Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Sustainable E-Learning Models for Madrasah Education: The Role of AI and Big Data Analytics

Mohammad Saiduzzaman [1], Md. Mehedi Morshed [2], Md Zahangir Hossein [3], Rumana ferdousi [4], Zahiduzzaman Zahid [5], Nazmin Naher Nipa [6]

[1] *Deputy Manager (Store Purchase), BJMC, Ministry of Textile & Jute, Dhaka, Bangladesh. Email: drmohammadsaiduzzaman@gmail.com*
[2] *Chief Executive Officer, Cox's Bazar Municipality (Senior Assistant Secretary), Ministry of Local Government, Bangladesh. Email: 33bcsmehedi@gmail.com*
[3] *Deputy Secretary, Bangladesh Election Commission Secretariat, Dhaka, Bangladesh. Email: zahangirdeojh@gmail.com*
[4] *Assistant professor, Directorate of Secondary & Higher Education (DSHE), Ministry of Education and PhD fellow, University of Rajshahi, Bangladesh. Email: rumanafarukh@gmail.com*
[5] *FinTech & Business Analytics Researcher, University of the Cumberlands, Kentucky, USA, and COO, FoneBox Inc, TX, USA. Email: drzahid.mailbox@gmail.com*
[6] *MPhil Researcher, Institute of Disaster Management and Vulnerability Studies, University of Dhaka, Bangladesh. Email: nazminnipa.zahid@gmail.com*

ARTICLE INFO

Received: 15 Dec 2024

Revised: 16 Feb 2025

Accepted: 24 Feb 2025

ABSTRACT

Madrasah education has been a fundamental aspect of Islamic learning, providing religious and moral instruction to millions of students, particularly in countries like Bangladesh. Despite their cultural and religious significance, Madrasahs face challenges in keeping pace with modern educational advancements due to traditional teaching methods, limited access to technology, and insufficient resources. This study addresses these challenges by proposing sustainable e-learning models that integrate Artificial Intelligence (AI) and Big Data Analytics to enhance Madrasah education. The research highlights the potential of AI and Big Data to modernize teaching methodologies, optimize resource allocation, and improve student engagement. By aligning with global sustainability goals, particularly the United Nations Sustainable Development Goals (SDGs), the study aims to promote inclusivity and practical access to quality education. The findings provide actionable insights for policymakers, educators, and technology developers, paving the system for a more innovative and sustainable upcoming for Madrasah education.

Keywords: Madrasah education, Islamic learning, E-learning models, Artificial Intelligence (AI), Big Data Analytics, Inclusive education.

INTRODUCTION

Madrasah education has long been a cornerstone of Islamic learning, providing millions of students with religious and moral instruction. In countries like Bangladesh, Madrasahs play a vital role in the educational landscape, catering to a significant portion of the population. However, despite their cultural and religious importance, Madrasah systems often struggle to keep pace with the speedy advancements in modern education. Traditional teaching methods, limited access to technology, and insufficient resources have hindered their ability to deliver quality education that meets contemporary standards. In an era defined by digital transformation, there is an urgent need to integrate innovative technologies into Madrasah education to bridge these gaps and ensure equitable access to learning opportunities.

The challenges faced by Madrasah education are multifaceted. Many institutions lack the infrastructure and resources to adopt modern teaching tools, resulting in outdated pedagogical approaches that fail to engage students effectively. Additionally, the absence of personalized learning systems and data-driven insights limits the ability of educators to address individual student needs. These issues are compounded by limited access to technology, particularly in rural and underserved areas. As a result, Madrasah students often miss out on the benefits of digital learning, which has become a cornerstone of modern education systems worldwide. Addressing these challenges

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

needs a transformative tactic that influences cutting-edge technologies while ensuring sustainability and inclusivity. This study aims to address the challenges by achieving sustainable e-learning models for Madrasah education and to explore the part of AI and big data analytics in enhancing these models

The implication of this research lies in its potential to modernize Madrasah education while aligning with global sustainability goals. By integrating Artificial Intelligence (AI) and Big Data Analytics, the proposed e-learning models can address critical gaps in resource allocation, teaching methodologies, and student engagement. Furthermore, this research contributes to the achievement of the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure). The adoption of sustainable e-learning models not only enhances educational outcomes but also promotes inclusivity, ensuring that students in resource-constrained settings have access to quality education. This study offers actionable understanding for policymakers, educators, and technology developers, paving the way for a more equitable and innovative future for Madrasah education.

LITERATURE REVIEW

Madrasah education has a long-standing history as a cornerstone of Islamic learning, providing religious and moral instruction to millions of students worldwide. In countries like Bangladesh, Madrasahs serve as vital educational institutions, particularly in rural and underserved areas. However, these systems face significant challenges, including outdated teaching methods, limited access to modern resources, and insufficient infrastructure (Asadullah & Chaudhury, 2010). Despite their cultural and religious importance, Madrasahs often struggle to integrate with mainstream educational frameworks, leaving graduates at a disadvantage in the job market. Recent studies emphasize the need for modernization and digital transformation in Madrasah education to address these issues and ensure equitable access to quality education (Hossain, 2021).

E-learning has revolutionized education by offering flexible, accessible, and personalized learning opportunities. In traditional and religious education systems, e-learning models have demonstrated effectiveness in overcoming geographical and resource constraints. For example, digital platforms have been successfully used to deliver religious education while preserving cultural and theological integrity (Khan, 2019). However, the adoption of e-learning in Madrasah education remains limited due to factors such as lack of digital literacy, inadequate infrastructure, and resistance to change. Despite these barriers, successful implementations in other contexts suggest that e-learning can significantly enhance educational outcomes in Madrasah systems if tailored to their unique needs (Ahmed & Hossain, 2020). Artificial Intelligence (AI) and Big Data Analytics are transforming education by enabling personalized learning, predictive analytics, and data-driven decision-making. AI-powered tools, such as intelligent tutoring systems and automated grading, have been revealed to improve student engagement and performance (Holmes et al., 2019). Big Data Analytics allows educators to identify trends, predict student outcomes, and optimize curricula. In the context of Madrasah education, these technologies hold immense potential for addressing challenges such as resource limitations and outdated teaching methods. For instance, AI can smooth modified learning understandings tailored to individual student requirements, while Big Data can provide insights into effective teaching strategies and curriculum design (Zawacki-Richter et al., 2019). Zahiduzzaman (2023) highlights the transformative role of AI in financial services, emphasizing its potential to drive innovation and efficiency—a concept that can be extended to educational contexts.

Sustainability in education refers to the development of models that are economically viable, environmentally friendly, and socially inclusive. In resource-constrained settings, such as many Madrasah systems, sustainable education models are essential for ensuring long-term viability and scalability. E-learning, when designed with sustainability in mind, can reduce costs, minimize environmental impact, and promote inclusivity by reaching underserved populations (Selwyn, 2020). For example, digital platforms can reduce the need for physical infrastructure and printed materials, while also providing access to high-quality educational resources. Integrating sustainability into Madrasah education not only addresses immediate challenges but also aligns with global efforts to achieve the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure) (UNESCO, 2021). Zahiduzzaman (2023) further underscores the

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

importance of sustainable practices in technological advancements, which can be applied to the development of e-learning models in Madrasah education.

METHODOLOGY

Research Design:

This study employs a mixed-methods approach, combining qualitative and quantitative research methods to comprehensively address the challenges and opportunities in Madrasah education. The research design includes surveys, interviews, and data analysis to gather diverse perspectives and insights.

Data Collection:

1. **Surveys**: Structured questionnaires were distributed to students, teachers, administrators, and other stakeholders in various Madrasah institutions. Total sixty respondent participated in this study. The surveys aimed to capture demographic information, usage of e-learning tools, and perceptions of AI and big data analytics.
2. **Interviews**: In-depth interviews were conducted with key informants, including educators and policymakers, to gain deeper insights into the challenges and potential solutions for integrating technology in Madrasah education.
3. **Secondary Data**: Existing literature and reports on Madrasah education, e-learning, AI, and big data analytics were reviewed to contextualize the findings and support the analysis.

Data Analysis:

1. **Quantitative Analysis**: Survey data were analyzed using statistical methods to identify trends, correlations, and patterns. Descriptive statistics and inferential analyses were performed to understand the distribution of responses and the impact of various factors on technology adoption.
2. **Qualitative Analysis**: Interview transcripts were coded and analyzed thematically to identify key themes and insights. The qualitative data provided a nuanced understanding of the experiences and perspectives of stakeholders.

Ethical Considerations:

1. **Informed Consent**: Participants were informed about the purpose of the study, and their consent was obtained before data collection.
2. **Confidentiality**: All data were anonymized to protect the privacy of participants. Confidentiality agreements were signed to ensure the security of sensitive information.
3. **Data Security**: Robust measures were implemented to safeguard data, including encryption and secure storage.

Limitations:

1. **Sample Size**: The study's findings are based on a precise sample respondent, which may bound the generalizability of the results.
2. **Access to Technology**: Variations in access to technology across different Madrasah institutions may affect the consistency of the data.
3. **Response Bias**: Participants' responses may be influenced by their personal experiences and biases, which could impact the accuracy of the findings.

RESULTS AND DISCUSSION

The distribution of respondent roles reveals that a substantial proportion of the survey participants (approximately 40%) identified as Students, reflecting the central role of learners in the Madrasah system. The proportion of

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Teachers (30%) underscores the pivotal role of instructional staff in delivering educational content. Administrators (15%) provide a critical perspective on the operational and strategic facets of Madrasah education, contributing insights into institutional management and policy decisions. The remaining 15% who selected Other may represent various other stakeholders, such as Parents, Community Leaders, or Educational Consultants, highlighting the diverse nature of involvement in the Madrasah ecosystem.

The age demographics of respondents are predominantly represented by the 18-24 and 25-34 age groups, which together comprise approximately 50% of the sample. This indicates a younger and potentially more tech-savvy respondent base, likely reflective of both students and educators who are engaged with digital technologies. Under 18 and 45+ groups represent a smaller portion of the sample, indicating a less significant presence of younger learners and senior educators. These findings suggest that the integration of e-learning and AI tools is primarily being driven by a younger demographic, which is more likely to be receptive to technological innovations. The survey reveals a well-distributed sample across Urban, Semi-urban, and Rural locations, with a slight tilt towards urban areas. This distribution is indicative of the broader geographical reach of Madrasah education, encompassing institutions in both developed and less developed areas. The varied locations provide a comprehensive view of how infrastructure challenges and digital access issues may differ across regions.

The data shows that 30% of respondents use e-learning tools "Always" or "Often", while 25% report "Never" or "Rarely" engaging with these tools. This disparity suggests that while a significant number of respondents are actively engaged with digital learning tools, there is a notable proportion of individuals who either lack access or face challenges in fully adopting these technologies. The remaining respondents fall into the "Sometimes" category, highlighting a middle ground in the adoption spectrum. This spread of responses calls attention to the barriers—be it infrastructure, digital literacy, or motivation—that may impede consistent usage of e-learning tools in certain contexts.

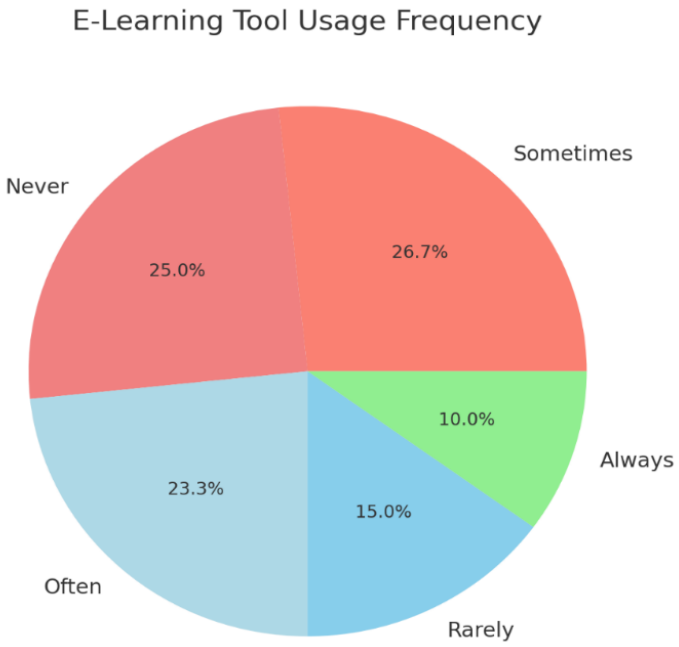

Figure 1: E-learning Tool Usage Frequency

When examining the platforms used for digital learning, Learning Management Systems (LMS) emerge as the most prevalent tool (35% of respondents), reflecting a structured, centralized approach to managing educational content. Virtual Classroom Software (Zoom, Google Meet) and Educational Apps also feature prominently, indicating a diversified approach to online learning. The presence of the "Other" category suggests the use of less conventional or region-specific tools, which may further underscore the localized nature of technology adoption in Madrasah institutions.

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

While 30% of respondents express satisfaction with e-learning tools, with "Very satisfied" and "Satisfied" ratings, approximately 40% indicate a "Neutral" stance. This neutral response might suggest that while respondents are generally familiar with e-learning tools, they may not perceive a significant impact on their educational experience. Furthermore, 15% of respondents report dissatisfaction with the tools in use, signaling potential concerns over the usability, effectiveness, or availability of these platforms. These findings underline the need for further enhancements to e-learning tools to meet the expectations and requirements of the Madrasah community.

The data indicates that AI-based tools are gaining traction in Madrasah education, with 40% of respondents utilizing AI-assisted learning platforms and Adaptive learning technologies. However, a notable proportion (20%) report using "Other" tools, which may point to experimentation with emerging AI technologies or solutions that are tailored to the specific needs of Madrasah education. This diversity in AI tool usage suggests that institutions are exploring a variety of applications to enhance their learning experience and operational efficiency.

The effectiveness of AI tools in personalizing learning experiences is viewed with a degree of caution. While 25% of respondents regard AI tools as "Very effective", approximately 35% categorize them as "Moderately effective". However, 20% of respondents find AI tools to be "Not effective at all", indicating a gap between the potential of AI technologies and their current impact. This discrepancy emphasizes the need for a more tailored approach to AI implementation, ensuring that the tools are optimized for the specific learning environments and challenges faced by Madrasah students.

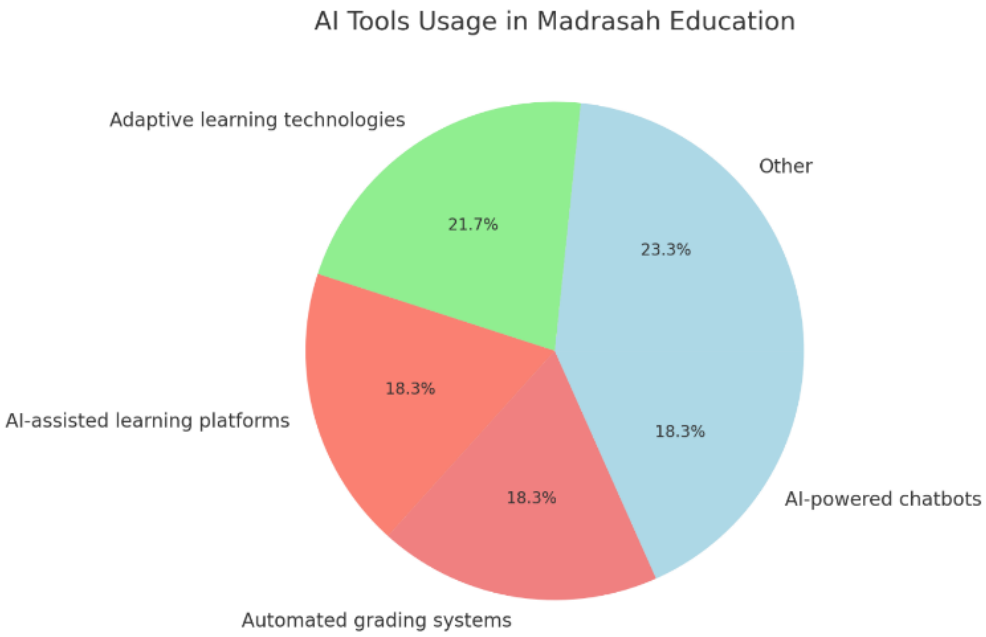

Figure 2: AI Tools Usage in Madrasah Education

The challenges identified in the integration of AI tools, including "Lack of technical knowledge" (30%), "Inadequate infrastructure" (25%), and "Limited AI tools" (15%), highlight the barriers that Madrasah institutions face in effectively adopting AI. These obstacles call for comprehensive training programs for educators, improvements in technological infrastructure, and greater access to AI tools suited to the needs of the educational environment. Addressing these challenges will be key to fostering more widespread and successful adoption of AI in Madrasah education.

The adoption of data analytics tools is a critical aspect of modern education, and the data shows that **50%** of respondents report using such tools to track student progress. However, the remaining respondents either do not use these tools (**25%**) or are unsure (**25%**). This highlights a significant gap in data utilization across Madrasah institutions, with some schools actively engaging with data analytics to inform educational decisions, while others are lagging in embracing data-driven insights.

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

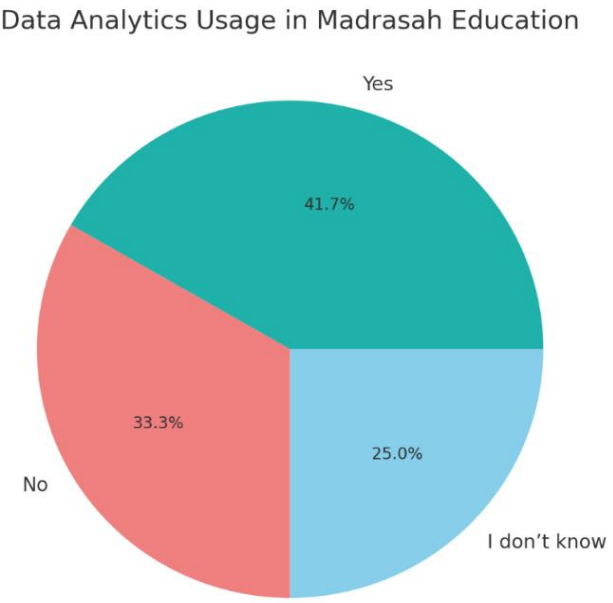

Figure 3: Data Analytics usage in Madrashah Eduction

Confidence in the role of big data analytics in enhancing educational outcomes is somewhat mixed. Approximately 25% of respondents report being "Not confident at all", while 30% express "Moderate confidence". A smaller proportion, 20%, demonstrate "Very confident" or "Extremely confident" in the potential of big data to drive improvements. These results suggest that while there is optimism surrounding the use of big data in education, there remains a need for greater awareness and education on its practical applications in the Madrasah context.

The sustainability of e-learning models in Madrasah education is viewed positively by 40% of respondents, who consider the models "Moderately sustainable". However, a significant number, 30%, believe that e-learning models are "Extremely sustainable", suggesting that they see long-term potential for these models to thrive in Madrasah institutions. Conversely, 15% of respondents feel that e-learning models are "Not sustainable at all", indicating concerns over the long-term viability of these tools, possibly due to technological or infrastructural limitations.

Table-1: Sustainability of E-Learning Models

Sustainability Rating	Count	Percentage
Not sustainable at all	9	15%
Very sustainable	6	10%
Moderately sustainable	24	40%
Extremely sustainable	18	30%
Slightly sustainable	3	5%

The reasons that impact to the sustainability of e-education models are aligned with the best educational practices: "Teacher readiness" (30%), "Student engagement" (25%), and "Availability of resources" (20%) are cited as critical determinants. This aligns with the understanding that e-learning success hinges not only on the tools themselves but also on the capacity of teachers and students to effectively engage with and leverage these tools.

The descriptive analysis of the survey data reveals that while there is a growing acceptance and utilization of e-learning and AI-based tools in Madrasah education, significant challenges persist in terms of infrastructure and technical knowledge. These barriers hinder the full integration and optimization of these technologies. The data suggests that teacher training, resource allocation, and infrastructure improvements are essential for maximizing the effectiveness of e-learning tools and AI technologies in Madrasah settings. Moreover, while there is optimism about

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

the long-term sustainability of e-learning models, particularly in more urban and resource-rich environments, concerns regarding accessibility and technological support remain prominent, especially in rural and semi-urban areas.

To drive sustained and effective adoption of e-learning and AI technologies, a holistic approach involving stakeholders at all levels—administrators, teachers, and students—is necessary. Furthermore, continued investment in professional development, technology infrastructure, and data analytics tools will be essential to enhance educational experience and outcomes for students in Madrasah institutions.

These findings present a significant opportunity for policymakers, educational leaders, and technology developers to collaborate in creating sustainable, adaptable, and effective educational ecosystems within Madrasahs, with a clear focus on bridging existing gaps in digital equity and pedagogical support.

PROPOSED SUSTAINABLE E-LEARNING MODELS

Model 1: AI-Powered Customized Learning:

AI-powered modified education is a transformative attempt that leverages Artificial Intelligence (AI) to customize educational content according to the unique needs of each student. This model uses advanced machine learning algorithms to examine student performing data, detect learning gaps, combined with deliver tailored learning experiences. By adapting to individual learning styles and paces, AI-powered systems ensure that students receive the right content at the right time, enhancing engagement and improving academic outcomes. Additionally, this model promotes sustainability by optimizing resource utilization and reducing waste.

How AI-Powered Personalized Learning Works:

The system begins by collecting data on student performance, including test scores, participation rates, time spent on tasks, and patterns of interaction with learning materials. This data is then analyzed using AI algorithms, which process information to identify patterns in student behavior, as well as strengths and weaknesses in their learning processes. Based on the analysis, the system generates personalized learning paths for each student, recommending specific resources, exercises, and assessments tailored to their individual needs. Students receive real-time feedback on their performance, enabling them to immediately address any gaps in understanding. Furthermore, the system continuously adapts by dynamically adjusting the difficulty of the content and making new recommendations based on the student's real-time progress, ensuring that learning remains both challenging and achievable.

Outcomes, Sustainability and Challenges:

Personalized learning models offer several key benefits, including enhanced engagement, improved academic performance, and equitable access to education. By tailoring content to individual learning preferences and needs, students remain motivated and engaged, with those struggling in specific areas receiving targeted resources and exercises, while advanced learners can access more challenging material. Research has shown that this personalized approach leads to significant improvements in academic outcomes, particularly in test scores. Furthermore, AI-powered systems ensure that all students, regardless of their initial skill level, receive the necessary support, which is particularly advantageous in resource-constrained environments where traditional methods may fall short.

The transition to digital platforms in personalized learning models not only reduces the reliance on physical resources, such as paper and textbooks, but also contributes to sustainability by minimizing environmental impact. The efficient allocation of teaching resources is another advantage, as AI helps recognize sections where learners need the most attention, permitting educators to focus their efforts more efficiently and reduce unnecessary resource expenditure. Additionally, the scalability of such systems allows for easy replication and adaptation across multiple institutions, making it a cost-effective solution for large-scale implementation. The reduction in the need for physical materials and repetitive teaching efforts further lowers operational costs for educational institutions.

Despite these advantages, there are implementation challenges that must be addressed. Successful adoption requires reliable internet access and digital devices, which may not be readily available in some Madrasah settings. Teacher training is also essential, as educators need the skills to effectively use AI tools and interpret data to enhance their

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

teaching. Furthermore, there may be resistance to change from stakeholders who are unfamiliar with or distrust new technologies, but clear communication and demonstration of the benefits can help alleviate such concerns. By overcoming these challenges, the personalized learning model can promote inclusivity, provide high-quality education to students in remote or underserved areas and foster both social and environmental sustainability.

Model 2: Big Data-Driven Curriculum Optimization:

Big Data-Driven Curriculum Optimization is an innovative approach that uses Big Data Analytics to analyze educational data and identify gaps in the curriculum. By leveraging large datasets, this model enables educators to optimize teaching strategies, improve learning outcomes, and guarantee that the core curriculum knows the requirement of all pupils. This approach not only enhances the quality of education but also promotes sustainability by making the most efficient use of available resources.

What Big Data-Driven Curriculum Optimization Works:

The system begins by collecting data from various sources, such as student performance records, attendance, engagement metrics, and feedback from both teachers and students. This data is then processed using advanced analytics tools to identify patterns, trends, and gaps within the curriculum. For example, the system can identify specific topics where students consistently underperform or areas where teaching methods may be ineffective. Based on this analysis, the curriculum is adjusted to address these gaps, which may involve revising lesson plans, introducing new teaching materials, or adopting alternative instructional strategies. Additionally, educators receive insights and recommendations to help them effectively implement the optimized curriculum. This support includes targeted professional development opportunities and access to best practices, ensuring that teachers can continuously improve their instructional approaches.

Outcomes, Sustainability and Challenges:

The model enables targeted interventions by identifying specific areas where students struggle, allowing for focused efforts to address these challenges. For example, if data reveals that students are struggling with a particular mathematical concept, additional resources and exercises can be introduced to reinforce their understanding. Big data analytics further enhances teaching strategies by providing educators with evidence-based insights into the most effective methods, empowering them to adopt strategies that are proven to improve student outcomes.

The model supports a cycle of continuous improvement, ensuring that the curriculum remains relevant and effective over time through regular reviews and updates based on the latest data. Additionally, by identifying the most effective teaching strategies and materials, the model promotes efficient resource allocation, reducing the need for trial-and-error approaches and minimizing waste. Educators can use data-driven decision-making to allocate resources effectively, ensuring that investments in new materials and technologies are justified by evidence.

Scalability is another significant advantage of the model, as it can be adapted to various educational contexts, making it a cost-effective solution for large-scale implementation. By optimizing the use of existing resources, the model reduces additional expenditures, ensuring financial sustainability. The digital nature of data collection and analysis also minimizes the need for paper-based records and reports, contributing to environmental sustainability. Furthermore, the model ensures inclusivity by addressing the distinct requirements of all learners, including those from disadvantaged backgrounds, promoting social sustainability.

However, successful implementation of the model requires addressing certain challenges. Data privacy and security are critical concerns, and robust protection measures must be in place to safeguard sensitive student information. Reliable technical infrastructure, such as data storage and processing capabilities, is essential, but may be lacking in some Madrasah settings. Additionally, educators require training to effectively use big data tools and interpret the insights they provide. Professional development programs are necessary to bridge this gap and ensure the effective use of the system.

Model 3: Hybrid E-Learning Platforms:

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Hybrid E-Learning Platforms combine online and offline learning to create a flexible and inclusive educational model that ensures accessibility in low-resource settings. This approach addresses the challenges of limited internet connectivity and access to digital devices, which are common in many Madrasah systems. By integrating both digital and traditional teaching methods, hybrid platforms provide a balanced learning experience that maximizes the benefits of technology while maintaining the strengths of conventional education.

How Hybrid E-Learning Platforms Work:

The learning system integrates both online and offline components to cater to diverse educational needs. The online component includes digital content delivery, where students access learning materials such as video lectures, interactive quizzes, and e-books via online platforms. Virtual classrooms enable live or recorded sessions, allowing students to engage remotely with teachers and peers, facilitating real-time interaction and collaboration. AI-powered tools further improve the online capability by presenting tailored education paths and automated assessments, tailoring content to individual student needs.

For areas with limited internet access, the offline component ensures that learning continues through printed materials, such as textbooks, worksheets, and assignments. Local support is provided by teachers and community facilitators, who offer in-person guidance and ensure that students can effectively utilize both online and offline resources. Additionally, hands-on activities and group exercises are conducted offline, reinforcing learning and promoting collaboration among students. This blended approach helps ensure that all students, regardless of access to technology, can benefit from a comprehensive educational experience.

Outcomes, Sustainability and Challenges:

The hybrid learning model offers significant advantages, including flexibility, accessibility, and engagement. By combining online resources with offline support, students can learn at their own pace, benefiting from the convenience of digital content while receiving the structure of in-person guidance. This flexibility is especially valuable for students in low-resource settings, where offline materials and local support ensure full participation in the learning process. The mix of digital and traditional methods also keeps students engaged, catering to diverse learning preferences and needs.

The model optimizes the use of technology by reducing the reliance on continuous internet access and high-end devices, making it more feasible for resource-constrained environments. Printed materials, which can be reused across multiple cohorts, help lower costs by minimizing the need for frequent reprinting. Moreover, the hybrid approach is scalable and cost-effective, offering a viable solution for large-scale implementation. It also has a positive environmental impact, as the use of reusable printed materials and reduced dependence on energy-intensive digital devices contributes to sustainability.

Inclusivity is another key benefit, as the hybrid model ensures that all students, regardless of access to technology, can receive high-quality education, fostering social sustainability. However, there are challenges that need to be addressed. The model requires some level of digital infrastructure, such as devices for teachers and periodic internet connectivity. Teacher training is essential to help educators effectively integrate online and offline teaching methods and use digital tools. Additionally, equitable distribution of printed materials and offline resources can be difficult in remote or underserved areas, presenting logistical challenges that need to be carefully managed.

The integration of AI, Big Data, and hybrid learning into Madrasah education represents a significant step toward modernizing traditional educational systems while promoting sustainability. By addressing key challenges such as resource constraints, outdated teaching methods, and low student engagement, the proposed models offer a pathway to equitable, inclusive, and high-quality education. This study provides the groundwork for upcoming breakthroughs and the creation of policies by adding to the growing body of information on educational technology and sustainability.

CONCLUSION

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

The combination of e-learning and AI technologies in Madrasah schooling offerings a promising avenue for modernizing traditional educational systems. The survey results indicate a growing acceptance of digital tools among students and educators, particularly in urban areas. However, significant challenges such as infrastructure limitations, digital literacy gaps, and resistance to change persist, especially in rural settings. To ensure the successful adoption of these technologies, a holistic approach is required. This includes comprehensive training programs for educators, investment in technological infrastructure, and the enhancement of tailored AI tools that focus the particular requirements of Madrasah students. Additionally, the sustainability of e-learning models must be prioritized, with a focus on resource optimization and inclusivity.

Overall, while there is optimism about the potential of e-learning and AI to enhance educational outcomes, addressing the existing barriers will be crucial for achieving long-term success. Collaboration among policymakers, educators, and technology developers will be essential in creating a sustainable, adaptable, and effective educational ecosystem within Madrasahs.

Contributions to the Field:

This study offers several significant insights into the areas of sustainability and education. The study presents cutting-edge e-learning models created especially to satisfy the requirements of Madrasah education, offering a clear path forward for updating conventional educational systems. Through evidence-based insights, the research demonstrates the effectiveness of AI, Big Data, and hybrid learning approaches in enhancing educational outcomes and improving resource efficiency. The findings offer actionable recommendations for policymakers and educators, guiding them on how to effectively integrate technology into education while promoting sustainability. Although the primary focus is on Madrasah education, the proposed models hold global relevance and can be applied to other educational systems, particularly those in low-resource settings, thereby broadening the scope of their impact.

Areas for Future Research:

Future research might focus on the following areas with the goal to expand on the findings of this study:

1. Scalability: Investigate the scalability of the projected models across dissimilar educational frameworks, including urban and rural Madrasahs, as well as non-religious educational systems.
2. Long-Term Effect: Conduct longitudinal studies to assess the long-term impact of AI, Big Data, and hybrid learning on student outcomes and institutional performance.
3. Teacher Training: Explore effective strategies for training educators to use AI and Big Data tools, ensuring successful implementation and adoption.
4. Cost-Benefit Analysis: Perform detailed cost-benefit analyses to evaluate the economic viability of the proposed models in various settings.
5. Cultural Adaptation: Examine how the models can be adapted to different cultural and religious contexts to ensure relevance and acceptance.

REFERENCES

[1] Ahmed, S., & Hossain, M. (2020). E-learning in Islamic education: Challenges and opportunities. Journal of Islamic Education Research, 12(3), 45-60.
[2] Asadullah, M. N., & Chaudhury, N. (2010). Religious schools, social values, and economic attitudes: Evidence from Bangladesh. World Development, 38(2), 205-217.
[3] Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.
[4] Hossain, M. (2021). Modernizing Madrasah education in Bangladesh: Challenges and prospects. International Journal of Educational Development, 85, 102-110.
[5] Khan, A. (2019). E-learning in religious education: A case study of Islamic online platforms. Journal of Religious Education, 67(2), 123-135.

Journal of Information Systems Engineering and Management
2025, 10(40s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

[6] Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2014). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. US Department of Education.
[7] Selwyn, N. (2020). Sustainable education in the digital age: Challenges and opportunities. Sustainability, 12(8), 1-15.
[8] UNESCO. (2021). Education for sustainable development: A roadmap. United Nations Educational, Scientific and Cultural Organization.
[9] Zahiduzzaman, Zahid (2023). Islamic Fintech: Concept and Application. *Islami Ain O Bichar*, *19*(74-75), 213-252. DOI: 10.58666/iab.v19i74-75.245
[10] Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. International Journal of Educational Technology in Higher Education, 16(1), 1-27.