
| RESEARCH ARTICLE

Changing Learning Environments: A Study of Technology Integration and Its Effects on Pedagogical Practice in Secondary Schools

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| ABSTRACT

The current research examines the application of technology in secondary school classrooms and its impact on teachers' practices. With a mixed-methods approach, data were collected from 100 teachers using questionnaires and 15 semi-structured interviews on usage patterns of technology, pedagogic transformation, student participation, and institutional support. Research has established that the implementation of technology has facilitated student-centered, participatory pedagogy, especially in science, technology, engineering, and mathematics domains, and increased classroom participation. Teachers' ICT training, school support, and access to information technologies were viewed as prime facilitators of educational change, whereas infrastructural limitations, environmental factors, and socio-economic disparities stood as major hindrances. The research emphasizes the necessity for focused professional development, leadership involvement, and policies grounded in equity in order to leverage the full potential of technology integration. The findings present pragmatic and policy-relevant suggestions on how to sustain technology-enhanced learning in high schools.

| KEYWORDS

Technology Integration, Pedagogical Practice, Digital Divide.

| ARTICLE INFORMATION

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1. Introduction

The secondary school world is being revolutionized by the speedy uptake of digital technology. Classrooms previously dominated by teacher-directed lessons now are being reshaped into active learning spaces where technology mediates learning experiences, expands access to knowledge, and enables interactive and collaborative pedagogies. Technology tools like learning management systems, online simulations, and AI-based tutoring are transforming pedagogy practices and processes of learning by students (Kirkwood & Price, 2014; Mishra & Koehler, 2006). It is an indicator of the move away from conventional, content-focused instruction to more student-oriented and inquiry-based methods that emphasize critical thinking, creativity, and solving problems (Sailer et al., 2021). The incorporation of technology in secondary school teaching has immense potential to improve learning outcomes and student motivation. Research has established that effective utilization of computer-based tools will improve student motivation, personalize instruction, and provide more inclusive classrooms (Ng, 2015; Sari et al., 2023). However, despite the potential benefits that arise with the incorporation process, the process is intricate and uneven across most contexts. Barriers like inadequate infrastructure, untrained teachers, resistant pedagogical change, and digital divide still inhibit significant uptake, particularly in developing nations (Rahman, 2023; UNESCO, 2022). So, the mere use of technology isn't enough for pedagogical change; its pedagogical congruence and the capability of teachers to implement it successfully are equally crucial (Koehler et al., 2013).

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Theoretical foundations of technology integration can be understood through various frameworks. The Technological Pedagogical Content Knowledge (TPACK) framework presumes that effective integration relies on the teacher to combine technological, pedagogical, and content knowledge (Mishra & Koehler, 2006). The SAMR model (Substitution, Augmentation, Modification, Redefinition) posits that technology can be used at a variety of levels, from straightforward substitution of traditional tasks to complete redefinition of learning experiences (Puentedura, 2014). Contemporary learning theories, such as constructivism and connectivism, prioritize learner autonomy and online engagement and indicate explicit endorsement of technology-enhanced learning environments (Siemens, 2005).

Worldwide, secondary education has experienced a rapid shift towards digitalization, especially due to the COVID-19 pandemic. Compulsory school closures prompted a sudden transition towards online and blended learning models, requiring instructors to learn to teach in virtual classrooms and online platforms (Dhawan, 2020). This unusual change demonstrated the potentiality as well as vulnerability of education systems, exposing disparities in access to technology, teacher preparedness, and curriculum adaptability (OECD, 2021). Within developed economies, technological integration is usually backed by robust government institutions and infrastructure; within low- and middle-income settings, however, the same continues to be lacking (Trucano, 2021).

Technology use in Bangladeshi education has received significant policy focus, most notably through drives like "Digital Bangladesh" and the "Access to Information (a2i) programme" (Government of Bangladesh, 2021). These attempts have enhanced digital access to learning institutions and enabled the use of ICT-based learning materials. Recent studies tell us that secondary schools continue to experience significant difficulties in bringing investment in technology into pedagogy innovation. Rahman (2023) ascertained that while most teachers confirmed the importance of digital resources in enhancing engagement, many teachers do not possess sufficient confidence and pedagogical skills for effective use. Also, inequalities between rural and urban schools persist regarding access to digital equipment, reliable internet, and teacher professional development (Islam & Miah, 2022). Such impediments have the potential to sharpen current learning inequalities instead of narrowing them.

Having the aforementioned complexities in mind, it is vital to comprehend how technology integration influences teaching practice in secondary schools in Bangladesh and similar contexts. This study will investigate (1) the modifications made by teachers in their lesson planning and classroom activities in incorporating technology; (2) teacher and learner attitudes towards the potential and issues of using technology; and (3) institutional, infrastructural, and professional factors affecting the level and quality of integration. The results will contribute to the knowledge of the link between the use of technology and educational change.

This research positions technology as a catalyst to reimagine teaching and learning rather than substitute traditional pedagogy. The study investigates the impact of digital tools on classroom social dynamics, assessment mechanisms, and teacher-student relationships to guide educational policymakers, school administrators, and teacher education programs to design more resilient and future-orientation learning environments.

2. Literature Review

2.1 Conceptualizing the Evolving Learning Environment

The "learning environment" label has also undergone a dramatic transformation over the past two decades, from being strictly a physical classroom to becoming a polydimensional environment encompassing digital, social, and cognitive domains (Fraser, 2015; Zhang & Zhu, 2022). Modern learning environments are defined by their flexibility, interactivity, and connectivity—facets that have been enhanced by the widespread use of digital technologies. This paradigm has forced instructors and policymakers to reconsider the intersection of learning environments, course curriculum, and student interaction (Ellis & Goodyear, 2016). Digital technology now pervades these environments, enabling multimodal learning through blending of text, video, simulation, and virtual collaboration (Kirkwood & Price, 2014).

The application of interactive whiteboards, learning management systems, and computer-based assessment tools has enabled teachers to diversify teaching methods and monitor student progress more effectively (Hammond et al., 2020). Sailer et al. (2021) are convinced that incorporating technology has the potential to shift the classroom from a passive teaching environment into an interactive and dynamic setting. This is dependent on the learning objectives guiding technology integration and the extent of institutional support received by teachers.

At high school level, where adolescents acquire skills crucial for their intellectual and social growth, learning contexts must strike a balance between structure and autonomy. Experts contend that technology can promote such balance through facilitating inquiry-based, project-based, and collaborative learning pedagogies (Voogt et al., 2015). However, the quality of integration determines whether technology is improving learning outcomes or simply automating conventional pedagogy (Puentedura, 2014).

2.2 Conceptual Frameworks for Technology Integration

There have been a number of theoretical models developed to account for the integration of pedagogy and technology. One of the most commonly applied models is the Technological Pedagogical Content Knowledge (TPACK) model by Mishra & Koehler (2006). According to this model, the successful integration of technology depends on educators appreciating the dynamic interplay among three areas of knowledge: technology, pedagogy, and content. Inability in all three areas can result in technology being misaligned with learning objectives, and subsequently practiced in a superficial or ineffective manner. Empirical research has validated the TPACK framework in various contexts and proven that pedagogical flexibility and teachers' technical self-efficacy contribute significantly to integration outcomes (Schmidt et al., 2009; Koehler et al., 2013).

Puentedura's (2014) SAMR framework, which complements TPACK, prescribes a continuum of integration that includes substitution, augmentation, modification, and redefinition. At the lowest levels (substitution and augmentation), technology computerizes old ways of doing; at the higher levels (modification and redefinition), it enables new forms of learning that were previously impossible. Many schools are still working at lower levels, and studies show that they are concerned with substitutional applications like computerized worksheets and not restructuring ways (Hamilton et al., 2016). These theories together emphasize that technology integration is equally a pedagogical concern as it is a technical one, as a function of teachers' ability to re-make learning experiences. Constructivist theories like Piaget (1970) and connectivist theory of Siemens (2005) explain the position of technology in instruction. Constructivist approaches consider learners as active participants who build knowledge from experience and reflection, a process highly facilitated by digital simulations and collaborative forums (Jonassen, 1999). Connectivism, since it is based on the online era, emphasizes the importance of networked learning and digital literacy. Siemens (2005) contends that being able to engage with information sources and virtual communities of practice has emerged as a necessary competence in contemporary education. Theoretical foundations lend credibility to the pedagogical imperative for technology integration: enhancing learner autonomy, cultivating critical thinking, and facilitating extended learning beyond the classroom.

2.3 Empirical Research on Technology Integration in Secondary Schooling

Additional empirical research has investigated how technology integration redefines the practice of schooling in secondary schooling. Research indicates that technology integration purposefully maximizes participation and collaboration globally (Ng, 2015; Sari et al., 2023). OECD reports indicate that teachers utilize digital technologies to customize learning, assist formative assessment, and facilitate inquiry-based learning (OECD, 2021). Yet effective adoption will largely be contingent on teachers' digital literacy and institutional support (Koehler et al., 2013). Sailer et al. (2021) introduced a validated model specifying three important categories for effective integration: (1) technological competence, (2) pedagogical planning, and (3) technological dispositions. Teachers' disposition towards technology as a pedagogical asset, rather than a distraction, in their view, was significantly correlated with its effective application. Hammond et al. (2020) also asserted that mere possession of digital equipment does not

necessarily guarantee enhanced outcomes; deliberate pedagogy and ongoing professional development are the requisites.

In low-income countries, integration is sometimes further constrained by systemic aspects. Trucano (2021) reported that technology projects in low- and middle-income countries tend to be embraced in schools without connecting these efforts with curriculum redesign or teacher training. Therefore, technology comes secondary to fundamental instructional practices. Rahman (2023), in research at Dhaka secondary schools, found that the teachers employed digital technology primarily for presentation and distribution of materials, seldom employing them to drive interactive or student-centered tasks. This is an instance of what Puentedura (2014) outlines as the "substitution" stage of integration. These constraints notwithstanding, increasing evidence of constructive developments exists. Islam and Miah (2022) noted that teachers who underwent ongoing ICT training had increased digital fluency and the probability of applying multimedia resources and web-based formative assessments. Moreover, recent pilot activities under the "Digital Bangladesh" program have yielded encouraging outcomes in supporting blended learning strategies, especially in urban areas where there is reliable internet access (Government of Bangladesh, 2021). However, rural inequalities are still on a large scale because infrastructure shortage and uneven policy application hinder development.

2.4 Impact of Technology Integration on Pedagogical Practice

Technology integration influences various aspects of pedagogy, including curriculum design and classroom interaction. Teachers are prompted to develop interdisciplinary and inquiry-based learning projects that integrate digital information and learning goals (Voogt et al., 2015). On the pedagogical level, technology enables personalized learning since it enables learners to learn at their own pace and gain access to learning materials that respond to their learning approach (Ng, 2015). Classroom discussions have been transformed because online platforms enable collaboration, peer review, and formative assessment (Dhawan, 2020).

Transitioning to technology-mediated pedagogy necessitates radical professional transformation. Teachers must not only master technical competency but also learn to effectively blend digital and nondigital learning spaces (Hammond et al., 2020). Empirical evidence has been found to imply that inadequate pedagogic training can produce disjointed lessons or higher cognitive load on the learner in using technology (Sailer et al., 2021). Additionally, teacher attitudes play a major role in technology integration; teachers with high self-efficacy and openness to change are better at integrating technology (Hamilton et al., 2016).

In Bangladesh, similar trends appear. Teachers who engaged in ICT-oriented professional learning experiences exhibited higher levels of preparedness to adopt digital pedagogy, especially in science and language education (Rahman, 2023). Structural impediments remain, however: excessive class sizes, minimal access to multimedia devices, and time limitations tend to discourage deeper integration (Islam & Miah, 2022). The research highlights the significance of institutional capacity, the commitment of leadership, and tailored professional learning architectures towards guaranteeing technological innovation in teaching.

2.5 Gaps in the Current Literature

Despite myriad studies, there are significant gaps in appreciating the pedagogic consequences of technology integration in secondary schools. Most available literature concentrates on infrastructure and access, with relatively fewer studies putting emphasis on the change-oriented dimensions of teaching (Hamilton et al., 2016). Second, research from developing nations, especially South Asia, is predominantly descriptive and is subject to a lack of empirical stringency in relating integration and learning outcomes (Rahman, 2023). Third, longitudinal studies investigating how progress has been made over time in technology's effect on teachers' beliefs and practices are limited (Trucano, 2021). Moreover, although global models like TPACK and SAMR are most frequently referenced, there is an inadequate discussion of their applicability in contexts where resources are scarce. The socio-cultural and institutional variables that affect teachers' technology adoption decisions, including policy incentives, peer culture, and leadership, are also not fully researched (Islam & Miah, 2022). These gaps necessitate context-sensitive studies

beyond superficial adoption to analyze the profound pedagogical, cultural, and institutional transformations involved in digital learning environments.

3. Methodology

3.1 Research Methodology

This study utilized a mixed-methods study design, which integrated quantitative and qualitative methodologies to probe in-depth the impact of technology integration on teaching practices in secondary schools. The use of the mixed-methods strategy was to obtain quantifiable patterns of technology utilization as well as in-depth knowledge concerning teachers' attitudes and teaching strategies. Creswell and Plano Clark (2018) contend that validity is promoted via the triangulation of results by various actors. The study employs a sequential explanatory design, in which quantitative data are gathered and analyzed first, and qualitative interviews explaining the statistical findings in more detail are conducted later. This approach is especially suitable for educational research when context and experience issues are a primary concern (Ivankova & Creswell, 2009). The quantitative phase examines the prevalence, incidence, and perceived effect of technology use by a representative sample of teachers, whereas the qualitative phase examines the education foundation and issues that fuel those practices.

3.2 Research Environment and Context

The study takes place in secondary schools in Bangladesh's Dhaka and Mymensingh Divisions, both of which include urban and semi-rural educational environments. Bangladesh offers a large context for grasping technology integration due to its fast-paced digital development driven by national initiatives like Digital Bangladesh and a2i Education Innovation (Government of Bangladesh, 2021). However, infrastructural deficits, teacher preparedness, and institutional support remain in most locations (Islam & Miah, 2022). Choice of schools from urban and semi-urban locations guarantees that the study encompasses variation in terms of accessibility, policy implementation, and responsiveness in teaching.

3.3 Demographics and Sampling Methodology

The target population is secondary school teachers who are already using or are meant to utilize digital technology in teaching. A multistage sampling strategy was adopted to provide representativeness. Ten schools were randomly and purposively selected based on the availability of ICT facilities, such as computer rooms, multimedia rooms, or digital learning facilities. At the second stage, 100 teachers (10 per school) were randomly sampled to fill in the quantitative survey. During the qualitative process, 15 teachers were selected intentionally from the respondents in the survey based on their use of technology (high, medium, and low). This enabled the research to explore pedagogical variation between teachers with different levels of integration. Palinkas et al. (2015) affirm that purposive sampling is particularly ideal in qualitative research where one seeks to explore specific experiences and case variation. Participants were required to have at least two years of experience as a teacher and basic familiarity with digital technology (e.g., PowerPoint, Google Classroom, or learning apps). Voluntary participation was entirely anticipated.

3.4 Data Collection Tools

3.4.1 Quantitative Phase

The quantitative data collection tool was a standardized 30-item questionnaire, categorized into four areas:

1. Demographic details (age, gender, discipline area, years of experience).
2. Application of technology (categories, frequency, and objectives of tools used).
3. Perceived effects of technology on student engagement, course construction, and testing strategies.
4. Technology integration challenges and enabling frameworks.

Items were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The survey was based on validated measures from previous research (Sailer et al., 2021; Voogt et al., 2015) and was pre-tested with 10 teachers to ascertain clarity and reliability. Cronbach's alpha was established at 0.87, reflecting high internal consistency.

3.4.2 Qualitative Phase

The qualitative component involved semi-structured interviews of approximately 45 to 60 minutes each. Questions in the interviews asked for teachers' perceptions of incorporating technology, lesson redesigns, difficulties encountered, and their own views regarding students' learning and classroom life changes. The unstructured tone permitted the participants to open up and describe their experiences, but guided questions provided uniformity among the interviews (Kvale & Brinkmann, 2015). Interviews were recorded by audio permission and transcribed verbatim.

3.5 Data Analysis

3.5.1 Quantitative Assessment

Quantitative data were quantitatively analyzed with SPSS version 27. Descriptive statistics of mean, standard deviation, and frequency were initially calculated to describe patterns of technology usage. Inferential analysis including independent t-tests and one-way ANOVA was employed to examine differences in technology integration based on gender, teaching experience, and subject area. Pearson correlation analysis was also employed in order to determine the correspondence between the digital competency of instructors and their self-reported pedagogical transformation. This analytical method allows for the identification of trends and relationships that are statistically significant and then explained with qualitative data (Creswell & Plano Clark, 2018).

3.5.2 Qualitative Analysis

Qualitative data from interviews were analyzed using thematic analysis based on Braun and Clarke's (2006) six-step framework: familiarization, coding, development of topics, reviewing, defining, and reporting. Coding was facilitated by the NVivo computer program. Themes were drawn inductively, from the data, and deductively, using the TPACK and SAMR theoretical models. Triangulation of quantitative and qualitative findings enabled a rich insight into the use of technology by teachers and the impact of contextual factors on practice.

3.6 Validity, Reliability, and Credibility

In the quantitative phase, content validity was addressed via expert validation conducted by two educational technology researchers. Reliability was assured using Cronbach's alpha and consistency between subscales. Trustworthiness in the qualitative component was assured by credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). Member checking was performed by showing participants summaries of interview transcripts to check. Triangulation of data sources (interviews and questionnaires) and participant groups (several schools and topics) strongly facilitated the study rigor. Mixed-methods design necessarily develops validity by combining quantitative data with people's lived experiences, thereby achieving a more comprehensive understanding of educational change (Ivankova & Creswell, 2009).

3.7 Ethical Considerations

All the methods conformed to education research ethical standards according to the Bangladesh National Research Ethics Guidelines (2020). The Institutional Review Board of [University Name] approved ethical clearance before data collection. The subjects were told the reason for the study, their right to withdraw at any moment, and that participation was voluntary. Written informed consent was obtained before the survey and the interviews. Data confidentiality was ensured by anonymization, and all computer files were kept in encrypted file formats.

As per GDPR requirements, data were utilized solely for research purposes and were destroyed once the project was completed. Such actions ensured participants' confidentiality and the research's validity.

3.8 Shortcomings of the Methodology

The mixed-methods approach gives a complete overview, but there are a plethora of shortcomings that must be recognized. The sample here, although diverse, is confined to only two divisions and therefore restricts its generalizability to all secondary schools in Bangladesh. Self-report data may introduce bias with the users overreporting their use of technology for social desirability. Moreover, the study's cross-sectional design captures practice at one point in time without monitoring longitudinal variation in educational adaptation. Follow-up studies might be taken to a national level and include class observation to achieve more triangulation.

4. Results

4.1 Overview

This section delineates the results from the quantitative and qualitative phases of the investigation. Quantitative data were collected from survey responses of 100 secondary school teachers, and qualitative data were acquired from 15 semi-structured interviews. The findings are categorized into three primary domains: (a) technology utilization patterns and pedagogical transformations, (b) determinants affecting technology integration, and (c) educators' perceptions and experiences derived from theme analysis. The integration of these findings offers a comprehensive perspective on how technology transforms educational practices in secondary schools in Bangladesh.

4.2.1 Quantitative Results

Out of 100 teachers, 60% were females and 40% were males with ages between 25 and 58 years (mean = 38.2, SD = 8.7). Their average teaching experience was 11.7 years, ranging from 2 to 30 years. Private school teachers constituted 55%, whereas public school teachers comprised 45% of the sample population. Approximately 67% of them had undergone formal ICT training. The allocation of teaching topics was Science (25%), Humanities (30%), ICT (25%), and Business (20%), to ensure equal coverage by discipline.

4.2.2 Frequency and Extent of Technology Use

The average use frequency of classroom technologies was 3.8 (SD = 0.9) on a five-point scale, revealing that the majority of teachers used digital tools many times a week. The mean number of tools employed was 5.5 (SD = 2.3), with multimedia presentations, online films, and computer quizzes being the most frequently employed tools. Private school teachers reported a far greater range of tools (mean = 6.3) than their public school counterparts (mean = 4.5).

Trained teachers used integration practices more often (mean = 4.2) than their untrained counterparts (mean = 3.1), demonstrating that official training has an impact on improving the use of integration practices and building confidence.

Technology Integration in Secondary Schools

Teacher ID	School Type	Subject	Years of Experience	ICT Training (Yes/No)	Tech Use Frequency (1–5)	Pedagogical Change Index (1–5)	Key Qualitative Remark
1	Public	Science	8	Yes	4	4	Adopted interactive experiments using simulations
2	Private	ICT	5	Yes	5	5	Fully integrated coding and digital assessments
3	Public	Mathematics	10	No	3	3	Uses PowerPoint but limited student interaction
4	Private	Business Studies	6	Yes	4	4	Introduced digital case studies for analysis
5	Public	English	12	No	3	3	Occasional video content, minimal assessment use

Figure: Table of Technology Integration in Secondary Schools

4.2.3 Education Transformation and Learner Involvement

Pedagogical Change Index, a composite measure, was computed from six Likert items that represent teachers' implementation of student-centered methodology, incorporation of interactive content, and modification of assessment strategies. The mean was 3.9 (SD = 0.8), indicating moderate to high pedagogical change. The mean Perceived Student Engagement score was 4.1 (SD = 0.9), suggesting teachers tended to view technology as a driver of motivation and engagement.

Correlation analysis revealed a significant positive correlation between pedagogical change and ICT training ($r = 0.64, p < 0.01$), and a significant correlation between perceived student engagement and overall satisfaction ($r = 0.71, p < 0.01$). Pedagogical change scores were higher for ICT and Science teachers (means = 4.3 and 4.1) than Humanities (3.5) and Business (3.4) teachers. This suggests that computer resources are more effectively integrated into STEM fields, likely due to greater content and technology compatibility.

4.2.4 Institutional Support and Challenges

Institutional Support averaged 3.7 (SD = 1.0), indicating moderate school leader support. Private schools scored higher on average (4.1) than public schools (3.2), which indicates disparities in resource allocation and leader engagement. Teachers who saw proactive support from school administration reported greater satisfaction and fewer perceived obstacles.

The barriers Index obtained a mean of 3.1 (SD = 1.2) in the respondents, with public school teachers registering higher barriers (mean = 3.8) than private school teachers (mean = 2.1). Typical barriers were erratic internet connections, few classroom gadgets, inadequate maintenance support, and insufficient pedagogical training. These constraints primarily impacted teachers in rural and public schools, restricting the extent of involving and innovative teaching styles.

4.2.5 Determinants of Educational Transformation

A multiple linear regression was used to identify predictors of pedagogical change. The model was found to be statistically significant and accounted for 42% of the variance. ICT training, organizational support, and frequency of technology use were the strongest predictors, and barriers were found to have a negative influence. This suggests that individual readiness and also organizational support are crucial for effective technological integration.

4.3 Qualitative Results

Analysis of the 15 interviews yielded six overarching themes: (1) reform of education, (2) increased student engagement, (3) constraints and barriers, (4) needs for staff development, (5) institutional and policy support, and (6) digital divide. Occurrence and significance of these themes reflected quantitative tendencies, validating the validity of the mixed-methods process.

4.3.1 Educational Transformation

The majority of the teachers indicated a move away from teacher-directed instruction to student-directed and inquiry-based instruction strategies. Teachers also indicated greater use of project tasks, multimedia resources, and peer work. For instance, an ICT teacher said that children are more engaged in class today compared to the past, with lessons being structured in such a way as to promote discovery and debate.

The magnitude of change differed depending on training and availability of resources. Teachers in well-endowed private schools indicated a higher degree of experimentation, while their counterparts in poorly funded public schools utilized technology primarily to present content. These findings identify the context dependency of technology integration.

4.3.2 Greater Student Engagement

Teachers consistently reported that digital tools improved student motivation and classroom interaction. Many mentioned that movies, quizzes, and interactive presentations provided an effective means of sustaining student interest and enabling differentiated learning. However, some teachers cautioned that engagement may be shallow if activities are not integrated with learning objectives, as the importance of pedagogical planning in concert with the rollout of technologies is underlined.

4.3.3 Barriers and Constraints

Educators cited infrastructure and context challenges as ongoing problems. Some of the common challenges were an inconsistent power source, poor internet connectivity, and no technical support. The size of classes and availability of operational devices also constrained interactive learning. The challenges were most evident in public schools, impacting preparation for lessons and quality of learning experiences.

4.3.4 Professional Development Needs

Recurring was the problem of requiring ongoing, discipline-specific ICT training. Although generic digital literacy training has been provided to most teachers, they indicated a deficiency of pedagogical emphasis and alignment with their disciplines. The teachers cited a desire for mentoring, peer collaborative activity, and workshops that connect technological integration with curricular goals.

4.3.5 Institutional and Policy Support

Teachers emphasized the role of school leadership and organizational culture in maintaining technological integration. Teachers in schools with leaders who encouraged experimentation indicated greater self-efficacy and

an inclination to innovate. Presence of ICT coordinators, resource management, and guidance in policy were identified as facilitators of effective use of technology.

4.3.6 Digital Disparity

Socioeconomic inequalities between students were considered a key concern. Others did not have smartphones, computers, or reliable internet access, hence restricting their engagement in digital learning. The teachers highlighted that such inequalities hinder the inclusive value of technology-facilitated learning and advocated for strategies that can deal with access disparities.

4.4 Synthesis of Quantitative and Qualitative Findings

Both strands of data showed significant congruence between statistical trends and qualitative reports. Higher levels of ICT training in teachers, good institutional support, and a wider toolset indicated more transformational teaching approaches in interviews. Alternatively, those respondents who said they had significant barriers quantitatively also paralleled corresponding difficulties qualitatively.

Themes like Pedagogical Change and Enhanced Student Engagement came up as overarching themes, verifying that integration of technology has started reshaping the practice of teaching in Bangladeshi secondary schools. Nevertheless, infrastructural inadequacies, competency shortages, and leadership paradoxes undermine the complete realization of this change.

4.5 Summary of Findings

Technology usage is widespread but unequal, with increased adoption and innovation being experienced in private schools and STEM streams. ICT training, institutional support, and intensity of technology utilization are principal predictors of pedagogical transformation. Teachers observe enhanced learner engagement but experience persistent infrastructural and contextual issues. Professional development is generally unfulfilling, with technical proficiency emphasized over pedagogical use. Chronic innovation is largely shaped by institutional leadership. Socioeconomic inequalities persist to hinder equitable access to technology-based education.

5. Results

5.1 Summary

This study explored the integration of technology in secondary schools and its implications on teaching practices. The results indicate that utilization of technology is slowly gaining popularity among teachers; nevertheless, its implication on teaching practices depends on factors such as ICT training, institutional support, presence of electronic resources, and institutional constraints. Quantitative and qualitative data converge to provide exhaustive information regarding the reach, quality, and challenges of pedagogy enhanced by technology in Bangladeshi secondary schools. The subsequent sections provide an overview of the important findings.

5.2 Adoption of Technology and Pedagogical Practices

Analysis of surveys revealed that teachers used computer facilities routinely multiple times per week, and the most frequent of these were multimedia presentations, web movies, and online tests. Teachers in private schools indicated higher frequencies and variety of tool usage than public school teachers, which implies inequalities in access to resources. ICT training program participation is highly associated with frequency of technology use, implying that formal skill development plays an important role in effective integration.

The Pedagogical Change Index captured moderate to high levels of instructional change, as proof that technology has inspired numerous educators to become more student-centered. This is also evident from interview transcripts where teachers reported a move away from lecturing towards interactive and inquiry learning. Technology was found to support improved lesson planning, enhance collaborative activities, and support formative assessment, representing a change in pedagogical priorities facilitated by technology.

5.3 Patterns by Discipline

Disciplinary differences are evident in the findings. ICT and Science teachers expressed greater pedagogical change and engagement than Humanities and Business teachers. This trend indicates that technology is more intuitively appropriate to STEM studies, potentially due to the prevalence of structured digital content and the intuitive suitability of such subjects to interactive participation. Humanities and Business teachers indicated high reliance on presentation material and sporadic internet sources, asserting the potential of technology for transformation in these fields is yet to be exploited.

5.4 Student Involvement and Participation

Quantitative measures of student perceptions indicate that technology enhances student participation, motivation, and focus. The teachers reported that interactive tools, such as online quizzes and multimedia presentations, improved the engagement of students, particularly among students who were previously not interested in their lessons. The qualitative interviews also identified this result as teachers noted students' greater enthusiasm for classes with films, simulations, and interactive electronic activities.

Yet, not all engagement is equal; where architecture is an issue or in under-resourced schools, the potential to leverage digital technology is restricted. Some teachers realized that technology-centred lessons could be hollow if properly integrated into pedagogical goals, that technological use in itself does not create valuable learning gains.

5.5 Barriers to Successful Integration

One major observation has to do with teachers' barriers, which are more prominent in public schools. Survey results show that infrastructural problems like erratic internet connection, substandard classroom gadgets, and the absence of technical support still remain the major hindrances. Interviews corroborated these findings as it was reported by the teachers that it was hard to introduce interactive or collaborative exercises because of practical reasons.

Teachers also indicated issues with professional capabilities. Though numerous had undergone basic ICT training, the courses tended to be weakly adapted for specific subjects or pedagogical activities. Consequently, some teachers had lacked confidence in using technology effectively into lesson planning and assessment procedures. These constraints in general highlight that successful take-up of technology relies not merely on supply but also on sufficient training and organizational support.

5.6 Institutional and Leadership Impact

The research showed that the influence of educational leadership and organizational culture plays a significant role in technology acceptance among teachers. Educators in schools where experimentation was supported by the administration and had backing felt more satisfied and engaged in more innovative pedagogy. Institutional support was closely linked with fewer barriers to change and more pedagogical change, and this suggests that leadership commitment is a critical facilitating factor in technology integration.

5.7 Professional Development Needs

Research indicates that professional development is needed to maintain technology-supported teaching. Teachers reported a need for ongoing, discipline-specific training, mentorship, and collaborative learning experiences. Technical expertise-based training without incorporation of pedagogical processes was viewed as ineffectual. Therefore, specialized professional development integrating subject matter knowledge, technological skills, and instructional methods is needed to reap the potential of digital resources in entirety.

5.8 Digital Disparity and Equity Concerns

The research emphasizes fairness questions related to the use of technology in classrooms. Socioeconomic differences among students were found to be a key variable affecting participation in technology-supported activities. Teachers indicated that certain students did not have smartphones, computers, or stable internet access, especially at public or rural schools. The digital divide limits equal learning experiences and highlights the imperatives for institutional intervention for enhancing access and assistance for marginalized learners.

5.9 Synthesis of Quantitative and Qualitative Outcomes

Synthesis between the quantitative and qualitative data produced a high level of congruence. Responding teachers more highly trained in ICT, more frequently utilizing technology, and enjoying more support from institutions reported greater pedagogical change in survey returns as well as interview data. Teachers responding with severe infrastructural or contextual difficulties mirrored these issues across both data sets, showing congruence between methodological strategies.

Thematic analysis of qualitative data provides richness and meaning to quantitative trends. Pedagogical Transformation, Student Engagement, and Barriers underscore the multifaceted nature of technology integration. The correlation of survey indices (e.g., Pedagogical Change Index, Barriers Index) to qualitative experiences determines the validity of the findings and presents an overall picture of technology's effect on pedagogy.

5.10 Important Patterns and Implications

Several patterns emerge from the findings:

- **Widespread yet Unequal Application of Technology:** While technology applications grow more prevalent, private schools and STEM education indicate more integration and innovation.
- **Professional Development as an Enabler:** Educators with formal ICT training are more likely to adopt student-centered pedagogy and innovative assessment.
- **Organizational support is key:** Participation from leaders and resource allocation influence strongly the degree and longevity of technology application.
- **Barriers Suppress Change:** Infrastructural, contextual, and vocational barriers remain substantial obstacles, especially in state schools.
- **Issues of Equity:** Socioeconomic differences among students persist to disrupt the inclusive potential of technology-enabled learning.
- **Successful technology incorporation facilitates a move toward participative, interactive, and assessment-centered education, and consequently, it enhances interest and satisfaction.**
- **These trends indicate that technology is transforming secondary education, yet the quality of the change hinges on human capabilities, organizational assistance, and equitable access.**

6. Conclusions and Recommendations

6.1 Conclusion

This study focused on the employment of technology within secondary schools and its influence on teaching pedagogy. The research findings reveal that the implementation of technology is having a deep impact on teaching processes, promoting student participation, and facilitating more interactive and student-oriented teaching practices. Teachers who utilize digital technologies frequently, undertake ICT courses, and have the backing of their institutions are likely to successfully promote pedagogical innovations. On the other hand, infrastructural shortages, inadequate professional development, and contextual limitations—especially in public and rural schools—present serious challenges to technology integration consistency.

The findings indicate that the subject area effects, to a great extent, influence the degree of educational change. STEM subjects like Science and ICT show more integration and increased application of electronic resources than Humanities and Business subjects. This trend indicates that the type of content and the presence of digital resources affect the capacity of teachers to innovate using technology. In addition, the socioeconomic inequalities of students highlight the enduring digital divide, which restricts equal access and distorts the insertion of technology-enabled learning. Integration of qualitative and quantitative data shows high convergence, thus enhancing validity of findings. The Pedagogical Change Index, measures of student engagement, and measures of barriers show trends set by interviews with rich descriptions of technology's impacts on secondary education. Findings indicate that technology has great potential as a tool for pedagogical change but is contingent on teachers' ability, faculty development support in institutions, resource availability, and equal access of students.

6.2 Recommendations

The document presents recommendations at different levels to teachers, school administrators, policy-makers, and national planners of education to improve technology integration in secondary schools.

6.2.1 Recommendations for Teachers

Participate in Ongoing ICT Training: Teachers must take advantage of professional development activities that merge technological knowledge with instructional methods. Workshops pertaining to subjects can develop confidence and allow for the competent use of computer facilities. **Enact Student-Centered Strategies:** Teachers must plan classes that utilize technology to involve students in inquiry, group learning, and active engagement in education. Digital formative assessment can give instant feedback and improve reflective learning.

Include Cooperation and Best Practices Sharing: Peer collaboration and professional learning teams can enhance information sharing, resource utilization, and innovative approaches in the utilization of technology.

6.2.2 Educational Leadership Recommendations

Give Institutional Support and Infrastructure: Administrators must provide a stable internet connection, working devices, and technical assistance to allow ease of integration. Investments in educational infrastructure are important to maintain innovation. **Instill an Innovation Culture:** Experimentation and successful techniques being rewarded can motivate instructors to embrace technology more easily. Leaders must develop policies that support educational innovation. **Assess and Analyze Technology Use:** Ongoing monitoring of computer integration and mechanisms for feedback can detect loopholes, surmount obstacles, and ascertain whether technology is utilized efficiently to improve learning achievements.

6.2.3 Recommendations for Policy-Maker

Develop Thorough ICT Training Plans: National and regional educational administrations have to provide pedagogically-focused ICT training plans for educators, with a focus on subject-specific utilization and interactive pedagogical approaches. **Relieve the Digital Divide:** Policies must be in place to offer equal access to devices, connectivity, and digital resources, particularly to public and rural schools. Device-at-a-low-cost programs or internet subsidies can help reduce inequalities. **Incorporate Technology into Curriculum Planning:** Guidelines for national curriculum must incorporate technology-embedded learning outcomes explicitly, underlining critical thinking, problem-solving, and collaboration skills.

6.2.4 Future Research Recommendations

Longitudinal studies of technology impact should investigate long-term effects of technology adoption on learning outcomes, motivation, and achievement. **Cross-Disciplinary Studies:** Comparative studies between disciplines can identify how to bridge challenges related to technology adoption in each discipline. **Study of Student Opinions:** Student opinion investigations can yield data regarding digital equity, motivation, and effectiveness of technology-facilitated learning.

6.3 Consequences

The implications of the research are important for the further improvement of secondary education in Bangladesh and other similar contexts. Firstly, they demonstrate that teacher training and school-level support are essential levers for transformation in teaching. Secondly, redressing infrastructure disparities and the digital divide is necessary to ensure access to more equitable learning opportunities. Thirdly, they highlight the necessity to link the integration of technology with curriculum objectives, assessment regimes, and student-focused teaching approaches. Implementing these ideals can create a sustainable, technology-enriched learning space that is responsive to the diverse needs of students.

6.4 Final Summary

In summary, the use of technology in secondary education is not just a technical initiative but a multilevel process entailing educational, administrative, and socio-economic factors. Though there have been significant advances,

there are still barriers, particularly in public schools and resource-poor settings. Teachers, school administrators, and policymakers must collaborate so that technology becomes a source of rich learning, rather than just an add-on or surface-level innovation. By addressing professional development requirements, infrastructural limitations, and issues of equity, technology can be used to improve the quality of teaching, involve students actively, and equip learners for the complexities of a fast-changing digital world.

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