Unizik Journal of Educational Research, Science and Vocational Studies (UJERSVOCS) Volume 2 (1); May-August, 2025; https://unilaws.org/ujervs
E-ISSN (Online): 1595-6199 ISSN (Print): 1595-6202

INTEGRATING ARTIFICIAL INTELLIGENCE (AI) CHATBOTS IN TEACHING INTEGRATED SCIENCE IN KADUNA STATE, NIGERIA: OPPORTUNITIES, PEDAGOGICAL IMPACTS AND ETHICAL CHALLENGES.

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ABSTRACT

The rapid advancement of Artificial Intelligence (AI) technologies is reshaping educational landscapes globally, with AI-powered chatbots emerging as promising tools for enhancing teaching and learning processes. This study investigates the integration of AI chatbots in the teaching of Integrated Science in secondary schools in Kaduna State, Nigeria. The study is focused on perceived opportunities, pedagogical impacts, and ethical challenges. A descriptive survey design was employed, using the entire population of fifty-seven (57) Integrated Science teachers in Zaria as the sample, adopting a census method suitable for small and accessible populations to ensure comprehensive data collection. A structured questionnaire was administered in accordance with standard procedures. Descriptive statistics and a t-test was used to analyse the collected data. The results indicate that although teachers perceive AI chatbots as pedagogically beneficial, this perception does not significantly predict their intention to adopt the technology. A significant difference was found between teachers' and students' ethical perceptions, with teachers showing greater concern for issues such as data privacy and algorithmic bias. Furthermore, prior Information and Ccommunications Technology (ICT) training did not significantly influence teachers' readiness to implement AI tools, suggesting the importance of other factors such as institutional support and technological self-efficacy. The study concludes that while AI chatbots offer valuable opportunities for improving Integrated Science instruction, successful integration depends on the establishment of ethical safeguards, the provision of targeted teacher training, and the development of contextually relevant implementation strategies. Recommendations are provided to inform policy, teacher development, and future research on the effective and responsible use of AI in Nigerian education.

Keywords: Artificial Intelligence, Chatbots, Teaching, Integrated Science, Pedagogy

Introduction

The integration of Artificial Intelligence (AI) in education has accelerated over the last decade, with AI-powered chatbots emerging as innovative tools for personalized instruction, immediate feedback, and learner engagement (Bali, Garba, Ahmadu, Takwate, & Malgwi, 2024). In Integrated Science, a subject designed to foster inquiry-based learning across multiple disciplines, AI chatbots offer the potential to simulate dialogue, scaffold understanding, and support self-paced learning (Davar, Dewan & Zhang, 2025).

However, according to Alasadi and Baiz (2023) while these opportunities are promising, ethical concerns such as data privacy, equity of access, teacher autonomy, and algorithmic bias have raised critical questions about responsible use. As educational institutions adopt AI tools, it becomes essential to investigate both the pedagogical benefits and ethical dilemmas associated with chatbot integration (Əşrəfova, 2025). Recent research identifies AI chatbots as effective tools in supporting inquiry-based learning and facilitating real-time feedback (Barredo Arrieta et al., 2020). In science education, chatbots simulate Socratic questioning, guide laboratory procedures, and provide personalized explanations (Johnson & Cuevas, 2016). Integrated Science focuses on the interconnectedness of biological, chemical, and physical phenomena, requiring tools that foster conceptual integration (Winarno, 2020). ICTs and AI are recognized as promising solutions to enhance engagement and understanding (Roehrig, Dare, Ring-Whalen, & Wieselmann, 2021).

Statement of the Problem

The incorporation of Artificial Intelligence (AI) chatbots within educational frameworks has attracted significant international scrutiny due to their capacity to revolutionize pedagogical practices and learning experiences. In the domain of science education, particularly within Integrated Science curricula, AI chatbots present substantial prospects for augmenting personalized learning, enhancing student engagement, and facilitating differentiated instructional approaches. Nonetheless, in numerous developing areas, such as Kaduna State, Nigeria, the implementation of such sophisticated technologies remains constrained and is not adequately understood. While certain educational institutions in Nigeria are commencing to explore the potential of digital technologies, empirical investigations concerning the pedagogical ramifications, opportunities, and ethical considerations surrounding the utilization of AI chatbots in Integrated Science classrooms are notably limited. Educators may lack the requisite technical skills or pedagogical frameworks necessary for the effective deployment of these instruments, and learners may encounter obstacles related to accessibility. Moreover, the integration of AI within educational settings evokes significant ethical dilemmas pertaining to data privacy, equity, algorithmic bias, and the possible diminishment of teacher autonomy. Consequently, there exists an urgent imperative to scrutinize how AI chatbots can be integrated into Integrated Science instruction in Kaduna State in a manner that is both effective and ethical. This research endeavor seeks to fill this void by examining the perceived opportunities, evaluating the pedagogical effects, and identifying the ethical challenges associated with the incorporation of AI chatbots in secondary educational institutions. Such an investigation is critical for informing policy, directing teacher

training initiatives, and ensuring the responsible implementation of AI technologies within the educational sector.

Aim and Objectives of the Research

The aim of the study is to examine key factors influencing the integration of AI chatbots into Integrated Science classrooms, focusing on perceptions of usefulness, ethical considerations, and ICT preparedness. The following is an outline of the objectives of the study:

1. To explore the perceived opportunities of using AI chatbots in teaching Integrated Science.
2. To investigate the ethical challenges encountered in the use of AI chatbots in the classroom.
3. To examine the readiness and attitudes of Integrated Science teachers toward the integration of AI chatbots.

Research Questions

The following research questions were outlined

1. What are the perceived pedagogical benefits of AI chatbots in Integrated Science instruction?
2. What ethical concerns do teachers and students associate with the use of AI chatbots?
3. How prepared are educators to implement AI chatbots in teaching Integrated Science?

Research Hypotheses

The following research hypotheses were formulated to guide the research:

1. There is no significant difference in the mean perceived pedagogical benefit scores of AI chabots between teachers and students in Integrated Science.
2. There is no significant difference in the mean ethical concern scores regarding AI chatbot use between teachers and students.
3. There is no significant difference in the mean preparedness scores for implementing AI chatbots between prior experience and teacher readiness in Integrated Science teaching.

Pedagogical Integration of Artificial Intelligent (Chatbots) For Integrated Science Education

The integration of ai chatbots in integrated science education represents a fundamental shift in pedagogical approaches, offering unprecedented opportunities to enhance teaching and learning processes. The comprehensive reviews examines the pedagogical application of AI (Chatbots) specifically for integrated science education, drawing from recent theoretical framework and empirical studies to understand how these technologies can transform educational practices. According to Wollny, Schneider, Di Mitri, Weidlich, Rittberger and Drachsler (2021) opined that Chatbots are digital systems that can be interacted with entirely through natural language via text or voice interfaces (See Figure 1).

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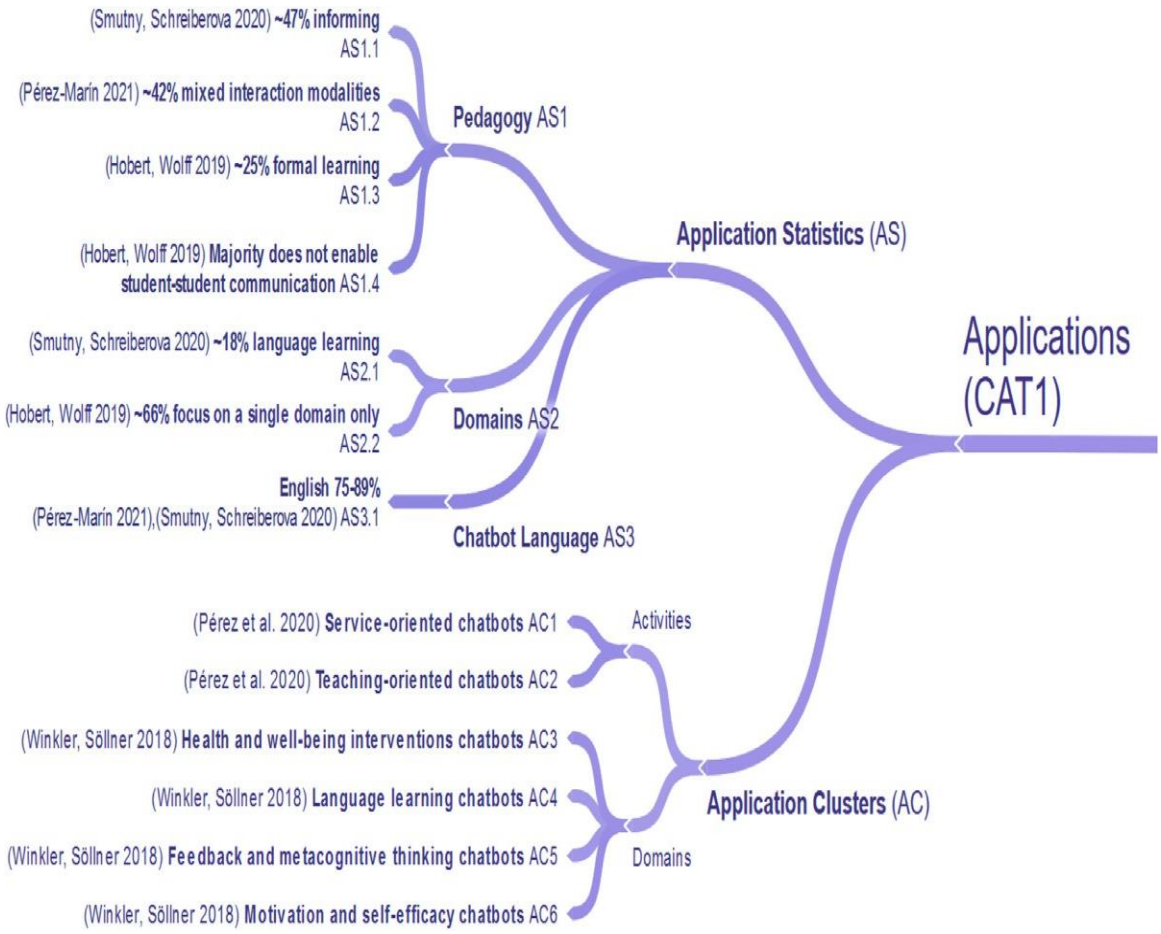
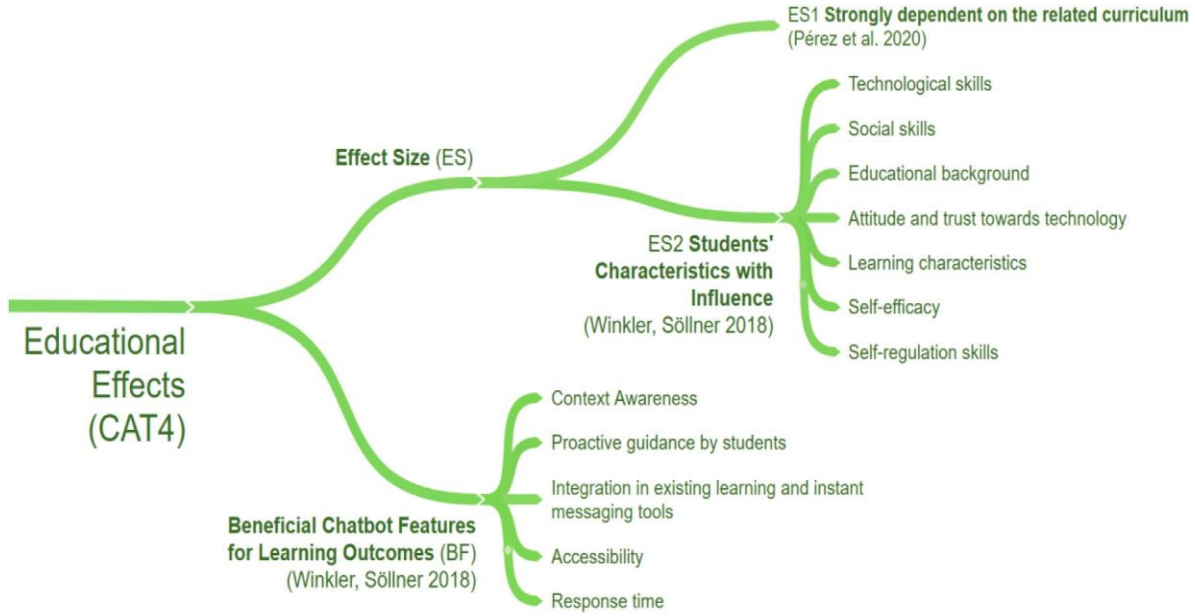


FIGURE 1: Applications of Chatbots
Source: Wollny, Schneider, Di Mitri, Weidlich, Rittberger and Drachsler (2021).

From the figure 1, the applications of chatbots (CAT1), application clusters (AC) and application statistics (AS) have been described in the literature. According to Pérez et al., (2020) identifies two application clusters, defined through chatbot activities: "service-oriented chatbots" and "teaching-oriented chatbots." (Winkler and Soellner, 2018) identify applications clusters by naming the domains "health and well-being interventions," "language learning," "feedback and metacognitive thinking" as well as "motivation and self-efficacy." Concerning application statistics (AS), (Smutny and Schreiberova, 2020) found that nearly 47% of the analyzed chatbots incorporate informing actions, and 18% support language learning by elaborating on chatbots integrated into the social media platform Facebook. Besides, the chatbots studied had a strong tendency to use English, at 89%. This high number aligns with results from (Pérez-Marín, 2021), where 75% of observed agents, as a related technology, were designed to interact in the English language. (Pérez-Marín, 2021) also shows that 42% of the analyzed chatbots had mixed interaction modalities.

FIGURE 2: Educational Effects of Chatbots
Source: Wollny, Schneider, Di Mitri, Weidlich, Rittberger and Drachsler (2021).



On educational effects of chatbots (CAT4), two key area are: Effect Size (ES) and Beneficial Chatbot Features for Learning Success (BF) as shown in Figure 2. The effect of size as identified by Pérez et al. (2020) is a strong dependency between learning and the related curriculum, while latter according to Winkler and Soellner, 2018 harnesses on general student characteristics that influence how students interact with chatbots. That students' educational background, attitudes towards technology, learning characteristics, self-efficacy, and self-regulation skills has significantly affect their interactions with chabots. Both studies study emphasizes chatbot features, that can be regarded as beneficial in terms of learning outcomes: "Context-Awareness," "Proactive guidance by students," "Integration in existing learning and instant messaging tools," "Accessibility," and "Response Time."

Methodology

This study employed a descriptive survey design to investigate the integration of Artificial Intelligence (AI) chatbots in the teaching of Integrated Science in Kaduna State, Nigeria, focusing on perceived opportunities, pedagogical impacts, and ethical challenges. The descriptive survey design was deemed appropriate as it enables the collection of data from a relatively large group, providing a comprehensive overview of teachers' perspectives and experiences. It also facilitates the identification of trends and patterns in how teachers perceive AI chatbot integration in Integrated Science instruction.

The population of the study comprised all Integrated Science teachers in secondary schools within Zaria, Kaduna State, totaling fifty-seven (57) teachers. In Zaria L. G. A., there are fifty five secondary schools of thirty one (31) are private while twenty four (24) are public schools (Kaduna State Bureau for Statistics, . Given the manageable size and accessibility of the population, the twenty four (24) public schools comprise the area of study where the entire group was included in the study adopting the census survey approach. This approach eliminates sampling bias and allows for a complete representation of the target group. As noted by Creswell (2014), using the whole population is particularly appropriate in small populations to ensure accurate and comprehensive data collection. Saunders, Lewis, and Thornhill (2019) also emphasized that a full population approach is advantageous when the research aims for in-depth analysis and precise conclusions applicable to the entire group. Data were collected using a researcher-structured questionnaire designed to gather information on the opportunities, pedagogical impacts, and ethical challenges of integrating AI chatbots into Integrated Science education. The questionnaire consisted of 20 items structured on a five-point Likert scale: Strongly Agree (SA), Agree (A), Undecided (UN), Disagree (D), and Strongly Disagree (SD). The instrument was divided into five sections:

1. Section A: Demographic information of respondents
2. Section B: Perceived opportunities of using AI chatbots
3. Section C: Perceptions of the pedagogical effectiveness of AI chatbots
4. Section D: Teachers' attitudes toward AI chatbot integration
5. Section E: Ethical and practical challenges hindering AI chatbot adoption in Integrated Science classrooms

The questionnaire was content validated by three experts from the Departments of Integrated Science and Computer Science at the Federal University of Education, Zaria. Feedback from the validation process was incorporated to enhance the instrument's clarity, relevance, and reliability. Before data collection, an introductory letter was obtained from the Department of Integrated Science and presented to the Ministry of Education, Science, and Technology, Zaria Zone, Kaduna State, to seek permission to visit schools within the study area. The questionnaires were personally administered by the researchers to ensure proper distribution and explanation where necessary. Respondents were allotted approximately ten (10) minutes to complete the questionnaire, which was collected immediately to ensure a high response rate. Participants were assured of the confidentiality and anonymity of their responses. The data collection process spanned approximately two (2) weeks**.** Data obtained were analyzed using descriptive statistical methods, including frequencies, percentages, means, and standard deviations. An inferential statistics, the t-test was used to test the various formulated hypothesis. These tools enabled the researchers to summarize and interpret the data effectively, offering insights into the prevailing trends and patterns related to the study objectives and hypothesis.

Results

Research Question One.

What are the perceived pedagogical benefits of AI chatbots in Integrated Science instruction?

Table 1:

Mean and Standard Deviation of Teachers' Perceived Usefulness and Intention to Integrate AI Chatbots in Teaching Integrated Science

Variables	N	$\bar{x}$	S.D.
Teacher Perceived Usefulness	31	51.06	11.66
Teacher Intention to Integrate	26	54.50	8.18

Table 1 presents the mean and standard deviation of teachers' perceived usefulness of AI chatbots ($\bar{x}$ = 51.06, S.D. = 11.66) and their intention to integrate them into Integrated Science teaching ($\bar{x}$ = 54.50, SD = 8.18).

Null Hypothesis One (H_{01}):

There is no significant difference in the mean perceived pedagogical benefit scores of AI chabots between teachers and students in Integrated Science.

Table 2:

Result of t-test Analysis on the mean perceived pedagogical benefit scores of AI chabots between teachers and students in Integrated Science.

Factors	N	$\bar{x}$	S.D.	T	Df	P
Teacher Perceived Usefulness	31	51.06	11.66	-1.263	55	0.212
Teacher Intention to Integrate	26	54.50	8.18			

Table 2 presents the results of a t-test analysis examining the relationship between teachers' perceived usefulness of AI chatbots and their intention to integrate these tools into the teaching of Integrated Science. The mean score for perceived usefulness was 51.06 (SD = 11.66, N = 31), while the mean score for intention to integrate was slightly higher at 54.50 (SD = 8.18, N = 26). The t-test yielded a t-value of -1.263 with 55 degrees of freedom and a *p*-value of 0.212. Since the *p*-value (0.212) is greater than the significance level of 0.05, we retain the null hypothesis. This result indicates that there is no significant difference in the mean perceived pedagogical benefit scores of AI chabots between teachers and students in Integrated Science. However, both variables recorded relatively high mean scores, suggesting generally positive perceptions and intentions among teachers.

Research Question Two.
What ethical concerns do teachers and students associate with chatbot use?

Table 3:
Mean and Standard Deviation on Teachers and Students Perception on Ethical Challenges Associated with the use of AI Chatbots in Integrated Science classroom.

Factors	N	$\bar{x}$	S.D.
Teacher Ethical perception	57	60.28	11.16
Students Ethical Perception	57	29.98	6.33

Table 3 shows that teachers reported higher ethical concerns ($\bar{x}$ = 60.28, S.D. = 11.16) compared to students ($\bar{x}$ = 29.98, S. D. = 6.33) regarding the use of AI chatbots in Integrated Science classrooms.

Null Hypothesis Two (H_{02}):
There is no significant difference in the mean ethical concern scores regarding AI chatbot use between teachers and students.

Table 4:
Result of t-test Analysis on the mean ethical concern scores regarding AI chatbot use between teachers and students.

Variables	N	$\bar{x}$	S.D.	t	Df	P
Teacher Ethical perception	57	60.28	11.16	17.823	112	0.000
Students Ethical Perception	57	29.98	6.33			

Table 4 presents the results of an independent samples t-test conducted to compare teachers' and students' perceptions of the ethical challenges associated with the use of AI chatbots in Integrated Science classrooms. The mean score for teachers' ethical perception was 60.28 (S.D. = 11.16, N = 57), whereas students recorded a significantly lower mean of 29.98 (S.D. = 6.33, N = 57). The analysis yielded a t-value of 17.823 with 112 degrees of freedom and a p-value of 0.000. The *p*-value (0.000) is less than 0.05, thus we reject the null hypothesis. This indicates a significant difference in the mean ethical concern scores regarding AI chatbot use between teachers and students. Teachers expressed significantly more concern about the ethical implications of AI chatbot use in the classroom than the students.

Research Question Three
How prepared are educators to implement AI chatbots in Integrated Science teaching

Table 5:
Mean and Standard Deviation of Teachers Readiness to Integrate AI chatbots and Prior ICT Training Experience

Factors	N	$\bar{x}$	S. D.
Prior Experience	31	56.42	11.46
Teacher readiness	26	53.00	7.33

Table 5 displays the mean and standard deviation for teachers' prior ICT training experience ($\bar{x}$ = 56.42, S.D. = 11.46) and their readiness to integrate AI chatbots ($\bar{x}$ = 53.00, S.D. = 7.33).

Null Hypothesis Three (H_{03}):
There is no significant difference in the mean preparedness scores for implementing AI chatbots between prior experience and teacher readiness in Integrated Science teaching.

Table 6:
Result of t-test Analysis on the mean preparedness scores for implementing AI chatbots between prior experience and teacher readiness in Integrated Science teaching.

Factors	N	$\bar{x}$	S. D.	T	Df	P
Prior Experience	31	56.42	11.46	1.312	55	0.195
Teacher readiness	26	53.00	7.33			

Table 6 displays the results of an independent samples t-test examining the mean difference between teachers' prior experience with ICT training and their readiness to integrate AI chatbots in Integrated Science instruction. Teachers with prior ICT experience had a mean readiness score of 56.42 (S.D. = 11.46, N = 31), while those with less or no prior experience had a slightly lower mean score of 53.00 (S.D. = 7.33, N = 26). The computed t-value is 1.312 with 55 degrees of freedom, and the associated p-value is 0.195. Since the *p*-value (0.195) is greater than 0.05, the retain the null hypothesis. This suggests that teachers' prior exposure to ICT training does not significantly influence their readiness to integrate AI chatbots into Integrated Science instruction. Nonetheless, the moderately high mean scores indicate that teachers generally feel prepared and experienced in using digital tools in education.

Implication Of Findings
The analysis revealed no statistically significant difference between teachers' perceived usefulness of AI chatbots and their intention to integrate them into Integrated Science instruction. This aligns with the findings of Hasan, Chowdhury, Rahman, Syed and Ryu (2023), who reported that teachers with a positive outlook toward technology are more likely to perceive chatbots as useful. Their study also noted that enthusiasm and creativity significantly correlate with perceived ease of use and the usefulness of chatbots. Similarly, Jere, Bessong, Mpeta, and Litshani (2024), (2024) found

that chatbots can facilitate lesson planning and formative assessment, thereby potentially enhancing student engagement in science education.

However, the study identified a statistically significant difference in the perception of ethical challenges associated with AI chatbot use, with teachers expressing greater concern than students. This finding is consistent with Jere et al. (2024), who, despite acknowledging the pedagogical benefits of chatbots, reported that teachers harbor concerns regarding the accuracy of chatbot-generated responses. Such concerns can negatively impact their willingness to incorporate these tools into their teaching practices. Wang (2024) also highlighted ethical issues, such as the potential for plagiarism and questions about the authenticity of student work. In a similar vein, Bettayeb, Abu Talib, Zahraa and Dakalbab (2024) warned that students might become overly dependent on AI tools, potentially undermining the development of their critical thinking skills.
Furthermore, the study found no significant difference between teachers' prior ICT experience and their readiness to integrate AI chatbots, indicating that prior exposure to ICT does not strongly predict implementation readiness. This supports the findings of Ofosu-Ampong (2024), who posited that teaching experience can influence attitudes toward AI integration, with more experienced educators often approaching new technologies with caution.

Conclusion

This study examined key factors influencing the integration of AI chatbots into Integrated Science classrooms, focusing on perceptions of usefulness, ethical considerations, and ICT preparedness. The findings reveal that teachers' perceived usefulness of AI chatbots does not significantly predict their intention to integrate them into instruction, suggesting that other variables such as institutional policy, pedagogical beliefs, or contextual constraints may play a more prominent role in shaping integration behavior. Additionally, no significant differences were found between students and teachers regarding ethical concerns, indicating a shared understanding or awareness of the moral implications surrounding AI use in educational contexts. Moreover, prior ICT training was not a significant determinant of teachers' readiness to adopt AI chatbots, underscoring the need to explore other determinants such as technological self-efficacy, contextual support, or ongoing professional development.

Recommendations

1. Existing ICT training programs in Kaduna State should be reviewed and updated to include practical, AI-focused modules, specifically tailored to pedagogical use in science education.
2. Education stakeholders in Kaduna State, including State Universal Basic Education Board (SUBEB) and the Ministry of Education, should develop supportive policies that encourage experimentation and innovation with AI tools.
3. Educational AI tools should be contextualized to align with the Nigerian science curriculum and sociocultural realities. Collaboration with local educational technology startups and curriculum developers can help in creating chatbots that are both curriculum-relevant and linguistically/culturally appropriate for Kaduna State learners.

4. There is a need for clear, context-specific ethical guidelines on AI usage in schools. These should cover data privacy, appropriate use, and equity of access, and must be communicated effectively to both educators and learners.
5. Efforts to integrate AI in education should involve teachers, students, school administrators, and parents in decision-making. This participatory approach ensures that adoption reflects the needs and values of the community, increasing the likelihood of sustained use.

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