this efficiency.

Data-Driven Insights: AI can provide valuable insights into student performance patterns, learning gaps, and areas for improvement. By analyzing data from multiple sources, including assessments, interactions with learning materials, and engagement metrics, educators can make data-informed decisions to optimize teaching strategies and interventions (Siemens, 2013).

Accessibility and Inclusivity: Education may become more accessible to students with a wider range of requirements thanks to AI technologies. Artificial intelligence-driven language translation systems have the potential to enhance learning for non-native speakers, and speech recognition software can help students with impairments engage fully in classroom activities.

Lifelong Learning and Skills Development: AI can support lifelong learning initiatives by offering personalized, on-demand learning experiences tailored to the needs of adult learners and professionals seeking to upskill or reskill in response to evolving job market demands (Koedinger& Corbett 2016).

Innovative Teaching Methods: With the use of augmented reality (AR), virtual reality (VR), and simulation-based environments, artificial intelligence (AI) makes it possible to create immersive learning environments. These interactive resources help improve comprehension and memory by giving students opportunities for experiential learning in virtual environments.

Global Collaboration and Knowledge Sharing: Platforms with AI capabilities enable remote cooperation between students and teachers. Through virtual discussion boards, cooperative

projects, and shared repositories of learning materials, students can interact with others from different cultural backgrounds and gain insight from their viewpoints.

Predictive Analytics for Student Success: AI algorithms can analyze historical data to identify early indicators of student disengagement, dropout risks, or academic struggles. By predicting these factors, educators can intervene proactively to provide targeted support and guidance to at-risk students, improving overall retention rates and academic outcomes.

However, alongside these opportunities, the integration of AI in education also raises ethical, privacy, and equity concerns (Luckin, Holmes, Griffiths, &Forcier 2016). It is crucial to address these challenges through thoughtful policy frameworks, transparent algorithms, and inclusive design principles to ensure that AI technologies in education serve the best interests of all learners.

Challenges of Artificial Intelligence in Education

Artificial intelligence (AI) has emerged as a promising tool for transforming various sectors, including education. By integrating artificial intelligence into educational systems, institutions aim to enhance teaching methodologies, personalize learning experiences, and streamline administrative tasks. However, the implementation of AI in education is not devoid of challenges. Addressing these challenges requires collaborative efforts among policymakers, educators, technologists, and stakeholders to ensure that AI enhances learning outcomes while upholding ethical standards and promoting inclusivity. These are some of the significant challenges encountered in harnessing AI for educational purposes.

Data privacy and security concerns

One of the primary challenges to employing AI in education revolves around data privacy and security. Educational institutions accumulate vast amounts of sensitive data, including student records, performance metrics, and personal information. Integrating AI systems into these environments raises concerns regarding data breaches, unauthorized access, and misuse of personal data (Hoel, 2020). Furthermore, the reliance on third-party AI solutions may exacerbate these risks, as outsourcing data management to external vendors could compromise confidentiality.

Equity and accessibility issues

While AI has the potential to personalize learning experiences and cater to diverse student needs, it also poses challenges related to equity and accessibility. Unequal access to technology and digital resources can exacerbate educational disparities, widening the gap between privileged and marginalized students (Williamson, 2019). Moreover, AI algorithms may inadvertently perpetuate biases present in educational systems, such as gender or racial biases, thus reinforcing existing inequalities (Wiggers, 2020). Addressing these issues requires proactive measures to ensure that AI-powered educational tools are accessible to all students and mitigate algorithmic biases.

Ethical Considerations

The ethical dilemmas surrounding AI implementation in education are multifaceted. As AI algorithms influence decision-making processes, questions arise regarding transparency, accountability, and fairness (Selwyn, 2019). For instance, using AI for student assessment raises concerns about algorithmic transparency and the potential for bias in grading practices (Gewertz, 2019). Moreover, the ethical use of student data for algorithmic predictions, such as identifying at-risk students or recommending learning pathways, necessitates clear guidelines to safeguard student privacy and autonomy (Daniel, 2020). Balancing the benefits of AI with ethical considerations requires careful deliberation and robust regulatory frameworks.

Technological Infrastructure and Skills Gap

Implementing AI in education requires adequate technological infrastructure and skilled personnel to develop, deploy, and maintain AI systems. Many educational institutions face challenges in upgrading their existing infrastructure to support AI applications, such as cloud computing, high-speed internet, and data analytics capabilities (Buckingham, 2021). Additionally, there is a shortage of educators proficient in AI technologies, hindering the integration of AI into curriculum design and pedagogical practices (Kennedy, 2019). Bridging the technological infrastructure gap and enhancing educators' AI literacy are essential for the successful adoption of AI in education.

METHODOLOGY

In carrying out the study, a descriptive survey design was adopted for this study and the study was carried out in Imo State. The targeted population for the study comprised all ICT teachers in secondary schools in Imo State. A stratified random sampling technique was used to select 80 ICT teachers each from the 3 senatorial districts of Imo State and this gave a total of 240 respondents used for the study. The instrument used for data collection was a structured questionnaire titled "Artificial Intelligence Roles in Teaching and Learning ICT Questionnaire (AIRTLICTQ)". 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 validity and accuracy for the study under consideration. The reliability coefficient obtained was 0.91, and this was substantially high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such as percentage analysis to answer research questions.

Research Questions 1: The research question sought to find out the prospect of artificial intelligence in education. To answer the research question, percentage analysis was performed on the data, (see table 1).

Table 1:

Percentage analysis of the prospect of artificial intelligence in education.

PROSPECTS	FREQUENCE	PERCENTAGE (%)
Personalized Learning	43	17.92**
Efficiency and Automation	40	16.67
Data-Driven Insights	36	15
Lifelong Learning and Skills Development	34	14.17
Innovative Teaching Methods	32	13.3
Accessibility and Inclusivity	24	10
Predictive Analytics for Student Success	18	7.5
Global Collaboration and Knowledge Sharing	13	5.42*
TOTAL	**240**	**100%**

** **The highest percentage frequency**

* **The least percentage frequency**

SOURCE: Field Survey

The above table 1 presents the percentage analysis of the prospect of artificial intelligence in education. From the result of the data analysis, it was observed that the prospect tagged "Personalized Learning" 43(17.92) was rated as the highest prospect of artificial intelligence in education, while "Global collaboration and knowledge sharing" 13(5.42) was rated the least. The result therefore is in agreement with the research findings of Koedinger & Corbett (2016), who noted that AI can support lifelong learning initiatives by offering personalized, on-demand learning experiences tailored to the needs of adult learners and professionals seeking to upskill or reskill in response to evolving job market demands.

Research Questions 2: The research question sought to find out the challenges of artificial intelligence in education. To answer the research question, percentage analysis was performed on the data, (see table 2).

Table 2:

Percentage analysis of the challenges of artificial intelligence in education.

CHALLENGES	FREQUENCE	PERCENTAGE (%)
Data privacy and security concerns	72	30**
Equity and accessibility issues	64	26.67
Technological Infrastructure and Skills Gap	58	24.17
Ethical Considerations	46	19.17*
TOTAL	**240**	**100%**

****** **The highest percentage frequency**

***** **The least percentage frequency**

SOURCE: Field Survey

The above table 2 presents the percentage analysis of the challenges of artificial intelligence in education. From the result of the data analysis, it was observed that the challenge tagged "Data privacy and security concerns" 72(30) was rated the highest challenges of artificial intelligence in education, while "Ethical Considerations" 46(19.17) was rated the least challenges. The result therefore is in agreement with the research findings of Hoel (2020), who noted that Integrating AI

systems into these environments raises concerns regarding data breaches, unauthorized access, and misuse of personal data.

Conclusion

In conclusion, the assessment of artificial intelligence (AI) roles in teaching and learning for problem-solving in secondary schools in Imo State reveals a landscape filled with both promise and hurdles. The prospect of integrating AI into education is undeniably enticing, as it offers innovative solutions to enhance the learning experience, foster critical thinking, and prepare students for the demands of the digital age. While the integration of AI in teaching and learning holds immense promise for enhancing educational outcomes and fostering 21st-century skills, it is crucial to navigate the associated challenges thoughtfully and ethically. By addressing issues of equity, privacy, and transparency, stakeholders can harness the transformative potential of AI to create inclusive and empowering learning environments for all students in Imo State and beyond. It was concluded that the major prospect of artificial intelligence in education is Personalized Learning. Finally, it was also concluded that the greatest challenge of artificial intelligence in education is data privacy and security concerns.

Recommendation

1. It is quite pertinent that as a matter of necessity, teachers should be provided with comprehensive training and professional development programs to enhance their digital literacy skills and proficiency in integrating AI technologies into teaching practices effectively.
2. By engaging parents, students, teachers, and community members in dialogue and decision-making processes concerning the integration of AI in education fosters a culture of inclusivity, transparency, and accountability.
3. Government and school management should establish mechanisms for continuous monitoring and evaluation of AI implementations in schools, gathering feedback from stakeholders to identify challenges, address issues promptly, and refine strategies for improvement.

4. It is good to develop and implement ethical guidelines and standards for the responsible use of AI in education, addressing concerns such as data privacy, algorithmic bias, and transparency to safeguard student rights and promote trust among stakeholders.

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