





Revolutionizing Teaching and Learning through Google Solutions

A Case Study of **Educators School**

(A Private School of Pakistan)









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EXECUTIVE SUMMARY

Technology has fundamentally reshaped educational practices worldwide, ushering in a new era of dynamic, inclusive, and effective learning. Google for Education Tools stands out as a prominent example, providing educators and students with a comprehensive array of digital resources and collaborative platforms, thereby revolutionizing education. Similarly, Artificial Intelligence (AI) has made its mark in education, supporting learning through tools like educational bots. This underscores the imperative for educational institutions to adapt to technological advancements. Despite the global shift towards digital education, Pakistani schools face significant hurdles in this transition, due to limited technological access, internet connectivity issues, socioeconomic disparities, and insufficient training. Overcoming these challenges requires demonstrating the clear benefits digital tools offer in the classroom. By showcasing these advantages, educators and policymakers can rally support for integrating digital tools into education and highlight their value in enhancing teaching and learning experiences. Project Aghaaz aims to underscore the benefits of leveraging technology for both teaching and learning.

The Capital Campus of The Educators, located in Islamabad, has been chosen as the focal point for Project Aghaaz. This research involved the participation of all Grade 7 teachers and students from the Capital Campus who received formal training on utilizing Google Solutions via Chromebooks over a period of 5 weeks. Techvalley Pvt Ltd. provided the school with Chromebooks, supplying a total of 32 devices, with 8 designated for teachers and 24 for students. The study employed a mixed-method approach, incorporating quantitative pre-surveys, qualitative interviews, classroom observations, quantitative post-surveys, and qualitative post-interviews. Descriptive analysis was utilized to analyze quantitative surveys, while the qualitative analysis employed Haas's adaptation of the Colaizzi method.

The research findings demonstrate a significant improvement in teachers' and students' understanding and perception of Google for Education and AI tools following training and integration into lesson plans. Notable benefits include time savings, increased efficiency, enhanced class engagement, and improved learning outcomes. Teachers have observed tangible improvements in student achievement and instructional effectiveness, facilitated by instant assessment capabilities that enable timely feedback and targeted interventions. The system fosters healthy competition among students and offers a user-friendly interface that simplifies administrative tasks, enhances participation, and maximizes engagement. Additionally, it streamlines time management by automating routine tasks, allowing teachers to focus more on instructional delivery, personalized student support, and collaborative learning activities, thereby optimizing teaching and learning efficiency. However, the introduction of Google Solutions also carries a few drawbacks. For instance, Google Docs, while convenient for collaborative writing, may lack the specialized features needed for scientific disciplines, limiting its effectiveness in science education. Digital learning environments also risk content redundancy, which can lead to disengagement and reduced learning achievements. Additionally, students' writing skills and work ethics may suffer, compounded by the challenge of managing both traditional materials and technology. Educators must strike a balance between utilizing technology and preserving essential aspects of human interaction and creativity. Overreliance on technology can diminish critical thinking skills and limit face-to-face interaction, hindering educational access and equity.

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During the implementation, several challenges arose, with the main one being teachers adopting a dual-mode teaching method, integrating Chromebooks alongside traditional textbooks due to doubts about the project's sustainability. Additionally, the implementation was confined to a single class. To ensure the scalability and upkeep of technologically advanced classrooms and to capitalize on long-term benefits, it is recommended that schools extend similar setups across all classes of the school. The primary limitation of this research is its narrow focus on a single private school, which restricts the applicability of its findings to other educational settings like public schools or religious seminaries (Deeni madaris). While exploring technology's role in a private school is informative, it neglects potential differences in alternative environments. Future research should encompass a broader range of school types to better grasp technology's effects on education in diverse contexts.

The research overall concludes that, despite facing various infrastructural and managerial challenges, integrating Google Solutions into education provides significant benefits that surpass these obstacles. It is evident that these tools have the potential to transform education in Pakistan, making it more accessible and inclusive for everyone.









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1 Introduction

- Among the extensively utilized technologies in the education sector is Google for Education Tools, which have been instrumental in transforming education by furnishing educators and students with an extensive array of digital resources and collaborative platforms.
- In Pakistan, the deterioration of the education system is already evident due to persistent language barriers, outdated teaching methodologies, and the failure to address contemporary societal challenges.
- Moreover, the transition to digital education posed significant challenges for Pakistani schools, due to multiple reasons such as limited technological access, internet connectivity problems, and socioeconomic disparities etc.
- Moreover, teachers exhibit lower motivation to shift towards digital teaching methods. They often lack the coping mechanism to address the challenges encountered during such transformation.
- Project Aghaaz aims to showcase the advantages of utilizing technology for both teaching and learning purposes.

1.1 Google for Education Tools

Technology has profoundly transformed teaching and learning in schools, revolutionizing traditional educational practices. The integration of technology has made learning more interactive, engaging, and accessible. With the advent of digital tools, students can access vast amounts of information instantly, enabling them to explore concepts beyond the limitations of textbooks. Additionally, technology has personalized learning experiences, allowing educators to tailor lessons to individual student needs. Collaborative tools have fostered teamwork and communication skills, preparing students for a digital world. Virtual and augmented reality have brought immersive experiences into the classroom, enhancing understanding of complex subjects. Overall, technology has made education more dynamic, inclusive, and effective, shaping a new era of learning. One of the widely used technologies in the education sector is known as Google for Education Tools, which has played a pivotal role in revolutionizing education by providing educators and students with a comprehensive suite of digital resources and collaborative platforms.

Google for Education offers a range of products and services tailored for educational institutions. These solutions are designed to help schools and educators enhance teaching, learning, and administrative processes using technology. Google Solutions comprise Google Chromebook: a portable device installed with Chrome OS, through which users may access Google Workspace for Education, including Google Classroom, Google Meet, Google Jamboard, Google Cloud, Google Drive, Google Slides, Google Docs, and Google Spreadsheets. The entire solution offers a comprehensive suite of potent tools that are tailored to elevate learning experiences and revolutionize the realm of education (Salih, 2021).





Designed for schools and homeschooling, Google Workspace for Education provides a collection of tools and services to promote collaboration, streamline teaching, and ensure a secure learning environment. Google has also integrated Artificial Intelligence (AI) into its educational products to enrich learning experiences. Each tool within the workspace is purpose-built to address specific needs by offering dynamic Al-driven features. Google Classroom acts as a digital center for organizing assignments, sharing resources, providing feedback, and simplifying workflows. It now integrates AI for automated grading and personalized learning. Machine learning algorithms enable educators to streamline administrative tasks, giving them the opportunity to offer more individualized support to students. Additionally, Google Docs, Sheets, and Slides enable real-time collaboration, allowing students to collaborate on projects and presentations remotely, fostering a more dynamic and inclusive learning setting. Google Forms simplifies the creation of quizzes, surveys, and assessments, helping educators collect and analyze data to enhance their teaching methods. Al also enhances collaboration and productivity within apps of Google Workspace for Education. For instance, tools like Smart Compose in Google Docs predict text to expedite writing, and AI-generated suggestions aid in comprehensive and efficient editing. Likewise, other AI tools, such as interactive AI-powered assignments, adaptive learning platforms, AI-assisted research tools, and Generative AI for content creation, empower educators to innovate their teaching approaches and equip students with essential skills for the digital era (Nguyen, 2023).



Google for Education tools collaborate seamlessly to revolutionize the teaching and learning experience, empowering every learner and educator to achieve their full potential. These tools are not only free but also user-friendly. They are meticulously crafted to save time by integrating and automating the use of Google apps, which are known for their simplicity. Furthermore, Google for Education is designed to be mobile-friendly and cloud-based, ensuring accessibility and flexibility for users. Moreover, these solutions enhance cooperation and coordination among teachers, as well as between teachers and students, without any time constraints. Both teachers and students can also rest assured about not missing any assignments or documents. Additionally, they benefit from ample storage and the ability to access it at any time due to the cloud-based service (Iftakhar, 2016; Sudarsana et al., 2019). Overall, Google for Education tools have made quality education more accessible, encouraged educators to innovate in their teaching approaches, and equipped students with essential digital skills for the 21st century.

1.2 Al Tools

Artificial intelligence, or AI, has emerged as a significant technological advancement, garnering increasing attention for its ability to emulate human behavior. It has also entered the realm of education, where AI systems support learning through tools like educational bots. This development highlights the need for educational institutions to adapt to technological changes, especially in





improving education quality through information and communication technology integration. Al applications have enabled the creation of modern digital learning content, transforming bulky textbooks into more concise and understandable formats like study guides and summaries. This evolution benefits students by enhancing their intellectual capacity. As a key element of the Fourth Industrial Revolution, Al plays a crucial role in facilitating technology-driven learning processes (Fitria, 2021). Considering the increasing importance of Al, a variety of tools are now utilized in the education sector. Some popular ones include ChatGPT, Magic Slide, Google Lens, ClassToolkit, Kahoot, Twee, and Read Along etc.



1.3 Education Sector of Pakistan

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In Pakistan, the education system is divided into three main groups: elementary schooling (grades 1 to 8), secondary education (grades 9 to 12), and higher education (beginning after grade 12). Elementary education is further divided into primary (grades 1 to 5) and middle (grades 6 to 8) levels, with primary and secondary schools catering to these stages. Secondary education (grades 9 to 12) is provided in secondary and higher secondary schools (colleges) (Zafar & Ali, 2018).

Since independence, the standards of education in Pakistan have been largely undermined by inefficiency, mismanagement, favoritism, nepotism, and corruption (Zafar & Ali, 2018). These issues have led to the proliferation of different school systems with varying mediums of instruction and curricula. The upper class predominantly favors English-medium education, while the middle class tends to opt for Urdu-medium institutions, and the lower class often turns to free madrassa education. Consequently, Pakistan's schooling system consists of three main school types namely Public Sector schools, Private Sector schools and Deeni Madaris. Public schools are government owned schools, which are mostly free. However, the quality of education in these schools is questionable. In contrast, private schools, being privately owned, have high fee structures and typically use English as the primary medium of instruction. As a result, they are primarily preferred by the affluent elite and upper-middle class. Naturally, the quality of education in these institutions is generally superior. In addition, graduates from these schools often secure well-paid jobs more easily due to their English proficiency, creating disparities in job opportunities (Zafar & Ali, 2018). Therefore, the private sector's involvement in education in Pakistan has seen a notable increase in recent years. By 2017–2018, private educational institutions accounted for 37.9% of all schools and 44.3% of total student enrollments. This trend reflects a growing willingness among families to invest in their children's education, driven by the poor quality and limited accessibility of public schools. The Annual Status of Education Reports (ASER) consistently highlight the better academic achievements of students in private schools compared to their counterparts in public schools (Rizwan et al., 2022).





1.4 The Educators (Capital Campus)

The Educators was founded in 2002 when Beaconhouse recognized the need to target middle to low-income groups not only in main cities but also to reach out to smaller towns where the provision of quality education was a challenge even for private schools. Since the need was enormous to provide access and quality across Pakistan, Beaconhouse came up with an innovative idea and introduced the concept of education franchise in Pakistan. The Educators is committed to fostering excellence in teaching and learning by providing quality education to empower teachers, students and academic leaders alike. Spread over the span of 22 years, The Educators have demonstrated remarkable growth, surpassing all private schools in their expansion efforts. Presently with an impressive network of 541 schools, The Educators cater to the educational aspirations of 216,460 students, embodying a commitment to equitable access and transformative learning experiences.

The Educators is part of a consortium of private schools functioning in Pakistan. The primary site for Project Aghaaz is the Capital Campus of The Educators, situated in Islamabad. Affiliated with the Federal Board of Intermediate and Secondary Education (FBISE), the Capital Campus is a distinguished educational establishment. Spanning across 4 Kanals, it boasts purpose-built facilities fostering an optimal atmosphere for learning and development. Founded in 2008 with the aspiration of delivering high-quality education, The Educators aims to empower students to realize their full potential and contribute positively to society. Since its inception, the school has expanded from a single campus to encompass seven campuses. From Playgroup to second year, the school provide a comprehensive educational journey covering early childhood to the culmination of schooling. The infrastructure comprises contemporary classrooms, fully furnished science and computer laboratories, and a meticulously curated library. With experienced and devoted educators at the helm, the institute endeavors to foster a nurturing and inclusive learning environment. Furthermore, its registration with PEIRA underscores its steadfast dedication to delivering quality education with transparency.

The Educators serves as a designated center for SSC and HSSC students due to its convenient and familiar setting. Over the years, students at this institution have consistently achieved remarkable results in FBISE examinations, with many attaining top positions. The capital campus boasts a distinguished history of accomplishments, including the 2020 Best School Award bestowed by The Educators Regional Office. Students here have demonstrated excellence across a spectrum of endeavors, from science fairs, and debate competitions, to sports championships. Moreover, they actively engage in prestigious events such as the International Kangaroo Linguistic Contest (IKLC) and International Kangaroo Mathematics Contest (IKMC), showcasing their linguistic and mathematical prowess on both national and international stages.

Additionally, The Educators collaborates with organizations like the Pakistan Red Crescent Society and Pehli Kiran School, providing avenues for students to partake in community service and nurture a sense of social responsibility. This initiative aims to advance education and social welfare by extending educational opportunities to matriculation students in SOS villages. Furthermore, the school's partnership with Oxford University Press not only benefits teachers by facilitating professional growth but also keeps them abreast of the latest teaching methodologies.







Figure 3 The Educators-Capital Campus



1.5 Problem Statement

The concept of digital learning has garnered considerable interest, particularly in light of the unprecedented global pandemic. UNESCO reports that more than half of the global student population has been affected by school closures due to the COVID-19 pandemic (Soon, 2020). This situation has expedited the worldwide embrace of digital classrooms and e-learning (Stoian et al., 2022). In Pakistan, the deterioration of the education system is already evident due to persistent language barriers, outdated teaching methodologies, and the failure to address contemporary societal challenges (Zafar & Ali, 2018). Moreover, the transition to digital education posed significant challenges for Pakistani schools. Issues such as limited technological access, internet connectivity problems, and socioeconomic disparities have hindered the successful implementation of online education in the country. Additionally, a considerable number of students, akin to those in other developing nations, lack access to essential devices like computers and tablets, as well as reliable internet connections, thereby impeding their engagement in digital learning. Furthermore, educators in these areas often lack the requisite training and resources to effectively utilize digital tools for instructional purposes (Ghani et al., 2024).

Another notable obstacle arises when educators endeavor to shift from conventional classrooms to technology-enhanced ones. Frequently, they find themselves lacking the motivation necessary for this transition. Motivation serves as a crucial catalyst that propels individuals towards accomplishing particular objectives. Teachers grapple with finding significant motivation to adopt technology-enhanced classrooms. Additionally, in a developing nation such as Pakistan, numerous hurdles may emerge during this transition. Teachers often contend with anxiety when facing these challenges and may find it challenging to cope up in such circumstances (Biewendt et al., 2021).

1.6 Objectives of the Research

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To introduce digital tools in Pakistani schools, one effective approach is to demonstrate the clear advantages they offer in the classroom. By showcasing these benefits, educators and policymakers can garner support for integrating digital tools into education and illustrate the value they bring to teaching and learning. Hence, the current study aims to examine how the use of Google for Education Tools transforms teaching and learning in a private sector school of Pakistan, by focusing on a single case of Educators. Accordingly, the objectives for this study are formulated as follows:





- 1. To assess the perception of teachers and students regarding their usage of technology (especially Google for Education Tools) and AI for teaching and learning.
- 2. To evaluate the understanding of teachers and students regarding the use of Google for Education Tools and AI in teaching and learning.
- 3. To explore the effects (both positive and negative) of using Google for Education Tools and AI for classroom teaching and learning.
- 4. To consider the hurdles of changing the teaching practices by utilizing Google for Education Tools & Al tools.
- 5. To understand teachers' motivational needs and coping during the transition from traditional teaching.



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2 Research Design

- The Capital Campus of The Educators, situated in Islamabad, has been selected as a case for Project Aghaaz.
- The participants in this research included all the teachers and students of Grade 7 from the Capital Campus who utilized Google Solutions via Chromebooks following formal training over a span of 5 weeks.
- Techvalley Pvt Ltd. equipped the school with Chromebooks for both teachers and students. In total, 32 Chromebooks were supplied, with 8 allocated for teachers and 24 for students.
- This investigation utilized a mixed-method approach, comprising quantitative pre survey, qualitative interviews, class observations, quantitative post surveys and qualitative post interviews.
- Quantitative surveys were analyzed using descriptive analysis, while the study used Haas's adaptation of Colaizzi method for qualitative analysis.

2.1 Case for the Research

The Capital Campus of The Educators, situated in Islamabad, has been selected as a case for Project Aghaaz. The participants in this research included all the teachers and students of Grade 7 from the Capital Campus who utilized Google Solutions via Chromebooks following formal training over a span of 5 weeks. The class consists of 7 teachers, with teaching experience ranging from 2 months to 10 years. Number of enrolled students in Grade 7 is 24.

Names	Working Tenure	Subjects Taught
Madiha	3	Mathematics
Rabia Iftikhar	More than 2 years	Physics and Mathematics
Muniba Tahir	Six years	Urdu , Islamiat
Saira Iqbal	6 years	Social studies and urdu
Sumera Malik	2 months	English, S,Studies
Ayesha Kanwal	3 years	Computer
Zaiba Ramzan	Almost 10 years	English

Table 1
List of Participants (Teachers)







2.2 Tools

Techvalley Pvt Ltd. equipped the school with Chromebooks for both teachers and students. In total, 32 Chromebooks were supplied, with 8 allocated for teachers and 24 for students.

Brand	CTL
SKU	SKU
Operating System	Google Chrome OS
Weight	2.6 lb
Google AU	June 2031
Screen Size	11.6"
Processor	Intel® Jasper Lake Dual-core N4500 CPU, 2.80GHz
Memory	4GB LPDDR4x-2933 SDRAM
Storage	32GB eMMC
Wi-Fi	Wi-Fi 6 (Intel AX201)
Bluetooth	5.0
Camera	HD 720P Front-facing Camera
Audio	Built-in 2x 2W stereo speaker
Dimensions	11.5 x 7.8 x 0.71 in.

Table 2
Teacher's Device Specification

CTL Brand RFNL7 SKU Google Chrome OS **Operating System** Weight 5.0 lb Screen Size 11.6" Intel® N3350 Celeron CPU Processor 4GB LPDDR4x-2933 SDRAM Memory 32GB eMMC Storage 180 Degree Lay-Flat Clamshell Laptop Camera Form Factor Built-in 2x 2W stereo speaker 2x USB-C charging, 2x USB 3.0, 1x micro SD, 1x combo audio jack Ports

Table 3 Students' Device Specification

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2.3 Research Method

Given the research goals, this investigation utilized a mixed-method approach. The data collection process included administering pre-surveys to both teachers and students, conducting open-ended interviews with teachers, observing classrooms, administering post-surveys to both teachers and students and conducting qualitative post-interviews with teachers.

The research started with a pre-survey both for teachers and students. It was based on quantitative research questions distributed to the teachers and students through Google Forms. The survey collected the data based on the following themes: Background of the participants, Technology usage, Comfort level with the usage of Google Apps, Teaching and Learning, Barriers in the utilization of technology, Frequency of usage of AI tools in the classroom and Comfort level with the usage of AI tools. Five-point Likert scale was used to measure the degree of perceptions. Subsequently, qualitative interviews were conducted following the survey analysis. These interviews, exclusively with teachers, featured open-ended questions addressing the identified themes. Recommendations for training were formulated based on the interview outcomes. Following the training sessions, both teachers and students transitioned to technology-enabled classes utilizing Google Solutions applications. Classroom observations occurred once this transition took place. Afterwards, quantitative postsurveys, comprising questions related to the aforementioned themes, were administered. Finally, post-interviews with teachers, focusing on changes in their perceptions regarding Google Solutions usage, were conducted using qualitative open-ended questions. Quantitative surveys were analyzed using descriptive analysis, while the study used Haas's adaptation of Colaizzi method for gualitative analysis (Hag et al., 2021).







Figure 6 Student's Training



2.4 Research Schedule

The research phase of Project Aghaaz spanned six months, from December, 2023 to May, 2024. The pre-survey commenced in the second week of December gathering insights from both teachers and students regarding their perspectives on the usage of Google Solutions. Qualitative pre-interviews were conducted in the second week of January. Based on the survey and interview findings, training programs for Google Solutions were tailored for teachers and students. The training sessions for teachers took place from the third week of January to the third week of February, while student training took place in the second and third weeks of February. Classroom observations were conducted in the month of March. Subsequently, post-surveys were conducted with teachers and students in the second and third weeks of April. Qualitative interviews were conducted in the last week of April and the first week of May. Finally, data analysis and report writing were completed by the end of May.

Activity/Date	Dec 23			Jan 24				Feb 24					Mar	ch 2	4	April 24					May 24				
Activity/Date	11	18	25	1	8	15	22	29	5	12	19	26	4	11	18	25	1	8	15	22	29	6	13	20	27
Pre-Survey																									
Pre-Interviews																									
Chromebook																									
Training (Teachers)																									
Chromebook																									
Training (Students)																									
Class Observations																									
Post-Survey																									
Post-Interviews																									
Data Analysis																									
Report Writing																									

Figure 7 Research Schedule







3 Research Findings

3.1 Perceptions before Using Google Solutions and Al Tools

Teacher's Pre-Survey Results

• A total of 7 teachers from the 7th grade took part in the survey. These teachers possess a moderate level of experience in their respective fields. The majority have less than 8 years of teaching experience at Educators. Specifically, 57% have taught for up to 3 years, 28% have 4 to 8 years of experience, and only 15% have been teaching for 8 to 10 years.

• Technology is frequently utilized in classrooms, with teachers employing it 1-2 times per month 50% of the time. Additionally, 12.5% of teachers use technology 1-2 times per week, while another 12.5% incorporate it daily. Conversely, 25% of teachers abstain from using technology altogether.



Figure 8 Percentage Usage of Technology in classroom (by Teachers)

• Most of the times traditional teaching methods through books, notebooks, and white boards etc. are used in the school. Only 12.5 % of the times teachers use PCs for teaching purposes.

• Teachers realize the importance and benefits of the technology. Almost all of them perceive technology as beneficial. Among them 50 % feel that there are visible benefits for using the technology in the classrooms but there are obstacles as well. The same percentage of the instructors find technology beneficial and also try to use.

• Instructors seem quite exposed with the usage of Google solutions. As findings revealed that, majority of them (62%) are generally comfortable, and a reasonable percentage of teachers (38%) are very confident in using Google solutions.



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Figure 9 Comfort Level with Google Solutions



- 12 % of the teachers are extremely confident and well trained in integrating Google Solutions in classrooms. 88 % of them have basic level of comfort integrating Google Solutions for teaching purposes.
- Teachers represent generally a good expertise for utilizing Google Apps. They are quite comfortable in using Gmail, Calendar, YouTube and Google Maps, however Chrome books, and Google classrooms, are the least expert avenues.



Figure 10 Comfort Level with Google Apps

- Teachers consider lack of training, as the topmost obstacles for using the technology. Lack of awareness to use tools and lack of access to technology are also one of important challenges which hinders to use the technology in the classrooms.
- The primary cause of technology disruption stems from bandwidth limitations and outages. Technical glitches with apps and hardware malfunctions also contribute significantly to disruptions.

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- Teachers have found 62 % students generally engaged in the class. 38 % of the students are little involved in their session.
- 37 % of teachers are moderately involved in student centered learning, while majority of them (50%) are fully involved. A very low percentage (13%) of the teachers are rarely involved in student centered learning.
- Throughout the week, instructors dedicate the majority of their time to teaching. It's advisable for teachers to allocate more time to student counseling, extracurricular activities, and professional development (PDs).





- All of the educators are enthusiastic about receiving training and certification, with one already certified.
- Teachers find usage of AI tools very effective in teaching. Most of the times they are using Chatgpt for teaching purposes.



Figure 12 Usage of Al Tools (by Teachers)





Student's Pre-Survey Results

- A total of 24 students of class 7th (selected for the Project Aghaaz) participated in the survey.
- Frequency of the technology usage in the classrooms is less. 48 % of the times, they are not using any technology at all for learning purposes. Most of the times traditional learning methods through books, notebooks, and white boards etc. are used in the school.
- Learners realize the importance and benefits of the technology. Almost 68% of them perceive technology as beneficial. However, 25% of them find obstacles in using the technology. Few of them (3%) find technology as harmful and few others are (4%) are indifferent.
- Students are already using Pcs, smart phones and Tablets for learning.



Figure 13 Percentage Usage of Technology in classroom (by students)

- Majority of the learners (63%) are quite comfortable in using Google solutions, however few of the students (12%) are not comfortable at all in the utilization of Google Solutions. Students have generally good expertise for all Google Apps.
- More than 80% of the students are engaged in classrooms. Half percentage of them even find their classes enjoyable.
- 78 % of the students find technical interruption with the apps as the biggest barrier to use the technology, however they also consider bandwidth limitations and outages, as well as technical interruption with hardware also plays a part.
- Most of the students have found AI tools as very effective for learning purposes. Only small
 percentage of the students (7%) do not find AI tools as effective. Chaptpt is the most used AI tool
 by learners as well.







Figure 14 Usage of AI Tools (by students)



Teacher's Pre-Interview Results

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The pre-interviews aimed to analyze the teacher's perceptions about using Google solutions and Artificial Intelligence (AI). The interviews were carried out in January 2024. The responses from the teachers showed that some of them do not use technology at all in the classroom. This specifically applied to the teachers who taught social sciences subjects such as Urdu. Furthermore, the teachers also considered projector's usage as part of technology. Those teachers who taught mathematics and computer science subjects were aware of the meaning of Google solutions and Al usage. These results are summarized in Table 4. It can be inferred from the results that the teachers with no prior experience of laptops usage may find it difficult to adjust with the inception of Google solutions and Al in the classroom. However, slides are also used by most teachers as a better teaching strategy over the traditional teaching methods.

The teachers were also asked about the perceived benefits of technology's integration in the classroom. All the teachers agreed that integration with the modern world is necessary. Initially, the transition will be hard, but with time, the students will adjust. This suggests that technology integration is essential for staying relevant in today's world, even though there might be initial challenges. The teachers were viewing Google solutions as an interesting new method for both students and teachers. Technology introduces engaging methods for both students and teachers. Visual aids and colorful presentations are believed to enhance student retention of lecture material. With Google solutions' help more content can be shown to students in less time. It allows for the efficient presentation of a larger volume of content within shorter timeframes.

The teachers also highlighted the anticipated benefits of Google solutions and AI for the students. The student's motivation level can be enhanced by making learning more interactive and engaging. Students' understanding can also be improved as technology facilitates various learning resources and methods that aid in improving student comprehension. Overall, the teacher's perceptions are encapsulated in Table 4 below which shows teacher's technology usage frequency and benefits.





Table 4 Teacher's perceptions regarding using technology

Areas	Opinions
Usage frequency	 Not much but we use projector for lectures, online classes through zoom and mobile. Audio/ visuals were used, zoom classes. Mostly we use slides on computer.
Benefits of technology	 Integration with the modern world is necessary. Initially the transition was hard but with time the students adjusted. New interesting method for both students and teachers. Visuals and colors help students retain the lecture. More content can be shown to students in less time due to technology. Student motivation level can be enhanced. Student's understanding can also be improved

It was important to assess the teacher's comfortability level with Google solution and Al. Most teachers showed comfortability with Google solutions but not all were aware of the Al tools and their usage. Regardless, since most of them showed comfortability, perhaps it is right to interpret that the teachers are comfortable in using Google solution tools. The teacher's preceptor preparedness towards Google solutions integration with the lesson plan was also analyzed during the interviews. Most teachers were confident in the implementation however they quoted that after training they will feel more confident for the integration. When teachers were asked about the possible impacts of Google solutions and Al integration in the classroom, most foresee improvement in student as well as teacher's learning. The only concern of the teachers was that the students needed to take the Chromebooks to their homes. This will provide them with more time to explore Google solutions gadgets and use the tools for homework submissions and related tasks. The teacher's perceptions are summarized in Table 5 below.

Areas	Opinions
Comfort level	 10/10 Comfortable Comfortable with google solutions but not with Al
Google solutions & Al integra- tion with lesson plan	Confident on the implementationAdjustments according to topic
Impact	 Anticipation of positive effects but more will be known after implementation. Students need to have access to the devices at homes as well.

Table 5 Comfort level with Google Solutions and AI









The assessment of barriers and challenges is imperative for a new phenomenon implementation. For this, the teachers were asked about the expected barriers and challenges that can be expected while implementing Google solutions and AI in the classrooms. The first and most obvious hurdle identified was load shedding. This disrupts the lecture's flow and causes unnecessary delays in lecture. This is one of the issues that is out of the school's management scope. It has been reported in media as one of the issue causing hindrances in day-to-day life of Pakistanis¹. In Table 6, other challenges are also highlighted that relate to lesson plans, pedagogical methods, and student's learning. The teachers were asked about their current teaching style, most used a mixed methodology. In this method, they prioritized student's engagement. The traditional teaching style was used when the teacher intended to teach a new topic. However, they reverted back to the student's engagement style.

In Table 5, the teachers were asked about their learning and development. For this purpose, the school conducted workshops to introduce and support the implementation of recent pedagogical methods. However, traditional educational environments pose challenges for implementing recent pedagogical methods. To overcome these challenges, the teachers often relied on online resources such as Google and YouTube for research and assistance in lecture's improvement. The improvement in the teaching method is made though incorporating question-and-answer format during lectures. Slide presentations also are considered as an effective method of delivering lectures. The biggest advantage of using slide presentations is that the students do not have to worry about copying the material from the board when the lecture will be given through slideshow.

In a bigger school setting, tracking student's progress becomes a major challenge. In the sample school, tracking student overall progress is manageable due to smaller class sizes. However, there are challenges in tracking individual student backgrounds. Also, at times managing and examining a large volume of assignments can be challenging. A relatively smaller class size does provide teachers with the opportunity to use more engagement-oriented strategies. More detail on this aspect can been seen in Table 6.

Areas	Opinions									
Obstacles/hurdles	 Internet connectivity issues disrupt the lecture's flow. Electricity issues spot settings issues. Time management is an issue while implementing. 									
	Challenges									
Typical lesson plans	 Mixed methods: the lesson plan depends on the content of the lecture. Typical style is used when teaching new phenomenon then shift to the engaging lecture style. 									
Recent pedagogical methods	 Regular workshops are conducted by the school. Implementation is difficult in the traditional setting. Always get help from research through google and YouTube. We follow QnA type of lecture method 									

Table 6 Barriers and Challenges



¹ https://www.pakistantoday.com.pk/2024/01/01/country-faces-severe-power-load-shedding-amid-extreme-cold-weather-season/





Student's progress track	 Not difficulty because of 25-30 students class size Sometimes tracking background of the student is difficult
Student's engagement	 Open discussion sessions with students Development of practical models Daily life examples help in student engagement. Explanation methods including discussions with the students
Teacher's learning and development	 Lectures are prepared with proper research on the material. Self-clarification of the concepts Technology is used for self-learning. Teachers learn from students as well

In Table 7, teacher's opinions regarding motivation and coping styles for using technology in teaching or learning are explained. Teamwork emerged as one of the strongest motivators among the teachers' group in our sample school. All the teachers relied heavily on each other to resolve the challenges encountered during learning of Google solutions and Al. They did not hesitate to seek help and support one another. Apart from this, the ambition to provide students with the best learning experience was also among the factors contributing to the teacher's motivation. The teachers in school were also willing to compromise on their personal time to best improve self-learning.

It is understandable that new technology is a challenge for the entire school, specifically, to change the traditional modes of teaching. Initially, when the project was introduced, some teachers felt panic but then again, the group's support helped them in overcoming the fear of new phenomenon implementation. The teachers found solace and assistance from colleagues, emphasizing the importance of teamwork and emotional support. The coping style was also characterized by a positive and focused mindset. Resultantly, the teacher did not succumb to panic and instead maintained optimism and concentration on the task. Whereas, some teachers were self-reliant, and opted to look at the greener side of the grass. This coping style reflects independence and self-sufficiency, with the teacher relying on their own resources and abilities to manage challenges (see Table 7 below).

Areas	Opinions
Motivation	 Internally motivated, eager to perform well on using the technology, help from the colleagues, curiosity level is high, Student's future motivates me to give my best, Student's optimum learning motivates us to provide best outputs Excited for self-learning as well Motivated to use technology for non-science subjects as well Compromise on time at home for full attention on technology usage
Coping style	Panic initially but help from colleagues solves the problem. Group work and social support from colleagues always helps emotionally and practically.

Table 7
Motivation and coping style of using Google solutions and A



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The teachers forecasted many advantages of Google solutions and AI implementation (see Table 8). The teachers suggested that integrating technology into education will facilitate early learning and aid students in preparing for board exams. For teachers themselves, the technology's implementation will save their time and aid in effective lectures. Moreover, using Chromebooks for drafting exam papers is perceived as a simpler process compared to manually preparing exam papers. Overall, there is optimism and positivity regarding the project's outcomes and benefits.

The teachers raised concerns about the challenges of implementing and utilizing Google solutions effectively, with uncertainty about their long-term adoption. Furthermore, the complete shift from traditional notebooks to laptops poses a significant challenge for both teachers and students. Also, there are some apprehensions about the potential access to various types of information through Google, raising concerns related to religious considerations or sensitivities.

Despite some disadvantages, the teacher's confidence levels are expected to be high after receiving proper training in using technology. Training sessions are anticipated to provide skills in time management, which would boost confidence levels. After completion of training, the teachers are expecting the permanent integration of Google solutions and artificial intelligence tools into student learning experiences. In a nutshell, the opinions expressed reflect a mix of optimism about the potential benefits of technology in education, alongside concerns about implementation challenges, confidence levels, and the need for effective management strategies. For more information on the themes, refer to Table 8 below.

Areas	Opinions
Benefits expectations/ advantages	 Students will learn from a young age, help students in board exams. Teachers: time saver, effective lectures. Positive expectations about the project. Story telling can be further enhanced for social sciences subjects
Disadvantages	 Usage will be challenging, unsure about permanent implementation of google solutions. Total transition from notebooks to laptops will be a great challenge.
Confidence level	 Full confidence after training Learning in training to manage time
Implementation expectations	 Permanent use of google solutions and Al for students. Student's focus will be difficult to retain. Check and balance mechanism on the students. Check and balance mechanisms on students.

Table 8 Teacher's Opinions







3.2 Perceptions While Using Google Solutions and Al Tools

Classroom Observations

The observations were carried out in the classrooms on 8th, 15th and 22nd March 2024. Most students were aged between 11 to 13 years old and belonged to the middle class of socio-economic class stratification. For all the subjects, the students mostly enjoyed reading on their Chromebooks. Particularly, science subjects were more enjoyable to learn due to the varied available visual aids. However, some students complained about eyesight issues and sleepiness due to excessive screen usage. As the class strength was around 25 students, having individual Chromebooks for students was not difficult for the teachers to manage. For example, the quizzes were easy to administer and gave students instant feedback on their performance. All the students were using Chromebooks responsibly-they charged it before lecture commencement. A few students encountered technical problems, such as some students forgot how to upload video on Google doc as part of their assignment. Nevertheless, since the class strength was ideal it was manageable for the teachers to address students' problems.

Apart from student's usage of Chromebooks, observations were also made on how teachers were delivering lectures. All teachers efficiently organized their lecture content using the Google docs. The teachers followed hybrid mode of lecture at times so that students can be prepared for their upcoming board examinations. The most effective way of lecture using Chromebooks was its delivery through projector screen as compared to the traditional pedagogical style. This made possible for all the students to easily see the lecture content, which was otherwise difficult for students sitting at the back of the classroom. At times, internet connectivity was an issue, but it was resolved and did not cause significant hindrance in the lecture. Overall, the students and teachers both seemed comfortable in using the Chromebooks and Google docs. The notable recommendations derived from the observation during the lectures would be to follow a hybrid mode of teaching to align the students with the existing education and examination system. Lastly, some precautionary measures must also be taken to ensure the optimum physical health of the students.



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Figure 15 Classroom Observations





3.2 Perceptions After Using Google Solutions and Al Tools

Teacher's Post-Survey Results

- Following the trainings, the survey results posted by teachers were notably positive. Previously, technology usage in classrooms was inadequate, with 25% of teachers not using it at all. However, the current utilization rate has risen to 100%, marking a significant improvement.
- Teachers have come to recognize the significance and advantages of technology. Nearly all of them view technology as beneficial. Previously, only 50% perceived visible benefits of using technology in classrooms, though obstacles were noted. However, the current sentiment among 75% of teachers is that technology is beneficial, leading them to actively integrate it into their classrooms.
- Previously, 62% of instructors were generally comfortable using Google apps. Presently, 75% of teachers feel very comfortable using Google solutions in the classroom, with over 12% expressing extreme confidence in their usage.
- Nearly 63% now feel very comfortable integrating Google solutions into their lesson plans, with 13 % expressing extreme confidence. Previously, the majority had only a basic level of comfort.
- There has been a noticeable improvement in teachers' proficiency in using all Google apps.
- Approximately 63% of teachers reported experiencing significant time savings (1-5 hours per week), while 25% noted substantial time savings (more than 5 hours per week) after incorporating Google apps into their teaching.
- The use of Google Solutions (GS) in the classroom has significantly enhanced student learning. Most teachers agree that after implementing GS, students have become more creative in their work. They can better find relevant information and knowledge, which improves their reading and writing abilities, especially in STEM subjects. Additionally, GS has notably boosted collaboration among students.
- Teachers also believe that Chromebooks save them a significant amount of time. Chromebooks
 assist in various ways, making lesson plans more effective and innovative. The devices provide
 easy access to all the resources needed for student learning and are user-friendly for teachers.
 Almost 74% of the instructors are highly likely to recommend a usage of Chromebook to their
 fellow teachers.
- 50% of teachers are highly likely to recommend Google Workspace for Education to their colleagues, with an additional 12% being very highly likely to do so.
- 62.5% of teachers agree that the Professional Development training was useful and met their needs, while the remaining teachers strongly agree. Likewise, 75% percentage of teachers agree that their trainers were knowledgeable and skilled, and the rest strongly agree.
- 75% of teachers find AI tools very effective in teaching, with an additional 12.5% finding them extremely effective.
- Table 8 summarizes teachers' ratings of the effectiveness of AI tools for learning after completing the training session. The instructors found all AI tools used in the training sessions to be effective for learning. However, the results indicate that ChatGPT and Kahoot were the most effective.







AI Tools	Extremely Effective	Very Effective	Effective	Not Effective	Not Effective at all
Chatgpt	2	4	0	0	1
Magic Slide	2	1	4	0	0
Google Lens	2	3	1	1	0
Class toolkit	1	3	3	0	0
Kahoot	2	4	1	0	0
Twee	1	0	6	0	0
Read Along	1	4	2	0	0

Table 9 Percentage Effectiveness of AI Tools (For Teachers)

Student's Post-Survey Results

- The frequency of technology usage by students has increased to 100%. Previously, technology usage was minimal, with students not using it 48% of the time. Additionally, over 90% of learners feel that technology is highly beneficial for learning.
- Currently, 22% of students are extremely confident in using technology, 62% are very confident, and the remaining students have a basic level of comfort. Previously, 12% of students were not comfortable using technology at all, and 60 % had only basic level of comfort. Likewise, learners already had expertise in using Google apps, their competence significantly improved after the training.
- Over 80% of students find their sessions much more enjoyable after the integration of technology.
- A significant majority of students, exceeding 75%, express a strong inclination to advocate for Google Solutions among their peers due to their high satisfaction with its application in learning contexts. They assert that it significantly economizes their time, thereby enhancing the appeal and enjoyment of studying. Google Solutions are regarded as both useful and efficient, amplifying productivity and enjoyment in the learning process. Notably, students value its reliability and assistance, as it grants effortless access to a plethora of information on relevant subjects through the internet.
- Likewise, more than 70% of students are inclined to endorse Chromebooks to their fellow students, attributing their efficacy to enhancing learning experiences. They perceive Chromebooks as catalysts for creativity and innovation, thereby enhancing the enjoyment of studying. Chromebooks streamline homework research, thereby saving considerable time. Additionally, these devices foster seamless collaboration with peers and boast user-friendly interfaces.
- Among students, 44% have identified AI tools as highly effective for learning, while 33% consider them to be very effective, with the remainder acknowledging their effectiveness. Kahoot is most effective AI tool as classified by students (see Table 10).







Al Tools	Extremely Effective	Very Effective	Effective	Not Effective	Not Effective at all
Chatgpt	8	4	4	7	1
Magic Slide	2	3	8	8	3
Google Lens	3	4	8	7	1
Class toolkit	3	3	8	8	2
Kahoot	12	2	3	5	2
Twee	2	4	8	7	2
Read Along	2	5	6	3	8

Table 10 Percentage Effectiveness of AI Tools (For Students)

Teacher's Post-Interview Results

The interviews were carried out with teachers post training and after a month's implementation of using Google and Al in the classroom at the Educators G-11 campus. The integration of technology has become increasingly pervasive, with its frequency varying across different classrooms and instructional contexts. During the interviews, amongst teachers, a significant trend emerges where most teachers are embracing technology as a fundamental component of their instructional toolkit. Within this cohort, technology isn't merely an occasional supplement but rather a cornerstone of their pedagogical approach. These teachers leverage a diverse array of digital tools, platforms, and resources to facilitate learning experiences that are interactive, engaging, and tailored to meet the diverse needs of modern learners. Whether it involves virtual simulations, multimedia presentations, online collaboration platforms, or digital assessment tools, these teachers exhibit a proactive commitment to harnessing technology's potential to enhance the educational journey of their students.

In some instances, the teachers find themselves navigating a hybrid mode of instruction, wherein the integration of technology is tempered by the unique requirements of certain subjects. For example, disciplines like languages may necessitate a blend of traditional hands-on methodologies with digital enhancements. In such cases, teachers adeptly navigate the balance between analog and digital modalities, ensuring that technology augments rather than supplants the core objectives of the subject matter. This hybrid approach underscores the nuanced understanding that effective technology integration demands a thoughtful alignment with the specific learning outcomes and instructional methodologies inherent to each academic domain. In Table 11 a summary of perceptions after Google solutions implementation is illustrated.

The incorporation of audio and visual aids has emerged as a pivotal strategy for enhancing teaching efficacy and enriching the learning experiences of students across various subjects. The perceived benefits of integrating such multimedia elements extend beyond mere pedagogical convenience to encompass profound enhancements in comprehension, engagement, and language acquisition. Audio and visual aids, particularly in the form of storytelling, serve as potent tool. By harnessing the power of narratives, teachers transform abstract linguistic concepts into vivid, relatable experiences that captivate students' imaginations and kindle their intrinsic curiosity. Through







compelling storytelling techniques, teachers breathe life into literary works, historical events, or cultural narratives, thereby fostering a deeper appreciation for the nuances of language and literature. This immersive approach not only renders language subjects inherently more engaging but also cultivates critical thinking skills by prompting students to analyze characters, themes, and plot structures within a rich narrative framework.

The ubiquitous availability of audio and visual resources empowers students to access a wealth of information spanning diverse subject domains. Whether through educational videos, interactive simulations, or multimedia presentations, learners are afforded unprecedented opportunities to augment their understanding of complex concepts through dynamic visualizations and real-world examples. This multifaceted exposure to knowledge not only bolsters academic achievement but also nurtures a broader intellectual curiosity, as students develop the capacity to explore interdisciplinary connections and contextualize their learning within broader socio-cultural contexts.

Also, the integration of audio aids facilitates seamless communication between teachers and students, fostering a conducive learning environment characterized by active participation and effective knowledge dissemination. Through audio mediums such as recorded lectures, or virtual conferencing platforms, teachers can deliver instructional content with clarity and precision, transcending temporal and spatial barriers to engage students. Moreover, the immediacy afforded by audio communication enables teachers to provide timely feedback and address students' queries in real-time, thereby promoting a dynamic exchange of ideas and facilitating personalized learning experiences tailored to individual learning needs.

Particularly in the realm of language acquisition, audio aids serve as indispensable catalysts for honing English speaking skills and fostering linguistic fluency. Through exposure to authentic spoken language samples, students develop an intuitive grasp of phonetic nuances, intonation patterns, and idiomatic expressions, thereby fortifying their oral communication proficiency. Whether through listening exercises, pronunciation drills, or conversational simulations, audio resources afford learners the opportunity to engage with language in its natural auditory context, thereby bridging the gap between theoretical language instruction and real-world communicative competence. In Table 11, a summary of teacher's perceptions post-implementation is provided.

Themes	Opinions
Frequency	 Most teachers were using it full-time. Some used technology in a hybrid mode due to the requirement of the subject.
Perceived Benefits	 Audio and Visual aids Story telling makes language subjects interesting. Students' understanding of the subjects improved due to widely available knowledge. Prompt response to students by the teachers. English speaking skills improved due to audio aids

Table 11
Post-usage Technology Perceptions



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After undergoing training, all teachers reported a notable increase in their comfort levels by utilizing technology in their classrooms. This enhanced comfort not only facilitated the integration of technology into their teaching practices but also motivated them to explore additional mediums for information retrieval. Notably, teachers began incorporating platforms such as ChatGPT, Google Bard, and Sider Al into their instructional repertoire, demonstrating a proactive embrace of innovative tools to enhance their teaching effectiveness and enrich student learning experiences.

The integration of Google solutions and artificial intelligence (AI) has resulted in several key outcomes. Teachers have experienced increased efficiency in delivering lectures through the utilization of Google solutions and AI integration. These technologies streamline the process of content delivery, allowing teachers to convey information more effectively and engage students in a more dynamic manner. The integration of Google solutions and AI has also promoted self-sufficiency among both teachers and students. By leveraging these tools, teachers can create comprehensive lesson plans and instructional materials, while students gain access to resources that facilitate independent learning and problem-solving. Following integration with the lesson plan, teachers have reported a significant increase in confidence, with approximately 90% expressing assurance in their teaching approach. This confidence stems from the seamless incorporation of technology into their instructional strategies, empowering teachers to adapt and innovate in response to evolving educational needs.

Furthermore, the integration of Google solutions and AI has resulted in several discernible impacts. Students' writing abilities and work ethic have been affected by the integration of technology. While digital tools offer opportunities for refinement and collaboration, some students may experience challenges in maintaining traditional writing skills and sustaining a disciplined work routine. The adoption of technology in education has led to an increased workload for students. The incorporation of digital assignments, research tasks, and online assessments necessitates additional time and effort from learners, potentially impacting their overall academic workload. In addition, the integration of technology has contributed to a heightened physical load on students, manifesting in the form of heavier book bags and the addition of Chromebook bags. This increased burden may lead to concerns regarding ergonomics, posture, and overall physical well-being among students. An overview of post-implementation can be seen in Table 12 below.

Themes	Opinions
Overall comfort	 Teachers were all comfortable after training. Higher comfort level propelled teachers to use other mediums of search: ChatGPT Google Bard Sider Al
Comfort with Google solutions & Al integration	 Efficiency in delivering lectures. Integration has also made both teachers and students self-sufficient. After integration with the lesson plan teachers are 90% confident
Impacts (positives & neg- atives)	 Student's writing and hard-working capabilities are affected. Increased workload on students Increased physical load on students-books bag and Chromebook bag.

Table 12
Post-implementation Comfort Level





Several obstacles and hurdles have been identified in the interviews with teachers. The classroom environment is occasionally challenged by connectivity issues stemming from fluctuations in electricity supply. These disruptions hinder seamless access to digital resources and may interrupt online instructional activities, necessitating contingency plans to mitigate their impact on teaching and learning. Another hurdle observed in the classroom is students' reliance on the copy-paste option. This practice undermines originality and critical thinking skills, detracting from the authenticity and depth of students' work. Teachers must address this issue through explicit instruction on proper research and citation practices, fostering a culture of academic integrity and intellectual honesty among students.

The enthusiasm and energy of students, while commendable, can sometimes pose a challenge in the classroom. Overexcitement may lead to disruptions, difficulty in maintaining focus, and impulsive behavior, detracting from the overall learning environment. Teachers must employ strategies to channel students' enthusiasm productively, fostering a balance between engagement and discipline to optimize learning outcomes. These obstacles at times underscore the dynamic nature of the classroom environment and the need for proactive measures to address challenges that arise in the pursuit of effective teaching and learning.

The teachers also highlighted some notable challenges encountered while Google solutions implementation. For instance, ensuring fair and accurate assessment of students' academic performance poses a significant challenge. Teachers must employ diverse evaluation methods that effectively measure students' understanding and skills across different learning domains while mitigating biases and ensuring consistency in grading. Maintaining equitable learning opportunities and outcomes for all students presents a challenge, particularly in diverse classroom settings. Teachers need to implement differentiated instruction strategies to address individual learning needs and provide additional support to students who may require it, thereby promoting inclusivity and academic excellence for all learners.

Apart from learning challenges, some students have reported experiencing eye strain and discomfort due to prolonged screen usage during digital learning activities. Addressing this challenge requires implementing measures to promote healthy screen habits, such as regular breaks, proper lighting, and ergonomic adjustments, to mitigate the risk of visual fatigue and ensure students' well-being. Parents also expressed concerns regarding the timely completion of the syllabus or curriculum, fearing potential gaps in their children's education. Open communication channels between teachers and parents, along with proactive updates on instructional progress and academic plans, can help alleviate parental anxieties and foster collaboration in supporting students' learning journey.

Student attendance may be affected during the fasting month, posing challenges to maintaining continuity in learning experiences. Teachers need to demonstrate flexibility and understanding while accommodating students' religious observances, ensuring equitable access to educational opportunities and supporting students' holistic well-being during this period. This also leads to sustaining student engagement and focus issues on the subject matter. Teachers need to employ interactive teaching methods, leverage technology judiciously, and cultivate a supportive learning environment to foster intrinsic motivation, active participation, and sustained attention among students.

Lastly, teachers expressed concerns about adequately preparing students for traditional board exams, which follow a conventional assessment setup. Balancing the demands of standardized testing with the broader goals of holistic education requires strategic planning, targeted

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preparation, and ongoing support to ensure students' readiness and success in these high-stakes examinations. A bird's eye view is provided in Table 13 below.

Table 13 Barriers and Challenges

Themes	Opinions
Obstacles/hurdles in the classroom	 Occasional connectivity issues due to electricity fluctuations Students used the copy-paste option. Over excitement of the students
Challenges	 Student evaluation. Maintenance of equal knowledge adoption among students. Some students complained of stress on their eyes due to screen usage. Parents are concerned about completion of syllabus/ curriculum. Student's attendance due to fasting month. Student engagement and focus on the subject. Teachers were concerned for students on taking the board exams, which follow a traditional setup.

In the interviews, the motivation of teachers is sourced from several key factors. A primary source of motivation for most teachers is the positive outcomes observed following the implementation of new methodologies or technologies. When teachers witness tangible improvements in student engagement, comprehension, and academic performance because of their efforts, it serves as a powerful incentive to continue innovating and refining their instructional practices. Additionally, the response of students to the integration of Google solutions and artificial intelligence (AI) serves as a significant motivating factor for teachers. When students exhibit enthusiasm, engagement, and a demonstrable grasp of concepts facilitated by these technologies, teachers are encouraged by the impact of their pedagogical decisions on student learning outcomes, driving them to further explore and leverage innovative tools and methodologies in their teaching practices.

Online classes conducted amidst the Covid-19 pandemic served as essential guiding tools for teachers to cope with the adoption of new technologies. Amidst unprecedented challenges, teachers leveraged online platforms to adapt their teaching methodologies, explore innovative pedagogical approaches, and enhance their proficiency in utilizing digital tools. The transition to virtual instruction provided valuable learning experiences and equipped teachers with the skills and confidence needed to navigate technological advancements in education. Peer and colleague support played a pivotal role in assisting teachers to overcome challenges associated with technology adoption. Through collaborative efforts and mutual assistance, teachers shared insights, strategies, and best practices for integrating technology into their teaching practices. This peer support network fostered a sense of camaraderie, encouraged knowledge exchange, and facilitated problem-solving, empowering teachers to address technical issues, navigate implementation hurdles, and adapt to evolving educational landscapes with confidence and resilience (see Table 14).





Table 14 Motivation and Coping Style

Themes	Opinions	
Motivation source	 Most teacher's motivation stemmed from the positive results post- implementation. Students' reaction to Google solutions and AI also served as a motivating factor. 	
Coping strategies	 Online classes conducted during Covid-19 served as a guiding tool to cope with new technology adoption. Peer/colleagues supported each other in resolving problems. 	

The teachers were asked about their expectations concerning Google Solutions implementation. The integration of Google Solutions and artificial intelligence (AI) with lessons met the high expectations set forth by the teachers. Anticipated outcomes, such as improved engagement, enhanced learning experiences, and increased efficiency, were realized through the seamless incorporation of these technologies into the instructional framework. Teachers witnessed tangible benefits instudent achievement and instructional effectiveness, validating the efficacy of technology integration in meeting and even surpassing initial expectations. While technology adoption has been extensive and impactful, it is acknowledged that human intervention remains essential. Despite the advancements in automation and AI, the role of teachers as facilitators, mentors, and guides in the learning process cannot be understated. Human intervention ensures personalized support, social-emotional development, and critical thinking cultivation, complementing the capabilitiesodtechnology and contributing to a holistic educational experience.

Other notable advantages include the capability for on-the-spot student evaluation. With this feature, teachers can promptly assess students' understanding and progress during lessons, facilitating timely feedback and targeted interventions to address learning gaps effectively. The integration of this system fosters healthy competition among students. By providing real-time feedback and performance metrics, it motivates students to strive for excellence and actively engage in the learning process, thereby promoting a dynamic and conducive academic environment. Moreover, its user-friendly interface benefits both teachers and students. The intuitive design and accessibility of the system streamline administrative tasks for teachers and enhance the learning experience for students, minimizing barriers to participation and maximizing engagement. Additionally, the system enables efficient usage of time. By automating routine tasks, such as grading assessments and managing administrative workflows, teachers can allocate more time to instructional delivery, personalized student support, and collaborative learning activities, optimizing the overall efficiency of teaching and learning processes.

The disadvantages of any newly implemented phenomenon are unavoidable. One disadvantage is the limited options available on Google Docs for science subjects. While Google Docs provides a convenient platform for collaborative writing and document sharing, its features may be insufficient for the specialized formatting and content requirements of science-related materials, such as equations, diagrams, and scientific notation, thereby limiting its effectiveness as a comprehensive tool for science education. Another drawback is the potential for repetition of content. In digital learning environments, there may be instances where students encounter redundant information across different resources or instructional materials. This repetition can lead to disengagement,







cognitive overload, and diminished learning outcomes, highlighting the importance of curating diverse and varied content to maintain student interest and optimize learning effectiveness.

Overreliance on technology represents a significant disadvantage. While technology offers myriad benefits in enhancing teaching and learning experiences, excessive dependence on digital tools can lead to challenges such as decreased critical thinking skills, reduced face-to-face interaction, and technological barriers that impede access and equity in education. Teachers must strike a balance between leveraging technology as a valuable instructional resource and preserving the essential role of human interaction, creativity, and critical inquiry in the learning process. Table 15 encapsulates the notable advantages and disadvantages observed while using Google solutions and AI during the lectures in classroom.

Themes	Opinions
Expectations	 Expectations were high and met while integrating Google Solutions and AI with lessons. Technology adoption is great but still needs human intervention as expected.
Advantages	 On spot student evaluation Healthy competition among students User-friendly for teachers and students Enables efficient usage of time
Disadvantages	 Limited option on Google docs for science subjects At times, repetition of content Over reliance on technology

Table 15 Post-implementation Opinions







4 ANALYSIS AND DISCUSSION

This investigation is focused to understand the transformation of teaching and learning in Pakistan through the use of Google for Education and AI tools, while also highlighting potential obstacles. To achieve this, five main objectives were developed to guide the research. Each objective is discussed individually based on the research findings.

Objective 1:

Perception of teachers and students regarding their usage of technology (especially Google for Education Tools) and AI for teaching and learning

Teachers have acknowledged the importance and benefits of the technology, specifically Google Tools, even before its implementation. Most educators acknowledge these solutions as advantageous, observing visible benefits of using technology in classrooms, despite some obstacles. However, prior to receiving training, teachers rarely used technology in their classrooms, relying instead on projectors for lectures, online classes via Zoom, mobile devices, and occasionally computers for slideshow presentations. Nonetheless, they believed that integrating technology into the classroom is essential to keep up with global standards, acknowledging the challenges of such a transition. According to them, incorporating technology can make classes more engaging for students. Visual aids and colors, facilitated by technology, may help students retain information more effectively. Additionally, using technology enables more content to be presented in less time, making it highly efficient. Utilization of technology in the classroom not only motivates students but also enhances their understanding of the material. Furthermore, instructors believe that employing AI tools could also lead to very effective learning. After incorporating technology in the classroom, teachers found it highly beneficial. Initially, only 50% of instructors recognized the visible benefits of using technology in the classroom. Currently, 75% of teachers believe that technology is beneficial and are actively integrating it into their teaching methods. As a result, some instructors have adopted technology full-time, while others use it in a hybrid mode based on the subject's needs. They have noted significant improvements in content delivery through audio and visual aids. Storytelling, enhanced by these tools, made language subjects more engaging. Students' understanding of various subjects improved due to the widespread availability of information, and teachers could respond to students more promptly. Additionally, English speaking skills improved due to audio aids. The perception of Pakistani teachers is no different from Indonesian teachers, as highlighted in the study conducted by Sudarsana et al., (2019). Google for Education tools have improved lecture quality, did considerable time-saving, and improved cooperation and communication with the students in Indonesia. In addition, teachers found the Google Workspace for Education more effective and helps in teaching. Besides, they have found the workspace convenient and userfriendly, as consistent with previous researches (Andri, 2022; Iftakhar, 2016; Martin, 2021). Despite the clear benefits of incorporating technology in classrooms, teachers recognize the need for training to fully leverage digital tools. This sentiment is also highlighted in the study conducted by (Martin. 2021).





Figure 16 Perception regarding utilizing Google for Education and AI tools for teaching and learning



Likewise, learners also realized the importance and benefits of the technology. Almost 68% of them perceive technology as beneficial. However, 25% of them find obstacles in using the technology. Few of them (3%) find technology as harmful and few others are (4%) are indifferent. Most of the students have found Al tools as very effective for learning purposes. Only small percentage of the students (7%) do not find Al tools as effective. After actually utilizing Google workspace for Education, over 90% of learners now consider these solutions to be highly beneficial for their education. Similarly, 44% of them found Al tools to be highly effective for learning, 33% view them as very effective, and the remainder also acknowledge their effectiveness. Learners find their classes more engaging and interesting with the integration of technology, leading to increased class participation. Additionally, using Google tools significantly saves them time. They not only find Al tools intriguing but also appreciate the expanded learning opportunities these tools provide. Their positive perceptions of Google Solutions align with findings from earlier studies as well (Andri, 2022; Oktaria & Rohmayadevi, 2021).

Objective 2:

Understanding of teachers and students regarding the use of Google for Education Tools and AI for teaching and learning

Instructors appear well-acquainted with using Google for Education tools even before the trainings. The findings showed that the majority (62%) were generally comfortable, and a significant percentage (38%) were very confident in using Google solutions. Additionally, 12% of teachers were extremely confident and well-trained in integrating Google Solutions into their classrooms, while 88% had a basic level of comfort in using these tools for teaching purposes. However, they still needed to learn how to tailor apps to specific topics and subjects and were not yet fully comfortable using AI tools. In addition, teachers generally exhibited good expertise with Google Apps. They were quite comfortable using Gmail, Calendar, YouTube, and Google Maps, but had less expertise with Chromebooks and Google Classroom. However, they anticipated positive impacts as they continue to learn and improve their implementation of these tools. After the training, 75% of teachers find themselves very comfortable using Google







for Education tools in the classroom, with over 12% expressing extreme confidence. Nearly 63% are very comfortable integrating Google solutions into their lesson plans, and 13% express extreme confidence in doing so. There has also been a noticeable improvement in teachers' proficiency with all Google apps. About 63% of teachers reported saving significant time (1-5 hours per week), while 25% noted substantial time savings (more than 5 hours per week) after incorporating Google apps into their teaching. Previously, technology usage in classrooms was inadequate, with 25% of teachers not using it at all. However, the current utilization rate has risen to 100%, marking a significant improvement, consequently, they found increased efficiency in delivering lectures after gaining competence with Google solutions. Instructors have become almost 90 % confident in integrating Google tools into their lesson plans, which have made them self-sufficient. Educators' competence level regarding using Al tools also increased, and their higher comfort level has encouraged teachers to further explore Al tools, such as ChatGPT and Google Bard.

Similarly, the frequency of technology usage by students has reached 100%. In the past, technology was used infrequently, with 48% of students not using it at all. Moreover, over 90% of students now believe that technology is highly beneficial for their learning. Currently, 22% of students are extremely confident in using technology, 62% are very confident, and the remaining students have a basic level of comfort. Previously, 12% of students were not comfortable with technology at all, and 60% had only a basic level of comfort. Additionally, while learners already had some expertise in using Google apps, their competence significantly improved after the training. In addition, learners also got hands on experience for using many Al tools, such as Chatgpt, Magic Slide, Google Lens, Classtoolkit, Kahoot, Twee, Read along etc. They are now particularly comfortable using Kahoot and ChatGPT.

Objective 3:

The effects (both positive and negative) of using Google for Education Tools and AI for classroom teaching and learning.

The implementation of technology in the classroom has significantly impacted teaching and learning, yielding both positive and negative effects. The integration of Google Solutions and artificial intelligence (AI) into lessons met the high expectations set by the teachers. The most notable benefit, recognized by both educators and students, is substantial time savings and increased efficiency. Teachers have also observed improved class engagement since incorporating technology into their classrooms. Furthermore, teachers have experienced enhanced learning outcomes through the implementation of technology in their teaching. Instructors have also observed tangible improvements in student achievement and instructional effectiveness. Other significant advantages include the ability to evaluate students on the spot. This feature allows teachers to promptly assess students' understanding and progress during lessons, enabling timely feedback and targeted interventions to effectively address learning gaps. Additionally, the integration of this system fosters healthy competition among students. By offering real-time feedback and performance metrics, it encourages students to pursue excellence and actively participate in the learning process, nurturing a dynamic and supportive academic environment. Moreover, its user-friendly interface benefits both teachers and students. The intuitive design and accessibility of the system streamline administrative tasks for teachers and enhance the learning experience for students, minimizing barriers to participation and maximizing engagement. Additionally, the system enables efficient usage of time. By









automating routine tasks, such as grading assessments and managing administrative workflows, teachers can allocate more time to instructional delivery, personalized student support, and collaborative learning activities, optimizing the overall efficiency of teaching and learning processes. Furthermore, its user-friendly interface benefits both teachers and students. The intuitive design and accessibility of the system simplify administrative tasks for teachers and enhance the learning experience for students, reducing barriers to participation and boosting engagement. Additionally, the system allows for efficient time management. By automating routine tasks like grading assessments and handling administrative workflows, teachers can devote more time to instructional delivery, personalized student support, and collaborative learning activities, thereby optimizing the overall efficiency of teaching and learning processes. Earlier studies have also demonstrated comparable advantages of incorporating Google for Education tools in classrooms (Andri, 2022; Lau, 2023; Martin, 2021; Oktaria & Rohmayadevi, 2021). While technology adoption has been extensive and impactful, it is acknowledged that human intervention remains essential. Despite the advancements in automation and AI, the role of teachers as facilitators, mentors, and guides in the learning process cannot be understated. Human intervention ensures personalized support, social-emotional development, and critical thinking cultivation, complementing the capabilities of technology and contributing to a holistic educational experience (Martin, 2021).

The disadvantages of any newly implemented phenomenon are unavoidable. One such downside concerns the restricted functionalities within Google Docs for science disciplines. Although Google Docs offers a convenient space for collaborative writing and document sharing, its capabilities might not fully meet the specialized formatting and content needs of scientific materials, like equations, diagrams, and scientific notation. Consequently, its utility as a comprehensive tool for science education may be limited. Another shortcoming involves the possibility of content redundancy. Within digital learning settings, students might come across repetitive information across various resources or instructional materials. This redundancy can result in disengagement, cognitive overload, and reduced learning achievements, underscoring the significance of selecting diverse and varied content to sustain student engagement and enhance learning efficiency. Furthermore, students' writing skills, work-ethics and workinghard capabilities are adversely impacted. Moreover, with the incomplete transition to technology, students face the added burden of managing both traditional school materials and Chromebooks. It's crucial for educators to find a balance, utilizing technology as a valuable instructional aid while preserving the fundamental aspects of human interaction, creativity, and critical inquiry in the learning journey. Excessive dependence on technology poses a notable drawback. While technology brings numerous advantages in enriching teaching and learning, relying too heavily on digital tools can result in issues like diminished critical thinking abilities, decreased opportunities for face-to-face interaction, and technological obstacles that hinder educational access and equity. Such drawbacks of using Google tools are also highlighted in the investigation conducted by (Martin, 2021).







Figure 17 Impact of implementing Google for Education and AI tools for teaching and learning



Objective 4:

Challenges during the transition to technology enabled classroom.

Previous studies (Lau, 2023; Sismanto et al., 2024) have identified numerous challenges and barriers associated with the integration of Google for Education and AI tools in the classroom. Comparable issues were also observed in the present investigation. The most prominent one is the connectivity issues arising from fluctuations in electricity supply and internet access occasionally pose hurdles in the classroom environment. These interruptions impede smooth access to digital resources and can disrupt online instructional activities, requiring contingency plans to minimize their effects on teaching and learning. An additional concern noted in classrooms is the prevalent reliance of students on the copy-paste feature. This inclination diminishes their originality and critical thinking abilities, consequently diminishing the authenticity and depth of their work. Also, the enthusiasm and energy exhibited by students, though admirable, can sometimes pose a challenge in the classroom. Excessive excitement may lead to disruptions, difficulties in maintaining focus, and impulsive behavior, all of which can disrupt the learning environment. Another challenge of similar nature identified by teachers pertains to ensuring equitable and accurate assessment of students' academic advancement. Likewise, it is also difficult to maintain an equitable learning opportunities and results for every student, especially in diverse classroom environments.

Beyond academic challenges, some students have reported eye strain and discomfort from extended screen time during digital learning activities. Additionally, parents are worried about the timely completion of the syllabus, fearing potential gaps in their children's education. In addition to these challenges, several issues were identified specific to the local context. For example, student attendance might fluctuate during the fasting month, posing difficulties in maintaining consistent learning experiences. Ensuring sustained student engagement and







focus on the subject matter becomes crucial. Moreover, teachers have raised concerns about adequately preparing students for traditional board exams, which usually follow conventional assessment methods.

Figure 18 Challenges/hurdles encountered in implementing Google for Education and AI tools for teaching and learning



Objective 5:

Teacher's handling of change

This research also examined the motivational factors for teachers, especially during the transition from traditional classrooms to technology-enabled ones. Motivation is crucial for the success of any transition. Specifically, for these teachers, a lack of motivation may result in lowered teaching standards (Kulikowski et al., 2022). One major motivating factor is task significance, which denotes the extent to which a person's work affects the lives of others. When this impact is positive, it generates motivation for the task (Azash et al., 2012). This was precisely the case with our teachers; observing the positive impact of technology on their students motivated them. A significant source of motivation for them was the positive outcomes observed after adopting new methodologies or technologies. When they noticed tangible improvements in student engagement, understanding, and academic performance due to their efforts, it strongly incentivized them to keep innovating and improving their teaching practices. Moreover, students' reactions to the integration of Google solutions and artificial intelligence (AI) considerably motivated instructors. The students' enthusiasm, engagement, and a clear understanding of concepts through these technologies encouraged their instructors. The positive impact on student learning outcomes inspired teachers to continue exploring and using innovative tools and methodologies in their teaching practices.

Navigating through transitions is invariably challenging for individuals and organizations alike. It necessitates stepping out of one's comfort zone and adjusting to new work environments. Coping entails the behavioral and cognitive strategies employed to handle stressful situations, particularly during transitions. These coping mechanisms function either by focusing on







addressing the problem directly or on managing its emotional and physiological repercussions (Ben-Zur, 2009). Given the circumstances, the prior experience of implementing online classes during the Covid-19 pandemic proved to be invaluable guidance for teachers in embracing new technologies. Amidst unforeseen challenges, educators utilized online platforms to adjust their teaching methods, experiment with inventive pedagogical techniques, and improve their mastery of digital tools. The shift to virtual instruction not only offered valuable learning opportunities but also empowered teachers with the capabilities and assurance required to navigate technological advancements in education. Their prior experience emerged as their primary problem-focused coping strategy. Following this, emotional and social support became prominent. Subsequently, peer and colleague support emerged as crucial in aiding teachers to surmount challenges linked with technology integration. Through collaborative endeavors and reciprocal aid, educators exchanged insights, strategies, and exemplary approaches for incorporating technology into their teaching methodologies. This network of peer support cultivated camaraderie, promoted the exchange of knowledge, and facilitated problem-solving, enabling teachers to tackle technical obstacles, navigate implementation barriers, and adjust to dynamic educational environments with assurance and resilience.









5 CONCLUSION

In many developing nations, where accessing education remains a persistent challenge across multiple regions, Google for Education tools play a crucial role in advancing digital learning. These tools provide an online learning platform, which is vital for reaching remote areas lacking traditional educational infrastructure. They simplify the distribution of educational resources, facilitate digital assessments, and foster collaboration among students and educators. Considering the current state of Pakistani schools, where digital transformation has yet to be fully utilized, Google Solutions offer an excellent opportunity to surmount this obstacle and expand learning beyond physical classrooms. Despite encountering various infrastructural and managerial hurdles, the integration of Google Solutions in education yields significant benefits that outweigh these challenges. It is clear that these tools hold the potential to transform education in Pakistan, making it more accessible and inclusive for all.

6 LIMITATIONS & DIRECTIONS FOR FUTURE RESEARCH

- The main constraint of this study lies in its concentration on a solitary private school, which
 restricts the applicability of the results to other educational institutions, particularly public
 schools or religious seminaries (Deeni Madaris). While examining the influence of technology
 in a private school offers valuable perspectives on the experiences of both educators and
 learners, it fails to acknowledge potential variances that could emerge in alternative school
 environments. Subsequent research endeavors should strive to encompass a diverse array of
 school categories to acquire a more holistic comprehension of the impact of technology on
 education within various contexts.
- Moreover, the current study is conducted in a school situated in the capital city of Pakistan, known for its relatively superior technological infrastructure compared to remote regions with restricted access to technology and lower levels of technological literacy. Undertaking a similar project in an underdeveloped area lacking fundamental infrastructure could produce divergent outcomes, underscoring the significance of context in evaluating the influence of technology on education.
- Furthermore, delving into the utilization of Google for Education tools in public sector schools could offer vital insights. Contrasting the results obtained from private schools with those from government schools could furnish a nuanced comprehension of the impacts of these tools within diverse educational environments.
- Additionally, conducting a thorough evaluation of students' academic performance both before and after the implementation of technology in classrooms can offer detailed insights into their advancement. This comparative analysis before and after the integration of technology can aid in comprehending the precise influence of Google Tools on students' learning outcomes, thereby enhancing the depth of analysis regarding the integration of technology in education.





7 **RECOMMENDATIONS**

The subsequent suggestions stem from the issues and hurdles faced during the implementation of Google for Education and AI tools in the classroom

- The biggest challenge that arose was teachers utilizing a dual-mode approach to teaching, incorporating both Chromebooks and traditional textbooks. This stemmed from a lack of confidence in the sustainability of the project. Furthermore, the implementation was limited to just one class. Therefore, it is advised for schools to establish similar setups across all classes to ensure scalability and maintenance of technologically enhanced classrooms, thereby reaping long-term benefits.
- Given the learners' tendency to exhibit excessive enthusiasm towards technology, which may
 result in disruptions, challenges in maintaining concentration, and impulsive actions, educators
 ought to employ strategies to channel this excitement effectively. They should aim to strike a
 balance between engagement and discipline, thereby maximizing learning outcomes.
- An additional concern noted in classrooms is the prevalent reliance of students on the copy-paste function. This habit compromises their originality and critical thinking abilities, consequently diminishing the authenticity and depth of their work. Educators need to tackle this issue by providing clear instruction on effective research methods and citation protocols, nurturing an environment of academic integrity and intellectual honesty among students.
- Another obstacle involves ensuring equal learning opportunities and outcomes for every student, particularly in diverse classroom settings. To tackle this challenge, educators should adopt differentiated instructional strategies customized to meet individual learning needs. They should provide supplementary support to students when necessary, thereby promoting inclusivity and academic success for all learners.
- Apart from academic challenges, some students have expressed worries about suffering from eye strain and discomfort due to prolonged screen exposure during digital learning sessions. Resolving this concern involves adopting measures to promote healthy screen practices. These include integrating regular breaks, optimizing lighting settings, and making ergonomic alterations to mitigate the likelihood of visual fatigue and ensure the well-being of students.
- Moreover, parents have expressed worries regarding the timely completion of the curriculum, fearing potential learning gaps in their children's education. Establishing clear communication channels between teachers and parents and delivering consistent updates on teaching progress and academic methodologies can alleviate parental concerns and promote collaboration in enhancing students' educational progress.
- In addition to these challenges, certain issues specific to the local context were identified, such as fluctuations in student attendance during the fasting month, posing difficulties in maintaining consistent learning experiences. Teachers should demonstrate flexibility and understanding in accommodating students' religious observances, guaranteeing equitable access to educational opportunities and promoting their overall well-being during this time.
- Achieving a balance between the requirements of standardized testing and the broader goals
 of holistic education requires strategic planning, focused preparation, and continuous support
 to ensure students are well-prepared and successful in these high-stakes assessments.

ctl.

Google

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