

Classrooms in Transition: Understanding the Impact of Educational Technology in a Pakistani School

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Abstract

Technology has redesigned the education sector by introducing e-learning and virtual systems, presenting novel opportunities for teaching and learning. However, its implementation in the schools of developing countries is yet to be explored. Therefore, the current research focuses on measuring the impact of integrating digital tools on teaching and learning, on 7th-grade classroom at a government school of Pakistan. This research uses a mixed-method approach, comprising pre- and post-surveys, interviews, and classroom observations. Descriptive statistics are used to analyze quantitative data, while Haas's adaptation of the Colaizzi method is employed for qualitative data examination. The study incorporated David Thornburg's device-sharing model for a fair use of technology, because of limited availability of the devices. The results demonstrated a visible improvement in instructional quality and student engagement through the use of digital tools, which facilitated audio-visual aids. Enhanced efficiency in teaching has been reported by the teachers. Learners confirmed their increased conceptual understanding, problem-solving skills, communication, and collaboration. However, not all the students could benefit because of their limited exposure to technology and low socio-economic background. These findings emphasize the dire need of such education policies which support the integration of digital tools to better prepare the students for future.

Keywords: Pedagogy, Teaching, Learning, Technology, Colaizzi method, Google for Education Tools, Google Solutions

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Introduction

The integration of technology into education has developed as an inevitable need due to the rapidly evolving digital era today. Digital tools are revamping the learning and teaching experiences as classrooms transform from the traditional chalk-and-board arrangements to more evolving, real-time learning environments supported by tech-enhanced setups. This shift is making a visible impact on student's learning experiences (Cloete, 2017). Technology brings innovative avenues, from online platforms and interactive apps to real-time response systems to virtual simulations, for getting more engaged learners, customizing their tutoring, and facilitating a wide range of educational requirements. Numerous researchers have highlighted number of advantages related with integrating technology into the classroom, including enhanced student's involvement and better personalized experience, along with some challenges (Syamsul & Bahri, 2024; Wang & Li, 2024; Zheng, Yuan and Pan, 2025). Therefore, making technology a significant and beneficial part of education entails a meticulous designing of a plan which also needs to capture a clear understanding of the obstacles and challenges involved in this transition (Khan *et al.*, 2022). This research focuses on exploring the multidimensional role of digital tools in school education, investigating how implementation of these tools impact teaching practices and student's learning, and at the same time considering the obstacles and challenges involved for effective implementation.

The notion of digital learning actually captured the limelight during the global pandemic, when more than half percent of the world's school going kids population got disturbed due to schools' closure (Soon, 2020). This led to the accelerated adoption of e-learning models and digital classrooms throughout the world (Stoian *et al.*, 2022). The educators started working more enthusiastically since then to integrate technology more deeply into everyday learning. While the majority of developed countries around the globe have now adopted digital learning; developing nations including Pakistan continue to grapple with how to successfully incorporate technology into their educational systems. Barriers such as limited access to technology, internet, socioeconomic differences and other limitations have prevented the successful integration of digital learning throughout the region. Additionally, most students in Pakistan do not have access to the devices needed to engage in digital learning i.e. computers/tablets nor do they have reliable internet connections which is an additional barrier to participating in digital learning. Many teachers within developing regions lack the appropriate training or resources to properly utilize digital tools to aid in the instruction of students (Ghani, Malik and Ullah, 2024).

As a result of the above-mentioned context, the purpose of this research is to demonstrate the potential benefits of incorporating digital tools into a traditional classroom environment so that educators and policymakers will be able to better understand the positive impact technology can have on teaching/learning. The added benefit of using technology in the classroom includes identifying potential obstacles/barriers. In light of this, the following research objectives were established for this study:

1. Explore teacher/student perceptions regarding the utilization of technology in the classroom prior to the implementation and post-implementation of technology.
2. Examine how utilizing technology in the classroom affects the experience of teaching and learning.
3. Investigate the challenges associated with the incorporation of digital tools into a traditional classroom.

The inclusion of technology within education is becoming an increasing focal point for both researchers and educators. With the continued evolution of classrooms and education, digital tools are being incorporated into the classroom as foundational components for effective instruction. Over time the application of technology in education has evolved; initially digital learning was generally limited to planned trips to school computer labs, where students were allowed to utilize pre-set software programs or engage in simple typing exercises. However, schools began to incorporate desktop computers into individual classrooms, and later replace them with more portable and interactive technologies such as tablet devices and smartboards. Currently, there exists an ever-expanding array of digital technologies available to support instructional delivery including online learning environments, virtual classrooms, Learning Management Systems (LMS), and even AI-based applications that offer customized learning experiences (Holmes, Bialik and Fadel, 2019). Such transitions have afforded opportunities for increased student engagement, creativity, collaboration, and flexibility within the modern classroom environment (Wang & Li, 2024). Additionally, this evolution allows teachers the opportunity to create different methods for presenting content using video, interactive assessments/quizzes, and virtual simulations. Furthermore, technology affords a level of personalization for students by allowing them to access material at their own rate of learning and receive immediate feedback regarding their performance (Momani, Alharashah and Alqudah, 2023).

While there is clearly both excitement and anxiety surrounding the integration of digital tools within the educational environment, many educators believe that technology offers opportunities to create a more interactive and manageable lesson. The ease at which one can organize materials or give immediate feedback makes digital tools ideal (Syamsul & Bahri, 2024). However, other educators are concerned that they will be unable to

confidently utilize new technology in the classroom. Additionally, some worry that students will be distracted from the lesson material and therefore will not learn the intended information (Tondeur *et al.*, 2017; Khan *et al.*, 2022). Similarly, students have shown enthusiasm towards digital tools once they understand how to properly use them. Students who have previously felt apprehensive towards utilizing digital tools in order to complete tasks related to their learning expressed greater comfort level after having gained experience working with those technologies (Wang & Li, 2024). It appears that both teachers and students will grow in confidence if provided adequate support and training to use technology in their own unique ways.

Despite the numerous benefits associated with educational technology, there are still several obstacles to overcome before technology can reach its full potential. The most obvious challenge is a lack of physical infrastructure in many schools located in developing countries. For example, schools may not have reliable access to electricity. Schools may have dated equipment, and may not have reliable internet connectivity. These conditions make it difficult for students to gain equal access to digital resources. Lack of professional development for teachers is another major obstacle. If teachers do not receive appropriate training, then they may feel inadequate to assist students with their academic work. This leads to either frustration among educators or resistance to implementing technology into their curriculum (Aijaz *et al.*, 2024). Studies conducted within the Pakistani context reveal that although policy makers continue to recognize the value of providing students with quality digital education, the implementation process continues to remain stagnant. Technology sits idle in many schools that have all the necessary tools because teachers were not adequately prepared nor was administration able to offer the required support (Nazir *et al.*, 2026).

Although research continues to emerge about how technology is changing education across the globe, most of that literature focuses upon private institutions where access to digital resources is plentiful (Tondeur *et al.*, 2017). Unfortunately, there is very little research about how technology is being utilized in public sector schools, especially within developing nations like Pakistan. Typically, the perspectives of teachers and students from these types of institutions are marginalized. Therefore, we know relatively little about what digital tools look like in a variety of settings around the world where resources are scarce (Jamil *et al.*, 2025). Moreover, there is a continued knowledge gap about the everyday problems faced by teachers when attempting to incorporate digital tools into their curricula. This study seeks to contribute to filling that void by examining specifically the integration of technology in a public sector school in Pakistan. The purpose of this study is two-fold. First, the findings of this study will highlight the positive effects of technology on

instruction and student learning. Second, this study will draw attention to the real-world challenges that public sector schools face when attempting to implement technology and encourage educators to develop a more realistic perspective of the role of technology in education within Pakistan.

Research Design

Case for the Research

The Islamabad Model College for Girls (IMCG), situated in the capital city Islamabad, has been chosen as a case for this investigation. The prime reason for its selection is due to its location which has better infrastructure and superior internet connectivity. The digital platform selected for this research is Google for Education Tools, widely used and adopted in the education sector. These tools are of great help to educators and learners due to the provision of its easy-to-use and collaborative tools, ultimately revolutionizing the traditional class experience (Salih, 2021).

The participants included all the teachers and students of grade 7 of IMCG. They were given formal training for the span of five weeks to use Google for Education tools through Chromebooks. The number of 7th grade teachers are ten, having diverse experience ranging from just three months to thirty-eight years. The registered students in 7th grade were seventy.

Device Sharing Model

In the current investigation, David Thornburg's device-sharing model was used because there were only 35 devices for 70 students (Thornburg, 2013). Each pair of students shared one device and desk. One student from the pair known as the "Keyboard Captain" was responsible for typing notes during discussions. This role rotated daily between students, who were divided into List A and List B to keep track. On one day, the List A student would use the device; the next day, the List B student would take over. The teacher used her own Chromebook throughout and could assign tasks to the whole class or start group discussions. For tests, she could either give a shared group test or separate tests to List A and B. While one group took the test on the device, the other was given alternative tasks, switching roles afterwards.

Research Method

Considering the objectives of the research, a mixed method study was adopted. Data collection involved pre-survey, interviews, class observations, post interviews, and post-survey (See Figure 1).

Surveys: The research started with a pre-survey both for teachers and students. It was based on in-built quantitative research questions distributed to the teachers and students through Google Forms. The survey content included items related to the following themes; Background of the participants, Frequency of technology usage in the classroom, Comfort level with Google Solutions, Schedule and Effect of Google Solutions on Participant's time, Participant's level of comfort and difficulty with devices, Impact of Google Solutions on learning and teaching, General Satisfaction with Google Solutions and Chromebooks. Five-point Likert scale was used to measure the degree of perceptions. The questionnaires were completed by teachers and students both, before and after the use of Google solutions (pre- and post-surveys). The questionnaires was developed considering previous studies (Albashtawi and Al Bataineh, 2020).

Interviews: Interviews were carried out based on pre-survey findings. These interviews were qualitative and included open-ended questions revolving around the mentioned themes. These interviews were conducted specifically with the teachers before and after the technology usage.

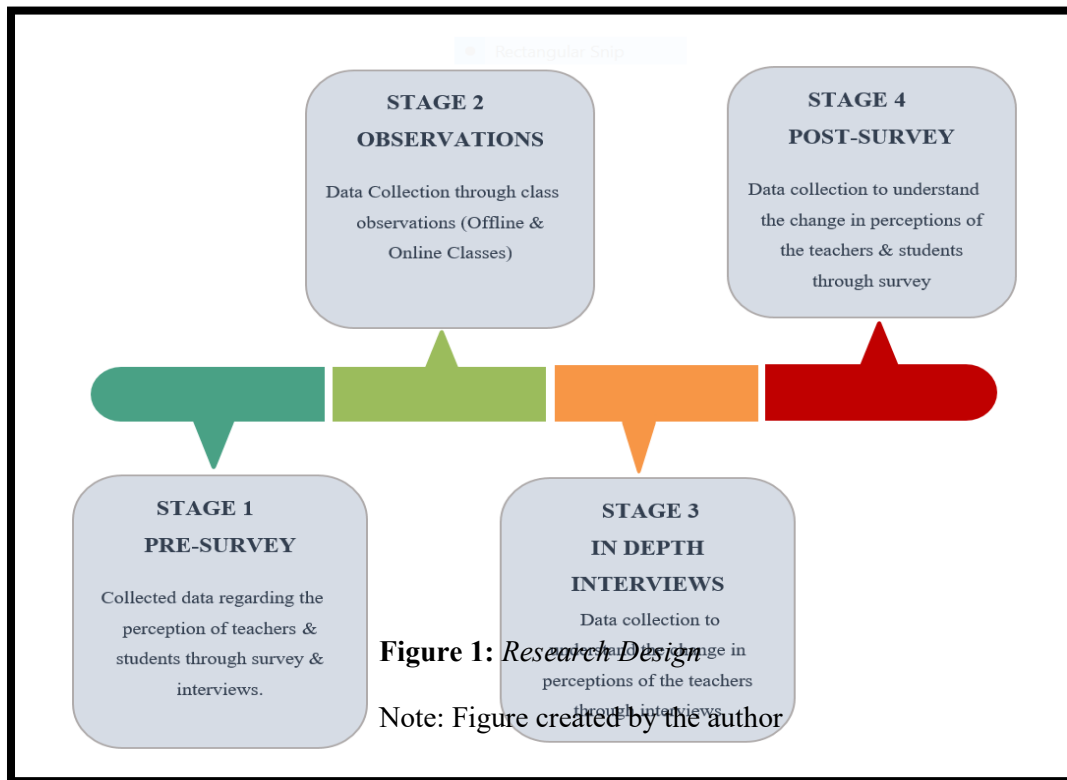
Training Session: Based on the results, the trainer was given recommendations for planning the training. The training session was based on five weeks for teachers and two weeks for students. After the training sessions, teachers and students shifted to technology-enabled classes by utilizing the applications offered by Google Solutions.

Observations: Classroom observations (Offline and Online) occurred once the transition took place. Observations were carried out considering the above-mentioned themes.

Data Analysis

Quantitative data collected through surveys are analyzed using descriptive statistical methods (Loeb et al., 2017), using MS Excel. In contrast, the qualitative component of the research employs Haas's adaptation of Colaizzi's method, a rigorous and structured approach to thematic analysis (Haq et al., 2021). This dual approach ensures that

both numerical trends and deeper experiential insights are effectively captured and analyzed.



Findings

4.1 Teacher's Survey Results

The results from the survey showed how educators viewed technology, how educators utilized technology, the number of struggles that educators faced while trying to utilize technology, how educators managed their time for teaching as well as student engagement. Approximately seventy percent of all educators indicated that they were encountering challenges when utilizing technology in the classroom, whereas approximately thirty percent felt that there were some benefits to utilizing technology in the classroom and therefore attempted to do so. When asked about frequency of usage for educational technology; only a small percentage (approximately twenty percent) of educators reported that they used educational technology at least two times a week.

Additionally, most of the surveyed educators did not feel confident when attempting to utilize Google applications. The majority of the issues that educators experienced included: limited access to reliable internet connections, insufficient number of available educational devices, and inadequate amounts of professional development/training. Educators also experienced other related issues such as: an educator's ability to effectively operate the technology/educational application tool(s), sufficient time for instruction and/or utilizing educational technology, as well as dealing with various forms of technological issues including: software malfunctions/glitches, hardware malfunction/glitches, slow internet speeds. Some teachers also mentioned that not all students have smartphones, which makes things harder. While teachers said that about 75% of students stay engaged in class, very few teachers (just 12%) are fully focused on student-centered learning. In fact, half the time, they don't prioritize student interaction at all. Teachers also admitted they don't use their time efficiently, most of it goes into marking or grading instead of actually teaching, mentoring students, or developing professionally.

Student's Survey Results

Students' feedback from the same survey was not very different from the teachers, however, their technology usage and familiarity with Google Solutions were much better than their instructors. Although half of the learners do not use technology in the classrooms, the other half percentage of the students do take advantage of it. 15% of them practice it for 3 times or more per week. Approximately 43% of them have a basic level of comfort in using Google Solutions. Regarding the ease of use of Google apps, most of the students are quite confident in using Google applications. However, they have a basic understanding of these applications and want to learn and experience them further to enhance their understanding of their usage. The biggest obstacle to using technology is the lack of access to technology, as mentioned by the students. The other two factors that play a part in this regard are insufficient time to learn to use technology and lack of training. Maximum interruption in the use of technology is due to the interruptions with the apps. 74% of the students feel that are generally engaged in the class.

Teacher's Interview Results

The results from pre-interviews showed that teachers did not use technology in the classrooms earlier. However, since the onset of Covid-19, teachers had to use technology to conduct online classes and examinations. For this purpose, they used mobile phones and WhatsApp groups to deliver lectures and share materials with the students. The students also had limited gadgets at home. Most students had to use their parent's mobile phones

and share that device among other siblings too. After the lockdown period, mobile phones were also used in the classrooms to access visual aids. The teachers noted several benefits of technology usage in the classroom. Before technology, teachers had to try to explain a certain topic to the students. With technology usage, teachers could cover more material in a short period. It was timesaving for the teachers, which reduced their workload. Technology usage also helped the teachers to improve lectures using visual aids and increased the student's learning. The freedom to access material also provided teachers to manage content accordingly for each subject, as each subject has its requirements for teaching (see Table 1).

Table 1

Teacher's Perception of Technology Usage and Benefits

Areas	Opinions
Usage frequency	<ol style="list-style-type: none"> 1. No usage 2. Started using during Covid-19 lockdown 3. Mobile phones were used in the classroom 4. Mostly in touch because of computer science subject 5. Used visual aids
Benefits of using technology	<ol style="list-style-type: none"> 1. Benefits are subject-oriented 2. Accessible and time-saver 3. Fast 4. Cover more material 5. Helps in preparation of lectures in subjects other than English 6. Better presentation of lecture (visual aids) 7. Student's learning will increase 8. Knowledge sharing with students 9. Freedom to access material 10. Content management

Since the teachers were somehow familiar with technology usage in the classroom, Google Solutions provided them with options to manage content, such as exam management, assignment submissions, and statistics. Most teachers found it user-friendly and interactive, but some were concerned about typing in other languages. Nevertheless, the teachers still plan to integrate it with their lesson plans because Google Solutions reduces the time for lecture preparation (see Table 2).

Table 2

Teacher's Perception regarding Comfort Level and Integration of technology

Areas	Opinions
Comfort level	<ol style="list-style-type: none"> 1. Comfortable enough for everyday usage 2. Moderate comfort, typing in other languages is difficult 3. More comfortable with MS office as compared to google solutions 4. User friendly 5. Not comfortable because not gadget friendly 6. Comfortable at a basic level
Integration of Google solution with the lesson plan	<ol style="list-style-type: none"> 1. Reduces time for lecture preparation 2. Assists in making precise lectures 3. Not used in class, need more time to practice without workload 4. Lesson plans made are interactive in nature (audio and videos) 5. Comfort level is 7 out of 10 6. Exam management will be easier

Teachers also highlighted barriers and challenges regarding the technology usage in the classroom, as depicted in Table 3.

Table 3

Teacher's Perception regarding Technology Obstacles/Challenges

Areas	Opinions
Existing teaching style (traditional or non-traditional)	<ol style="list-style-type: none"> 1. Traditional style that lacks student engagement 2. Restricted to using traditional style due to huge curriculum 3. Traditional method is boring for students 4. Story-based/point-based teaching increases learning 5. Interactive learning prompts the student to explore more 6. Mix and match both traditional and non-traditional styles
Recent pedagogical methods Causes of non-implementation	<ol style="list-style-type: none"> 1. Not know much but coming across them 2. Lack of infrastructure; a cause of non-implementation 3. Difficult to implement new pedagogical methods because students come from varied backgrounds 4. Parents do not understand the latest pedagogic methods

	<ol style="list-style-type: none"> 5. Culture issues hinder the implementation 6. Lack of resources and required environment 7. Workload obstacles implementation of pedagogical methods
Difficulty in progress tracking of students	<ol style="list-style-type: none"> 1. Challenging to manage, class size should be approx. 30 2. Examination pattern needs to be modified 3. Large class size undermines teacher's capabilities 4. Difficult management with the traditional setup 5. Smaller physical class also makes it hard to reach student physically 6. Time consuming 7. Difficult to communicate progress with parents 8. Hard to focus on each student's progress
Nature of activities carried out in class	<ol style="list-style-type: none"> 1. Physical experiments like games 2. Limited activities because restriction of going through the entire syllabus 3. Design unseen questions to provoke the thinking process of students 4. Stories and suspense words 5. Warmup questions 6. Group discussions
Teacher's learning and development	<ol style="list-style-type: none"> 1. Refresher courses/training are required for improvement according to each teacher's capabilities 2. Lack of material availability 3. Use YouTube and Google to improve my skills 4. Improved my typing speed and lecture-making skills 5. Guidance from colleagues and seniors helps 6. Out of touch with improvement due to workload 7. Technology helped in increasing knowledge
Obstacles using technology in class (teaching material, sources, process)	<ol style="list-style-type: none"> 1. Limited infrastructure 2. Materials are hard to find for subjects (e.g., Islamic studies) 3. Limited number of devices available in computer lab 4. Did not use technology in the classroom 5. Student distractions because of lack of familiarity 6. Unavailability of gadgets to students 7. Some students lack interest in technology usage

Offline Class Observations

The observations showed that teachers were somewhat comfortable using Google Solutions in the classroom. The touchscreen Chromebooks made it easier for both students and teachers to navigate apps, which made learning more interactive and fun for the students. Teachers made great use of Google Slides as a tool to create interesting lesson plans. The visual aspects of the slides greatly enhanced their ability to be able to help students learn. Additionally, with all of the Chromebooks having access to Google Slides, students that may have otherwise been unable to see what was being written or shown at the board due to their location could still view everything. In addition to improving classroom interaction by teachers being able to assess individual student progress easier than before, Google Solutions also allowed all students to actively participate in class discussions via the chat feature built into Google Docs. Also, it became easier for teachers to monitor which questions their students had difficulty answering during quizzes and keep an eye on how well their students are performing. However, there were several issues. One of the biggest issues was that there simply were not enough Chromebooks available. If each student was able to have a Chromebook available while they were learning, this would have created a completely different learning experience. Power outages during class time also disrupted lessons. Finally, a few teachers struggled with the technology, showing that more time and training are needed to help them adjust to digital teaching methods.

Online Class Observations

The teachers of all the subjects seemed to easily handle the lecture when conducted online. They carried out the lecture fluently and presented their lecture in an effective manner. They followed a similar style of classes during Covid-19. That previous practice helped them in organizing their lecture content and time. The positive aspects of using Google Solutions include improved student engagement, real time participation check, easy monitoring of student's progress and efficient content sharing between teachers and students. On the down side, as much as the students were excited to learn this new style of learning, they were distracted by other available options on Chromebook. This hindered the lectures and the teachers had to constantly try the control mechanisms to keep the students focused.

Teacher's Post Interview Results

The themes and sub-themes extracted from the interview results are shown in Table 4, Table 5 & Table 6. Most of the teachers were satisfied with this new teaching methodology. However, when they were asked about the efficiency of this method, one of the teachers quoted as: *"Totally improved the efficiency, the students are more involved,*

this teaching method also contributes to the memory of students.”Not only has the technology usage assisted the teachers in making their content and lectures more effective, but it has also improved the student’s learning efficiency. However, some teachers also highlighted that due to the nature of subjects such as Mathematics, a hybrid teaching mode is required where the teacher can explain the process in detail using a whiteboard. The teacher’s opinion is as: *“There should be hybrid model due to demand of subject.”*

The classroom command also changes significantly. The students were engrossed in the chrome books. This shows that the teacher could make an interactive lesson that captured the student’s focus. One of the teachers observed as follows: *“It also depends on students, now they are so much engrossed, I don’t have to control the class like I used to in the traditional teaching methods.”* One of the teachers believed that a high number of students in the class proved to be difficult to maintain classroom command. One of the teacher's views as: *“Control is difficult while they are using the chrome books, class strength should be low.”*

Table 4

Satisfaction, Efficiency and Classroom Command

Themes	Opinions	Experts
Satisfaction level	Most teachers were satisfied after using google solutions. On average 8/10 teachers were satisfied.	“I am satisfied with Google Solutions as it has made teaching and learning easier. I prefer Google search and other Google solutions as they are useful and reliable.”
Efficiency	Teachers expected increase in their overall teaching efficiency	“Google Solutions have helped improve the efficiency of my work in several ways. Google's productivity tools, such as Google Docs and Google Drive, allow me to collaborate with other teachers and students and save important data and information in a secure and easily accessible manner. Overall, Google Solutions have played a

		significant role in enhancing the efficiency of my work by providing me with powerful tools.”
Classroom Command	Less intervention was required by the teachers	“The class command changed with Google Solutions as they were more interested in learning with visual aids.”

Regarding the teacher’s learning and knowledge depth most teachers were satisfied with Google tools. They found the slides to be excellent in facilitating them to deliver a lecture with audio and visual aids. These tools have also eliminated the sole reliance on course books. The teachers could improve the quality and quantity of their lectures by incorporating various sources. One of the teachers said as: *“Material wise, we used to use text books only, now we use varied internet sources to prepare lecture. This helps us to prepare an authentic lecture that is full of rich content from different sources, since my subject demands variety.”*

Moreover, the teachers had many options to strategize their lectures. For example, one of the teachers stated as: *“It is easy for me now to teach. Now I have to make more strategies to deliver lecture, I have to be well prepared using the content and tools.”* Nevertheless, those teachers with no prior experience using technological tools were a bit nervous regarding their usage. For instance, one of the teachers narrated: *“For teaching purpose, it is good, but confidence level will take time.”*

Table 5
Teaching depth, Student learning and Engagement

Themes	Opinions	Experts
Teaching and learning depth	All the teachers were of positive opinion by using Google tools to prepare their lectures.	“Traditional methods were not that rich content quality and quantity wise.”
Learning for students	The device sharing model improved learning capabilities of slow learners in the class.	“It has greatly helped to the slow learners. The combination of slow and fast learners helped students in better learning with enjoyment.”

Communication	Student-student communication improved. The teacher-student communication reduced because of focus on the chrome books	“The communication has improved significantly, if they could take the chrome books at home, the communication would have been better.”
Student Engagement	Mixed reviews were dependent on the type and nature of subject taught	“Google Classroom facilitated communication with the students in real-time. Google solutions like Google Docs, Sheets, and Slides are also highly effective in facilitating collaboration and communication among students. In terms of feedback mechanisms, Google solutions provided a variety of tools for personalized feedback e.g. Google Forms to create interactive quizzes and assessments that provide students with immediate feedback, while Google Classroom allowed providing individualized feedback to students on their assignments.”

The student’s learning capabilities also improved using Google Solutions tools. For example, they learned how to use various typing keyboards for subjects such as Urdu, Mathematics and Arabic. Also, the History teacher stated as: *“This has helped us to use google earth and maps, to visualize the history topics.”*

The device-sharing model also encouraged and created an environment of group learning. The fast learners took the lead and taught the slow learners. This was usually not possible in the traditional class setup. The English teacher was of the opinion: *“Class strength is huge, but sometimes group study is effective in the sense that weak students also benefit from the brilliant students. Students can access the material anytime, and repeated exposure to the material enhances learning.”*

The student-student communication improved as all of them were excited to learn from this new teaching method. However, the only limitation in the student-teacher

communication was that the students were not allowed to take Chromebooks to their homes. Teachers believed that students should also have Chromebooks at home to forward their queries and communicate other concerns whenever they practice at home. This will improve their communication skills and their learning capabilities.

Teachers had mixed opinions on student's engagement via Google class. One of the language teachers believed that a hybrid model needs to be followed so that the student's speaking skills are also improved. The teacher stated as: *"The student engagement with the traditional method was more effective because in they used to read from the book, this improved their pronunciation skills but with the chrome books we could not access each student's speaking capabilities of the students"*.

Teachers' overall perception about using Google Solution tools also changed. Most of the teachers did not have prior knowledge or training about technology usage in the classrooms. The Google Solutions training provided to them greatly helped them gain knowledge and confidence to improve their teaching skills using Google Solutions tools such as slides, docs, and meet. For example, the Persian teacher narrated: *"Before using it, I thought it would be difficult but after using the google solution my perception is converted to now possible."*

Table 6

Teachers' overall perception about using Google Solution tools

Themes	Opinions	Experts
Teacher's perception post using Google solutions	Positive expectations were met after Google solutions implementation	"Before we had concerns that is it going to work or not, but after using it, it became quite interesting."
Advantages/strength	<ol style="list-style-type: none"> 1. User-friendly interface 2. Easy monitoring of the students 3. Effective lectures 4. Time saver-less hectic for teachers 5. Accessibility to all students 6. Collaborative tools: Google Solutions like Google 	"The slides are self-explanatory, it has reduced our effort to use the white board, and time saver during lecture, which provides room to focus more on other learning techniques, material is always available to the students."

	Docs, Sheets, and Slides allow collaboration real-time	
	7. Audio/visual aids	
	8. Increased student engagement	
Challenges/weakness	1. Internet connectivity issues	“Typing issues to teach the math subject, inserting the symbols is time consuming, but it needs to be user friendly. We have administrative tasks overload.”
	2. Shortage of time	
	3. Heavy load of Google applications on the internet	
	4. Less creative options as compared to MS word	
	5. Huge class strength	
	6. Privacy concerns	

Perceptions, Advantages and Disadvantages

Teacher’s Post-Survey Results

After hands-on experience and training, 40% of teachers now see clear benefits in using technology and are actively trying to use it up to 10% from before the training. 60% of teachers still face challenges with technology use. Before the training, 10% of teachers weren’t comfortable using Google Solutions at all. Now, that number has dropped to zero. In fact, half of the teachers now feel confident using these tools. Similarly, integrating Google Solutions into lesson planning has improved: where 25% previously struggled, now only 10% do. About 50% of teachers now feel basically competent, and 40% feel very confident in incorporating the tools into their teaching. Many of the teachers also reported increased awareness about and familiarity with Google Solutions as an overall result of training. As many teachers reported an increase in their students’ engagement as well as a 60% saving of time, over half of them (58%) would "strongly" or "very likely" recommend the use of Google Workspace for Education. Most importantly, most teachers viewed Google Apps as an essential part of teaching in today's classroom. There were still some issues. A math teacher noted that not all of his subject matter can be taught through Google Apps. Some of the non-technical teachers stated that lesson preparation will take longer due to learning new software. Also, as expected, internet connectivity was one of the main problems. All teachers agreed that a better, more consistent connection is required. The teachers have asked for additional offline functionality within the applications and more features on Google Docs and Google Sheets.

Student's Post-Survey Results

The majority of students enjoyed using technology as part of their classroom experiences, particularly with Google Solutions and Chromebooks. Approximately 75 percent of all students could identify at least one benefit from utilizing technology. Additionally, about 62 percent of students reported feeling "very" to "extremely" confident when using Google tools; meanwhile, approximately 30 percent of students stated they are at least somewhat comfortable with the tool. Overall, only 10 percent of students reported that they do not feel either confident or comfortable when utilizing Google tools. Student's ability to utilize various applications through Google has increased since the implementation of the program. More than half of all students reported being confident when utilizing Google tools. The overall engagement levels within the classroom have been significantly enhanced due to the utilization of technology. Specifically, 55 percent of all students reported being "very" engaged during lessons that utilized Google apps; 25 percent indicated they were "extremely" engaged, and 15 percent stated they were generally engaged. Furthermore, more than half (50 plus percent) of the students surveyed would "strongly" encourage other classmates to utilize Chromebooks and Google Apps.

Many students responded positively to the convenience and utility of Google tools which made learning more interactive. Fifty-three percent (53%) of the students participating in this survey indicated that their classes utilizing these tools were more interesting than those classes conducted prior to the introduction of Google Apps. Twenty-six percent (26%) of the students responding to this question indicated that their classes were just as engaging as they were prior to the introduction of Google Apps. Some students noted that Google Apps assisted them in completing homework and assignments by reducing their workload. Chromebooks provided significant assistance to students who used them for researching in class, completing homework, creating creative works, and working together with peers on group projects. While most students experienced a number of advantages when utilizing technology in the classroom, many students also identified several disadvantages. For example, some students reported that technology was often times distracting; others believed that there should be adequate instruction and training provided to allow them to properly utilize technology. Finally, some students believed that if each student were able to use an individualized Chromebook, they may be able to achieve higher academic performance

Discussion

The data collected as part of this study's first goal was to determine whether the use of technology within the classroom environment is perceived differently by both the instructors and the students. The data collected demonstrated a clear shift from the negative perceptions initially held by the instructors toward positive perception regarding the tools used. At the beginning of the study there were many teachers who lacked prior experience working with Chromebooks or Google applications. This is similar to what has been documented historically about technology integration in Pakistan. After they received formal instruction on the use of Chromebooks and Google solutions and began to utilize them in their instructional practices, the majority of teachers indicated an increase in their confidence and comfort level when utilizing these tools. Prior to the implementation of these tools, less than five percent of the teachers surveyed indicated they would be able to incorporate these tools in their instructional plans comfortably. Following post-survey results it was determined that no educators fell into the "not comfortable" category. Therefore, there was significant evidence of an improvement in the digital competence of all of the educators participating in this project. Additionally, nearly half of the teachers reported that utilizing Google Solutions in their instructional activities resulted in better-planned instructional activities as well as more engaging lectures due to some of the new features such as videos and interactive visual elements. These tools also allowed teachers to better engage their students during class presentations. Further, these tools provided instructors with additional support with respect to classroom management. For example, assessing student knowledge became easier through Google Forms; therefore, teachers could save time previously utilized to grade assignments. Of further importance, sixty percent of the educators reported a marked increase in the amount of time available for completing additional educational-related responsibilities. These findings were supported by previous researches as well (Iftakhar, 2016; Sudarsana *et al.*, 2019).

Teachers noted other concerns including unreliable access to the internet, intermittent availability of electricity, limited access to devices and time constraints which affect the consistency with which they could utilize technology in the classroom. Some teachers indicated that certain subjects such as mathematics were difficult to convert to digital format, while some teachers said they could not locate suitable online resources for subjects such as Islamic Studies or Arabic. In addition, those who did not have confidence utilizing computer technology felt that developing technology-based lesson plans were both time consuming and overwhelming. Yet over half of the teachers surveyed strongly encouraged their colleagues to utilize Google Workspace for Education due to its effectiveness for instruction, convenience and ease-of-use, as reported previously (Iftakhar, 2016; Andri, 2022). A large number of teachers identified an urgent need for continuing

education and refresher training so that they can continue to develop their skills utilizing digital tools in their instructional practice. While approximately 80% of teachers utilized the professional development training provided by Google and considered the training to be useful and effective, a teacher's ability to adapt to and benefit from educational technology is dependent upon having sufficient training as well as having reliable access to devices, access to the Internet and having sufficient time to adequately incorporate these tools into their teaching (Khan *et al.*, 2022; Aurangzeb, Kashan and Rehman, 2024).

Both teachers and students demonstrated significant positive results as a result of implementing Google solutions; however, the same cannot be said about all students who began this experience. As can be expected based on prior knowledge, many students already possessed an understanding of how to utilize technology before entering the classroom. Nonetheless, both teachers and students indicated increased engagement within the classroom upon implementing Google Solutions. Indeed, approximately sixty percent of respondents stated they were generally engaged during classes utilizing Google Solutions. Approximately fifty percent of the total respondents further stated they would "strongly" recommend Google Solutions and Chromebooks to their peers. Many students felt that various tools provided by Google such as Google Classroom, reduced time spent on tasks assigned by instructors and produced a greater sense of enjoyment and interactivity in completing schoolwork. Additionally, as noted by other investigations (Oktaria and Rohmayadevi, 2021; Andri, 2022; Diantari, Artini and Dewi, 2023), students mentioned that the use of these tools greatly assisted them in completing homework and assignments. Some students found technology to be at times distracting. A number of students also felt that they would have been able to perform significantly better, had each student been equipped with their own Chromebook rather than having to share one. While there was an obvious benefit to using technology in educational settings from the perspectives of both teachers and students, it is evident that the results demonstrate a need for ongoing support for both educators and students alike through the development of adequate infrastructure and continued professional training and development for long term success.

To evaluate the second objective of this research project, the results demonstrated that most of the teachers surveyed were very pleased with how easy to use and supportive these programs were for daily instructional purposes. The majority of the respondents stated that they regularly used Google Slides and Google Docs to distribute notes or handouts to students. Google Slides received praise for allowing instructors to include video, images, and/or music into lesson plans to go beyond static textbooks and provide a more engaging experience for students. Additionally, many teachers appreciated that Google's tool set provided them with increased flexibility in developing their own lesson

plans. Teachers were able to integrate different media sources, methods, etc. into their lessons resulting in what seemed to be a more enriched experience for all participants. As a direct result of this increased engagement, it appeared that students were more attentive and invested in the learning activities. Similar outcomes have been reported in prior research projects (Sudarsana *et al.*, 2019; Diantari, Artini and Dewi, 2023). Students' ability to communicate and collaborate with each other was greatly enhanced through the utilization of Google Classroom. It was apparent that students thoroughly enjoyed the collaborative nature of this new way of learning. Google Classroom contributed significantly to establishing a culture of cooperative learning, as students were able to exchange feedback, ask questions of one another, and request assistance from fellow classmates as needed. This type of peer-to-peer support also helped students develop comfort and confidence utilizing the technology itself. Often times, students would assist each other in mastering the appropriate use of the tools while also supporting each other in the learning process. An additional positive finding was related to the increase in classroom management. Since students were so actively engaged with their Chromebooks, it was much easier for teachers to maintain focus and deliver interactive lessons. Both students and teachers realized substantial time saving advantages with the aid of Google tools. Teachers indicated that the tools assisted them in creating more effective lessons and streamlined the assessment process making their school days more productive. Students indicated that their completion of homework became less arduous with the organizational assistance provided by the platform. Furthermore, students in this current study evidenced growth in both digital literacy and discipline specific knowledge. Many students developed proficiency in typing using various keyboards in multiple languages (Urdu, Arabic, mathematical symbols) demonstrating how these types of tools enhance functional skills across multiple disciplines. Overall, these digital tools did not only make learning more efficient and fun for students but empowered teachers to create more dynamic teaching environments. These results align with previous studies that highlight similar advantages of integrating technology into education (Rahmad *et al.*, 2019; Eimer, 2021; Oktaria and Rohmayadevi, 2021; Lau, 2023).

Another primary focus of this research was to identify the obstacles related to utilizing digital tools within a classroom setting. A number of barriers were identified through conducting teacher interviews, soliciting feedback from students and observing classrooms. One major barrier cited by teachers and other researchers alike (Rehman, Zhang and Iqbal, 2021), including the lack of stable technology. The frequent loss of electricity, slow internet speeds, etc., resulted in interruptions to the utilization of digital tools, especially at public sector schools. Where the lack of reliable technology results in the inability of teachers to utilize digital tools (such as Google Classroom, Docs and Slides) in an on-going manner. Notably, teachers also identified unequal availability of digital

devices in classrooms. While many classrooms had fewer than a one-to-one ratio of digital devices per student, teachers indicated it was impossible to provide equal opportunities for every student. Furthermore, although tools such as Google Workspace were beneficial to teachers, they were unable to adapt most of their subject matter to be utilized digitally. Examples included subjects such as Mathematics, Islamic Studies, etc. where digital versions of content are lacking or difficult to create. Lastly, another significant barrier was the variable level of digital literacy amongst teachers. When creating lesson plans and navigating new technology can be time consuming and overwhelming, teachers with little to no experience utilizing digital technology may be less likely to implement it in the classroom. Specifically, given the relatively recent emphasis placed on digital pedagogy in Pakistan, providing educators with the necessary support through ongoing practical and contextually relevant training will be crucial in developing their confidence in utilizing digital tools. On the student side, while students reported being familiar with various types of basic digital tools; distraction was identified as an additional barrier when attempting to learn in a digital environment. This barrier was identified in previous studies (Gul, Tahir and Ishfaq, 2023) in addition to this study. Students reported that without appropriate instruction and digital discipline they had difficulty staying engaged during lessons. Additionally, students reported that if each student had access to their own Chromebook, it would greatly improve their learning experience and decrease their reliance on shared devices. Overall, the results indicate that while there is much potential for digital tools to assist with enhancing the quality of education within the classroom, the successful implementation of digital tools relies upon stable infrastructure and resources, teacher training and thoughtful inclusion into curriculum design.

Limitations and Future Implications

While there are a number of limitations to this study, one major limitation is that it was conducted at a single school. Because of this, the results from this study may be less likely to generalize to many other schools. Therefore, future studies would be beneficial if they were to investigate how multiple school types use technology in their educational practices. A second major limitation of this study is that it was conducted in a school located in the capital city, which has a relatively well-developed technological infrastructure as compared to rural or remote communities that have very limited access to technology and have low levels of technology literacy. As such, conducting this type of study in an environment with these characteristics (i.e., a community lacking even basic infrastructural supports) could result in significantly different findings and serve to emphasize the importance of the context in assessing the impact of technology on student learning. A final potential method for obtaining additional information about the impacts of using

technology in the classroom would be to conduct a complete evaluation of student academic achievement prior to and subsequent to the implementation of technology in the classroom. This type of comparative analysis will allow for the determination of what aspects of student learning have been positively impacted by the use of technology in the classroom and ultimately contribute to a greater overall analysis of the impacts of integrating technology into educational environments.

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