ARTIFICIAL INTELLIGENCE AND THE IMPLEMENTATION OF INNOVATIVE TEACHING METHODS IN THE 21ST CENTURY SECONDARY EDUCATION IN RIVERS STATE

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Abstract

This study investigated artificial intelligence and the implementation of innovative teaching methods in 21st-century secondary schools in Rivers State. The study adopted the survey research design. The study's population was 8,362 teachers from selected secondary schools (public and private) in Rivers State. The sample size consisted of 367 teachers, comprising 196 digital natives and 171 digital migrants. Simple random sampling procedures were employed to choose the participants. The data was gathered using a standardised questionnaire called the Artificial Intelligence and the Implementation of Innovative Teaching Methods Questionnaire. The questionnaire was subjected to face and content validity, and assessed for reliability, producing an coefficient of 0.812. Mean and standard deviation and the Z-test were used to answer the research questions and test the hypotheses at the 0.05 level of significance respectively. Among others, the study revealed there is no notable disparity in how digital natives and migrant teachers perceive the current state of artificial intelligence integration in 21st-century classrooms, and there is a notable disparity in how digital natives and migrant teachers perceive the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools in Rivers State. The study concluded that implementing AI in Rivers State secondary schools could be a game-changing step towards improving educational quality and preparing students for success in a rapidly evolving digital world. The study recommended, among others, that teachers should be trained on how to integrate AI-powered tools into their teaching practices to maximize their benefits for student learning, and the management of schools should consider allocating resources for the purchase of AI tools and software to support the implementation of these methods.

Keywords: *Artificial Intelligence, Implementation, Innovation, Teaching Methods, 21st century.*

Introduction

Innovative teaching is one of the much-talked-about topics in education, especially in the 21st century. With the advancement of technology, artificial intelligence has emerged as a tool that can revolutionize teaching methods and enhance learning outcomes in the educational landscape. According to Akudo and Eziuzo (2023), secondary schools have as one of their objectives in the 21st century to devise novel approaches to education that would guarantee that pupils have the abilities needed to prosper on a planet that is changing quickly. As such, artificial intelligence (AI) has become a key focus for educators looking to adapt to the demands of the modern world. AI-powered tools having merit and potential are considered to be game changers concerning the implementation of curriculum at the secondary school level, noting that students at that level are increasingly digital natives who

are accustomed to technology in their daily lives (Shobita, 2019). Introducing AI into the classroom can help adolescents develop the analytical, problem-solving, and teamwork skills required for success in the twenty-first-century workforce (Aina et al., 2023).

Curriculum implementation in the Nigerian educational system is one of the responsibilities of teachers as they are tasked with translating the curriculum into meaningful learning experiences for students. This process involves planning, organizing, and delivering instruction in a way that aligns with the objectives and goals of the curriculum. Curriculum implementation, according to Ohamobi et al. (2020), is the process of putting everything in the curriculum document into practice through the collaborative efforts of teachers, school leaders, students, and other stakeholders. It requires effective communication, collaboration, and coordination among all parties involved to ensure successful implementation. As such, AI can play a significant role in streamlining this process by providing data-driven insights and personalized recommendations to educators. By leveraging AI technology, educators can enhance their curriculum implementation strategies and improve student outcomes through targeted interventions and adaptive learning experiences.

The 21st-century classroom values innovation and technology to suit students' different needs and prepare them for success in an ever-changing world. Today, instructional AI software exists to address kids' unique demands (Diwan, 2017). With most teachers as digital migrants; those who did not grow up with technology but have had to adapt to it in their teaching practices, educational AI software can provide valuable support in personalizing learning experiences for students. By leveraging these tools, educators can better address individual learning styles and needs, ultimately leading to improved academic outcomes for all students.

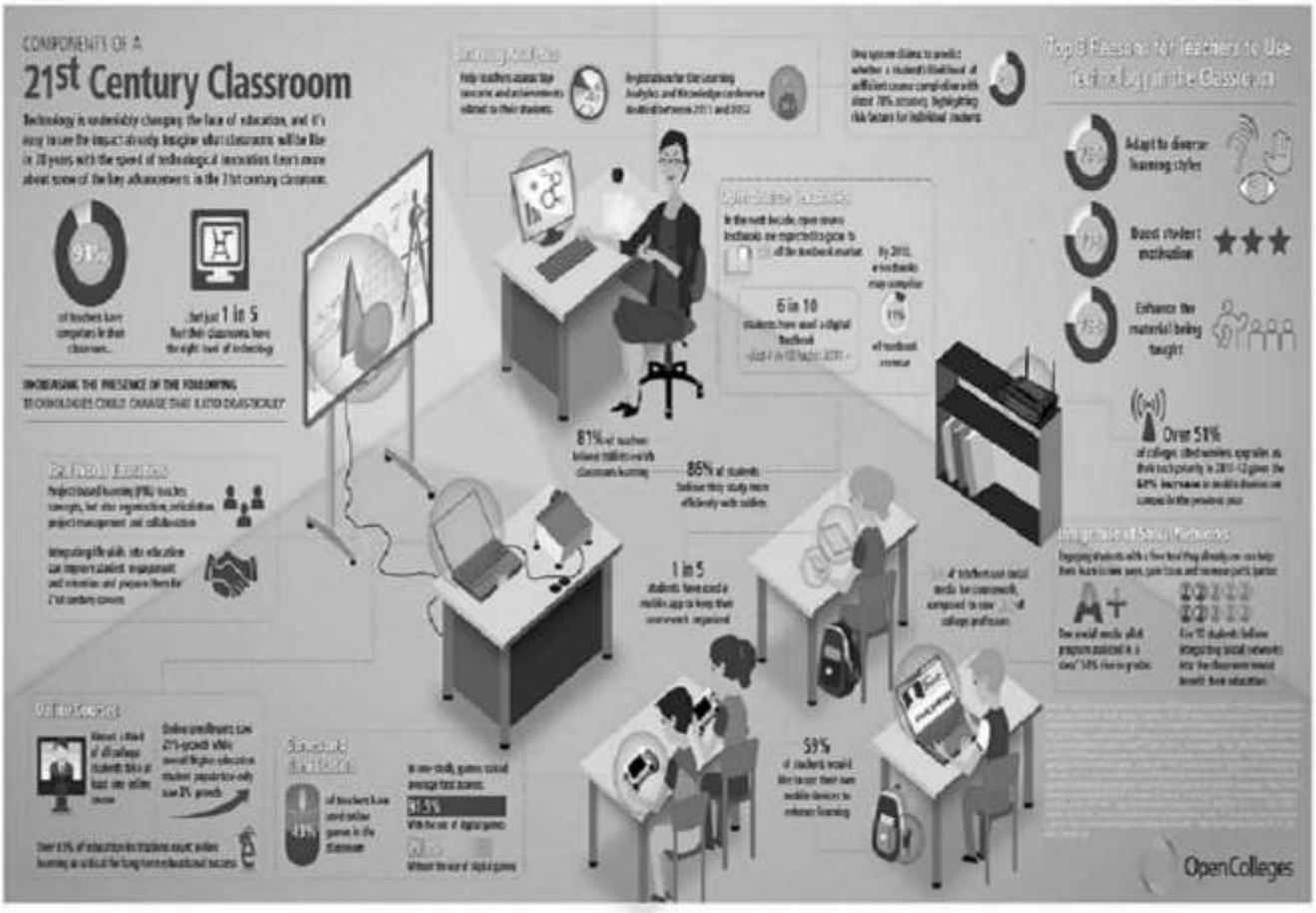

Figure 1: 21st-century smart classrooms

Source: Wogu et al. (2019)

As shown in Figure 1, the 21st-century classroom utilizes a variety of digital tools and platforms to enhance student engagement and collaboration, creating a dynamic and interactive learning environment. These advancements in educational technology are reshaping traditional teaching methods and empowering educators to personalize instruction for each student's unique learning style (Wogu, 2018). Nonetheless, there have been contentious discussions among modern education and artificial intelligence experts on whether or not effective learning and education can occur in these smart classrooms (Diwan, 2017; Wogu, 2017). However, in terms of curriculum implementation at the secondary school level, it is believed that incorporating AI into innovative teaching methods like blended learning, active learning, jigsaws, project-based learning, flipped classrooms, collaborative learning, and game-based learning, among others can enhance student engagement. As such, it is on this basis, that this study investigated the extent to which artificial intelligence would facilitate the implementation of innovative teaching methods in 21st-century classrooms.

Statement of the Problem

The persistent gap in the Nigerian secondary educational system in terms of access to innovative teaching methods and resources has hindered the effective delivery of quality education. This has resulted in a lack of preparedness among students for the demands of the 21st-century workforce, ultimately impacting their future success and competitiveness in a global economy. With the revelations made possible by the shutting down of schools due to the COVID-19 pandemic, about how poorly equipped many educational systems are to adapt to remote learning, in the face of such challenges, it becomes clear that Nigerian public and private schools have a long way to go in terms of preparing their students for the demands of the 21st-century workforce. As a result, the curriculum in schools is designed to meet the country's educational aspirations, which are broken down into learning outcomes, goals, aims, and objectives that must be met at various educational levels. However, it seems that our national ideals have been perverted, and national cohesiveness and integration have remained elusive. One starts to question if a curriculum created with the demands of the workforce of the twentyfirst century is successful in addressing these important challenges. Today, innovative teaching methods and a focus on developing critical thinking skills are essential in preparing students for the demands of the 21st-century workforce is widely prioritized by developed nations, while our educational system seems to be lagging in incorporating these important elements. It is against this backdrop, that AI integration in curriculum implementation becomes increasingly necessary to close the distance between traditional educational practices and the skills needed for success in the modern workforce.

Aim and Objectives of the Study

The study explored the extent to which artificial intelligence would facilitate the implementation of innovative teaching methods in 21st-century secondary schools in Rivers State. The specific objectives of the study included to:

1. Examine the current state of artificial intelligence integration in 21st-century secondary schools.

2. Identify the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools.

3. Assess the readiness of teachers to embrace AI technology to implement innovative teaching in 21stcentury secondary schools.

4. Ascertain the impact of artificial intelligence on the implementation of innovative teaching in improving student learning outcomes in 21st-century secondary schools.

Research Questions

1. What is the current state of artificial intelligence integration in 21st-century secondary schools?

2. What are the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools?

3. What is the readiness of teachers to embrace AI technology to implement innovative teaching in 21stcentury secondary schools?

4. What is the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools?

Hypotheses

1. There is no notable disparity in how digital natives and migrant teachers perceive the current state of artificial intelligence integration in 21st-century secondary schools.

2. There is no notable disparity in how digital natives and migrant teachers perceive the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools.

3. There is no notable disparity in the readiness of digital natives and migrant teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools.

4. There is no notable disparity in how digital natives and migrant teachers perceive the impact of artificial intelligence on the implementation of innovative teaching methods for improving student learning outcomes in 21st-century secondary schools.

Methodology

The research design used to carry out the study was a survey design. The study's population consisted of 8,362 teachers from selected secondary schools (public and private) in Rivers State. The criteria for the inclusion of the schools and teachers were based on the fact that; the chosen schools were equipped with 21stcentury learning tools and technologies, and the teachers had received training on integrating artificial intelligence into their teaching practices. The sample size consisted of 367 teachers, comprising 196 digital natives and 171 digital migrants. The sample size was ascertained using the Krejcie and Morgan sample size table. However, simple random sampling was utilised to select teachers from the selected senior secondary schools located mainly in the urban areas of Rivers State.

A questionnaire designed by the researcher and titled Artificial Intelligence and the Implementation of Innovative Teaching Methods Questionnaire (AIIITMQ) was employed to get replies from the respondents regarding the topic under investigation. The 28-item questionnaire was rated on a 4-point Likert scale ranging from Strongly Agree (SA) = 4, to Strongly Disagree (SD) = 1; with a criterion mean of 2.5. The split-half approach was utilised to evaluate the dependability of the instrument, resulting in a reliability coefficient of r = 0.812. The mean score and standard deviation were used to answer the study questions, and the Z-test was used to evaluate the hypotheses at a significance level of 0.05.

Data Presentation

Research Question 1: What is the current state of artificial intelligence integration in 21st-century secondary schools?

Table 1: Mean and std. dev. of the current state of artificial intelligence integration in 21st-century secondary schools

S/N	Items	Teachers (n=367)		
		$\bar{x}$	SD	Remark
.1	AI-powered tools are currently being used to enhance personalized learning experiences for students	3.06	0.65	SA
.2	AI tools are being utilized to analyze student performance data to identify areas for improvement and personalize learning experiences	2.90	0.79	A
.3	AI-powered tools are being used to provide real-time feedback to students on their work.	1.88	0.91	SD
.4	Virtual reality simulations powered by AI are being incorporated into lessons to provide immersive learning experiences	2.10	1.03	D
.5	AI-powered tools are being used to create adaptive learning platforms that cater to individual student needs.	3.17	0.80	SA
.6	AI-powered tools are being used by teachers to automate administrative tasks, allowing them to focus more on teaching.	3.22	0.75	SA
.7	AI-powered tools are used for lesson planning and content creation, helping teachers save time and improve the quality of their instruction.	3.01	0.90	SA
	Grand Mean	**2.76**		

Criterion Mean = 2.5, Mean: 1.0-1.99 = Strongly Disagree (SD), 2.00 – 2.49 = Disagree (D), 2.5-2.99= Agreed (A), 3.00-4.00 = Strongly Agree (SA).

Table 1 shows the current state of artificial intelligence integration in 21st-century secondary schools. The majority of the teachers strongly agreed with items 1, and 5-7, having mean scores that are equal to or greater than the mean criterion (2.50), and within the range of 3.00-4.00. Furthermore, the majority of the teachers agreed to items 2, having mean scores that are equal to or greater than the mean criterion (2.50), and within the range of 2.50-2.99. On the other hand, the majority of the teachers disagreed with item 4, having mean scores that are less than the mean criterion (2.50), and within the range of 2.00-2.49. Also, the majority of the teachers strongly disagreed with item 3, having mean scores that are less than the mean criterion (2.50), and within the range of 1.00-1.99.

The grand mean of 2.76, implies that the majority of the teachers agree that AI-powered tools are currently being used to enhance personalized learning experiences for students, analyze student performance data, create adaptive learning platforms, automate administrative tasks, and for lesson planning and content creation.

Research Question 2: What are the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools?

Table 2: Mean and std. dev. of the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools

S/N	Items	Teachers (n=367)		
		$\bar{x}$	SD	Remark
.8	Blended learning: by personalizing the mix of online and in-person instruction based on individual student needs and progress.	3.29	0.71	SA
.9	Active learning: through interactive simulations and real-time feedback to engage students in the learning process	3.10	0.77	SA
.10	Jigsaws: by creating personalized learning paths for students based on their strengths and weaknesses	3.44	0.62	SA

.11	Project-based learning: by providing resources and guidance tailored to each student's project goals	3.16	0.55	SA
.12	Flipped classroom: through online platforms that deliver instructional content outside of class time	3.02	0.75	SA
.13	Collaborative learning: through virtual group projects and discussions to promote teamwork and communication skills	3.37	0.76	SA
.14	Game-based learning: by creating interactive educational games that adapt to each student's learning pace and style	3.54	0.63	SA
	Grand Mean	**3.74**		

Criterion Mean = 2.5, Mean: 1.0-1.99 = Strongly Disagree (SD), 2.00 – 2.49 = Disagree (D), 2.5-2.99= Agreed (A), 3.00-4.00 = Strongly Agree (SA).

Table 2 shows the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools. The majority of the teachers strongly agreed with items 8-14, having mean scores that are equal to or greater than the mean criterion (2.50), and within the range of 3.00-4.00. The grand mean of 3.74, implies that the majority of the teachers strongly agree that blended learning, active learning, jigsaws, project-based learning, flipped classroom, collaborative learning, and game-based learning are innovative teaching methods that could be implemented with the help of artificial intelligence.

Research Question 3: What is the readiness of teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools?

Table 3: Mean and std. dev. of the readiness of teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools

S/N	Items	Teachers (n=367)		
		$\bar{x}$	SD	Remark
.15	Teachers are excited about the potential benefits of AI in education	3.20	0.77	SA
.16	Teachers are open to learning new technologies to enhance their teaching practices	3.27	0.71	SA
.17	Teachers believe that AI can personalize learning experiences for students	3.03	0.63	SA
.18	Teachers are willing to adapt their teaching methods to incorporate AI tools	3.06	0.58	SA
.19	Teachers recognize the importance of staying updated on technological advancements in education,	3.45	0.68	SA
.20	Teachers are confident in their ability to effectively integrate AI into their lesson plans	3.32	0.61	SA
.21	Teachers understand the value of collaboration with AI experts to improve their teaching strategies	3.18	0.63	SA
	Grand Mean	**3.22**		

Criterion Mean = 2.5, Mean: 1.0-1.99 = Strongly Disagree (SD), 2.00 – 2.49 = Disagree (D), 2.5-2.99= Agreed (A), 3.00-4.00 = Strongly Agree (SA).

Table 3 shows the readiness of teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools. The majority of the teachers strongly agreed to items 15-21, having mean scores that are equal to or greater than the mean criterion (2.50), and within the range of 3.00-4.00. The grand mean of 3.22, implies that the majority of the teachers strongly agree that teachers are excited about the potential benefits,

teachers are open to learning new technologies to enhance their teaching practices, and teachers believe that AI can personalize learning experiences for students, among others, highlight the readiness of teachers to embrace AI technology to implement innovative teaching.

Research Question 4: What is the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools?

Table 4: Mean and std. dev. of the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools

S/N	Items	Teachers (n=367)		
		$\bar{x}$	SD	Remark
.22	AI tools have the potential to enhance the implementation of innovative teaching for students based on their individual needs and abilities	3.34	0.75	SA
.23	AI can provide real-time feedback to teachers to adjust instruction accordingly	3.03	0.61	SA
.24	AI can analyze student data to identify areas of improvement	3.02	0.56	SA
.25	AI can assist in creating interactive and engaging learning materials	2.92	0.62	A
.26	AI can support teachers in managing classroom activities more efficiently	2.90	0.51	A
.27	AI can help in identifying students who may need additional support	3.26	0.69	SA
.28	AI can facilitate collaboration among students through online platforms.	3.26	0.52	SA
	Grand Mean	**3.10**		

Criterion Mean = 2.5, Mean: 1.0-1.99 = Strongly Disagree (SD), 2.00 – 2.49 = Disagree (D), 2.5-2.99= Agreed (A), 3.00-4.00 = Strongly Agree (SA).

Table 4 shows the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools. The majority of the teachers strongly agreed to items 22-24, and 27-28, having mean scores that are equal to or greater than the mean criterion (2.50), and within the range of 3.00-4.00. Also, the majority of the teachers agreed to items 25 and 26, having mean scores that are equal to or greater than the mean criterion (2.50), and within the range of 2.50-2.99.
The grand mean of 3.10, implies that the majority of the teachers strongly agree that AI tools have the potential to enhance the implementation of innovative teaching for students based on their individual needs and abilities, AI can provide real-time feedback to teachers to adjust instruction accordingly, and AI can analyze student data to identify areas of improvement, among others are the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes.
Hypothesis 1: There is no notable disparity in how digital natives and migrant teachers perceive the current state of artificial intelligence integration in 21st-century secondary schools.

Table 5: Z-test analysis on how digital natives and migrant teachers perceive the current state of artificial intelligence integration in 21st-century secondary schools

Participant	n	$\bar{x}$	SD	df	Z_{cal}	Z_{tab}	Sig.	Decision
Digital Natives	196	19.53	2.71	365	1.47	1.96	1.14	Retain: H_{O1}
Digital Migrants	171	19.11	2.74					

Table 5 indicates that Z_{cal} = 1.47, df = 365, and Z_{tab} = 1.96. Therefore, since $Z_{cal}<Z_{tab}$ and P > 0.05, there is no notable disparity in how digital natives and migrant teachers perceive the current state of artificial intelligence integration in 21st-century secondary schools. Therefore, the null hypothesis one is upheld at a significance level of 0.05.

Hypothesis 2: There is no notable disparity in how digital natives and migrant teachers perceive the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools.

Table 6: Z-test analysis on how digital natives and migrant teachers perceive the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools

Participant	n	$\bar{x}$	SD	df	Z_{cal}	Z_{tab}	Sig.	Decision
Digital Natives	196	22.25	2.65	365	5.94	1.96	0.00	Reject: H_{O2}
Digital Migrants	171	23..70	1.92					

Table 6 indicates that Z_{cal} = 5.94, df = 365, and Z_{tab} = 1.96. Therefore, since $Z_{cal}> Z_{tab}$ and P < 0.05, there is a notable disparity in how digital natives and migrant teachers perceive the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools. Therefore, null hypothesis two is not accepted at the significance level of 0.05.

Hypothesis 3: There is no notable disparity in the readiness of digital natives and migrant teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools.

Table 7: Z-test analysis on the readiness of digital natives and migrant teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools

Participant	n	$\bar{x}$	SD	df	Z_{cal}	Z_{tab}	Sig.	Decision
Digital Natives	196	21.39	2.31	365	10.13	1.96	0.00	Reject: H_{O3}
Digital Migrants	171	23.81	2.25					

Table 7 indicates that Z_{cal} = 10.13, df = 365, and Z_{tab} = 1.96. Therefore, since $Z_{cal}>Z_{tab}$ and P < 0.05, there is a notable disparity in the readiness of digital natives and migrant teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools. Therefore, the null hypothesis three is not upheld at a significance level of 0.05.

Hypothesis 4: There is no notable disparity in how digital natives and migrant teachers perceive the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools.

Table 8: Z-test analysis on how digital natives and migrant teachers perceive the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools

Participant	n	$\bar{x}$	SD	df	Z_{cal}	Z_{tab}	Sig.	Decision
Digital Natives	196	21.88	2.37	365	1.26	1.96	0.21	Retain: H_{O4}
Digital Migrants	171	21.56	2.60					

Table 8 indicates that $Z_{cal} = 1.26$, df = 365, and $Z_{tab} = 1.96$. Therefore, since $Z_{cal} > Z_{tab}$ and $P < 0.05$, there is no notable disparity in how digital natives and migrant teachers perceive the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools. Therefore, null hypothesis four is accepted at the significance level of 0.05.

Discussion of Findings

The outcome of the first research question showed that the majority of the teachers agree that AIpowered tools are currently being used to enhance personalized learning experiences for students, analyze student performance data, create adaptive learning platforms, automate administrative tasks, and for lesson planning and content creation. The test of hypothesis one indicated that there is no notable disparity in how digital natives and migrant teachers perceive the current state of artificial intelligence integration in 21st-century secondary schools. The results are consistent with Tapalova and Zhiyenbayeva's (2022) findings, which outlined the main advantages of creating personalised learning pathways. These advantages included training in virtual environments, 24/7 access to instruction, adapting instructional materials to students' individual needs, regular and real-time feedback, improvements in the educational process, and mental stimulation. The proposed educational paradigm reflects artificial intelligence's growing role in socioeconomic life, the political and ethical concerns it may raise for humanity, and its significance in the digitalization of education.

The outcome of the second research question showed that the majority of the teachers strongly agree that blended learning, active learning, jigsaws, project-based learning, flipped classroom, collaborative learning, and game-based learning are innovative teaching methods that could be implemented with the help of artificial intelligence. The test of hypothesis two indicated that there is a notable disparity in how digital natives and migrant teachers perceive the innovative teaching methods that could be implemented with the help of artificial intelligence in 21st-century secondary schools. Akudo and Eziuzo (2023) provide support for the findings. They investigated the extent to which innovative techniques, such as switching, project-based learning, and the use of technology, were implemented for managing instructional and educational activities in public secondary schools in the 21st century.

The outcome of the third research question indicated that the majority of the teachers strongly agree that teachers are excited about the potential benefits, teachers are open to learning new technologies to enhance their teaching practices, and teachers believe that AI can personalize learning experiences for students, among others, highlight the readiness of teachers to embrace AI technology to implement innovative teaching. The test of hypothesis three indicated that there is a notable disparity in the readiness of digital natives and migrant teachers to embrace AI technology to implement innovative teaching in 21st-century secondary schools. The results align with those of Slimi (2023), who found that to adequately educate graduates for the workforce of the future, higher education institutions need to include AI into their curricula on a larger scale.

The outcome of the fourth research question indicated that the majority of the teachers strongly agree that AI tools have the potential to enhance the implementation of innovative teaching for students based on their individual needs and abilities, AI can provide real-time feedback to teachers to adjust instruction accordingly, and AI can analyze student data to identify areas of improvement, among others are the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes. The test of hypothesis four indicated that there is no notable disparity in how digital natives and migrant teachers perceive the impact of artificial intelligence on the implementation of innovative teaching for improving student learning outcomes in 21st-century secondary schools. The results corroborate those of Slimi (2023), who found that AI has the potential to revolutionise education by tailoring instruction to the needs of each student, giving prompt feedback, and automating administrative duties. Additionally, technology can assist with grading and assessment, freeing up teachers to focus on creating curriculum and providing high-quality training.

Conclusion

The study looked into how artificial intelligence could help Rivers State secondary schools implement innovative teaching methods in the 21st century. The findings show that AI technologies have the potential to transform the way students learn and teachers teach by providing more personalised and engaging educational

experiences that are tailored to individual learning styles and requirements. This suggests that incorporating AI into Rivers State's educational system may lead to better academic outcomes and overall student success in the future. Thus, the study concludes that implementing AI in Rivers State secondary schools could be a gamechanging step towards improving educational quality and preparing students for success in a rapidly evolving digital world. To achieve this, educators and policymakers must work together to effectively integrate AI technologies into the curriculum and ensure that students have the skills they need to thrive in the twenty-first century.

Recommendations

Following the findings, the study recommends as follows:

1. Teachers should be trained on how to integrate AI-powered tools into their teaching practices to maximize their benefits for student learning.
2. The management of schools should consider allocating resources for the purchase of AI tools and software to support the implementation of these methods.
3. Schools should create a supportive environment that encourages collaboration and experimentation with AI tools to foster a culture of innovation among teachers.
4. The Rivers State government should prioritize the procurement of AI tools that are user-friendly and align with the curriculum to ensure seamless integration into classroom instruction.

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