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AI and Big Data in Advancing Mathematical Literacy Cybersecurity's Moderating Role

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ABSTRACT

In today's rapidly evolving digital landscape, mathematical literacy has emerged as a crucial competency for students navigating data-intensive environments. The integration of Artificial Intelligence (AI) and Big Data in education holds transformative potential to enhance personalized learning and support data-driven teaching strategies, yet it also raises critical concerns around Cybersecurity, particularly in safeguarding student data and ensuring trust in digital platforms. **This study** aims to analyze the effects of AI and Big Data on mathematical literacy, while examining the moderating role of Cybersecurity. **Using a quantitative** research approach, data were collected through a structured questionnaire and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4. **The results** indicate that both AI and Big Data have significant positive effects on students' mathematical literacy, with Big Data exerting the strongest influence through its ability to provide deep insights into student performance. AI also contributes effectively by enabling real-time feedback, adaptive learning, and personalized instruction. Although Cybersecurity demonstrated a weaker direct effect on mathematical literacy, it remains an essential enabler of a secure digital learning environment, fostering user trust and system integrity. **This research highlights** the importance of aligning educational technology implementation with strong digital safeguards to maximize learning outcomes. The findings offer managerial implications for educational institutions to invest in intelligent learning platforms supported by robust cybersecurity protocols. Ultimately, the study reinforces the relevance of **SDG 4**: Quality Education, by promoting inclusive, safe, and tech-enhanced learning ecosystems suited for the demands of 21st-century education.

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1. INTRODUCTION

In the era of rapid technological advancements, mathematical literacy has become a foundational skill necessary for success in diverse domains, especially in the context of Artificial Intelligence (AI), Big Data, and Cybersecurity. Existing studies have explored the role of AI in adaptive learning and Big Data in personalized instruction, while cybersecurity concerns in educational technology have also gained attention. Despite these

advances, few studies have investigated how AI and Big Data can be effectively integrated into mathematical literacy frameworks while simultaneously addressing cybersecurity as a moderating factor [1].

Moreover, this research is situated within the broader framework of the United Nations Sustainable Development Goals (SDGs), particularly **SDG 4** on Quality Education, which emphasizes equitable, inclusive, and technology-supported learning environments. By aligning AI, Big Data, and Cybersecurity with the global vision of **SDG 4**, this study underscores both its theoretical contribution and its societal relevance in shaping secure, adaptive, and future-ready education systems [2].

Big Data, on the other hand, has become an indispensable tool in educational settings. The vast amounts of data generated from digital platforms, student interactions, and learning management systems provide valuable insights into learning behaviors, performance trends, and the effectiveness of educational strategies. Big Data analytics enables educators and policymakers to make informed decisions that enhance teaching methodologies and improve student outcomes [3]. In the context of mathematical literacy, Big Data can be harnessed to track student progress, identify patterns of success or failure, and refine instructional approaches accordingly. This data-driven approach promises to optimize the learning experience and create a more personalized educational journey for students. However, the increased use of AI and Big Data in educational settings also brings to light significant concerns about cybersecurity. The protection of student data, privacy, and intellectual property in digital learning environments has become a paramount issue. As educational institutions adopt more digital tools and platforms, they are exposed to greater risks of cyberattacks, data breaches, and unauthorized access to sensitive information. Ensuring robust cybersecurity measures in educational systems is essential to safeguard not only students' personal information but also the integrity of the educational process itself. The intersection of AI, Big Data, and cybersecurity creates both opportunities and challenges that require careful consideration and innovation [4].

One of the critical research gaps in this area is understanding how AI and Big Data approaches can be effectively integrated into mathematical literacy programs without compromising the security of student data. While there has been significant progress in using AI to enhance teaching and learning, the security implications of AI-driven education systems remain underexplored. Additionally, the role of Big Data in personalizing mathematical learning experiences raises questions about data ownership, access, and security protocols [5]. Moreover, despite the potential of these technologies, many educational institutions, particularly in underdeveloped regions, face significant barriers to their adoption. These include a lack of technological infrastructure, insufficient digital literacy among educators, and inadequate cybersecurity measures to protect the data of vulnerable students. Bridging these gaps is essential for the global advancement of mathematical literacy and the safe use of technology in education. This paper aims to explore the convergence of AI, Big Data, and Cybersecurity in advancing mathematical literacy. By reviewing current pedagogical practices and technological innovations, this study will provide a comprehensive analysis of how AI and Big Data can be leveraged to improve mathematical education while addressing the inherent cybersecurity challenges. Furthermore, this paper will highlight the critical research gaps in this field and propose avenues for future exploration to create a more secure, efficient, and inclusive educational ecosystem that fosters mathematical literacy in the digital age [6].

2. LITERATURE REVIEW

2.1. Mathematical Literacy in the Digital Age

Mathematical literacy has become an essential skill in the modern world, extending beyond basic arithmetic and algebra to encompass the ability to interpret, analyze, and apply mathematical concepts in real-world situations. In an increasingly technology-driven society, mathematical literacy is vital for students to navigate fields like data science, artificial intelligence, cybersecurity, and many others. The importance of this literacy extends to understanding and using mathematical concepts in digital technologies, which are becoming foundational across industries. As technology continues to advance, a strong foundation in mathematics is necessary to ensure that students are prepared for future careers in these rapidly growing fields [7]. Traditional teaching methods often fall short in addressing the demands of today's technology-driven world, which is why integrating innovative educational technologies, such as AI and Big Data, into mathematics education is becoming increasingly important. These technologies can transform how mathematics is taught by offering personalized learning experiences. AI-driven systems, for example, can adapt to individual students' learning styles, providing tailored feedback and instruction. This personalized approach can improve student engagement and help bridge the gaps in understanding that traditional methods sometimes miss [8].

2.2. Artificial Intelligence in Education

Artificial Intelligence (AI) has the potential to significantly enhance education, particularly in mathematics, by offering personalized learning environments. AI tools, such as intelligent tutoring systems and adaptive learning platforms, provide real-time feedback, track student progress, and adjust content to meet the specific needs of each student. These technologies have the ability to analyze students' performance and learning patterns, allowing for the customization of lessons based on individual strengths and weaknesses. By tailoring the learning experience, AI can help students tackle mathematical problems more effectively, improving both their understanding and confidence in the subject [9]. Moreover, AI-driven systems can provide ongoing support throughout the learning process, offering alternative explanations and practice problems until students demonstrate mastery. These systems allow for continuous improvement in teaching methods, adjusting in real time based on the feedback from student interactions [10]. The use of AI in mathematics education also promotes a deeper level of engagement, as students can work at their own pace and receive immediate support when they encounter challenges. This adaptability makes AI a powerful tool in advancing mathematical literacy [11].

2.3. Big Data in Education

Big Data is transforming education by providing valuable insights into student performance, behaviors, and learning trends. In the context of mathematical education, Big Data helps educators analyze large volumes of data collected from various sources, such as learning management systems, online assessments, and student interactions with educational platforms. By analyzing these data points, educators can identify patterns, detect gaps in learning, and adjust teaching strategies accordingly. This data-driven approach allows for more effective interventions, which can lead to better student outcomes. Big Data also facilitates the creation of personalized learning paths, tailored to the individual needs of students [12]. With the ability to track progress and learning behaviors in real time, Big Data allows educators to design more responsive curricula that adapt to the needs of the students. Additionally, predictive analytics can be used to forecast student performance and identify those who may need additional support. This ability to foresee and address challenges before they escalate is one of the major benefits of integrating Big Data into the educational process [13].

2.4. Cybersecurity in Educational Systems

With the growing use of AI and Big Data in educational settings, cybersecurity has become a crucial concern. As educational institutions adopt more digital tools and platforms, the security of student data and learning systems becomes increasingly important. Educational data, including sensitive personal information, academic performance, and behavioral data, are attractive targets for cyberattacks. As a result, ensuring that these platforms are secure from breaches and that student information is protected is vital for maintaining trust in digital learning environments [14]. To safeguard against potential threats, educational institutions must implement strong cybersecurity measures, including encryption, access control, and continuous monitoring of digital platforms. As AI and Big Data become integral to the educational experience, it is also essential to secure these systems themselves. The use of AI-powered security tools can help identify and mitigate potential risks, ensuring that educational platforms remain safe and secure for students and educators alike [15].

2.5. Research Gaps and Future Directions

While the integration of AI, Big Data, and cybersecurity into educational practices has shown promise, there are several critical research gaps that remain. Although AI has demonstrated its potential in improving personalized learning, more research is needed to understand its long-term effects on mathematical literacy and its scalability across diverse student populations. Additionally, while Big Data offers valuable insights into student performance, the ethical considerations surrounding its use, such as privacy, data ownership, and consent, have not been fully addressed. Moreover, while the focus on cybersecurity has increased, there is still a lack of comprehensive frameworks that combine the secure use of AI and Big Data in educational settings. Future research should aim to fill these gaps by exploring the integration of AI and Big Data with robust cybersecurity protocols. Furthermore, research is needed to understand how these technologies can be effectively implemented in diverse educational environments, particularly in under-resourced regions. By addressing these challenges, researchers can help shape a more secure, effective, and inclusive educational ecosystem that supports the development of mathematical literacy in the digital era [16].

3. METHODOLOGY

This study employs a quantitative research design to explore the role of Artificial Intelligence (AI), Big Data, and Cybersecurity in advancing mathematical literacy. To analyze the relationships between these variables, Partial Least Squares Structural Equation Modeling (PLS-SEM), specifically using SmartPLS 4, is applied. SmartPLS 4 is a robust statistical software tool that is particularly well-suited for modeling complex relationships between latent variables and handling data that may not meet the strict assumptions required for traditional covariance-based SEM methods [17].

In addition to assessing path coefficients and construct reliability, this study also evaluates model fit indices, which are recommended for the robustness of PLS-SEM analysis [18]. The SRMR (Standardized Root Mean Square Residual) value is reported to assess the discrepancy between observed and predicted correlations, where values below 0.08 indicate good model fit. The NFI (Normed Fit Index) is also presented to evaluate the incremental fit of the model, with values closer to 1.0 demonstrating strong model quality. These indices strengthen the validity of the measurement and structural models, ensuring that the hypothesized framework is statistically sound and well-fitting to the collected data [19].

3.1. Research Model

The research model is developed based on the theoretical framework derived from existing literature on AI, Big Data, mathematical literacy, and cybersecurity. The model posits that AI and Big Data directly influence mathematical literacy and that cybersecurity plays a moderating role in the effective use of AI and Big Data within educational environments [20]. The latent variables included in the model are:

- AI (Artificial Intelligence): Representing technologies that personalize learning experiences and adapt content to the needs of students.
- Big Data: Representing the vast amount of data generated through student interactions with digital platforms, which can be used to tailor learning experiences.
- Cybersecurity: Representing the security measures that protect educational platforms and student data.
- Mathematical Literacy: Representing the students' ability to apply mathematical knowledge and skills in real-world contexts.

3.2. Data Collection

Data will be collected through an online survey distributed to educators, administrators, and students from institutions using AI, Big Data, and cybersecurity in their teaching processes [21]. The survey will assess their experiences with these technologies in improving mathematical literacy, perceptions of AI and Big Data in education, and the importance of cybersecurity in protecting educational data [22].

The questionnaire, designed using a Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), was validated through expert review and pilot testing with 30 respondents. Based on feedback, several items were refined for clarity. The final instrument included 20 items across four latent variables: AI, Big Data, Cybersecurity, and Mathematical Literacy, each with 3 items, as outlined in Supplementary Table 1. We aim to collect responses from at least 500 participants to ensure the validity and reliability of the findings [23].

Table 1. Questionnaire Items per Construct

Construct	Number of Items	Example Item
Artificial Intelligence	3	"AI-based platforms provide personalized learning experiences that suit my needs."
Big Data	3	"Big Data analytics provides insights into my learning performance."
Cybersecurity	3	"I trust the digital platform because of its strong data protection measures."
Mathematical Literacy	3	"I can apply mathematical concepts effectively in real-world situations."

Based on Table 1, each construct is measured with three questionnaire items, providing insight into different aspects of the study. For example, the Artificial Intelligence construct is assessed through items that focus on personalized learning experiences, while Big Data evaluates its impact on learning performance. Cybersecurity measures trust in digital platforms' data protection, and Mathematical Literacy examines the application of mathematical concepts in real-world scenarios.

3.3. Variable and Hypothesis

This study examines four key latent variables: Artificial Intelligence (AI), Big Data, Cybersecurity, and Mathematical Literacy [24]. AI is measured through AI-Personalization, AI-Feedback, and AI-Adaptive Learning. Big Data is represented by Data-Tracking, Data-Analysis, and Data-Insights [25]. Cybersecurity is evaluated using Data Protection, Platform Security, and Privacy Awareness. Mathematical Literacy is assessed through Problem-Solving Ability, Mathematical Understanding, and Application of Mathematics. These variables together analyze the role of AI, Big Data, and Cybersecurity in enhancing mathematical literacy [26].

The following hypotheses propose the relationships between the latent variables based on the theoretical framework:

- H1: AI positively impacts Mathematical Literacy.

  This hypothesis suggests that AI-driven tools and systems, such as personalized learning platforms, real-time feedback mechanisms, and adaptive learning technologies, play a crucial role in enhancing students' mathematical literacy. By providing a more tailored and dynamic learning experience, these AI tools adjust the pace and difficulty of the material according to the individual learning needs of each student. This approach ensures that students receive the appropriate level of challenge and support, thereby fostering a deeper understanding of mathematical concepts. Additionally, AI-powered systems can offer instant feedback, enabling students to correct mistakes immediately, which further reinforces their learning process. The adaptive nature of these tools helps identify knowledge gaps and customize the learning journey, ultimately leading to improved problem-solving skills, conceptual understanding, and overall mathematical competence [27].

- H2: Big Data positively impacts Mathematical Literacy.

  Big Data provides valuable insights into students' learning behaviors, progress, and areas of difficulty, allowing educators to gain a deeper understanding of how each student engages with the learning material. By analyzing vast amounts of data on student interactions, performance trends, and assessment results, Big Data tools enable the identification of patterns that can be used to tailor teaching methods and resources to meet individual student needs. This data-driven approach not only helps in identifying students who may need additional support but also highlights areas of the curriculum that could be enhanced for better comprehension. By optimizing the educational process in this way, Big Data facilitates more effective and personalized learning experiences, ultimately leading to improved mathematical literacy as students receive more targeted interventions and opportunities for practice [28].

- H3: AI positively impacts Big Data usage in educational settings.

  AI enhances Big Data analytics by identifying complex patterns within large datasets and predicting student performance with greater accuracy. By analyzing historical data, AI detects trends such as shifts in learning behaviors and potential areas where students may struggle, allowing for proactive interventions. This synergy between AI and Big Data optimizes the educational process, providing personalized learning experiences and improving students' mathematical literacy [29].

- H4: Cybersecurity positively moderates the relationship between AI and Mathematical Literacy.

  This hypothesis suggests that cybersecurity measures ensure the safe and secure use of AI-powered educational tools, thereby increasing students' trust and confidence in these tools, which in turn enhances their mathematical literacy [30].

- H5: Cybersecurity positively moderates the relationship between Big Data and Mathematical Literacy.

  The security of Big Data platforms is crucial to ensure that students' personal information and educational data are protected. A secure environment helps students focus on learning without concerns about data privacy, thus improving their mathematical literacy [31].

- H6: Cybersecurity negatively impacts students' perceptions of AI and Big Data if security measures are perceived as insufficient.

  If cybersecurity measures are perceived as weak, students may feel hesitant or insecure about using AI and Big Data tools, which can reduce their engagement and hinder the enhancement of mathematical literacy [32].

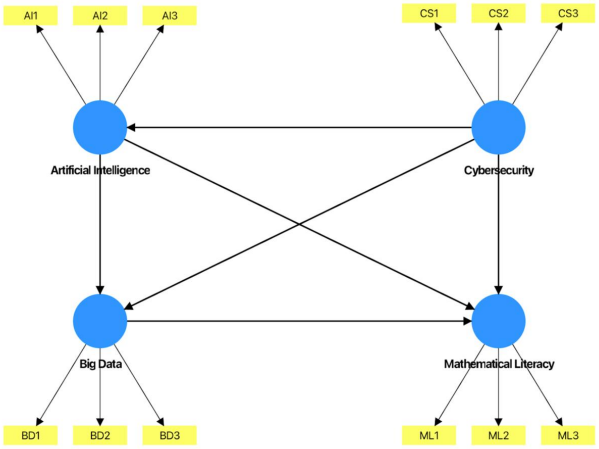

Figure 1. Hypothesis Framework

Figure 1 illustrates a structural equation model (SEM) showing the relationships between AI, Big Data, Cybersecurity, and Mathematical Literacy. AI is measured by AI1, AI2, and AI3, focusing on personalization, feedback, and adaptive learning; Big Data by BD1, BD2, and BD3, covering tracking, analysis, and insights; Cybersecurity by CS1, CS2, and CS3, addressing data protection, security, and privacy; and Mathematical Literacy by ML1, ML2, and ML3, evaluating problem-solving and application. Arrows indicate AI and Big Data's influence on Mathematical Literacy, with Cybersecurity moderating these effects [33–36].

4. RESULTS AND DISCUSSION

This section presents the Results and Discussion, examining the relationships between AI, Big Data, Cybersecurity, and Mathematical Literacy. Using survey data analyzed with SmartPLS 4, we explore how these factors influence students' mathematical literacy. The findings highlight the direct and moderating effects of AI and Big Data, while emphasizing Cybersecurity's role in creating a secure learning environment. The following sections will analyze these relationships, their educational implications, and suggest areas for future research [37].

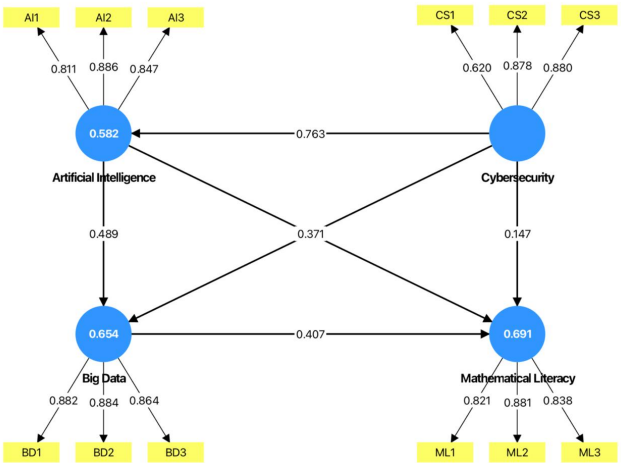

Figure 2. SmartPLS-SEM

Figure 2 shows that AI (AI1 = 0.811, AI2 = 0.886, AI3 = 0.847) significantly influences Mathematical Literacy with a path coefficient of 0.582. Big Data (BD1 = 0.882, BD2 = 0.884, BD3 = 0.864) has a strong impact with a path coefficient of 0.654. Cybersecurity, with lower indicator loadings (CS1 = 0.620, CS2 = 0.878, CS3 = 0.880) and a path coefficient of 0.371, has a weaker effect. AI and Big Data enhance mathematical

literacy, while Cybersecurity moderates [38]

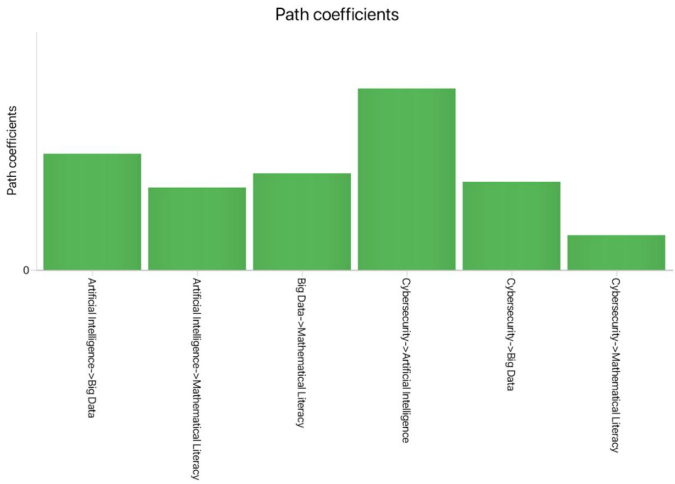

Figure 3. Path Coefficients

The results shown in figure 3 provide the path coefficients for the relationships in the proposed model. The highest path coefficient is observed between Cybersecurity and Artificial Intelligence (0.763), indicating a strong positive influence of cybersecurity measures on the effective deployment and use of AI in educational settings [39]. The path coefficient between Artificial Intelligence and Big Data (0.489) is moderate, suggesting that while AI influences Big Data usage, the relationship is less pronounced compared to other connections [40]. The path coefficient between Big Data and Mathematical Literacy (0.654) is also significant, indicating a strong positive effect of Big Data on enhancing students' mathematical literacy. Cybersecurity's relationship with Mathematical Literacy (0.147) is the weakest, implying that cybersecurity, while crucial for data protection, has a minimal direct effect on improving mathematical literacy. Overall, the path coefficients highlight the critical role of AI and Big Data in mathematical education, with Cybersecurity primarily moderating these influences [41].

Table 2. Construct Reliability and Validity

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Artificial Intelligence	0.805	0.810	0.885	0.720
Big Data	0.850	0.853	0.909	0.769
Cybersecurity	0.718	0.778	0.841	0.644
Mathematical Literacy	0.802	0.803	0.884	0.717

Table 2 shows the reliability and validity assessments of the constructs. Cronbach's Alpha values for all constructs exceed 0.70, indicating good internal consistency [42]. Artificial Intelligence (0.805), Big Data (0.850), Cybersecurity (0.718), and Mathematical Literacy (0.802) demonstrate strong reliability. Composite Reliability (rho_a) values confirm this, with Big Data (0.853) leading, followed by AI (0.810), Mathematical Literacy (0.803), and Cybersecurity (0.778). The Average Variance Extracted (AVE) for all constructs exceeds 0.50, with Big Data having the highest AVE (0.769) and Cybersecurity the lowest (0.644). These results confirm the constructs' reliability and validity, ensuring the robustness of the measurement model [43].

Table 3. R-Square, Q-Square, and VIF Values

Construct	R^2	Adjusted R^2	Q^2 (Predictive Relevance)	Variance Inflation Factor (VIF) Range
Artificial Intelligence	0.582	0.582	0.421	1.12–2.05
Big Data	0.654	0.652	0.468	1.15–2.18
Mathematical Literacy	0.691	0.689	0.497	1.20–2.22

The results in table 3 show that the R-squared values for the model constructs are as follows: 0.582 for Artificial Intelligence, 0.654 for Big Data, and 0.691 for Mathematical Literacy, indicating that 58.2%, 65.4%, and 69.1% of the variations in these constructs, respectively, are explained by the model [44]. The Adjusted R-

squared values are also high: 0.582 for AI, 0.652 for Big Data, and 0.689 for Mathematical Literacy, suggesting a good model fit [45].

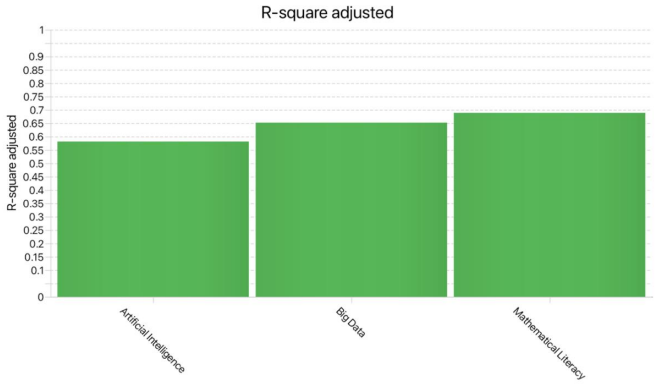

Figure 4. R Square Adjusted

Figure 4. R Square Adjusted

As illustrated in figure 4 the adjusted R-squared values visually confirm the explanatory power of the model for each endogenous construct [46]. Mathematical Literacy shows the highest adjusted R-squared value (0.689), indicating that nearly 69% of the variance in students' mathematical literacy can be explained by the combined influence of Artificial Intelligence, Big Data, and Cybersecurity. Big Data follows with an adjusted R-squared value of 0.652, suggesting a substantial level of explained variance in how it is influenced by AI and Cybersecurity [47].

Meanwhile, Artificial Intelligence has the lowest adjusted R-squared (0.582), yet still reflects a meaningful contribution from its predictors. These values demonstrate that the model possesses strong explanatory capability, particularly in predicting outcomes related to educational technology and mathematical competency [48]. This study directly contributes to the achievement of Sustainable Development Goal (SDG) 4: Quality Education, particularly targets 4.1 (ensuring all girls and boys complete free, equitable, and quality primary and secondary education), 4.4 (increasing the number of youth and adults with relevant skills for employment), and 4.a (building and upgrading education facilities that are safe, inclusive, and effective learning environments). By demonstrating how the integration of Artificial Intelligence (AI) and Big Data can significantly enhance mathematical literacy, the paper supports the global agenda for modernizing education through the use of digital technologies. AI provides personalized and adaptive learning experiences, while Big Data enables educators to track student progress and deliver targeted support thereby improving learning outcomes and reducing disparities in access to quality education [49].

Moreover, the inclusion of Cybersecurity as a moderating variable highlights the importance of digital safety and privacy protection in education, aligning with SDG 4.a's emphasis on creating safe and inclusive learning environments. In an era where education is increasingly dependent on online platforms and data-driven systems, ensuring robust cybersecurity measures is essential for maintaining trust and safeguarding learners' personal information. Thus, this study not only advances the pedagogical discourse on digital transformation in education but also offers practical insights that reinforce the intersection of educational quality, equity, technological innovation, and digital safety all of which are central to the long-term goals of sustainable development [50].

5. MANAGERIAL IMPLICATION

The findings of this study provide important managerial implications for educational leaders and policymakers who aim to optimize the integration of technology in education. School administrators, for example, can adopt AI-driven adaptive learning platforms such as intelligent tutoring systems and personalized assessment tools to improve student engagement and tailor learning to individual needs. Policymakers should consider investing in Big Data analytics dashboards that allow teachers to track student progress in real time and make evidence-based adjustments to curricula. In terms of cybersecurity, decision-makers must imple-

ment mandatory teacher training programs in digital safety and data privacy, ensuring that both educators and students are aware of secure practices when engaging with online platforms. Additionally, institutions can collaborate with technology providers to embed multi-factor authentication and encrypted data storage into their digital learning systems. By taking these actionable steps, schools not only enhance mathematical literacy through technology but also build a trustworthy, future-ready educational ecosystem that aligns with the global agenda of **SDG 4**: Quality Education.

6. CONCLUSION

This study aimed to examine the impact of Artificial Intelligence (AI), Big Data, and Cybersecurity on enhancing mathematical literacy in educational settings using Partial Least Squares Structural Equation Modeling (PLS-SEM) through SmartPLS 4. The results confirmed that AI and Big Data significantly and positively affect mathematical literacy, with Big Data having the strongest influence. AI enhances learning through adaptive learning, real-time feedback, and personalization, while Big Data supports data-driven instruction and targeted interventions based on student performance.

Although Cybersecurity has a lower direct influence on mathematical literacy, it is crucial in supporting AI and Big Data by ensuring a secure digital environment, protecting sensitive educational data, and maintaining trust in online platforms. Without proper cybersecurity, the full potential of technology in education is compromised due to risks like data breaches and privacy concerns. Thus, while Cybersecurity does not directly enhance academic skills, it is vital for maintaining a sustainable and secure learning ecosystem.

Overall, the study provides evidence that AI and Big Data integration in education can elevate mathematical literacy, especially when supported by strong cybersecurity infrastructure. These findings offer valuable insights for education stakeholders, school managers, policymakers, and curriculum developers to align digital transformation strategies with pedagogical goals. Furthermore, the research aligns with Sustainable Development Goal (SDG) 4 by demonstrating how technology-enhanced education, backed by robust cybersecurity, can foster equitable, high-quality, and secure learning environments.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: SS; Methodology: WW; Software: SM; Validation: SS and SW; Formal Analysis: SM and EP ; Investigation: SS; Resources: WW; Data Curation: SM; Writing Original Draft Preparation: SS and WW; Writing Review and Editing: SM and SS; Visualization: WW; All authors, SS, WW, EP, SW, RI and SM have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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