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The Rise of Artificial Intelligence for Research among University Students Studying Stem-Related Courses

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ABSTRACT: The increasing integration of Artificial Intelligence (AI) into education has raised questions about its utilization in academic environments, particularly in STEM fields. This study focused on the utilization of AI-based tools among STEM students at Lagos State University. The research sought to determine the level of awareness, usage patterns, and perceptions of AI tools, with particular attention to whether AI could replace or assist human instructors. The study was guided by three research questions and two hypotheses centered on AI's impact on research and education. A descriptive survey research design was adopted, with a population comprising STEM students across different academic levels. A sample size of 150 respondents was selected through stratified random sampling. Data were collected using a structured questionnaire, validated with a reliability index of 0.82. The analysis was conducted using descriptive and inferential statistics. The results indicated that 95.1% of the respondents had utilized AI tools, with ChatGPT being the most commonly used. Students generally found AI tools effective in enhancing their research outcomes, but challenges such as technical difficulties and limited access were prevalent. Furthermore, while students acknowledged AI's potential to assist educators, a majority emphasized that AI should not replace human instructors due to its lack of human empathy and adaptability. The study concluded that AI-based tools are beneficial for research and education, but there is a need for improved access and training. It was recommended that educational institutions invest in AI tools and ensure that students receive adequate training to enhance their research skills while maintaining a balance between AI usage and human-led learning.

KEYWORDS: Artificial Intelligence, STEM education, AI-based tools, student perception, academic research

1. INTRODUCTION

In a globalized economy where every nation is racing to keep up with technological trends, science and technology programs are becoming increasingly prominent in universities. Artificial Intelligence (AI) is the study and development of machines and computer systems that imitate human cognitive process and are able to accomplish tasks using learning algorithms that duplicate patterns in new data (Joiner, 2018), (Monte-Serrat & Cattani, 2021). The development of technologies like big data, robotics, and the Internet of Things is mostly driven by artificial intelligence, which is impacting how humans will live in the future in practically every industry (Powers, 2022). Its applicability has been evident in different areas like healthcare, engineering, finance, gaming, social media, manufacturing industry, entertainment, agriculture, and education. Nowadays, computer systems that handle tasks like voice recognition and translation on smartphones, autonomous driving, and controlling robots that automate domestic and industrial labor all rely on Artificial Intelligence (Savage, 2020)

AI as a system is composed of different tools working inter-dependently to achieve a singular purpose. Numerous AI-based tools have been developed to cater to the unique needs of teaching and research in the academic setting. These tools harness advanced algorithms and data processing capabilities to streamline tasks, offer personalized learning experiences, and provide valuable insights for research endeavors. Some of these AI-based tools include Intelligent Tutoring Systems (ITS): Intelligent Tutoring Systems utilize AI algorithms to adapt to individual learning needs. These systems provide personalized feedback and guidance to students, aiding in their academic progress. For lecturers, ITS can be a valuable tool for tailoring teaching materials based on individual student requirements (VanLehn, 2011). Plagiarism Detection Software is an AI-powered plagiarism detection tools crucial in maintaining academic integrity. These tools employ advanced algorithms to compare submitted work with vast databases, identifying instances of plagiarism and ensuring the authenticity of research outputs (Anih 2019). Automated Grading Systems: Automated grading systems, driven by AI, can efficiently assess assignments, exams, and coursework. These systems

not only save time for lecturers but also provide consistent and unbiased evaluations, fostering fairness in the assessment process (Zafar, Rehman & Amin, 2018).

In this context, the utilization of AI-based tools for teaching and research refers to the effective and efficient application of these technological solutions in educational and research settings. It involves leveraging AI tools to enhance teaching methodologies, streamline research processes, and ultimately improve the overall quality of education (Anderson & Dron, 2011). The utilization of these AI-based tools is paramount, because, it enhances Personalization, take for instance, AI-based tools, such as Intelligent Tutoring Systems (ITS), enable personalized learning experiences by adapting to individual student needs. This personalized approach enhances student engagement and comprehension. It is also enabling efficiency in Grading and Assessment, like, Automated grading systems, powered by AI, streamline the assessment process for lecturers. This not only saves time but also ensures consistency and objectivity in evaluations.

More also in research for instance, it provides Advanced Data Analytics, Predictive analytics tools utilize AI algorithms to analyze historical data, providing insights into student performance trends. Lecturers can proactively identify students at risk and tailor interventions accordingly. AI-based tools as well provides Innovative Research Insights, AI facilitates more efficient literature reviews and research topic selection. Recommendation systems help researchers stay abreast of emerging trends, fostering innovative and impactful research (Siemens, 2013). In no doubt, the utilization of AI-based tools in teaching and research holds immense importance for advancing education and knowledge creation. Not only that, in education, numerous global systems have embraced digital technology-based approaches such as e-learning, distance education, e-assessment, artificial intelligence, cloud computing, and gamification for instructional delivery and assessment (Nwankwo & Ukeh, 2023)

STEM education is a complex system, from a system perspective, consisting of interdependent elements, including subject, information, medium, and environment (Rapoport & Von, 1986). The application of AI, as a critical technology element, should take careful consideration of these complex factors, to achieve a high-quality STEM education (Bryne & Callaghan, 2014).

2. THE PURPOSE OF THE STUDY

The purpose of this study is to identify the extent of Utilization of Artificial Intelligence based tools among students studying STEM-related courses in Lagos State University. The study also intends to discover the factors mitigating redundancy in utilization of Artificial Intelligence based tools and the impacts on the students. Another purpose of conducting research on Utilization of Artificial Intelligence is to explore how it has affected students' creativity and critical thinking.

3. RESEARCH QUESTION

The following research questions were formulated to guide the study;

1) To what extent are Artificial Intelligence based tools utilized for research among students studying STEM-related courses in Lagos State University?

4. LITERATURE REVIEW

Education refers to the process of acquiring skills, knowledge, attitudes and values through formal or informal instructions. It aims to develop the cognitive, emotional and social abilities of an individual. It can also be defined as the process of training man to fulfill his aim by exercising all faculties to the fullest extent as a member of the society (Aristotle 350 B.C.E)

Technology refers to the application of scientific knowledge for practical purposes, especially in industry. It encompasses the tools, techniques, methods, and processes used to create products, services, and systems that meet human needs and improve the quality of life. It is also defined as a system created by humans that uses knowledge and organizations to produce objects and techniques for the attainment of specific goals (Volti, 2009)

Artificial intelligence has been growing in prominence in the past decade. Almost in every area, it has become very helpful and useful, making a lot of things very easy. It has grown into a strong technology that has revolutionized communication and even how humans view and expectations of the future. This research is focused on knowing and showing the perceived benefits of Artificial Intelligence (AI), the risks, how it affects the society and so many more.

5. THEORETICAL FRAMEWORK

5.1 The SAMR model

A useful framework for understanding how to use technology effectively in education is the SAMR model, developed by Ruben Puentedura in 2006. The SAMR framework focuses on the use of technology in education in four ways: substitution, augmentation, modification, and redefinition. Substitution can be thought of as substituting an analogue method, such as quizzes on paper, with a digital version. Augmentation implies an improvement of a function, such as automatically graded worksheets, freeing up teachers' time.

The other two types of technology use, Puentedura argues, are fundamentally different and align to our view on the potential of education technology innovations to support leapfrogging. Modification allows for significant task redesign, such as aiding the

teacher in connecting students with peers from a distant part of the world and exchanging essays to provide feedback with a different cultural perspective. Another example is students using geographical information system mapping technology to transform and display census data in a social studies class. Redefinition means that the use of technology creates an experience that was previously inconceivable. An example is dividing students into groups and having them collaborate on a video tutorial on how to multiply and divide polynomials. This video can then be used in class and posted online so other students can ask questions or discuss the topics covered. Redefinition requires the innovation to expand access to educational opportunities, amplifying active learning, and allowing teachers and students to create and innovate beyond the existing material. Digital technologies have brought changes to the nature and scope of education. Versatile and disruptive technological innovations, such as smart devices, the Internet of Things (IoT), artificial intelligence (AI), augmented reality (AR) and virtual reality (VR), blockchain, and software applications have opened up new opportunities for advancing teaching and learning (Gaol & Prasolova-Forland, 2021; OECD, 2021). Hence, in recent years, education systems worldwide have increased their investment in the integration of information and communication technology (ICT) (Fernández-Gutiérrez et al., 2020; Lawrence & Tar, 2018) and prioritized their educational agendas to adapt strategies or policies around ICT integration (European Commission, 2019).

5.2 The Theory of Planned Behaviour (TPB)

The theory of planned behaviour (TPB) is a theory of psychology and it explains how attitudes, beliefs and intentions influence behaviour (especially in this case, concerning the awareness of the utilization of Artificial Intelligence) – Icek Ajsen, 1985

It is important to note that there are three factors that influence an individual's "behavioural intentions" which is their plan or intention to perform a behaviour, in this case of literature the individual's behavioural intention to utilize Artificial Intelligence which in turn affects their actual behaviour. These factors are Attitude, Societal norms and perceived behavioural control.

It is important we understand how these three factors influence Artificial Intelligence as it will help in increasing the awareness of its utilization.

5.3 The Theory of Acceptance and Use of Technology (UTAUT)

The Theory of Acceptance and Use of Technology (UTAUT) is a model that explains how users adopt and use technology, including Artificial Intelligence. Developed by Venkatesh and colleagues in 2003, UTAUT posits that four key factors influence an individual's intention to use technology:

- Performance Expectancy (PE): The degree to which an individual believes that using AI will improve their performance or productivity.
- Effort Expectancy (EE): The ease of difficulty of using AI, as perceived by the individual.
- Social Influence (SI): The extent to which an individual is influenced by others to use AI, including social norms and peer pressure.
- Facilitating Conditions (FC): The availability of resources and support that facilitate AI use, such as training, infrastructure, and technical assistance.

UTAUT also considers four moderating variables that can affect the relationship between these factors and AI adoption. These variables include gender, age, experience and voluntariness (whether AI use is mandatory or voluntary). By understanding these factors and moderators, organizations can design strategies to promote AI adoption and usage, such as:

- Highlighting AI's benefits and performance improvements
- Providing training and support to reduce effort expectancy
- Encouraging social influence through peer networks and leadership support
- Ensuring facilitating conditions are in place
- Considering individual differences and moderating variables

UTAUT has been widely applied in various context, including AI adoption, to predict and explain technology acceptance and use.

6. METHODOLOGY

The research adopts a descriptive survey research design, aiming to comprehensively understand and describe the preferences, perceptions, and experiences of participants regarding different instructional methods in educational settings. This approach entails collecting data through structured surveys administered to a representative sample of participants. Participants will be surveyed using a comprehensive questionnaire designed to capture various aspects of their educational experiences, including their preferences, satisfaction levels, perceived effectiveness, engagement, and overall attitudes towards instructional methods. The survey also gathered demographic information, including gender, to allow for the examination of potential differences between male and female participants. This research work adopted the direct and purposive sampling technique in selecting the respondents from the total population (STEM-based programs). This has a total of 103 respondents.

7. DATA ANALYSIS

Data analysis involved statistical techniques to examine the interaction effects between the type of instructional material and participant gender on various outcome measures. Findings from the survey provided valuable insights into the preferences and perceptions of participants regarding different instructional methods, contributing to a deeper understanding of effective educational practices.

The research question was assessed using descriptive statistics, specifically simple frequency and graphical illustration using Pie charts and Bar charts.

8. RESULTS

8.1: Sex Distribution of Respondent

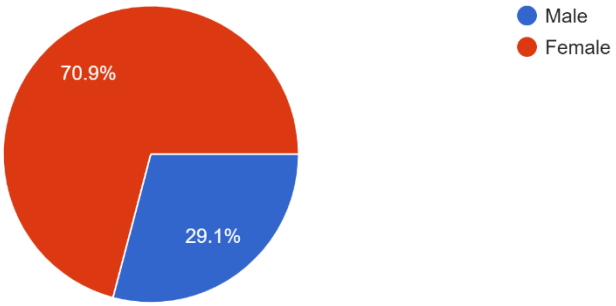

Fig 8.1.1 shows the distribution of respondent according to sex. As can be seen from the pie chart, 70.9% of the respondent included in this study were female and 29.1% were male. This pattern of distribution has shown that there are more females who are utilize Artificial intelligence in this study.

8.1.2: Academic level of respondent

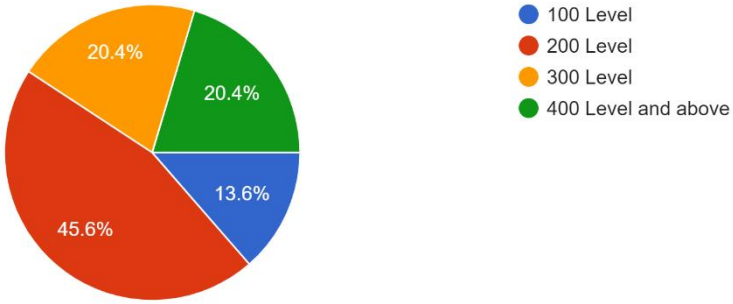

Fig 8.1.2 shows the distribution of respondent according to their academic levels. As shown in the pie chart above, 13.6%, 45.6%, 20.4%, 20.4% appear to be in 100L, 200L, 300L and 400L and above respectively where 200L turns out to be the largest group level.

8.1.3: Field of study of respondent

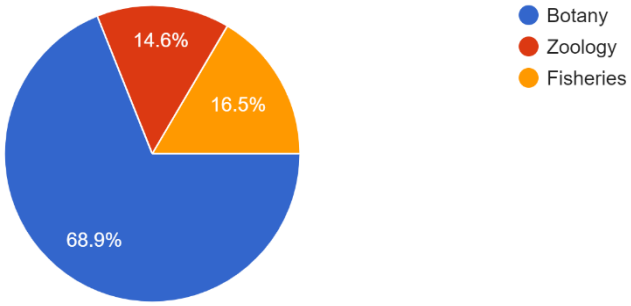

Fig. 8.1.3 shows the distribution of the field of study of respondent. 68.9% are from botany department, 16.5% are from fisheries department while 14.6% are from zoology department.

Q 8.1 To what extent are Artificial Intelligence-based tools utilized for research among students?

8.1.1: Have you ever used AI-based tools for your academic research and teaching?

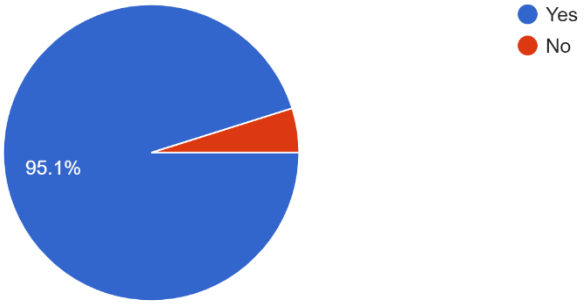

Fig 8.1.1 shows if respondents have ever used AI-based tools for their academic research and teaching. The pie chart shows that 95.1% have used AI-based tools for their academic research and teaching while 4.9% have not ever used AI-based tools for their academic research and teaching.

8.1.2: If yes, which AI-based tools have you used for research purposes?

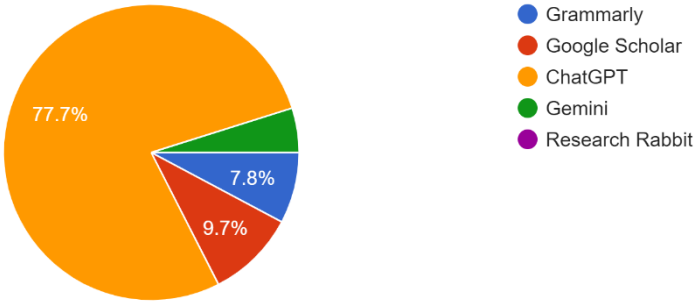

Fig. 8.1.2 specifies the AI-based tools respondents use for their research purpose. The response states that 77.7% use ChatGPT, 9.7% use Google Scholar, 7.8% use Grammarly and 4.8% use Gemini for their research purpose. The pie chart also shows that no respondent use Research Rabbit for their research purpose.

8.1.3: How often do you use AI-based tools for your research?

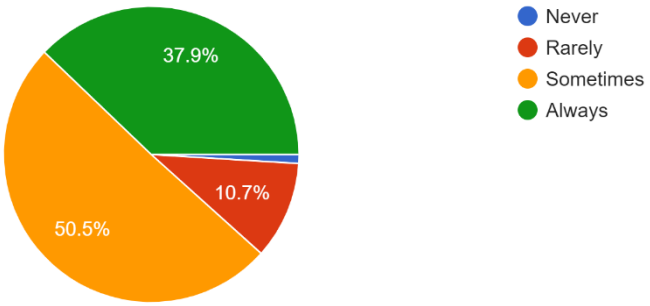

Fig. 8.1.3 shows how often respondents use the afore-mentioned AI-based tools for their research work. From the pie chart, it is denoted that 50.5% respondents use these AI-based tools sometimes, 37.9% use it always, 10.7% rarely use these AI-based tools while 0.9% never use these AI-based tools for their research work.

8.1.4: How effective do you find AI-based tools in improving your research outcomes?

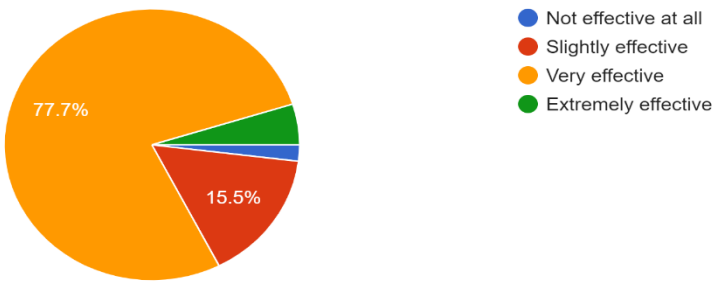

Fig. 8.1.4 shows how effective respondents find AI-based tools in improving their research outcomes. From the response, it is deduced that 77.7% of the respondents find the AI-based tools very effective, 15.5% respondents find the AI-based tools slightly effective, 5.2% respondents find it extremely effective and 1.6% find it not effective at all.

8.1.5: What challenges have you encountered when using AI-based tools for research?

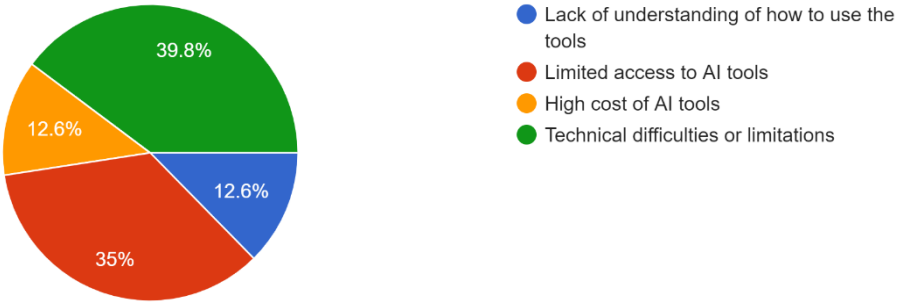

Fig. 8.1.5 shows the challenges respondents has encountered when using AI-based tools for their research work. From the response, it is deduced that 39.8% encountered technical difficulties, 35% encountered limited access to AI tools, 12.6% encountered high cost of AI tools and the remaining 12.6% encountered lack of understanding on how to use the AI tools.

8.1.6: How likely are you to recommend the use of AI-based tools to your peers or colleagues?

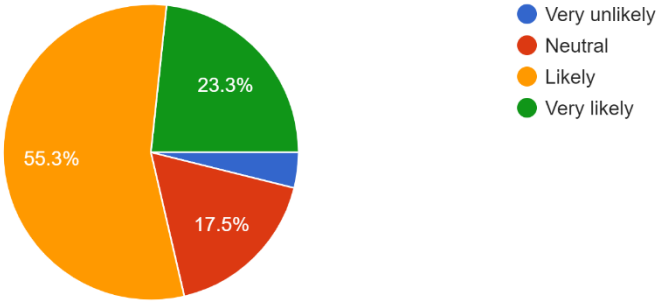

Fig. 8.1.6 shows how likely respondents will recommend the use of AI-based tools to their peers or colleagues. From the response, 55.3% will likely recommend the use of AI-based tools to their peers, 23.3% will very likely recommend the use of these tools, 17.5% respondents are neutral on this question while 3.9% of the respondents are very unlikely to recommend the use of AI-based tools to their peers and colleagues.

8.1.7: Do you have any additional comments or thoughts on the use of AI in education and research?

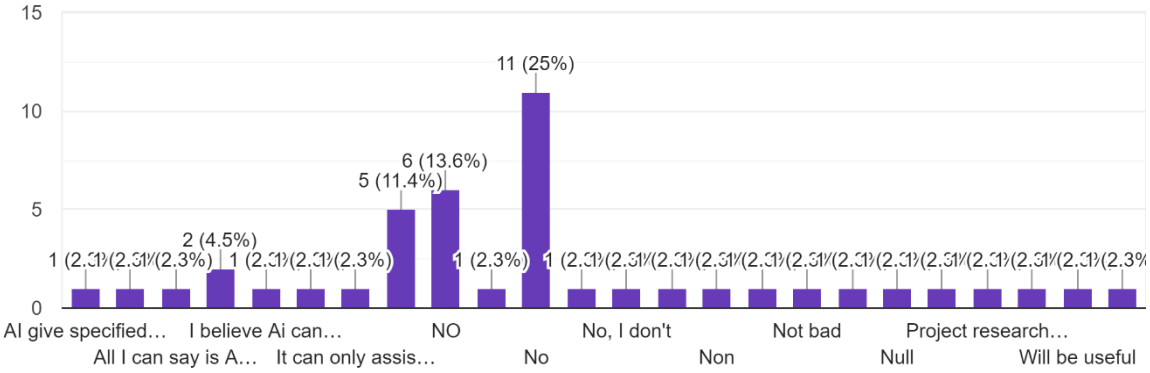

Fig. 8.1.7 presents respondents' additional comments and thoughts on the use of AI in education and research. From the data gathered, approximately 30% of respondents provided extra feedback on this topic. One respondent mentioned that AI offers precise and detailed answers, making concepts easier to understand. Another highlighted that AI is available anytime and pays attention to even the smallest details shared by students. However, one respondent noted that while AI can aid student improvement, it may also make students lazy, as they might rely too heavily on AI without conducting further research or verifying the tool's output. Additionally, AI can assist in teaching but should not replace educators, as the importance of human involvement cannot be overstated. Respondents also emphasized the usefulness of AI for research and general inquiry.

9. DISCUSSION

The present study explored the level of utilization of AI-based system among students studying STEM-related courses at Lagos State University. The findings of the research showed that students with better awareness and use of AI based systems held more accepted perception along with improved academic outcome than those who had less levels than them. These results correspond to the findings of (Ariyibi, 2021) who demonstrated how technological interventions can enhance student engagement and performance. Similarly, Rezaee et al. Advanced e-learning approaches had positive effects on Academic achievement and Problem-solving ability of students in a study by Okobia (2022).

Bawa (2016) found in his study that students who were placed into personalized learning environment scored less on a cognitive load scale, they demonstrated to be more engaged and had higher test scores when subjected to an achievement exam. The interactive and dialogue driven nature of the multimedia software was cited as a reason for this. These results are in line with the modality principle of Mayer (2015) that states using visuals and audio narration is better for learning than text alone. While Moreno's (2006) meta-analysis showing substantial learning benefits due to the modality effect contributes an additional level of support for this view.

Gender differences in the awareness, utilization, and perception of AI-based systems were also observed. Female students in the STEM-based faculties at Lagos State University demonstrated higher levels of awareness and more positive perceptions of AI-based systems compared to their male counterparts. This finding is consistent with Dutsina, Tanbayal, and Sabitu's (2020) research, which noted that female students generally excel in online learning environments. It also supports González-Gómez et al. (2012) and Ciuclea and Ternauciuc (2019), who found that females tend to have a more favorable view of e-learning technologies. In contrast, studies by Wangu (2014), Kashu (2014), Anih and Egbo (2015), and Kisigot, Ogula, and Munyua (2021) reported that male students sometimes showed better performance in specific contexts. Factors such as teachers' attitudes and cultural influences, which were not investigated in this study, may contribute to these differences.

10. CONCLUSION

The research found that when students knew more about and used AI systems more often, they got more involved and thought better of STEM-related departments at Lagos State University. Also, it turned out that female students knew more about AI systems and had a better opinion of them than male students did.

11. LIMITATIONS

On this study, One significant limitation of this study is the sample size and representativeness of the respondents. The accuracy and reliability of the study's conclusions are heavily dependent on obtaining a sufficiently large and diverse sample of students and faculty members from the STEM-related faculties. If the sample is too small or lacks diversity, the findings may not accurately reflect the broader population of the university. This limitation underscores the importance of meticulous sampling methods to ensure that the data collected is representative of the varied perspectives within the STEM-related disciplines.

12. RECOMMENDATION

Based on the findings, the following recommendations are made:

1. **STEM Educators**: Emphasize the use of AI tools and technologies in teaching to improve academic outcomes. Enhancing integration of AI systems can provide students with practical experience and improve their technological proficiency.
2. **Educational Technology Specialists**: Organize training sessions, workshops, and conferences to equip faculty with the skills needed to effectively use and integrate AI-based systems into their teaching practices.
3. **Infrastructure Development**: Ensure that STEM-related departments are equipped with up-to-date computer systems, AI tools, and reliable internet connectivity to support effective learning and utilization of AI-based systems.
4. **Gender Inclusivity**: Promote equal engagement of both male and female students in AI-related learning activities to address any potential gender biases and ensure equitable access to technological resources.
5. **Curriculum Enhancement**: Integrate AI technologies into the STEM curriculum to provide students with relevant, hands-on experience and to support the use of advanced technology in practical applications.
6. **Teacher Training**: The Federal and State Ministries of Education should sponsor training programs for STEM faculty on the effective use and integration of AI-based systems, ensuring they are equipped with the latest skills and knowledge.

Future research in this domain should focus on longitudinal studies that track shifts in public perceptions over time, particularly as AI technologies become more integrated into daily life. Such studies can provide valuable insights into how attitudes evolve in response to new developments, policies, and educational initiatives.

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