Approaches to Technology Integration and Pedagogy Transformation during Covid-19 Pandemic: A Study on the Government College Teachers

Nazmul Hossain
Master Trainer Associate in Education, University of Nottingham, Malaysia & Lecturer, Azam Khan Govt. Commerce College, Bangladesh, *nazmulmktdu90@gmail.com*

The COVID-19 pandemic compelled the government colleges in Bangladesh to transition rapidly to online platforms. Although technology integration had already been emphasized in alignment with the objectives of the Fourth Industrial Revolution (IR 4.0), the crisis acted as a catalyst, accelerating this transition far beyond the pace of prior reforms. The study investigates how novice teachers transformed their instructional practices through the adopting of technology during the pandemic. An explanatory sequential mixed-methods design was employed: first, an online survey of 100 novice teachers was analyzed using SPSS to identify patterns of technology use, followed by a semi-structured interviews with ten teachers, chosen by a stratified sampling approach, which were thematically analyzed to capture deeper insights into instructional transformation. Findings show rapid digital platform adoption as primary tools for instruction, the pedagogical modifications to suit online contexts, and the progressive improvement in teachers' digital literacy and confidence in technology-mediated instruction. The findings provide policy recommendations for administrators, instructional leaders, and policymakers in Bangladesh for strengthening digital infrastructure, designing training programs, and preparing teachers for future disruptions. Overall, the findings highlight how an unanticipated crisis can serve as a catalyst pedagogical transformation and technological integration in the era of technology-driven education.

Keywords: technology integration, on-line pedagogy, pedagogical transformation, pandemic impacts, teachers

INTRODUCTION

The COVID-19 pandemic, which severely curtailed our ability to interact with one another and engage in outside activities, necessitated the search for alternative solutions. The educational institutions of the affected countries were closed (König, Jäger-Biela, & Glutsch, 2020). The government of Bangladesh was forced to close all educational institutions due to the country's dense population and the rapid spread of COVID-19 (Miah et al., 2023). Regrettably, it took considerable time for institutions to reopen. Therefore, the government initiated the measures to resume online instruction using online platforms. The rapid shift from traditional instruction to online learning was necessary but challenging (Shohel et al., 2025). The existing literature on the COVID-19 pandemic and the education system highlight the effects on the educational system, including learning disruptions, high dropout rates, social discrimination, anxiety, and the educational attainment gap between rich and poor people (Major & Machin, 2020; Bao, 2020; Schleicher, 2020; Sibley et al., 2021; Shohel et al., 2025). Furthermore, to examine the applied pedagogical approaches, technology use, and crisis management during pandemic, many studies have been conducted to understand how teachers and institutions worked to lessen the impact (Cutri, Mena & Whiting, 2020; Basilaia & Kvavadze, 2020; Jin et al., 2021; Palau et al., 2021; Pokhrel & Chhetri, 2021; Peimani & Kamalipour,

2021). There are only a few studies accentuating tertiary education (Dutta and Smita, 2020), but at the primary level, there are many studies (Putri et al., 2020; Ogunode, Ndubuisi & Terfa, 2021), also at the higher education level (Pokhrel & Chhetri, 2021). Some similar studies have been conducted in India, Indonesia, China, and Italy (Huang, 2020; Joshi, Vinay & Bhaskar, 2020; Truzoli, Pirola & Conte, 2021). More precisely, several significant studies have been conducted at the higher education level in Bangladesh; however they have been predominantly focused on universities (Karim et al., 2025; Shohel et al., 2025).

Although there is an abundance of primary-level studies and certain international higher education reports, research specifically addressing tertiary government colleges, especially in Bangladesh, is limited. However, none have examined the perspective of government college teachers, particularly their approaches to technology adaptation. This research utilizes two complementary theoretical frameworks to evaluate teachers' responses and educational reforms. The Technology Acceptance Model (TAM) clarifies adoption processes through perceived utility and perceived ease of use, aiding comprehension of educators' acceptance or rejection of new tools. The TPACK (Technological Pedagogical Content Knowledge) framework delineates how educators integrate technology knowledge with pedagogical and content knowledge in their practice. The TAM elucidates the rationale for individuals' use of technology, whereas the TPACK framework offers a lens to for analyzing technology integration in education during the pandemic. As a result, this study will evaluate the teachers' prior IT expertise, their level of IT usage prior to COVID-19, the degree to which technology and pedagogy changed during the pandemic, and the extent to which pandemic improved their teaching practice. The goals of the study are to investigate the government college teachers' technological competencies and instructional practices before the pandemic and analyze the subsequent shift in technology integration and pedagogical transformation during the pandemic. To achieve these goals, the study seeks to answer the following research questions:

RQ1: Prior to the COVID-19 pandemic, what kinds and degrees of technical and pedagogical strategies were employed by government college teachers?

RQ2: Given the increased emphasis on online and remote learning during the pandemic, how much have government college teachers' technology and pedagogical approaches changed?

This study contributes to exploring the means of quick pedagogical transformation during crisis moment and also might be an example of future change management system. The study contributes to providing information on the kinds and capacity of technology and pedagogy employed prior to the pandemic, as well as demonstrate any advancements or modifications made to these elements throughout the pandemic. Specifically, this paper narrows its focus to fill in the existing gap in the literature on pedagogical transformation at the tertiary level by examining the government college teachers in Bangladesh, thereby it contributing to a deeper understanding of technology integration processes in resource-constrained settings. The findings will provide legislators and college administrators with evidence regarding teacher training mandates, infrastructure goals, and crisis-induced change management strategies to enhance future remote or blended learning.

LITERATURE REVIEW

Pedagogical Strategies for Online Distance Education

A major paradigm shift in the field of education, particularly in the era of distance learning, has been brought about by technological advancement and the COVID-19 pandemic (Kurnaz & Ari 2024). Given the long history of online pedagogy, numerous innovative pedagogical strategies were employed in this field (Keengwe & Kidd, 2010). The literature is structured around three core themes: (1) technology integration by teachers including the issues of adoption and digital readiness, (2) pedagogical transformation, highlighting the methodological strategies and student-centered shift, and

(3) contextual considerations specific to the government college teachers in Bangladesh. This review is organized around these criteria, elucidating how previous studies feed the current study and pinpointing extant gaps.

Distance learning can be categorized into two broad types: synchronous and asynchronous learning. Synchronous learning is real-time that enables teachers and students from various geographic areas to join together and exchange opinions as a community (Basilaia & Kvavadze, 2020). Here, punctuality and accessibility are required of both the teachers and the students. According to Barry and Kanematsu (2020), the most widely used synchronous tools are online chat, Facebook live, Zoom, MS Team, online TV, Google Meet, among others. In contrast, asynchronous platforms do not involve real-time communication such as YouTube channels, web-based platforms, collaborative learning, or community-based learning (Pelz, 2010; Amos, 2021). Both learning strategies help overcome time and location restrictions. Goodwin, Graham, and Scarborough (2001) say synchronous learning is better than asynchronous because it promotes real-time collaboration

According to Goodwin, Graham, and Scarborough (2001), synchronous learning fosters real-time interaction and teamwork, making it superior to asynchronous learning. These distance learning tools indicate the degree of digital preparedness and technology integration among educators. Synchronous technologies support immediate engagement and collaboration, whereas asynchronous tools provide flexibility and promote student-centered learning. These categories underscore differing degrees of digital preparedness and technology assimilation among educators, a critical element in this research. The Technology Acceptance Model (TAM) and the TPACK framework can be utilized to analyze how perceived ease of use, usefulness, and the integration of technology with pedagogy affect teachers' adoption.

Since the fourth industrial revolution began, managers and administrators have shifted their role from mentors and facilitators to ensure participatory learning, with a primary focus on student-centered learning (Elayyan, 2021; Soni, 2021). Therefore, rather than being a teacher's decision, the choice of online pedagogy needs to be based on what the students want. Similarly, Burns (2011) divides technologies used in remote learning into several categories, including web-based, emergent web-based, print-based, audio-based, televisual-based, multimedia-based, and mobile technologies. Barry and Kanematsu (2020) had experiences with Zoom, Microsoft Teams, and online evaluation tools during the initial stage of the pandemic. The majority of educational institutions in Bangladesh started offering online classes via social media, such as Facebook Live sessions, and uploaded videos to Facebook. During the pandemic, Facebook emerged as a widely adopted and flexible online learning platform. The most government college teachers delivered lessons by via recorded videos on Facebook. This platform allows teachers and students from multiple locations to participate asynchronously, making it more flexible and student-centered (Basilaia & Kvavadze, 2020). Baran and Correia (2009) propose the application of Transformative Learning Theory as a means of effectively transforming pedagogy through an empowerment process, moving from teacher-centered to student-focused and from physical classroom to online setting. Online pedagogical practices can be consolidated into comprehensive Pedagogical Innovation Models that prioritize student-centered learning, collaborative involvement, and mentorship. Collectively, these methodologies illustrate the variety of pedagogical evolution evident in online education.

Collaborative learning: One of the most widely accepted methods for online education is collaborative learning, which can create knowledge through activities. Johnson and Johnson (1987) note that positive interdependence, individual accountability, social negotiation, face-to-face interaction, and group processing are some of the distinctive features of collaborative learning, which are the student-centered constructivist approach. Here, both the teachers and the students must be equipped with the right tools and have basic technical knowledge. According to Pouezevera and Khan (2007), as smartphones are more readily available than other tools, they may be the most convenient

tool for participating in online collaboration. When working together virtually, teachers lead group activities rather than imparting knowledge, and students collaborate with one another to engage in idea production, sharing, problem-solving, case studies, critical discussion, and question-answering (Thompson & Ku, 2006; Du, Ge & Xu, 2015). In this case, learning happens in a mixed interactive and participatory setting.

Online coaching: Throughout the COVID-19 pandemic, numerous countries employed online coaching as a popular pedagogical technique for distant learning (Barry & Kanematsu, 2020; Atad & Grant, 2021; Howlett et al., 2021). According to Burns (2011), online coaching is a flexible learning platform that empowers students to develop certain knowledge and abilities through a student-centered educational approach. Since the coaches in this situation don't function as traditional teachers, they must instead take on the role of mentors, facilitators, or change agents. Burns (2011) distinguishes between coaching and mentoring, stating that the former is better suited for more experienced learners, while the latter is more appropriate for learners with less experience. Academic coaching was a well-known student support service during the COVID-19 pandemic (Atad and Grant, 2021; Howlett et al., 2021). Various online formative assessment tools, including Kahoot!, Poll Everywhere, Google Forms, Quizizz and Nearpod, were employed to examine students' work in order to mold and enhance their ability to handle pandemic scenarios (Stahl, 2021).

Online learning community: An online learning community unites teachers and students through computer-mediated community-based learning. Teachers and a group of students from various geographic areas can gather together and exchange their opinions in a community through this type of synchronous and asynchronous distance learning (Basilaia & Kvavadze, 2020). According to Burns (2011), community learning involves exchanging ideas, actively collaborating, having open discussions, providing constructive criticism, peer monitoring, self-evaluation, and other methods in an adaptable and structured environment. In this instance, educators play a proactive role in community engagement (Zuev, 2012). More precisely, Moodle is referred by Martinez and Jagannathan (2008) as an affordable, well-organized, and extensively utilized community learning platform for educators, learners, and instructional leaders worldwide. Both urban and rural students found successfully engaged Moodle-based online learning during the pandemic. According to Li (2021), Moodle shifted the traditional form to online by offering self-dependent student-centered independent study. Since Moodle is not commonly used in Bangladesh, the Facebook group proved to be an effective online learning tool during the COVID-19 pandemic. Students were able to gain knowledge from thousands of postings and comments pertaining to their subjects (DeKorver, Chaney, and Herrington, 2020). However, DeKorver, Chaney, Herrington (2020) identify several limitations of Facebook groups.

Pedagogical Transformation and Technology Integration

The pedagogical shift from traditional to online distance learning has a long history, which Keengwe and Kidd (2010) summarized and illustrated with specific evidence-based strategies and approaches used during the shift. From 1975 to 1980, behavioral approaches were used with little interaction or participation; from 1983 to 1990, interactive multimedia was applied with some educational software clearly visible; from 1990 to 1995, internet-based content delivery for active learning; and from 1995 to 2005, a new dimension of pedagogical change was introduced with the widespread use of distributed constructivist and cognitivist models for user interactions. Ultimately, interactive disseminated learning made possible by wireless devices has been the dominant trend since 2005. These historical patterns demonstrate the transition from teacher-centered to student-centered teaching, emphasizing that this transformation is context-dependent and continuous for particular consequences.

Specifically, there is no hard and fast rule for pedagogical transformation, which is why numerous academics have discussed various methods. Redmond (2011) demonstrated a three-stage shift in the way that pedagogy is perceived: teachers who are skeptical and resistive to online instruction at the first stage, blended learning and the introduction of fully online instruction at the second stage, and working in-person, blended, and fully online environments at the third stage. Various studies (Pajo & Wallace, 2001; Finley & Hartman, 2004) have demonstrated the motives why teachers are reluctant to adapt their pedagogical techniques to include online learning and technology integration, including a lack of time, support, or training. One disadvantage of Redmond's (2011) study was that a change in teaching methodology took four years to implement. Additionally, Baran, Correia, and Thompson (2013) conducted a case study on a group of exemplary teachers to examine the shift from traditional to online learning. They discovered that these teachers successfully navigate a three-stage critical path that involves empowering them, encouraging critical reflection, and integrating technology into pedagogy to transform their role in an online environment and adapt their instructional presence to meet students' needs effectively.

The literature indicates that successful pedagogical transformation depends on teacher empowerment, reflective practice, and the integration of technology with pedagogy. It also provides insights into the challenges encountered and the strategies employed in settings like government colleges in Bangladesh. In online distance education, students faced various challenges (Kurnaz & Ari 2024), whereas teachers struggled with technology integration and pedagogy transformation due to inadequate time, lack of institutional support, insufficient training, and resistance to change. Identifying these issues is crucial for comprehending how government college educators in Bangladesh adjusted (or failed to adjust) to online instruction during the pandemic.

Thus, evidence suggests that a number of research projects were carried out in the areas of managing education transformation, pedagogical practices in distance learning, and educational technologies. This study finds three research gaps: limited studies on Bangladeshi government college teachers, insufficient research on the technology integration and pedagogical transformation, and scare literature on crisis-driven pedagogical change like COVID-19. The current study examines technological integration and pedagogy transformation among government college teachers during the epidemic to fill these deficiencies.

METHOD

Research Method

This study followed an explanatory sequential mixed-methods design, in which quantitative survey data were collected first to examine general patterns and relationships among key variables. After the survey, qualitative interviews were conducted to elaborate on and explain the survey findings. This sequential approach facilitates a comprehensive exploration of interrelationships and underlying themes. Also, a pilot test was conducted prior to the main study to examine the relevance and effectiveness of the selected instruments and procedures. The research process prioritized ethical considerations and reliability throughout all stages.

Research Population and Sampling

The population of this study included approximately 2,000 government college teachers with at least five years of teaching experience. A sample of 100 government college teachers was selected for the survey, while 10 teachers were chosen for the interview phase. Convenience sampling was employed for the qualitative phase for time constraints, cost, accessibility, and participants' willingness. In contrast, stratified sampling was employed for the qualitative phase. The interview and survey participants were selected from heterogeneous backgrounds to ensure diversity and feasibility and

align qualitative insights with quantitative data, thereby enhancing the power of explanatory efficacy of the mixed-method design.

Data Collection Methods

An explanatory sequential mixed-methods design was employed in this study. The researcher conducted a survey followed by a semi-structured interview with a purposefully selected group of participants to further explore the survey findings. Brundrett and Rhodes (2013) identify three survey data collection methodologies and discuss the credibility associated with their response rates, noting that telephone and online surveys are both inexpensive and rapid. Therefore, quantitative data were collected using a Google form questionnaire as the first step in the explanatory sequential technique. Following the survey, a semi-structured interview schedule was used to conduct the second phase of data collection with a purposively selected subset of respondents. A semi-structured interview can yield rich data, particularly when the sufficient preparation time is available and interviews can be conducted in a private, comfortable settings (Brundrett & Rhodes, 2013). Additionally, this approach allows the researcher to efficiently collect rich, relevant data through pre-planned, focused questions. Brundrett and Rhodes (2013) identify three survey data collection methodologies and discuss their credibility, noting that telephone and online surveys are cost-effective.

Pilot Study

This study used a pilot study to examine the survey items' reliability and interview questions' clarity, 25 participants participated in a self-administered questionnaire and two semi-structured interview before the main survey. This approach follows Hassan, Schattner, and Mazza's (2006) recommendations that pilot studies are essential for instrumental refinement. The study exposed high internal consistency (Cronbach's α = .934), exceeding Nunnally's (1994) threshold of .70. However, the pilot study also revealed some minor issues with the instruments. In order to address these issues, some items were removed, and others were modified for greater clarity. Additionally, data analysis indicated a few inconsistent and incomplete responses. The majority of the issues were resolved through revisions and refinements.

Data Analysis Method

This study employed both quantitative and qualitative data analysis techniques. Preparation and organization are the primary steps to analyze quantitative data (Creswell, 2012). At the preparation and organization stage, an Excel file from Google form replies was retrieved, data was cleaned, and the cleaned data was transferred to an SPSS worksheet for statistical analysis. Generally, the SPSS software is the most extensively used and prominent statistical software that enables both parametric and non-parametric analyses with assumptions (Ong & Puteh, 2017). Every RQ was broken down into some broader themes and presented in suitable tables accompanied by comprehensive justifications to maintain analytical clarity and align them with the suitable statistical tools (Creswell, 2012). For instance, the RQ1, *Technological and Pedagogical Status before the Pandemic,* was divided into three broad themes: (a) location of the institutions and the available technologies, (b) teaching area and the extent of IT usage, and (c) teaching level and the extent of IT usage. The first theme, the status of the geographic location of the institutions and the available technologies, was analyzed using the descriptive statistics such as mean and percentage. Similarly, the teaching disciplines and the extent of IT usage were analyzed using mean and standard deviation. Likewise, the teaching level and the extent of IT usage were analyzed using mean and standard deviation. Finally, the sub-components of the RQ1 were taken together to critically analyze and align with the demographic findings using independent sample t-test and Pearson correlation. Then again, the RQ2, *Change in Technology and Pedagogy during the Pandemic,* was divided into three sub-components: (a) changes in the amount of technology usage, (b) Approaches to shift online classes during pandemic, and (c) Changes in pedagogy during the pandemic. Likewise, the sub-components of RQ2 were analyzed using mean and

standard deviation and the results were critically interpreted using independent-sample t-test and Pearson correlation to align with geographic findings. Alike, the interview data was analyzed using Creswell's (2012) six steps: data preparation, coding, categorization, representation through figures, tables, and maps, interpretation, and validation of findings' accuracy. Consistent with Creswell's (2012) six-step methodology, the transcriptions were initially subjected to open coding to discern repeating themes and salient utterances. The codes were further categorized into overarching classifications and principal themes, which were directly compared with the quantitative results for convergence and triangulation. Each theme was distinctly associated with one or more research questions. This systematic connection ensured that the qualitative findings effectively clarified and enriched the statistical trends identified in the survey.

Validity and Reliability

The instruments' dependability was assessed through internal consistency analysis. The coefficient alpha test result of 0.934 ensures that the questionnaire has an excellent level of internal consistency (Cronbach, 1984). Because member checking and triangulation were more relevant to this study, we employed them to validate the qualitative results. To assure the study's correctness, firstly, numerous sources of information, personnel, and methods were employed to justify and critically evaluate the arguments (Creswell, 2012). Second, two participants were chosen at random to confirm the correctness of the report by returning the findings to the participants and questioning them about the report's veracity (Creswell, 2012). No participant raised any objections or claims regarding the study's general conclusions.

Ethical Consideration

This study was conducted compliant with the British Educational Research Association (BERA) rules and Bangladeshi ethical norms. Strong ethical practices were followed and all ethical issues were given top priority during the data collecting, storage, and analysis processes. The training institution's course director gave written consent prior to the survey. Participants were provided with a General Information Sheet (GIS), an ethical consent form, and a model questionnaire after their consent. It was done to get their permission and tell them about the specifics of the study. The participants were also informed of the possible challenges and given the assurance that, because their involvement would remain anonymous, the study would not negatively impact their personal or professional lives. Likewise, the recorded interview and the participants' anonymous answers were stored on a password-protected computer. In the data analyses, biases, manipulations, and incomplete replies were removed in an honest manner. Since everyone was treated equally, no community or group was given preference when the results were reported. The American Psychological Association (APA) guidelines were followed, ensuring that published sources were correctly cited. Ultimately, a copy of the report was distributed to a few participants without any tampering with the outcome

FINDINGS

Demographic Findings

Demographic results are organized according to participants' characteristics. The findings shows that 77% respondents were male and 23% were females. The geographical findings of the study show that 44% were from districts, 30% were from divisional cities, and 26% were from upazila. Similarly, respondents' teaching background results show that the highest (33%) were from the arts and humanities discipline and the least (7%) were from education. Additionally, the teachers' teaching level results show that the most respondents were from the higher secondary level teaching, undergraduate, and postgraduate levels, whereas only 8% taught at graduate and postgraduate level. Furthermore, 71% of inexperienced teachers had worked as teachers for two to four years, the remainder for more than four years, and 5% for less than two years. Eighty percent of the interviewees

had been teaching for four years or less, while the remaining twenty percent had more than four years of experience. Lastly, 22% of teachers had no training, and 64% of teachers had fewer than thirty days of ICT training. Only 13% had received more than thirty days of ICT training. In summary, this demographic findings help interpret future studies.

Technological and Pedagogical Status before Pandemic (RQ1)

The RQ1 examines the types and extent of technology and pedagogy used before the pandemic, taking into account the following variables: geographic location, infrastructure, instruments, teachers' technological proficiency, teaching experience, ICT training; teaching level, and teaching disciplines. The combined findings of the variables point to a deficient technical environment and level of use.

The first element is the accessibility of tools and resources. Teachers in Bangladesh's government colleges are not provided with equal resources and tools based on their geographic locations. The degree of IT application in various geographic locations categorized on a four-point scale: unavailable (1), poor (2), fair (3), and excellent (4). The main conclusions state the teachers in the divisional city receive superior facilities compared to other teachers with equivalent qualifications.

Table 1

Location of colleges and available technologies

Available technologies	Mean score (Division)	Mean score (District)	Mean score (Upazila)
Smartphone	3.36	3.25	3.12
Computer	3.25	2.98	2.54
UPS facility	2.54	2.43	2.23
Internet connection	2.68	2.59	2.58
Computer lab	1.96	1.82	1.66
Multimedia classroom	2.32	2.20	2.15
Routine maintenance	2.29	2.41	2.27

Table 1 demonstrates that the smartphone facility was excellent, regardless of its geographical location. Unexpectedly, the worst lab facilities could be found exclusively in three geographic locations: Division (M = 1.96), District (M = 1.82), and Upazila (M = 1.66). Lastly, all regions lacked adequate multimedia and maintenance facilities. However, the results of the interviews revealed that, prior to the pandemic, 40% of teachers occasionally used computers to create multimedia and PowerPoint presentations. Of those who worked in Divisional cities, only three (30%) used digital boards, while 70% used their smartphones to communicate educational content on Facebook. These findings suggest that before to the pandemic, teachers used traditional teaching methods and little technology. In conclusion, both survey and interview results indicate the diversity of technology use across geographic locations within instructional domain.

The field of instruction represents another factor affects teachers' IT use. Differences in IT integration across disciplines likely reflect the variations in pedagogical needs and technological relevance. A five-point scale: Never (1), Seldom (2), occasionally (3), often (4), and always (5) was used to measure the extent of IC use. The data show that Business and Science teachers used technology more than others.

Table 2

Teaching area and extent of IT usage

Teaching area	Mean	Std. Deviation
Science	3.36	0.97
Arts and Humanities	3.48	1.03
Business	3.70	1.29
Social Science	2.88	1.09
Education	3.29	1.60

Table 2 shows that prior to the pandemic, business teachers frequently used technology for teaching (M = 3.70). A similar pattern was noticed for science teachers (M = 3.67). Similarly, teachers of the humanities and arts may employ IT in their lessons occasionally or frequently (M = 3.48). Teachers in education reported a similar pattern (M = 3.29). In contrast, social science teachers demonstrated relatively low level of technology use (M = 2.88) suggesting infrequent or minimal level of technology use in teaching. Interview data also showed that two arts and social science teachers did not use technology before the pandemic. The teaching level may have distinct influence on technology use than geographic locations and instructional areas.

The extent of technology use may have an impact on technology use. Generally, teachers in higher education are expected to possess more experience than those in lower level educational. Therefore, teachers at higher educational level are more likely to use technology.

Table 3
Teaching level and extent of IT usage

Teaching level	Mean	Std. Deviation
HSC	3.38	1.17
HSC & Graduate	3.38	1.12
HSC, Graduate & Post-graduate	3.77	1.17
Graduate & Post-graduate	3.46	1.30
Total	3.46	1.15

Table 3 shows that teachers across different discipline occasionally or frequently used technology for teaching. Teachers at higher secondary, undergraduate, and graduate levels more frequently integrated technology than others (M = 3.77). Additionally, the frequency of technology use was greater (M = 3.46) for postgraduate and undergraduate level. However, teachers at lower levels reported the least frequent use of technology (M = 3.38) compared with those in higher levels. These results imply that gender, teaching level, specialization, and geographic location may affect technology use.

A comparative investigation of independent sample t-test results showed no significant difference between male (M=2.03, SD=0.72) and females (M=1.82, SD=0.63) teachers in IT use; t (98) = 1.25, p = .21. However, a different independent sample t-test reveal a notable difference in the amount of IT between male (M=3.62, SD=1.08) and female (M=3.10, SD=0.72) teachers, t (98) = 2.15, p = .03. Overall, the combined findings indicate that male teachers outperformed female teachers in terms of IT skill. Further analysis is essential to explore the relationships between teaching experience, technological aptitude, and ICT training and IT usage in addition to demographic influences.

Teachers' technological skills were assessed based on their ability to use different tools and platforms including basic computer operations, PowerPoint, online platforms (e.g., Zoom, Microsoft Team, Kahoot!, Google Meet) as well as their capacity to solve basic problems. A Pearson correlation analysis revealed a positive relationship between teachers technological proficiency and their level of IT use (r = 0.28, n = 100, p = .004). Likewise, a positive correlation was found between IT usage before to the pandemic and ICT training (r = 0.50, n = 100, p <.001). However, Pearson correlation indicated no discernible relationship between IT usage and teaching experience (r = 0.14, n = 100, p = .16). there is. These results suggest that training and IT expertise has a significantly influence on IT use than teaching experience. Interviews findings supported these quantitative results. Teachers benefited greatly from technological abilities, while ICT training was less helpful due to a variety of factors, including inconsistent use, teachers' reluctance, and lack of experience, which prompted many to revert to traditional teaching method. The pandemic prompted a significant shift in the learning environment, necessitating the swift adoption of new technologies in teaching.

Change in Technology Usage during Pandemic (RQ2)

The extent of IT use during a pandemic depends on a number of factors, including gender, geographic location, teaching experience, digital skills, subject area, and instructional level. The results indicate that the pandemic remarkably increased teachers' IT use in teaching.

Table 4
Change in in the amount of technology usage

Gender		Before COVID-19	During COVID-19
Male	Mean	3.00	4.42
	Std. Deviation	1.40	0.69
Female	Mean	2.09	4.04
	Std. Deviation	1.41	0.82
Total	Mean	2.79	4.33
	Std. Deviation	1.45	0.74

The findings (Table 4) indicates that the use of technology increased significantly between the pre-pandemic (M = 2.79) and during the pandemic (M = 4.33). During the pandemic, the data exhibited greater consistency as evidenced by the reported lower standard deviation (SD = 1.45 > SD = 0.74). Specifically, before the pandemic, male teachers reported higher and more consistent IT use than female teachers. But during the pandemic, female teachers consistently outperformed men (SD = 1.41, SD =.82). In addition to gender disparities, there could be other causes for the shift.

Initially, it was assumed that variations in IT application might be location-specific. The comparison mean results showed that, before the pandemic, the teachers' divisional city was the most technologically sophisticated and consistent (M = 3.10, SD = 1.47). However, after the pandemic, the district level showed the most progress (M = 4.30). The results of the interviews confirmed that the teachers in the divisional cities get certain advantages. Comparatively, teachers with the least amount of experience used technology before the pandemic, whereas the group with between two and four years of experience had the highest and most consistent usage (M = 2.87, SD = 0.73). However, the group with more than four years of experience showed the greatest improvement (M = 4.42). Nonetheless, the majority of teachers (80%) who participated in interviews stated that while more seasoned educators had utilized a lot of technology before the pandemic, these findings changed during the outbreak. The shift could also be attributed to the level of instruction. Similarly, the data showed that undergraduate and postgraduate level teachers were the most improved than others during the pandemic (M = 4.38) when the mean between teaching level and the extent of change in IT usage was compared, but the top users stayed in the same place. Furthermore, additional research comparing the use of technology in the classroom to the teaching area revealed that social science teachers improved the most during the pandemic (M = 4.1), while having the lowest usage rates prior to the outbreak. However, during the pandemic, science teachers (M = 4.57) replaced business teachers as the top IT users. Nonetheless, according to the interviewees' comments, science and business teachers were the most technologically savvy and improved than the others, using a variety of teaching resources both before and after the pandemic. The pandemic has the potential to significantly alter the way people utilize IT due to the need for technological expertise and training.

There may be a connection between demographic shifts in IT usage and changes in technological abilities and training. The Pearson correlation between IT skills and IT usage declined from (r = 0.28, n = 100, p = 0.004) during the pandemic to (r = 0.21, n = 100, p = 0.039) during it. Similarly, there were declines in IT utilization both before (r = 0.50, n = 100, p = 0.00) and during the pandemic (r = 0.11, n = 100, p = 0.284) according to the association between training and IT usage. Overall, the findings imply that teachers' IT skills or training did not drive the increase in IT use but may have been influenced by other underlying factors.

Change in Pedagogical Approaches during Pandemic (RQ2)

Changes in the extent of technology use influence changes in the instructional approach. In order to investigate the reasons behind changing the pedagogical approach and implementing online instruction during the pandemic, the teachers were asked to score the following statements on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The overall findings suggest that teachers were forced to adapt their instructional approach to fit the online platforms due to situational demands and formal responsibilities.

Table 5
Approaches to shift online classes during pandemic

Approaches to shift online classes	Mean	Std. Deviation
For responsibility	4.23	0.93
For government order	4.17	0.84
From colleagues' inspiration	3.08	1.13
From online support	3.46	0.98
From colleagues support	3.01	1.11
Self-directed	2.76	1.23

Table 5 presents a summary of several approaches to shift classes online during the pandemic. The results indicate that educators predominantly transitioned from in-person to online instruction primarily for their professional responsibilities (M = 4.23) and governmental mandates (M = 4.17). Upazila-level teachers used online tutorials more frequently (M = 4.5) than teachers in other geographic areas. In particular, females (M = 3.57) were more proficient in using online tutorials than males (M = 3.43). Beyond professional responsibilities and government orders to reform pedagogical styles, the qualitative findings revealed that the situation prompted them to change their teaching approach, as all respondents (100%) agreed. Furthermore, beyond identifying the root causes of pedagogical change, it is critical to consider teachers' actual use of online classrooms.

The way teachers conducted their classes reflected changes in pedagogy. Overall, the results of the five-point Likert scale (1 = strongly disagree to 5 = strongly agree) indicate that, with a few notable exceptions, teachers become more focused on the students' needs when teaching online.

Table 6
Changes in pedagogy during pandemic

Pedagogical transformation during pandemic	Mean	Std. Deviation
Teachers encouraged to raise question on online classes	3.79	1.03
Teachers arranged peer-work, group activities and discussion	3.45	0.97
Teachers arranged formative assessments	3.68	0.94
Teachers welcomed students' idea, thoughts and opinions	3.97	0.90
Teachers support students to improve their confidence	4.17	0.91

An overview of pedagogical shift is shown in Table 6. Since the mean score for every statement is very close to the 'agree' level, the results show that the teachers became more student-focused in their online instruction. Males were more student-oriented than females in all situations except group activities. Teachers in education also applied a more student-centered approach than teachers in other fields, emphasizing confidence building rather than generalizations. Teachers who specifically helped students grow their confidence were noteworthy (M = 4.17) and business teachers performed better than other teachers.

Furthermore, technical proficiency may also be necessary for educational reform. However, the qualitative interviews reveal that for a various reasons, the majority of participants (90%) were unable to make the class interactive. One interviewee responded, "I found it difficult to make my class interactive because I get limited time to complete my session," of one interviewee. Another interviewee noted that "because it gets challenging for me to keep an eye on a diverse set of students, I

discouraged their participation". Quantitative analysis further suggested that teaching style, IT proficiency training, and experience may be related. The correlation results show that technical skills and teaching style have a positive link ($r = 0.23$, $n = 100$, $p = .02$). This suggests that technical abilities can enhance flexibility and involvement in online learning. On the other hand, there was no statistically significant relationship between experience and ICT training with student-centered educational approach and technology usage during the pandemic. The government implemented a number of measures to guarantee that students could connect with them, but the outcomes were insufficient when compared to in-person instruction because only around one-third to one-fourth of the students attended.

DISCUSSION

This study reported a rapid integration of technology into teaching and learning and pedagogical shift to online learning during the pandemic. Before this period, inadequate technology provision and infrequent use of technology for instruction was a common feature. The pandemic, however, acted as a catalyst, exposing gaps in training and infrastructure while also accelerating pedagogical adaptation among technologically competent teachers.

To interpret these findings, I used three complementary lenses. Constructivism explained how the pre-existing student-centered practices shaped technology incorporation. Transformative Learning (Mezirow) described how the pandemic acted as a disorienting dilemma that prompted reassessment of teaching assumptions. The impact of teachers' ability on the rate and extent of technology integration is interpreted by Barrett's ICT competency framework. The following sections analyze each RQ through these lenses to move beyond description toward theoretical explanation.

Technological and Pedagogical Status before Pandemic (RQ1)

Technology use is influenced by several underlying factors, including the state of the technology infrastructure (Freeman, 2004), the expertise and experience of teachers (Buabeng-Andoh, 2012), their educational approach (Gibson, 2001), and current practices (Pokhrel & Chhetri, 2021). Constructivists believe that educators' attitudes and classroom practices were the key mediators between technology and educational implementation. Teachers who prioritized interactive, student-centered instruction used multimedia and smartphones more, even when technology was available, teachers' established procedures and expectations limited its use. The existence of equipment like a multimedia unit does not automatically lead to regular pedagogical use: the gadget supports new practices only when teachers' pedagogical frameworks and classroom routines allow them.

The study's findings demonstrate that the government colleges' pre-pandemic technology infrastructure was subpar because the teachers rarely used computers, multimedia, or cellphones. This may be attributed to limited institutional budget and broader economic constraints. The outcomes are consistent with the research conducted in the Indian context by Joshi et al. (2020), who found that teachers used fewer technologies before the pandemic than during it. These findings highlight technological adoption is constraints not only by infrastructure but also by pedagogical practice. Inequalities, such as the concentration of well-equipped colleges in divisional cities, reinforced educational conservatism by limiting access. A constructivist explanation emphasizes that material access alone does not guarantee active usage; teaching and learning beliefs are crucial.

The amount of technology used, which varies depending on the institutions' diverse geographic locations, is another significant result. The divisions for computers, multimedia, and smartphones had the highest average across all geographic locations. The evidence suggests that government institutions could not provide much technological support, which was further biased because only 28% of colleges were located in divisional cities, which had superior facilities compared to other locations. Policy interventions should be context-sensitive: infrastructural development must be

accompanied by pedagogical training and continuous assistance to guarantee fair technology integration across rural and urban institutions. The results align with those of Palau et al. (2021), who explained the disparate infrastructure in Spain's rural and urban areas. Ramij and Sultana (2020), who previously reported on the significance of infrastructure variety in relation to the nations' economic conditions and development status, shared a similar perspective. Thus, the inadequate pre-pandemic technology integration in government universities is not a local issue but a trend in developing nations where economic and policy restrictions meet pedagogical inertia.

Furthermore, it is not possible to deduce that the availability of technology will guarantee its intended uses. The results of this study have validated this idea, as prior to the COVID-19 pandemic, all colleges possessed at least one multimedia facility. However, only 40% of teachers used multimedia in their classes on occasion. This supports constructivist claims that technological tools are only valuable in interactive, learner-centered pedagogies. Teachers' technological proficiency and pedagogical belief determine the extent to which they employ digital resources for instruction. Beyond infrastructural disparities, teachers' digital competency emerged as a key determinant of technology integration. The study found that Barrett's ICT competency framework indicated that instructors' proficiency—comprising practical digital abilities, confidence, and task-specific knowledge—strongly predicted technology use, whereas experience alone did not. This shows that ICT integration into teaching requires targeted skill development, not seniority or length of service. Because proficient teachers use technology more extensively, the study's findings establish that technological abilities positively impact technology usage levels. These results support the findings of Singh and Chan's (2014) earlier research, which found that higher technical proficiency was positively correlated with ICT integration. The results indicate that while experience, training, and practice all contribute to the development of technological abilities (Brown & Pickford, 2006), ICT training had a significant impact, whereas experience did not. The content mismatch between available ICT training and the actual needs of online or technology-enhanced classrooms can explain this. Interviews revealed that training often covered basic computer literacy rather than pedagogical application, leading to a weak connection between formal training and classroom practice.

However, Mahdi and Al-Dera (2013) presented a contrasting perspective, stating that women reported using technology less frequently than men. Minor gender and subject-based variances were less predictive than individual competency levels, demonstrating that skill rather than demographic determinants drove ICT adoption in this setting. The amount of technology used may depend not only on infrastructure and technological proficiency but also on the pedagogical practices already in use. The results of this study demonstrate that teachers occasionally include multimedia resources in their lessons to enhance student engagement. Constructivist pedagogy encourages teachers to adopt a student-centered approach (Shu-jie, 2010). Constructivist, learner-centered environments foster technological integration. When the crisis hit, teachers who occasionally used formative evaluation, group discussions, and creative tasks showed latent technological readiness. As a result, they had to modify their pedagogical strategy to fit online platforms, which substantially altered how they adapted to technology and transformed pedagogy.

Technological Change during Pandemic (RQ2)

The findings of this study show that the pandemic acted as a catalyst for accelerating technology use in teaching. Rather than viewing technology as an auxiliary tool, educators recognized it as an integral part of sustaining instructional continuity (Jin et al., 2021; Pokhrel & Chhetri, 2021; Peimani & Kamalipour, 2021; Truzoli et al., 2021). According to Mezirow's (1991) Transformative Learning Theory, this change represents the initial phase of transformation, in which a crisis force to critically reevaluate their pedagogy. Teachers faced the shortcomings of traditional, face-to-face teaching methods and reformed their professional identities towards technology enabled reflective adaptation. Aligned with the improvement of teachers' technological skills during the pandemic, Arantes et al.

(2023) reported that students improved their IT and communication skills during pandemic. These findings not only reflect a quantitative increase in technology use for teachers and students but also signify a qualitative shift in teachers' pedagogical practice, highlighting a closer alignment between technology integration and instructional strategies.

A key insight is that teachers' pre-existing IT skills, rather than the formal ICT training, emerged as the strongest determinants of effective online teaching. These findings resonate with Barrett's (2010) ICT competency Framework, which postulates that teachers' IT competency could significantly increase their confidence in pedagogical experimentation. However, it also exposes a serious weakness in institutional readiness because the pre-pandemic ICT training was primarily theoretical and less aligned with practical application in classroom. Therefore, the lack of contextual evaluation and experiential interaction during training limits transformative learning. The outcome is consistent with Spitzer's (1984) findings sometimes the instruction is often ineffective when it lacks relevance or follow-up assistance. Additionally, the results show that teachers' informal and self-directed learning was a major factor in their adaptability. Stronger digitally literate teachers used experimentation in demonstrating transformative learning theory (Mezirow, 1991), which holds that crises encourage introspection and a shift in viewpoint. Conversely, those who lacked skills tended to use technology with their peer support primarily to replicate conventional habits online, relying mainly on a few recorded videos. This collaborative behavior reflects the application of social constructive model (Vygotsky, 1978), wherein teachers build competency shared knowledge and reciprocal learning. But the discrepancy emphasizes that the ability to critically examine and interpret one's teaching practice is just as important for transformation as exposure to technology. Therefore, the contrast underscore that technological exposure alone is insufficient; transformation requires critical reflection and social engagement that link theory, experience and practice. Practically, the findings convey significant implications for government colleges. Institutions often constrained by rigid bureaucratic structures and scarce resources must move beyond isolated ICT training towards continuous, practice-based professional learning. Investing in context-specific, peer-supported training programs could enhance both digital literacy and pedagogical innovation. Aligning with Transformative Learning Theory, teachers' training should emphasize experiential engagement rather than abstract skill acquisition. Moreover, administrators should recognize that developing teachers' confidence is as essential as providing infrastructure. Nevertheless, the interpretation of these results should be made with caution. The study's dependence on self-reported data can inflate the true degree of technological integration, and results may vary across situational context. Additionally, the short timeframe of data collection limits conclusions about the sustainability of behavioral change. In conclusion, the pandemic did not merely increase technology use; it transformed teachers' pedagogical identities, revealing that confidence, relevance of training, peer support, and institutional support are critical intermediaries of transformation. Thought the combined lenses of Transformative Learning, Constructivism, and ICT competency reveals that technological change is not driven by training alone, but the interaction of reflection, collaboration, and competence. These insights contribute to the growing understanding of how crises can accelerate-not just disrupt-educational innovation, particularly resource-limited government college contexts.

Pedagogical Transformation during Pandemic (RQ2)

A radical shift in pedagogical approach resulted from the abrupt transition from traditional classroom settings to virtual learning environments. According to Crawford et al. (2020), it will take time to transition from a wholly online delivery strategy to traditional or blended learning. The need to adapt to technology is one of the factors that necessitate pedagogical reform (Peimani & Kamalipour, 2021). This study identified that teachers mostly adjusted to online learning because of their obligations and compliance with laws. Applying transformative learning theory, the coercive nature of this adaptation represents an externally triggered transformative experience. Teachers' professional identity and sense

of responsibility acted as motivators for compliance, while reflection on teaching purpose led some to internalize the change, gradually reconstructing their pedagogical beliefs. Even though in-person and virtual learning differ greatly, educators sought to make online classes engaging through formative assessments, group discussions, and student involvement. While transformative learning theory describes teachers' attitudinal and reflective adaptability, constructivist analysis emphasizes virtual environment interaction and design. From a constructivist standpoint, teachers failed to design collaborative experiences and sustain sufficient interaction despite their efforts. Given these results, concerns about the interactivity of online classes remain valid. The lack of interactivity reflects broader scholarly concern about online learning system. This aligns with the previous critiques of online learning interaction (Mabrito, 2004; Kent, Laslo, & Rafaeli, 2016; Abrami et al., 2012). These findings raise important questions about the effectiveness of teachers' efforts and students' perceptions of learning outcomes. The interviews found that teachers struggled to engage students in online classes. This contradicts Martin, Parker, and Deale's (2012) research of graduate students in a southeast US instructional technology program, which showed how dynamic online virtual classrooms can be. More importantly, Martin, Parker, and Deale's (2012) findings do not apply to this study since participants' talents and knowledge with online virtual platforms vary. Despite engagement difficulties, a broader pedagogical transformation occurred. Inexperienced educators may have played a significant role in the quick adoption of new technologies and the evolution of education (Dvir & Schatz-Oppenheimer, 2020). The evidence indicates that there was a rapid yet situational pedagogical shift during the pandemic. Consequently, to translate the findings into practice, a few crucial recommendations that surfaced during discussions must be considered. While it will take time for educators to adapt to technology and for pedagogy to change, external factors and commitments may accelerate this process. From a policy perspective, government colleges should institutionalize this momentum by embedding reflective professional development and peer mentoring programs to sustain pedagogical innovation beyond crisis conditions.

CONCLUSION AND RECOMMENDATION

This study confirmed that teachers' instructional approach was more traditional, with little application to technology before the pandemic. However, the pandemic accelerated the teachers' technology integration in education.

This trend shows teachers' enhanced IT proficiency and openness to online learning environments and pedagogical change, which has boosted their professional dynamism and digital readiness.

These results support transformative learning theory by showing that disruptive occurrences can change teachers' beliefs and practices.

The findings also align with constructivist since the learners constructed new knowledge through interaction and experience. The student-centered, interactive, and reflective method of teaching with the help of educational technologies confirms a shift towards constructivist. They also align with technology adoption models that assumes individual skill, perceived utility, and environmental factors influence technology integration in teaching. When combined, these results can have a good effect on IT promotion, which would otherwise need significant effort and financial investment to accomplish. While it will take time for technology to adapt and pedagogy to adjust, external factors such as obligations and circumstances can hasten this process.

To maximize IT integration and improve educational achievements in present and post-pandemic contexts, educators need ongoing support to enhance their skills, build experience, and manage contextual pressures. Educational institutions should provide IT-focused professional development, encourage peer collaboration to share best practices, and support online teaching infrastructure to maintain these advancements. Finally, researchers may study the long-term effects of pandemic-induced IT integration, while policymakers may develop digital pedagogy incentives.

Limitations and Future Study

There are several important limitations to the study that must be addressed. First, the researcher was unable to make generalizations about senior teachers because the study was restricted to juniors. The most significant limitation is that the study was conducted exclusively from the teachers' perspective, although the administration's and students' responses may have produced more accurate findings, particularly when it came to determining how the teachers, students, and administration interacted. Another limitation concerns the lack of direct physical contact with the survey respondents can introduced some uncertainty about the accuracy of the responses.

Despite these drawbacks, the research points to a notable improvement in teachers' use of technology and a shift in pedagogical transformation throughout the pandemic. Given these constraints, the author suggests that further research be done to look into the difficulties and solutions associated with integrating technology and modifying pedagogy to reflect the times we live in. The author suggests that government-sponsored training programs with an emphasis on online distance learning pedagogy and technology be set up. Finally, the author advises increasing engagement in online pedagogy and suggests continuing to adopt a blended-learning strategy after the pandemic.

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