Educational Technology Integration in the Age of Artificial Intelligence and Digitalization: A Qualitative Study of Pedagogical Practices and Challenges in Secondary Schools in Bangladesh

Abdul Malek and Noryati Alias

Abstract- ***This study examines the integration of educational technology in the context of artificial intelligence (AI) and digitalization in secondary education in Bangladesh. While AI-driven tools are widely recognized for their potential to transform teaching and learning, empirical qualitative evidence on their classroom integration remains limited, particularly at the secondary level. This study explores teachers' instructional practices, experiences, and challenges in integrating digital and AI-based technologies. A qualitative research design was employed, using semi-structured interviews with 20 purposively selected secondary school teachers. Data were analyzed through thematic analysis, guided by the Technological Pedagogical Content Knowledge (TPACK) framework. The findings indicate that although teachers demonstrate positive attitudes toward AI and digital technologies, their classroom use remains limited, fragmented, and largely supplementary rather than transformative. Key barriers include insufficient professional training, inadequate infrastructure, limited access to digital resources, and weak institutional support. The study also reveals a persistent disconnect between national digitalization policies and their practical implementation at the school level. These findings highlight the need for sustained professional development, improved infrastructural support, and context-responsive policy strategies to enable meaningful technology integration. This study provides actionable insights for policymakers and educators to support context-responsive AI integration in resource-constrained educational environments.***

Keywords- ***Artificial Intelligence (AI), Educational Technology, Digitalization, Secondary Education, Teacher Practices, Technology Integration***

I. INTRODUCTION

The integration of educational technology has become increasingly significant in contemporary education, particularly with the rapid advancement of artificial intelligence (AI). AI-driven tools have the potential to transform instructional practices by enabling personalized learning, automating assessment, and enhancing student engagement (Luckin et al., 2016; Holmes et al., 2019). More recent studies further highlight the growing role of AI in supporting adaptive learning environments and data-informed pedagogical decision-making (Zawacki-Richter et al., 2022; UNESCO, 2023). As a result, education systems worldwide are prioritizing the adoption of digital technologies to improve teaching and learning outcomes.

Abdul Malek, Kuala Lumpur University of Science and Technology, Malaysia (Email: 243925187@s.klust.edu.my)
Noryati Alias, Kuala Lumpur University of Science and Technology, Malaysia (Email: yati2121@gmail.com)

However, the implementation of digital education remains uneven, particularly in developing contexts (UNESCO, 2023). In Bangladesh, significant infrastructural and capacity-related challenges persist, limiting the effective adoption of digital technologies in schools.

For instance, the student computer ratio is substantially higher in rural schools (46:1) compared to urban institutions (22:1), reflecting unequal access to digital resources. Additionally, more than 80% of teachers responsible for ICT instruction lack formal training in ICT-related disciplines, indicating serious limitations in teacher preparedness for effective technology integration.

In developing countries such as Bangladesh, the integration of educational technology presents both opportunities and challenges. National initiatives, including the Digital Bangladesh agenda, emphasize the importance of ICT and AI in modernizing education. However, the implementation of these policies in secondary classrooms remains inconsistent. Teachers often encounter barriers such as inadequate infrastructure, insufficient professional training, and limited institutional support, which constrain effective technology use.

While existing research has examined technology use in education, much of the literature focuses on primary or higher education contexts, with limited attention to secondary education from a qualitative perspective. Furthermore, there is a lack of empirical evidence on how teachers engage with AI-driven tools in real classroom settings in Bangladesh. This highlights the need for context-specific research that captures the complexity of technology integration at the secondary level.

Therefore, this study aims to explore how secondary school teachers in Bangladesh integrate educational technology within their pedagogical practices in the era of AI. It investigates teachers' experiences, instructional strategies, and the challenges they encounter, while also examining the role of institutional factors in shaping technology integration.

This study contributes to the growing body of research on artificial intelligence (AI) in education by providing context-specific empirical insights into technology integration in secondary schools in Bangladesh. Using the Technological Pedagogical Content Knowledge (TPACK) framework, it examines how technological, pedagogical, and institutional factors interact in real classroom settings. The findings highlight a pattern of surface level technology integration, where digital and AI driven tools are used in a fragmented and supplementary manner rather than transforming instruction. By linking policy context with classroom practice, the study offers practical and theoretical

implications for educators, policymakers, and stakeholders seeking to achieve meaningful and sustainable technology integration in resource-constrained educational environments.

II. PROBLEM STATEMENT

Despite increasing national emphasis on digitalization and the integration of artificial intelligence (AI) in education, a significant gap persists between policy intentions and actual classroom practices in Bangladesh. While initiatives such as the Digital Bangladesh agenda aim to promote the use of information and communication technologies (ICT) in education, their implementation at the secondary school level remains uneven and often limited in scope. Teachers frequently encounter barriers including insufficient professional training, inadequate digital infrastructure, lack of technical support, and limited institutional readiness, all of which hinder the effective integration of educational technology.

Existing research on technology integration in Bangladesh has predominantly focused on primary or higher education contexts, with comparatively less attention given to secondary education. Moreover, much of the current literature emphasizes structural challenges without adequately exploring teachers lived experiences and pedagogical practices, particularly in relation to emerging AI-driven tools. This lack of context-specific, qualitative insight limits a comprehensive understanding of how educational technology is actually implemented in secondary school classrooms.

Addressing this gap, the present study seeks to explore the integration of educational technology in secondary education in Bangladesh by focusing on teachers' practices, challenges, and the influence of institutional and policy contexts. Specifically, the study is guided by the following research questions:

- How do secondary school teachers in Bangladesh integrate educational technology and AI-driven tools into their pedagogical practices?
- What structural, pedagogical, and institutional challenges constrain the effective integration of educational technology and AI in secondary school classrooms?
- How do policy directives and institutional conditions interact to shape the nature and depth of technology integration in secondary education?

III. LITERATURE REVIEW

The integration of educational technology in teaching and learning has been widely explored across global educational contexts. Existing research consistently demonstrates that effective technology adoption depends not only on access to digital tools but also on teachers' pedagogical readiness, beliefs, and professional competencies (Ertmer & Ottenbreit-Leftwich, 2010). While earlier studies primarily emphasized infrastructural access, more recent scholarship highlights that meaningful integration requires a shift from viewing technology as a supplementary aid toward its strategic use in enhancing pedagogical practices and improving learning outcomes (Zawacki-Richter et al., 2022). This shift reflects a growing recognition that the impact of technology depends not on its availability, but on how it is pedagogically applied in classroom contexts.

The emergence of artificial intelligence (AI) has further expanded the scope of educational technology by enabling adaptive, personalized, and data driven learning environments. AI-driven tools, such as intelligent tutoring systems, automated assessment platforms, and adaptive learning technologies, offer significant potential to enhance instructional effectiveness and student engagement (Holmes et al., 2019; UNESCO, 2023). However, despite these advancements, the practical integration of AI in classroom settings remains limited. This is largely due to constraints related to teachers' pedagogical readiness, insufficient professional training, and limited institutional capacity (Bond et al., 2023; Crompton & Burke, 2023). Furthermore, teachers often lack clear pedagogical guidance and contextual adaptation strategies, resulting in fragmented or superficial use of AI technologies in practice.

In developing country contexts, including Bangladesh, these challenges are further intensified by systemic constraints such as limited infrastructure, unequal access to digital resources, and insufficient institutional support (Hasan et al., 2021; Hossain & Rahman, 2020). While national initiatives promote digitalization in education, a persistent gap remains between policy aspirations and classroom realities. These structural inequalities significantly shape teachers' capacity to integrate technology into their pedagogical practices.

To examine the complexity of technology integration, this study adopts the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). The framework emphasizes the dynamic interaction between technological, pedagogical, and content knowledge, highlighting that meaningful integration occurs when these domains are effectively aligned in instructional practice. In the context of AI and digitalization, this requires teachers to move beyond basic technological use toward pedagogically informed application within subject-specific contexts.

Despite its relevance, existing studies often apply the TPACK framework in a generalized or conceptual manner without adequately examining how these knowledge domains interact within specific classroom contexts, particularly in relation to emerging AI technologies. As a result, the application of TPACK in AI integrated pedagogical settings remains insufficiently contextualized and lacks strong empirical grounding.

However, limited qualitative evidence exists in secondary education contexts in developing countries, particularly in relation to how teachers engage with AI-driven tools in real classroom settings.

Despite the growing body of research on educational technology and AI, several critical gaps remain. Much of the literature focuses on developed contexts or emphasizes structural barriers, with limited attention to teachers lived pedagogical experiences in secondary education. Therefore, this study addresses these gaps by providing a context-specific, qualitative exploration of how secondary school

teachers in Bangladesh integrate educational technology and AI within their pedagogical practices.

IV. METHOD

Research Design

This study employed a qualitative research design to gain in-depth insights into secondary school teachers' experiences and practices regarding the integration of educational technology in the context of artificial intelligence (AI) and digitalization. A qualitative approach was considered appropriate as it allows for the exploration of participants' perspectives, meanings, and contextual realities in natural settings.

Participants

The study involved 20 secondary school teachers from selected institutions in Bangladesh. This sample size is consistent with qualitative research practices and was considered sufficient to achieve thematic saturation, where no new themes emerged from the data. Participants were selected using purposive sampling based on their experience with digital tools in teaching. The sample included teachers from both urban and semi-urban schools to ensure contextual diversity and to capture a range of experiences related to technology integration.

Data Collection

The interview protocol was designed to align with the research objectives and the Technological Pedagogical Content Knowledge (TPACK) framework. Key guiding questions focused on teachers' experiences with technology integration, their use of AI and digital tools in classroom instruction, and the challenges encountered in practice. Example questions included: "How do you incorporate digital or AI-based tools into your teaching?", "What challenges do you face when using technology in the classroom?", and "What kind of institutional or policy support influences your use of educational technology?". Follow-up probing questions were used to elicit deeper insights and clarify participants' responses, allowing for a more comprehensive understanding of their pedagogical practices and contextual constraints. Data were collected over a period of January to March 2026, and each interview lasted approximately 30-45 minutes, allowing for in-depth exploration of participants' experiences and perspectives.

Ethical Considerations

Ethical approval for the study was obtained from the relevant institutional authority. Participants were informed about the purpose of the study, and their voluntary participation was ensured through informed consent. Confidentiality and anonymity were maintained by assigning pseudonyms to participants and securely storing all collected data. Participants were also informed of their right to withdraw from the study at any stage without any consequences.

Data Analysis

The collected data were analysed using thematic analysis following the approach proposed by Braun and Clarke (2006). The analysis was conducted through a systematic multi-stage coding process. In the first stage, open coding was applied to identify initial concepts and patterns from the interview transcripts. In the second stage, axial coding was used to organize and group related codes into broader categories by identifying relationships between them. In the final stage, these categories were refined into overarching themes that captured key aspects of teachers' experiences, pedagogical practices, and institutional challenges. The analysis was both inductive and theoretically informed, allowing themes to emerge from the data while being guided by the TPACK framework. This iterative process ensured that the findings were grounded in participants' perspectives while maintaining conceptual alignment with the study's theoretical framework.

Trustworthiness and Validity

To ensure the credibility and trustworthiness of the findings, several strategies were employed. Member checking was conducted by sharing summaries of the findings with selected participants to verify the accuracy of interpretations. Additionally, peer debriefing was used to enhance analytical rigor by discussing emerging themes with colleagues. Thick description was provided to ensure transferability, while a clear audit trail of the research process was maintained to support dependability and confirmability.

V. FINDINGS

The analysis of interview data revealed four major themes related to the integration of educational technology and AI in secondary education in Bangladesh: (1) teachers' positive attitudes toward technology, (2) limited integration in classroom practice, (3) barriers to effective implementation, and (4) the disconnect between policy and practice. These themes not only describe teachers' experiences but also reflect deeper systemic and pedagogical dynamics shaping technology integration.

Positive Attitudes toward Technology

Most participants expressed positive perceptions of digital and AI-driven tools, recognizing their potential to enhance teaching and learning. Teachers highlighted that technology can increase student engagement, support interactive learning, and facilitate access to diverse educational resources. This suggests a generally favourable disposition toward innovation and indicates a readiness among teachers to adopt new technologies when appropriate support is available.

One participant stated:

"Technology helps students become more interested in lessons, especially when we use videos or interactive content." (Teacher A)

Another teacher noted:

"AI tools can make teaching easier by helping us prepare materials and explain difficult topics." (Teacher B)

However, these positive attitudes do not consistently translate into effective classroom integration. This indicates that teachers' willingness is not matched by their capacity for meaningful implementation.

Limited Integration in Classroom Practice

Although teachers demonstrated enthusiasm for technology, its integration into classroom teaching was largely superficial and supplementary. Most participants reported using digital tools primarily for presentations, video demonstrations, or accessing online content rather than embedding them into core pedagogical strategies. This suggests that technology is being used to reinforce traditional teaching methods rather than to transform instructional practices.

As one teacher explained:

"We mostly use PowerPoint or YouTube videos, but not in a way that changes how we teach." (Teacher C)

Another participant added:

"Technology is used occasionally, not regularly, because it is not part of our daily teaching plan." (Teacher D)

This pattern shows that technology integration remains at a basic level, functioning as an add-on rather than an integral part of instruction. Thus, technology use remains supportive rather than transformative in classroom practice.

Barriers to Technology Integration

Participants identified several interconnected challenges that hinder the effective integration of educational technology and AI tools. The most frequently cited barriers included lack of professional training, inadequate infrastructure, limited access to devices, and insufficient technical support. These findings point to systemic constraints that extend beyond individual teacher capability.

One teacher emphasized:

"We don't have enough training to use advanced tools like AI in our teaching." (Teacher E)

Another noted:

"Sometimes the internet connection is poor, or there are not enough devices for students." (Teacher F)

Additionally, teachers highlighted the absence of institutional support:

"If something goes wrong technically, there is no one to help us." (Teacher G)

Even when technology is available, teachers often lack the pedagogical knowledge to use it effectively. These findings show that technology integration is constrained by structural and institutional limitations.

Policy Practice Disconnect

The findings also revealed a significant gap between national digitalization policies and their implementation at the school level. While teachers were aware of government initiatives promoting ICT and digital learning, they reported limited practical support or guidance in translating these policies into classroom practice. This indicates a misalignment between policy intentions and institutional readiness.

One participant stated:

"The government talks about digital education, but in reality, we do not get enough support to implement it." (Teacher H)

Another teacher observed:

"Policies exist, but schools are not fully prepared to follow them." (Teacher I)

This suggests a misalignment between policy intentions and institutional readiness. Without adequate support and context-specific strategies, policy initiatives risk remaining largely symbolic.

Summary of Findings

Overall, the findings indicate that while teachers in Bangladesh hold positive attitudes toward educational technology and AI, their classroom integration remains limited and largely superficial. This gap is shaped by pedagogical, institutional, and systemic factors. Meaningful technology integration requires alignment between teacher capacity, infrastructural support, and policy implementation.

VI. DISCUSSION

The findings of this study provide important insights into how secondary school teachers in Bangladesh engage with educational technology and artificial intelligence (AI) in their instructional practices. While teachers demonstrate generally positive attitudes toward digital tools, their classroom integration remains limited and largely supplementary. Rather than simply reflecting a gap between intention and practice, this pattern points to deeper issues related to pedagogical readiness and systemic alignment.

To provide a clearer analytical understanding of these dynamics, this study proposes a conceptual model (Figure 1) illustrating the interaction between policy context, institutional factors, and teachers' competencies within the Technological Pedagogical Content Knowledge (TPACK) framework. The model demonstrates how alignment-or lack thereof-across these dimensions shapes the nature and depth of technology integration in classroom practice.

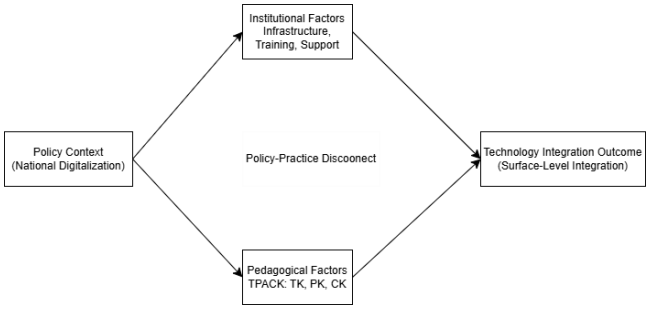


Figure 1. Conceptual Model of AI and Educational Technology Integration in Secondary Education

Figure 1 illustrates the interaction between policy context, institutional factors, and teachers' competencies within the TPACK framework, highlighting how misalignment across these levels leads to surface-level technology integration rather than transformative practice.

As shown in Figure 1, effective integration of AI and educational technology depends on the alignment between policy directives, institutional support mechanisms, and teachers' pedagogical competencies. However, the findings indicate that such alignment remains limited in practice, reinforcing a persistent policy–practice disconnect. Institutional constraints and insufficient pedagogical integration hinder the meaningful use of digital tools, resulting in fragmented and largely supplementary classroom practices. These findings suggest that access to technology alone is insufficient to achieve transformative educational outcomes.

The results can be meaningfully interpreted through the TPACK framework (Mishra & Koehler, 2006). The findings highlight an imbalance within the TPACK domains, where technological knowledge (TK) is present at a basic level, but its integration with pedagogical knowledge (PK) and content knowledge (CK) remains underdeveloped. This imbalance limits teachers' ability to use AI and digital tools in ways that meaningfully enhance learning outcomes. While teachers are familiar with basic technologies, they often lack the pedagogical strategies required to integrate them effectively into subject-specific teaching contexts. Consequently, the development of technological pedagogical knowledge (TPK) and technological content knowledge (TCK) remains constrained.

These findings are consistent with previous studies emphasizing the importance of pedagogical competence in technology integration (Zawacki-Richter et al., 2022; Bond et al., 2023). However, this study extends existing research by demonstrating that in resource-constrained contexts, technological access alone is insufficient without corresponding development in pedagogical capacity and institutional support. This underscores that successful AI integration requires not only technological provision but also a transformation in teaching practices.

The limited and supplementary use of technology observed in this study reflects what can be described as surface-level integration. In this form of adoption, digital tools are primarily used to support traditional instructional methods rather than to transform them. As a result, existing pedagogical structures are reinforced rather than reimagined. Such patterns align with earlier research suggesting that, without adequate training and support, teachers tend to adopt technology in ways that replicate rather than innovate teaching practices (Ertmer & Ottenbreit-Leftwich, 2010).

The barriers identified in this study further reinforce the importance of systemic and institutional factors in shaping technology integration. These challenges should not be interpreted solely as individual limitations but as manifestations of broader structural constraints within the education system. Inadequate infrastructure, limited access to devices, insufficient training, and lack of technical support collectively restrict teachers' capacity to adopt AI meaningfully. Teachers' reliance on basic forms of technology use can therefore be understood as a rational response to contextual limitations rather than a lack of willingness or motivation.

Another key finding is the disconnect between policy and classroom practice. Although national initiatives promote digital education and AI integration, their impact at the school level remains limited. This suggests that policy efforts are often not sufficiently grounded in the realities of classroom contexts, leading to a gap between intended and actual implementation. Without clear implementation strategies, contextual adaptation, and institutional readiness, policy initiatives risk remaining symbolic rather than producing meaningful change.

The conceptual model developed in this study provides a useful framework for understanding these dynamics. It illustrates how meaningful AI integration emerges from the alignment between teacher capacity, institutional support, and policy implementation. The model emphasizes that technology alone cannot drive educational transformation; rather, effective integration depends on the interaction of pedagogical knowledge, technological resources, and supportive organizational environments.

Overall, the findings highlight that AI integration in secondary education is a complex and multidimensional process. It is shaped not only by teachers' attitudes and skills but also by systemic, institutional, and policy-level factors that influence classroom practice. Without alignment across these dimensions, the transformative potential of AI and educational technologies is likely to remain underutilized, particularly in resource-constrained educational contexts.

VII. CONCLUSION

This study provides empirical insights into the integration of educational technology and artificial intelligence (AI) in secondary education in Bangladesh. The findings reveal that while teachers demonstrate positive attitudes toward digital tools and recognize their potential to enhance teaching and learning, their actual classroom integration remains limited and largely supplementary. This gap is shaped by a combination of pedagogical, institutional, and systemic challenges, including insufficient professional training, inadequate infrastructure, limited technical support, and a lack of alignment between policy initiatives and classroom realities.

The study underscores the importance of moving beyond mere access to technology toward the development of teachers' integrated competencies, particularly within the Technological Pedagogical Content Knowledge (TPACK) framework. Effective integration of AI and educational technology requires not only technological familiarity but also the ability to align these tools with pedagogical strategies and subject content. Accordingly, sustained professional development, improved infrastructural support, and context-responsive policy implementation are essential to enable meaningful and transformative use of technology in education.

Despite its contributions, this study has several limitations. The relatively small qualitative sample and its focus on a specific national context may limit the generalizability of the findings. Future research could address these limitations by employing larger sample sizes and adopting quantitative or mixed-method approaches. Comparative studies across different educational contexts would also be valuable in identifying broader patterns and contextual variations in technology integration. Additionally, incorporating the perspectives of students, school leaders, and policymakers could provide a more

comprehensive understanding of the ecosystem influencing AI adoption in education.

In conclusion, this study contributes to the growing body of knowledge on AI and educational technology integration in developing country contexts. It highlights that without alignment across pedagogical capacity, institutional support, and policy implementation, technology integration is likely to remain at a surface level rather than achieving transformative impact. Addressing these challenges through coordinated, context-sensitive strategies will be critical to realizing the full potential of AI in enhancing teaching and learning in secondary education.

ACKNOWLEDGEMENT

The author acknowledges the support of participating teachers and schools, whose insights made this study possible. Gratitude is also extended to colleagues and mentors who provided guidance throughout the research process.

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