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PERCEPTIONS OF AI USE AND RISKS AMONG SCIENCE AND MATHEMATICS EDUCATION STUDENTS

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Abstract

This study investigated the perceptions of AI use and its accompanying risks among science and mathematics education students**.** In particular, the risks associated with using AI in science and mathematics education, with a focus on cultural diversity, optimization of student learning, incorrect responses, and a crisis in motivation to learn. The study adopted the descriptive survey design. Five research questions guided the study. The sample was obtained through a simple random, but stratified technique comprising 178 out of a population of 568 undergraduate students in the Department of Science and Mathematics Education, Rev. Fr. Moses Orshio Adasu University, Makurdi. Data was collected using an instrument tagged Artificial Intelligence in Science and Mathematics Education Questionnaire (AISMEQ). Simple percentages and bar charts, as well as thematic analysis of the responses, were used to analyse the data. Results revealed that on the frequency of daily and weekly usage alone, 62 out of the 178 who responded gave a percentage of 34.8%, which illustrates the number who appear to more frequently use AI tools in learning, 93(52.2%) showed that Chatbots or Virtual Assistants were the most used by the students; 33(18.5%) were “familiar” and 36(20.2%) were “very familiar” with AI tools. It is interesting to note that 49(27.5%) of the students (concerned plus very concerned) were opposed, while 50(28.1%) were “not concerned at all” about the risks posed by AI. In addition, results revealed that about 50% of the respondents feel that AI systems can effectively address the issue of cultural diversity, and a steadily rising opinion about the effectiveness of AI systems in optimizing student learning, which possibly includes the minimization of wrong answers provided by AI. The students were of the view that implementing "human review and feedback mechanisms to ensure AI-generated content is accurate and appropriate". This study concluded that AI integration in Science and Mathematics Education is a welcome development, but the creation of algorithms must seek a balance to suit the standards obtainable in developing countries like Nigeria.

Keywords: Perceptions, Artificial Intelligence, Science and Mathematics Education, Risks, Students

Some AI systems offer step-by-step problem-solving guidance, track student behavior, and provide teachers and parents with multi-strategy advice and detailed performance data, which can prove to be an invaluable tool for both teachers and students in Science and Mathematics Education (SME). The system combines computer-based learning and standardized tests to predict and improve mathematics and science-based skills, offering new problems or tutorials based on student performance.

There is an AI renaissance, driven by the widespread adoption of machine learning across various sectors. This surge is due to the exponential growth of data, over 2.5 quintillion bytes created daily, and computer processing power, with today's mobile phones rivaling supercomputers from 40 years ago (Orhani, 2021; UNESCO, 2021). AI is used in education in different ways among Nigerian university students. For instance, AI is integrated into several technologies such as chatbots, intelligent tutoring, and automated grading systems (Celik, Dindar, Muukkonen & Jarvela, 2022).

Despite the potential of AI to transform education for the better, there are also risks at play. Within the education world, teachers and school districts have been wrestling with how to respond to this emerging technology (Al-Matari, 2023). Some researchers who work at leading Artificial Intelligence laboratories posit that the prevailing view is that AI progress will likely continue gradually, however, others also believe an explosion in intelligence is nearing (The Economics, 2024). For example, research has shown that ChatGPT has reached more than 100 million unique users, and 30% of all College students have used it for assignments, making it one of the fastest-ever applications ever adopted overall – and certainly, in education settings (Al-Matari, 2023).

However, AI systems may inadvertently perpetuate cultural biases or fail to account for cultural nuances, leading to inequitable learning experiences for students (Al-Matari, 2023; Celik, Dindar, Muukkonen, and Jarvela, 2022). Optimizing student learning through AI involves tailoring instruction to individual student needs and preferences. However, there is a risk of overreliance on AI algorithms, which may limit students' critical thinking skills and creativity. Additionally, AI-driven educational platforms may generate incorrect or misleading responses, undermining the validity and reliability of learning outcomes. Furthermore, while undergoing studies, AI systems may fail to provide appropriate support and guidance to students, exacerbating stress and anxiety due to the fear of a lack of jobs.

Celik, Dindar, Muukkonen, and Jarvela (2022) did a synthesis of relevant studies, which showed that there had been little interest in investigating AI in pre-service teacher education. Hence, more empirical studies on pre-service teachers' AI use are recommended. This study critically evaluated the use and potential risks associated with AI in SME using survey research methods and proposed strategies to mitigate them effectively. By addressing these risks, educators, policymakers, and AI developers can harness the potential of AI to improve educational practices while ensuring equitable and inclusive learning environments for all students.

Research Questions

The following research questions guided the study.

i. How do students in Science and Mathematics Education (SME) perceive AI?
ii. How frequently do students in SME interact with AI platforms?

iii. What types of AI-driven educational technologies do students in SME use?
iv. How do students perceive some potential risks in AI use in SME?
v. How do students perceive AI-driven systems' effectiveness in addressing potential risks?
vi. What improvements can enhance the use of AI in SME to minimise associated risks?

Materials and Methods

The study adopted a descriptive survey design. The data was collected using a semi-structured questionnaire titled Artificial Intelligence in Science and Mathematics Education Questionnaire (AISMEQ), which was designed using Google Forms. It is instructive to note that Google Forms is in itself a kind of AI platform with the ability to read, interpret, and respond to text keyed in while designing an instrument. The structured items were on a scale of 1-5, while the free-response items allowed the respondents to openly state their views. The instrument was first tested on a group of 35 students who were not allowed to participate in the survey itself and yielded a reliability coefficient (Cronbach's alpha) of 0.87.

There were 250 male and 318 female students, making a total of 568 students in the Department of Science and Mathematics Education, Benue State University, Makurdi, from 200L and 400L (Survey of students' data). A sample of 178 students responded to the survey; a number that was determined through a simple random but stratified sampling technique, which ensured that each programme in the department of Science and Mathematics Education, as well as students from all the levels, were captured. The respondents' data showed that 74 (41.6%) were male, while 104 (58.4%) were female. This implies that 29.6% and 32.7% of the male and female population, respectively, responded. This shows a nearly balanced representation regarding the gender of the students, with more female students responding to the survey. The data was collected by sharing the instrument with the selected sample, which ensured that only those whose biodata, like gender, course of study, and matriculation number, matched the selection responded to the survey. Their responses were auto-recorded online and downloaded into an Excel spreadsheet for analysis, which was done using percentages and bar charts. The open-ended item on the questionnaire, which allowed the students to proffer solutions to AI risks, was also analysed.

Results

The analysis is done following the research questions, which were formulated to guide the study.

Research question one: How do students in Science and Mathematics Education at Benue State University, Makurdi, perceive AI? To answer this research question, the students were required to respond to: **"**In your own words, what is Artificial Intelligence?". A summary of their responses is presented.

The students broadly defined Artificial Intelligence (AI) as the simulation of human intelligence processes by machines, particularly computer systems. This involves enabling machines to perform tasks that typically require human cognitive functions such as learning, problem-solving, reasoning, perception, and understanding language. As noted in one definition, AI "refers to the development of computer systems that can perform tasks that typically require human intelligence, such as learning, problem-

solving, decision-making, and perception." This encapsulates the goal of AI to replicate and often enhance human cognitive abilities, allowing machines to think, learn, and make decisions similarly to humans.

The practical applications of AI are diverse and span various fields, including virtual assistants like Siri and Alexa, image and speech recognition, robotics, expert systems, and predictive analytics. AI is used to automate tasks, enhance decision-making, and increase efficiency across different domains. It serves as a powerful tool to augment human capabilities, providing solutions and insights that were previously unattainable. One definition aptly describes AI as "a computer system that can perform tasks requiring human intelligence such as learning, problem-solving, etc."

As an evolving technology, AI continues to advance rapidly, with ongoing research and development aimed at creating more sophisticated and autonomous systems. The potential of AI to revolutionize industries and improve daily life is significant, reflecting its broad scope and dynamic nature. From narrow AI applications that handle specific tasks to the hypothetical development of general AI with human-like intelligence, the field of AI represents a major frontier in modern technology. Another definition notes AI's potential as "the science of making machines that can think like humans," which underscores the transformative potential of AI technologies.

In educational contexts, AI is seen as "a platform that helps students make inquiries and research about things they don't know," demonstrating its utility in facilitating learning and providing personalized support. Additionally, AI's role in enhancing user interactions is emphasized with descriptions such as "an online assistant platform in the educational sector which helps in tutoring and answering questions," showcasing its application in delivering real-time assistance and information.

Research question two: How frequently do students in SME interact with AI platforms? This question is answered using Figures 1 and 2

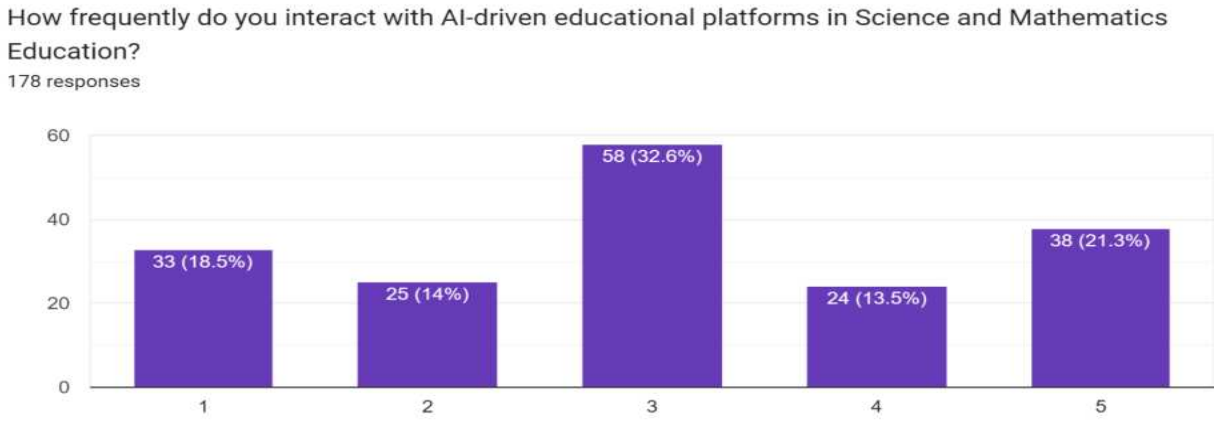

Figure 1: Frequency of AI Use

The question "How frequently do you interact with AI-driven educational platforms in Science and Mathematics Education?" illustrated in Figure 1, was rated as Daily (5), Weekly (4), Monthly (3), Occasionally (2), and Never (1). Figure 2 shows that 33(18.5%)

responded as "Never", while 25(14%) – Occasionally, 58(32.6%) – "Monthly", 24(13.5%) – "Weekly" and 38(21.3%) responded "Daily". Daily and weekly alone had 62 out of the 178 who responded, giving a percentage of 34.8%, which illustrates the number who appear to use AI tools more frequently in learning.

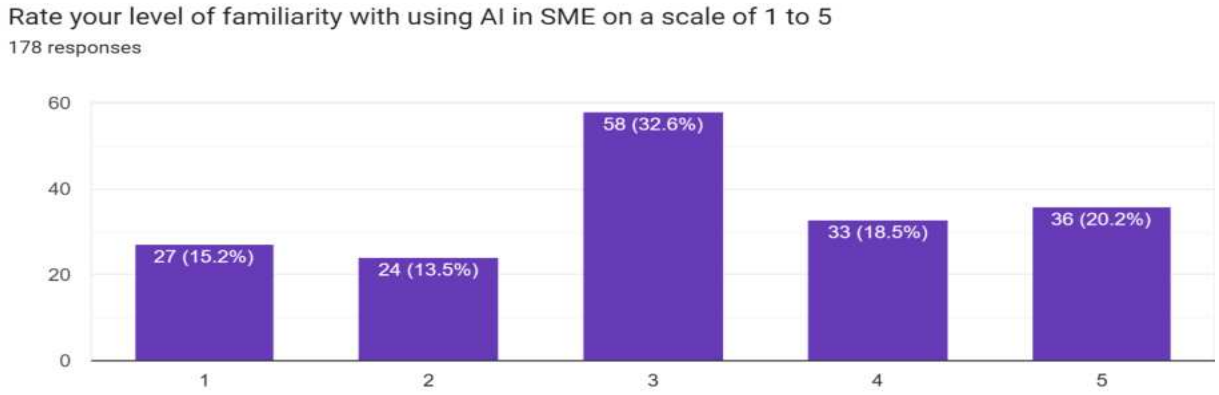

Figure 2: Level of Familiarity with AI

The item "Rate your level of familiarity with using AI in SME" was on a scale of (1 - Not familiar at all, 2 - maybe familiar, 3 - fairly familiar, 4 - familiar, and 5 - Very familiar). This item was designed to reinforce the item about the frequency of use of AI among the students, since use may transcend to familiarity, and it seemed to elicit a similar trend in the responses. Figure 2 shows that 27(15.2%) chose "Not at all familiar", 24(13.5%) – "Maybe familiar", 58(32.6%) – "Fairly familiar", 33(18.5%) "Familiar" and 36(20.2%) "Very familiar".

Research question three: What types of AI-driven educational technologies do students in SME use?

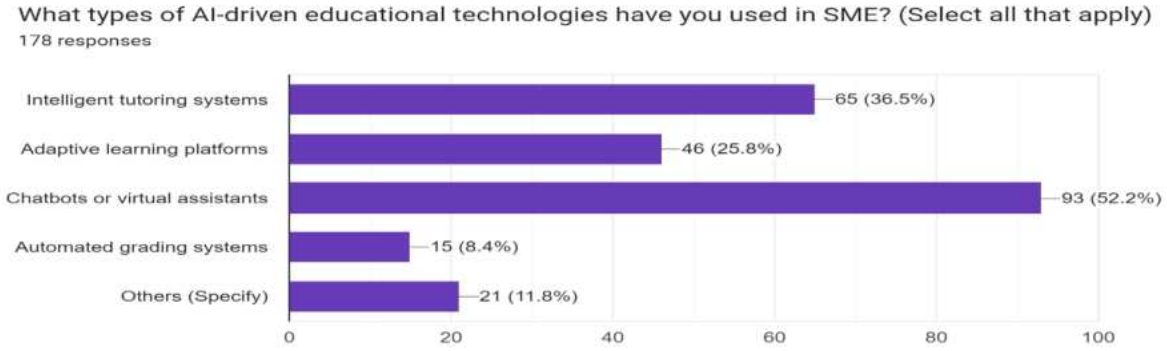

Figure 3: Types of AI in Use

On the question "What types of AI-driven educational technologies have you used in SME?" the students were allowed to choose all that applied to them. Figure 3

reveals that 65(36.5%) of the respondents have used Intelligent Tutoring Systems; 46(25.8%) used Adaptive Learning Platforms; 93(52.2%) used Chatbots or Virtual Assistants which happens to be the most used by the students; 15(8.4%) used Automated Grading Systems, while 21(11.8%) used others which they failed to specify.

Research question four: How do students perceive some potential risks in AI use in SME? This question is answered using Figures 4 and 5.

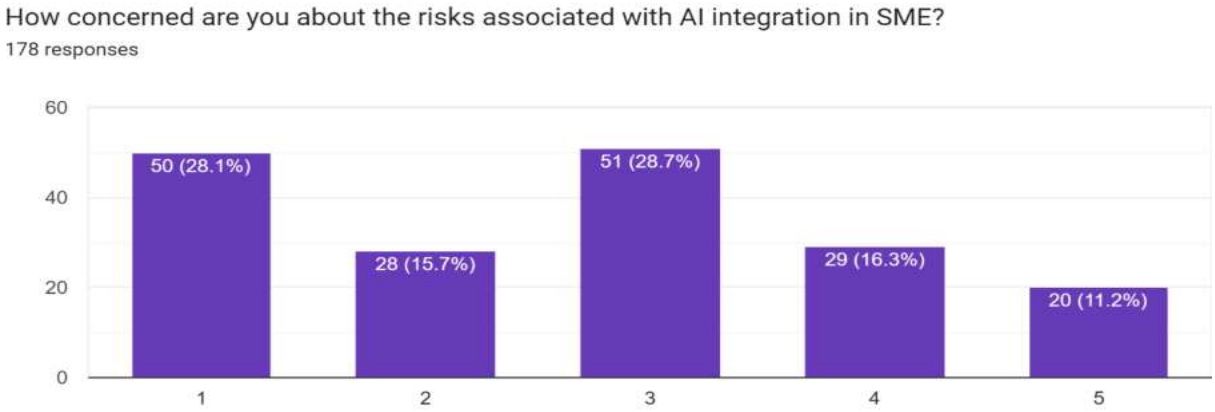

Figure 4: Concerns about AI Risks

The item "How concerned are you about the risks associated with AI integration in SME?" was rated as: 1 = Not concerned at all, 2 = maybe concerned, 3 = fairly concerned, 4 = concerned, and 5 = Very concerned), 50 (28.1%), 28 (15.7%), 51 (28.7%), 29 (16.3%), and 20 (11.2%) of the students responded respectively, as depicted in Figure 4. It is interesting to note that 49 (27.5%) of the students (concerned plus very concerned) were opposed to 50 (28.1%) who were not concerned at all.

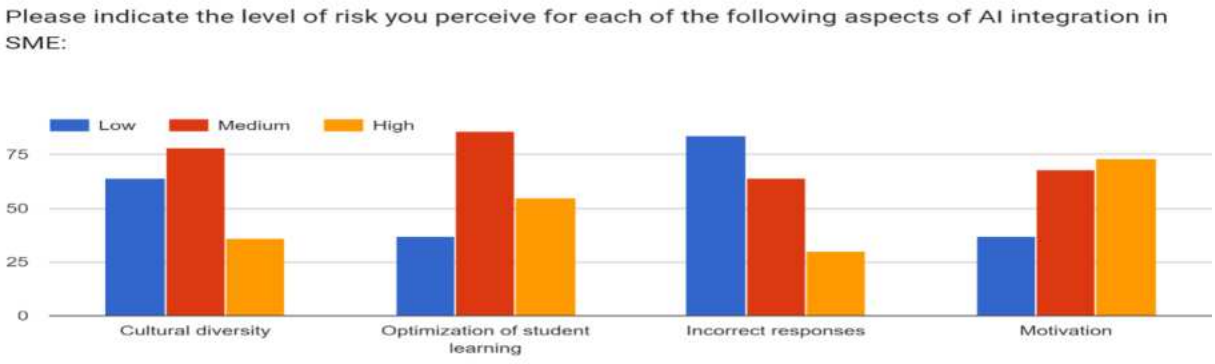

Figure 5: Potential Risks in AI Use

Figure 5 shows the responses to the students being required to indicate the level of risk they perceive for each of the aspects of AI integration in SME, nominally scaled as Low, Medium, or High. The students did not view a lack of cultural diversity or giving incorrect responses to be of high risk; optimization of student learning was taken with caution, as well as inhibiting students' motivation to learn, which suggests that students may have fears that AI could pose a danger to their careers. To probe how these supposed risks were being addressed by AI products, the next three items were created.

Research question five: How do students perceive AI-driven systems' effectiveness in addressing potential risks? This question is answered using Figures 6, 7, and 8.

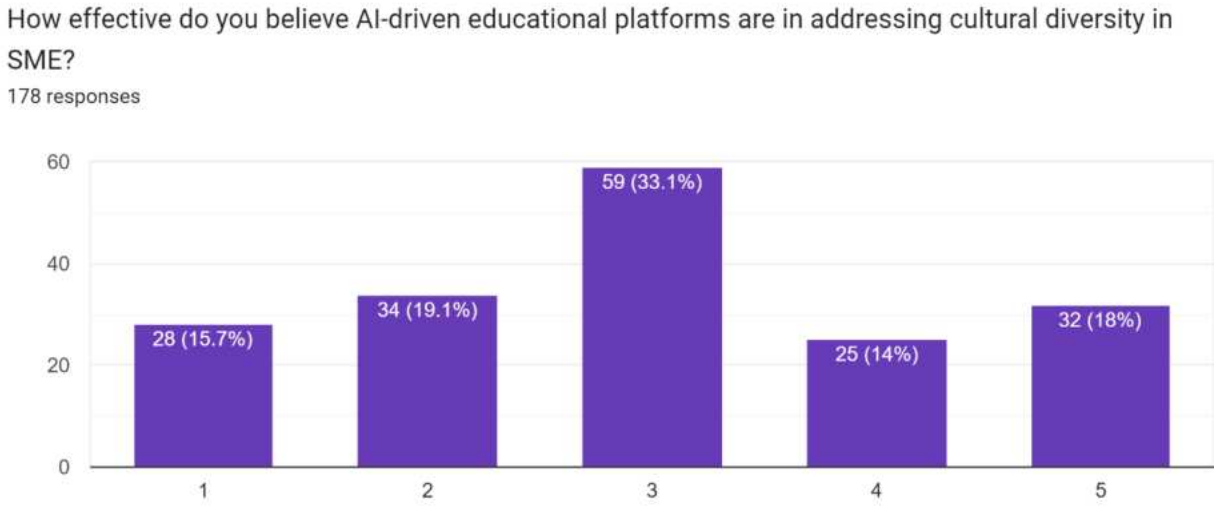

Figure 6: Effectiveness of AI in Cultural Diversity

The item "How effective do you believe AI-driven educational platforms are in addressing cultural diversity in SME?" was on the scale of 1 = Not effective at all (28,15%), 2 = maybe effective (34,19.1%), 3 = fairly effective (59,33.1%), 4 = effective (25,14%), and 5 = Very effective (32,18%). What this reveals is that about 50% of the respondents feel that AI systems can effectively address the issue of cultural diversity, as depicted in Figure 6.

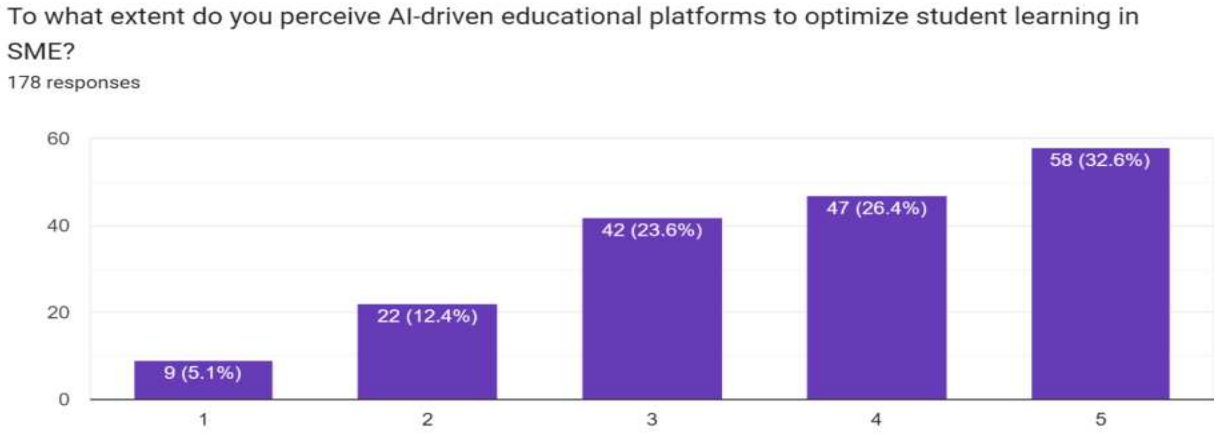

Figure 7: Effectiveness in Addressing the Optimisation of Student Learning

Figure 7 shows the responses to the item "To what extent do you perceive AI-driven educational platforms to optimize student learning in SME?" The scale for the item was 1 = Not at all (9,5.1%), 2 = maybe optimized (22,12.4%), 3 = fairly optimized (42,23.6%), 4 = optimized (47,25.4%), 5 = To a great extent (58,32.6%). The bars show a steadily rising opinion about the effectiveness of AI systems in optimizing student learning, which possibly includes the minimisation of wrong answers.

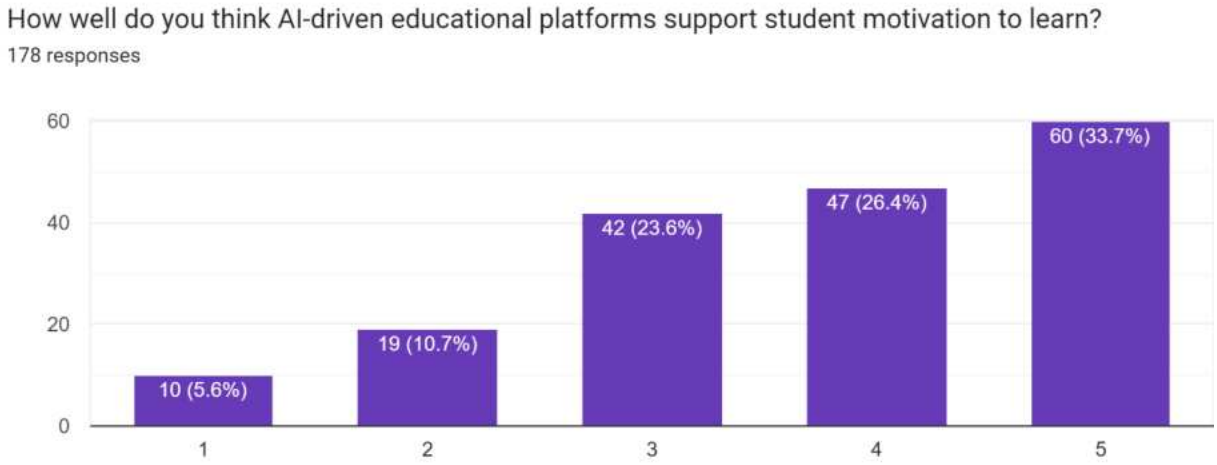

Figure 8: Effectiveness in Student Motivation to Learn

The item "How well do you think AI-driven educational platforms support student motivation to learn?" was on a scale (responses) of 1 = Poorly (10, 5.6%), 2 = fairly 19,10.7%), 3 = moderately (42,23.6%), 4 = well (47,26.4%), 5 = Very well (60,33.7%). Here, too, there is a rising magnitude in the responses as depicted by the bar graphs, which reveal that the students feel

that AI systems do not pose a danger to their future careers or jobs.

Research question six: What improvements can enhance the use of AI in SME to minimise associated risks? This was a free-response question, and the responses are presented below.

The students posited that leveraging data augmentation and improving data quality are essential steps in addressing concerns in the use of AI. The responses included: "leverage data augmentation," "improve data quality," "enrich the data," and "ensure valid, relevant, accurate, and unbiased data to train and validate AI models." High-quality data is the foundation of effective AI systems and reduces the risk of errors and biases. Proper orientation and training are crucial for the successful implementation of AI. Providing "proper orientation" and ensuring that "students should be fully exposed to relevant books, materials to study and read in SME" can help in better understanding and utilization of AI. Additionally, it's important to "provide training and education for employees necessary to work with AI technology" and "invest in employee training: educate employees on AI basics, benefits, and risks." Well-trained personnel can maximize the benefits of AI while minimizing potential risks.

Monitoring and maintaining AI systems are vital to ensure their continued efficacy and safety. Regular "monitoring" and high monitoring" are necessary to promptly identify and rectify any issues. It's also essential to "regularly monitor and audit AI systems to identify and address any biases, errors, or potential risks." Continuous oversight helps maintain the reliability and integrity of AI applications. Creating "more awareness on the importance of AI and how to use it effectively" and increasing "public awareness and education about AI technologies, their capabilities, limitations, and potential implications to empower individuals to make informed decisions" can foster a better understanding of AI. Informed users are more likely to use AI responsibly and effectively.

In addition, human oversight should be maintained in AI decision-making processes. Implementing "human review and feedback mechanisms to ensure AI-generated content is accurate and appropriate" and encouraging "human oversight in critical decision-making processes to ensure that AI complements rather than replaces human judgment" are crucial steps. Human involvement ensures that AI decisions are sound and ethically appropriate. By implementing these strategies, schools, colleges, and universities can leverage AI effectively to enhance productivity and competitiveness while managing potential risks.

Discussion of Results

The results of this study reveal a growing, though cautious, engagement with AI tools among students in Science and Mathematics Education. Notably, 34.8% of respondents report using AI tools daily or weekly, and 52.2% identify chatbots or virtual assistants as the most utilized forms of AI. This trend aligns with Mohammed et al. (2022) and Al-Matari (2023), who assert that AI, though still emerging in educational contexts, is expected to revolutionize sectors like testing, assessment, and personalized instruction. Their work supports the view that AI offers innovative strategies to enhance teaching and learning processes.

Students' familiarity with AI tools show that 18.5% being "familiar" and 20.2% "very familiar" confirms the gradual penetration of AI into educational settings, corroborating Qiu, Pan, and Ishak (2022), who observed that intelligent systems not only engage students but promote computational problem-solving skills and multifunctional learning approaches. Interestingly, the divided student perspectives on the risks of AI, 27.5% expressing concern versus 28.1% being unconcerned, echo Chen (2023) and UNESCO (2021), who discussed anxiety over AI's implications for employment and human relevance. Such existential concerns may affect students' motivation and perception of their long-term career prospects, which adds depth to understanding learners' mixed responses to AI integration.

In terms of the potential of AI in promoting inclusivity, around 50% of respondents believe that AI can address cultural diversity. However, Stefanova and Georgiev (2024) and Limna et al. (2023) identify current limitations in AI systems like ChatGPT and MathGPT. These tools sometimes provide inaccurate or biased responses, especially when confronted with tasks requiring cultural or linguistic sensitivity. Your findings reinforce these concerns and underscore the students' recommendation for *human review and feedback mechanisms* to ensure AI-generated content is contextually appropriate and pedagogically sound.

Further, the steadily increasing belief in AI's capacity to optimize learning, particularly in minimizing incorrect answers, supports Orhani (2021) and Stefanova and Georgiev (2024), who highlight the benefits of intelligent tutoring systems (ITS). These systems adapt to learners' needs, delivering tailored content that fills knowledge gaps and enhances understanding. Yet, the complexities of AI algorithms must be balanced with local educational standards, especially in developing countries like Nigeria, where infrastructural and cultural factors influence AI adoption.

The classification of AI applications into categories such as intelligent tutoring systems, profiling and prediction, and personalization, as noted in Stefanova and Georgiev (2024), offers a framework through which the findings of this study can be understood. The emphasis on chatbot use falls under the personalization and assistance category, whereas students' call for algorithmic fairness and human oversight aligns with the broader AI ethics discourse. This is also supported by Koretsky (2023) in advocating for interpretability in AI. Students and educators must be able to understand and trust AI-generated outputs for these technologies to have a sustainable impact on scientific education.

Conclusion

In summary, the findings of this study resonate well with the current body of empirical literature. They reinforce the idea that while AI holds significant promise in enhancing Science and Mathematics Education, especially through personalization and tutoring systems, it also presents challenges. These include issues of interpretability, cultural relevance, and user trust. As AI tools continue to evolve, ongoing research and stakeholder feedback will be essential in ensuring they are implemented ethically and effectively, particularly in developing contexts.

Recommendations

The following recommendations are therefore made:

i. AI improves learning in SME and should be a gradual and controlled introduction in Nigerian universities.

ii. The role of AI tools should be discussed by the educational community, since there is the possibility that the availability of these tools may change the goals of mathematics and science education.
iii. Efforts should be made to address the concerns raised, including improving the accuracy of information provided by ChatGPT, finding ways to maintain personal interaction between educators and students, and prioritising data privacy and security.
iv. IVAI developers and software companies should consider involving teachers in the development process to a greater extent to mitigate risks associated with the use of AI.

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