Teachers' Perspectives on Emerging Issues in Using Digital Technology and Artificial Intelligence in Teaching Mathematics and Science in Secondary Schools in Bayelsa State

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ABSTRACT

This study explores teachers' perspectives on emerging issues in using digital technologies and artificial intelligence (AI) in teaching mathematics and science in secondary schools in Bayelsa State. The study used a descriptive survey research design, collecting data from 750 science and mathematics teachers across five Local Government Areas. Nine validated instruments with high reliability indices (Cronbach's alpha ranging from 0.81 to 0.93) were utilized to assess teachers' perspectives. The findings reveal significant disparities in digital access, gaps in digital literacy, and concerns about data privacy and security, teacher autonomy, ethical concerns, plagiarism, and impact on critical thinking skills. The study provides actionable recommendations for stakeholders to address these issues and enhance teacher preparedness and confidence in effectively integrating digital technology in the classroom, contributing to the ongoing discourse on harnessing technology to improve educational outcomes.

Keywords: Artificial Intelligence, Digital Technology, Emerging Issues, Gender, Mathematics,

INTRODUCTION

Digital technologies have experienced significant growth and development over the years. It is now ubiquitous in nature and heavily applied across various fields, influencing diverse aspects of daily life. One particular importance is the presence of digital technologies in the educational context and the influences, innovations and challenges it brings.

Digital technologies offer a wide variety of tools and functionalities that have proved applicable to teaching and learning. As such the use of digital technologies in learning has become quite the common recommendations for facilitating better achievement and meaningful learning in fields, especially in science and mathematics, that tend to be more associated with underachievement.

Science is a vital field of study that explores the world and its phenomena. Science is beneficial for providing knowledge, leading to technology development, making the world a global society, and improving life expectancy and health. It also enhances productivity in vital industries like agriculture and food production [1]. Mathematics is a universal field of study that deals with quantity and abstractness, using numbers, symbols, and formulas in problem-solving operations [2]. It is heavily applied in daily activities and decision-making. Mathematics is considered a necessity for living well in today's world and plays a significant role in national development, economics, and commerce. It also helps build mental capabilities like problem-solving and higher-order thinking skills.

Digital technology is commonly recommended for teaching and learning in schools. However, the process of its integration into the instructional process is not entirely smooth sailing. There are several issues that mitigate their use to varying extents. Some emerging issues in integrating digital technology into the instructional process include problems with; digital equity and access, technological infrastructure, teacher training and professional development, curriculum development to reflect the latest advances in technology, data privacy

and security, digital literacy skills, quality of online content, students' engagement and motivation despite distracting contents, assessment and evaluation, teacher-student interaction, technology overreliance, constant technological changes, etc. [3].

The rise of Artificial Intelligence (AI) is the most recent advancement and focus in the digital domain. AI also holds several major implications for the learning process. Artificial Intelligence (AI) refers to the simulation of human intelligence in machines designed to perform tasks that typically require human cognition [4]. AI systems are fully equipped with complex algorithms and data, which enable them to recognize patterns, make decisions, and improve over time [5],[6]. They are heavily used nowadays in a wide variety of applications and tools, and have experienced a steady growth, most prominently in recent years. The education field has not been left out of its encompassing effect.

AI in education is transforming how students learn and how educators teach [7]. Though it offers some useful features ranging from tools for personalized learning to task automation, it also presents a series of new challenges for the educational system and process.

Thus, considering how digital technology and AI are changing and influencing the educational landscape, and increased calls for their proper integration into the learning process, this study seeks to explore teachers' perspectives on emerging issues in using digital technologies and AI in teaching and learning. It is essential that these issues be comprehensively addressed, and the first step to addressing such issues is fully understanding them. In this context, it is important to consider the perspectives of teachers, as they direct the flow of learning in the classroom, and will be responsible for ensuring the effective integration of such technologies for teaching and learning. Addressing these emerging issues is fundamental to harnessing the full potential of technology in education, and it is not mitigating meaningful learning.

The issues related to the use of digital technology that will be considered in this study include: digital access and equity, digital literacy skills, curriculum development to reflect technology Integration, and data privacy and security. The issues related to the use of artificial intelligence that will be considered in this study include Loss of teacher autonomy, ethical concerns, plagiarism from content generation, reduction in students' critical thinking due to over-reliance on AI, and increased workload for teachers (for instance, having to screen students' work for AI content).

Statement of the Problem

In an era characterized by rapid technological advancement and increasing reliance on digital tools like AI, the integration of digital technology into educational practices has become inevitable. It offers some tools to enhance the learning process and outcomes, especially for core and essential fields like science and mathematics. However, the successful integration of digital technology in education also brings about a series of issues that can mitigate actual meaningful learning. To address those issues, it is essential to gain adequate insight into them. Teachers are the facilitators of learning and are responsible for any potential use of digital technology in teaching, and are impacted by the use of such technologies by learners. Thus, gaining insights into technology and AI from the teacher's perspective is essential. Despite this, little has been done to comprehensively explore specific emerging issues related to the use of technology and AI in teaching in this region, which makes this study imperative.

Purpose/Objectives of the Study

The general purpose of the study is to explore "teachers' perspectives on emerging issues in using digital technology and artificial intelligence in teaching mathematics and science in secondary schools in Bayelsa State." Specifically, the study will determine the following;

1. The teachers' perspectives on digital access and equity in using digital technology to teach science and mathematics

2. The teachers' perspectives on digital literacy skills in using digital technology to teach science and mathematics

3. The teachers' perspectives on making curriculum development reflect technology integration in using digital technology to teach science and mathematics

4. The teachers' perspectives on data privacy and security in using digital technology to teach science and mathematics

5. The teachers' perspectives on loss of teacher autonomy in using artificial intelligence in science and mathematics

6. The teachers' perspectives on ethical concerns in using artificial intelligence in science and mathematics

7. The teachers' perspectives on content plagiarism in using artificial intelligence in science and mathematics

8. The teachers' perspectives on overdependence and reduction in critical thinking in using artificial intelligence in science and mathematics

9. The teachers' perspective on increase in workload due to the use of artificial intelligence in science and mathematics

10. Gender differences in teachers' perspectives on digital access and equity in using digital technology to teach science and mathematics

11. Gender differences in teachers' perspectives on digital literacy skills in using digital technology to teach science and mathematics

12. Gender differences in teachers' perspectives on making curriculum development reflect technology integration in using digital technology to teach science and mathematics

13. Gender differences in teachers' perspectives on data privacy and security in using digital technology to teach science and mathematics

14. Gender differences in teachers' perspectives on loss of teacher autonomy in using artificial intelligence in science and mathematics

15. Gender differences in teachers' perspectives on ethical concerns in using artificial intelligence in science and mathematics

16. Gender differences in teachers' perspectives on content plagiarism in using artificial intelligence in science and mathematics

17. Gender differences in teachers' perspectives on overdependence and reduction in critical thinking in using artificial intelligence in science and mathematics

18. Gender differences in teachers' perspectives on the increase in workload due to the use of artificial intelligence in science and mathematics

Research Questions

In line with the study's objectives, eighteen (18) research questions are raised to guide the study.

1. What are the teachers' perspectives on digital access and equity in using digital technology to teach science and mathematics?

2. What are the teachers' perspectives on digital literacy skills in using digital technology to teach science and mathematics?

3. What are the teachers' perspectives on making curriculum development reflect technology integration in using digital technology to teach science and mathematics?

4. What are the teachers' perspectives on data privacy and security in using digital technology to teach science and mathematics?

5. What are the teachers' perspectives on the loss of teacher autonomy in using artificial intelligence in science and mathematics?

6. What are the teachers' perspectives on ethical concerns in using artificial intelligence in science and mathematics?

7. What are the teachers' perspectives on content plagiarism in using artificial intelligence in science and mathematics?

8. What are the teachers' perspectives on overdependence and reduction in critical thinking in using artificial intelligence in science and mathematics?

9. What are the teachers' perspectives on the increase in workload due to the use of artificial intelligence in science and mathematics?

10. What are the gender differences in teachers' perspectives on digital access and equity in using digital technology to teach science and mathematics?

11. What are the gender differences in teachers' perspectives on digital literacy skills in using digital technology to teach science and mathematics?

12. What are the gender differences in teachers' perspectives on making curriculum development reflect technology integration in using digital technology to teach science and mathematics?

13. What are the gender differences in teachers' perspectives on data privacy and security in using digital technology to teach science and mathematics?

14. What are the gender differences in teachers' perspectives on loss of teacher autonomy in using artificial intelligence in science and mathematics?

15. What are the gender differences in teachers' perspectives on ethical concerns in using artificial intelligence in science and mathematics?

16. What are the gender differences in teachers' perspectives on content plagiarism in using artificial intelligence in science and mathematics?

17. What are the gender differences in teachers' perspectives on overdependence and reduction in critical thinking in using artificial intelligence in science and mathematics?

18. What are the gender differences in teachers' perspectives on the increase in workload due to the use of artificial intelligence in science and mathematics

Null Hypotheses

The following null hypotheses were raised to guide the study and will be tested at a 0.05 significance level

1. There is no significant gender difference in teachers' perspectives on digital access and equity in using digital technology to teach science and mathematics

2. There is no significant gender difference in teachers' perspectives on digital literacy skills in using digital technology to teach science and mathematics.

3. There is no significant gender difference in teachers' perspectives on making curriculum development reflect technology integration in using digital technology to teach science and mathematics.

4. There is no significant gender difference in teachers' perspectives on data privacy and security in using digital technology to teach science and mathematics.

5. There is no significant gender difference in teachers' perspectives on loss of teacher autonomy in using artificial intelligence in science and mathematics.

6. There is no significant gender difference in teachers' perspectives on ethical concerns in using artificial intelligence in science and mathematics.

7. There is no significant gender difference in teachers' perspectives on content plagiarism in using artificial intelligence in science and mathematics.

8. There is no significant gender difference in teachers' perspectives on overdependence and reduction in critical thinking in using artificial intelligence in science and mathematics.

9. There is no significant gender difference in teachers' perspectives on the increase in workload due to the use of artificial intelligence in science and mathematics

LITERATURE REVIEW

The search for previous literature reveals a prominent gap centered around the insufficiency of studies that have taken the teachers' perspectives into consideration, particularly for emerging and current issues related to how digital technology and AI can affect learning.

For instance, the issue of digital access and equity, there is a prominent dearth of literature exploring teachers' perceptions of that issue of digital access and equity as a whole. Most similar studies that have been conducted only explored the availability of tools and infrastructure as a challenge of using technology to teach, but digital access and equity go beyond that. Some of those studies are highlighted below.

According to [8] who conducted a study on the integration of emerging technologies in the educational process and its challenges from the perspectives of teachers and students in Nigeria, the results of the study, though acknowledged the importance of technology in education, reported that the integration of technology for teaching is constrained by several issues, including poor availability and accessibility, epileptic power supply, insufficient skills, poor funding, inadequate professional development, and poor internet connectivity, all of which fall under the scope of digital access issues.

Meanwhile, [9] study explored teachers' perspectives on the use of technology for remote teaching during the COVID-19 era in some of Zimbabwe's southern regions (Bulawayo, Matabeleland North, and Matabeleland South provinces). The findings of the study showed that using technology to teach is mitigated by barriers like lack of infrastructure, cost of data, lack of connectivity and lack of access to computing devices. Also, [10] in their study explored the availability and usability of digital technologies for teaching public primary school pupils in Gwale Local Government Area of Kano State. The findings of the study showed that the schools severely lack most of the digital technologies needed for using technologies to teach. The findings further showed that using technologies to teach is mitigated by some challenges like information literacy, computer literacy, integration literacy, effective communication networks, high cost of digital technologies, etc.

The gap in the literature was also present in the digital literacy variable. As little had been done to explore the issue from the teachers' perspectives. Some similar studies that could be found are highlighted below.

Similarly, [11] in their study explored pre-service teachers' perceptions and views of digital literacy in Turkey. The findings indicated that the pre-service teachers had high and positive perceptions of digital literacy. [12] conducted a study that explored perceived teachers' competency levels in applying digital technology to the physical education classroom. The study's findings show that teachers perceived significantly low competency levels in digital technology in physical education. In the same vein, [13] conducted a study on teachers' digital literacy, as a challenge during the COVID-19 era. The results of the study showed that overall, the teachers had low self-perceptions of their digital skills.

[14] explored the digital literacy skills of teachers in elementary schools in the city of Bogor. The results of this study indicate the level of digital literacy among elementary school teachers is average across all aspects.

As with the other emerging issues, little has been done to explore the issue of data privacy and security (as a whole concept) from teachers' perspective. Instead, most previous similar studies tend to focus on social media use rather than the use of technology to teach and learn.

[10] in their study explored the availability and usability, as well as the challenges of using technology to teach public primary school pupils in Gwale Local Government Area of Kano State. The findings of the study showed that amongst others, the use of digital technologies to teach is mitigated by the lack of availability of curriculum-specific applications for technology integration in education. In like manner, [15] conducted a study that explored "prospective teachers' perceptions of barriers to technology integration in education" at a university in the North East part of the US. The result of the study revealed that amongst others, pre-service teachers have critical perceptions related to the inclusion of technology in the curriculum.

The lack of literature was most prominent with the issue of making curriculum reflect technology, with this area receiving almost no attention, and only mentioned in passing along with several other factors when it did appear.

Again, [16] conducted a cross-sectional study that explored the perceptions of pre-service teachers from universities in four countries (Germany, New Zealand, Spain, and the USA) on educational and professional social media use, as well as data privacy awareness and practices. The study reported, amongst others that data privacy concerns were present and knowledge related to data privacy was lacking. Also, [17] in their study explored pre-service teachers' perceptions of data protection in primary education. The results show a high perception of risk in online-based activities such as accepting cookies when surfing the internet or transferring banking information. In addition, [18] in their study explored the "Pre-service teachers' perceptions of social media data privacy policies". The results of the study showed that though the pre-service teachers expressed discomfort with how social media companies use data, but they lacked knowledge on the issue of data privacy.

The dearth of literature was especially prominent with teachers' perspectives concerning emerging issues in AI use in educational context, and this can be linked to the fact that compared to digital technology as a whole, AI has only experienced a surge in usage and functionalities recently. Furthermore, previous research has not comprehensively studied and explored any of the emerging issues being focused on, in this study.

METHODOLOGY

This study adopted a descriptive survey research design. The study's population consisted of all secondary school science and mathematics teachers in Bayelsa State.

Five (5) Local Government Areas were involved in the study. Probability sampling in the form of simple random sampling was used to select 150 science and mathematics teachers from each of these local government areas, making a total of 750 teachers involved in the study.

Nine instruments were used for data collection, based on the eight emerging issues explored in the study. The instruments included:

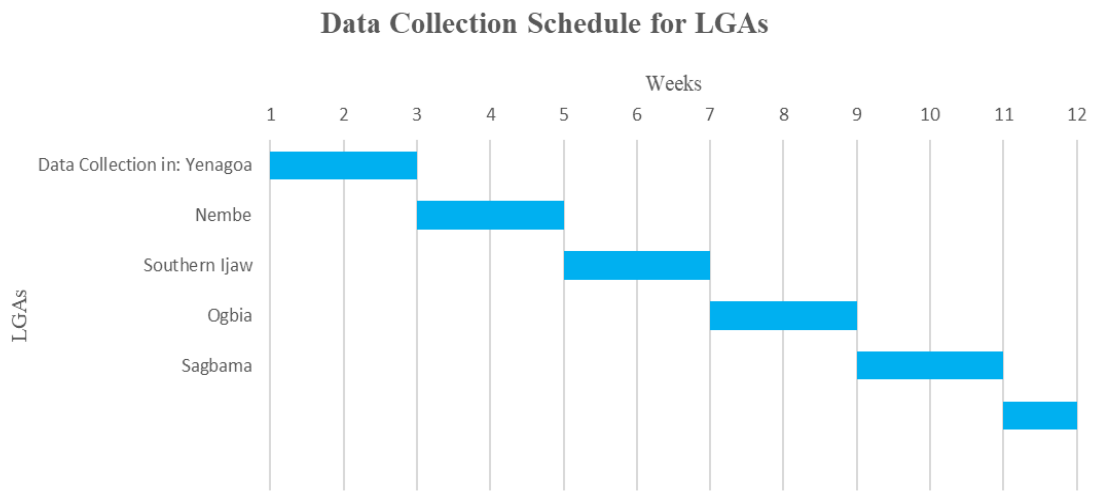
- Perspectives on Digital Access and Equity in Using Technology to Teach Science and Mathematics (PDAEUTTSM)
- Perspectives on Digital Literacy Skills in using Digital Technology to Teach Science and Mathematics (PDLSDTTSM)
- Perspectives on Technology-Reflective Curriculum Development in using Digital Technology to Teach Science and Mathematics (PTRCDDTTSM)
- Perspectives on Data Privacy and Security in using Digital Technology to Teach Science and Mathematics (PDSDTTSM)
- Perspectives on Teacher Autonomy in using Artificial Intelligence in Education (PTAAIE)
- Perspectives on Ethical Concerns in using Artificial Intelligence in Education (PECAIE)
- Perspectives on Content Plagiarism in using Artificial Intelligence in Education (PCPAIE)
- Perspectives on Overdependence and Reduction in Critical Thinking in Using Artificial Intelligence in Education (PORCTAI)
- Perspective on Increase in Workload due to the use of Artificial Intelligence in Education (PIWAIE)

All the instruments collected the teachers' demographic data, particularly their gender and field of study such as Mathematics, Biology, Chemistry, and Physics. Each instrument had sections comprehensively exploring the issues of concern from the teachers' perspectives, including perceptions of the relevance or prominence of the issue, perceived causal factors, and recommendations. The instruments were constructed on a 4-point scale and included open-ended areas for additional insights.

The instruments were validated through expert review. To establish the reliability of the research instruments, they were distributed to 100 teachers outside the study sample. The collected data were analyzed using Cronbach alpha to determine the internal consistency of the items.

Data collection was systematically carried out across the chosen five Local Government Areas. The researcher distributed the instruments to the teachers in each Local Government over at least one week. The Principals of the schools were trained as research assistants. The researchers visited the teachers in their schools, administered and retrieved the instruments across different days.

Data collected were analyzed using mean and standard deviation to answer the research questions and t-test for the null hypotheses at a 0.05 significance level.



RESULTS

The study yielded the following key results:

1. Digital Access Disparities: The study revealed significant disparities in digital access among secondary schools in Bayelsa State, highlighting infrastructure and digital tool gaps that affect the integration of digital technologies in teaching mathematics and science. The findings of this study are in line with [19] who worked on Digital Divide and Education, and highlighted that the disparities in digital access and its impact on education

2. Digital Literacy Levels: The study assessed the current level of digital literacy among teachers and their perceptions of students' literacy, identifying gaps and areas for improvement to ensure successful digital technology integration. The result of this study is supported by [20], who discuss the importance of digital literacy for teachers and its impact on education.

3. Curriculum Development Insights: Teachers provided valuable insights on the adequacy of the current curriculum in supporting digital integration, highlighting areas for revision to align with emerging technological trends. Curriculum and Teaching in the Digital Age by [21] who emphasizes the need for curriculum revision to align with emerging technological trends supports the result of this study.

4. Data Privacy and Security Concerns: The study highlighted teachers' awareness and concerns about data privacy and security in education, with recommendations provided to address these concerns. Similar findings by [22] highlights the importance of data privacy and security in education which is in line with the finding of this research.

5. AI's Impact on Teacher Autonomy and Workload: Teachers shared their perspectives on how AI tools may affect their autonomy and workload, providing insights into potential strategies to address these issues. Artificial Intelligence in Education by [23] discusses the potential impact of AI on teacher autonomy and workload supporting the findings of this study.

6. Ethical Concerns and Plagiarism: The study documented teachers' views on ethical concerns related to AI use, including plagiarism and authenticity of students' work, contributing to the development of guidelines and best practices. Likewise, [24] study on Academic Integrity in the Digital Age emphasizes the importance of addressing plagiarism and academic integrity in the digital age. This is supported the findings of this study

7. Impact on Critical Thinking Skills: Teachers expressed concerns about the potential impact of overreliance on AI tools on students' critical thinking and problem-solving abilities, with insights provided to mitigate this issue. The Impact of Technology on Critical Thinking by [25] discusses the potential impact of technology on critical thinking skills which is in terms with the result of this study.

8. Policy and Practice Recommendations: Actionable recommendations were provided for teachers, school administrators, and policymakers to address identified issues. Policy Guidelines for ICT in Education by [26] provides guidelines for policymakers to support the effective use of technology in education. This is in support to the findings if this study.

9. Enhanced Teacher Preparedness and Confidence: The study's insights and recommendations are designed to boost teacher preparedness and confidence in effectively integrating digital technology in the classroom. Teacher Readiness for Technology Integration by [27] emphasizes the importance of teacher readiness and confidence in technology integration supports the result of this research.

CONCLUSION

The study provides actionable recommendations for stakeholders to address these issues and enhance teacher preparedness and confidence in effectively integrating digital technology in the classroom, contributing to the ongoing discourse on harnessing technology to improve educational outcomes.

RECOMMENDATION

From the findings of this study, it is recommended that policymakers and educators to consider the following:

1. Develop Comprehensive Digital Infrastructure Ensure reliable internet, devices, and technical support in all schools.

2. Invest in Teacher Development: Provide regular training on digital literacy, AI tools, and effective integration.

3. Establish Clear Guidelines: Develop and enforce standards for data privacy, security, and ethical AI use.

4. Bridge the Digital Divide: Implement programs for equal access to technology for all students.

5. Foster Collaborative Partnerships: Encourage school-industry partnerships to support technology integration.

By implementing these recommendations, teachers and students can harness the potential of digital technology and AI to improve educational outcomes and prepare students for success.

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