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The Impact of ICT Interventions on Elementary School Students' Learning and Engagement: A Study of Use and Experience

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Abstract

The study investigates the capacity and engagement of female elementary school students in Punjab regarding Information and Communication Technology (ICT) and e-learning, aiming to identify factors that promote or hinder their involvement. Employing a blended research approach, qualitative and quantitative data were gathered through surveys and interviews to explore students' perceptions of ICT and their experiences with e-learning. The findings reveal a significant gap between the recognized advantages of e-learning—such as flexibility and accessibility—and the students' actual engagement with ICT tools. While many students acknowledged these benefits, a notable percentage expressed a lack of confidence in their technological skills and reported limited computer use in various contexts. The study highlights that students often find e-learning experiences monotonous and disengaging, which detracts from their willingness to participate in ICT-based education. By contrasting these current findings with previous research, whichemphasized the transformative potential of ICT, this study underscores ongoing barriers related to engagement, accessibility, and instructional design that

need to be addressed to fully harness the benefits of technology in education. To enhance engagement among female students, the study recommends developing interactive and high-quality e-learning materials, improving access to technology, and implementing ongoing evaluations of e-learning programs. Ultimately, this research contributes to a deeper understanding of ICT use in education within a specific cultural context, offering insights for policymakers, educators, and curriculum developers, while emphasizing the necessity for targeted interventions to empower female students in Punjab and promote gender equity in technology use in educational settings.

Keywords: ICT interventions, Learning engagement, Elementary School, STEM

Introduction

Information and communication technology (ICT) has transformed modern society, influencing education, economy, and global connectivity on an unprecedented scale. Today, ICT tools—ranging from computers to the Internet—are integral to the educational landscape, providing new avenues for learning and student engagement (Rehman, Zhang & Iqbal, 2021). The potential of ICT in education has been widely acknowledged for enhancing instructional practices, fostering critical thinking, and preparing students for the demands of the 21st-century workforce. According to recent studies, ICT use in education not only equips students with necessary digital skills but also promotes more interactive and student-centered learning environments, a significant shift from traditional, teacher-centered approaches (Alghamdi, 2024; Suman et al, 2023). In primary education, ICT's role is particularly crucial, as it introduces young learners to foundational skills and engages them in the learning process from an early age (Suman et al, 2023).

Primary school students can benefit immensely from ICT interventions, as these tools often foster creativity, collaboration, and engagement in ways that traditional learning approaches cannot achieve (Antoninis et al., 2023). For example, educational programs integrating ICT in elementary settings have been shown to improve students' motivation and understanding of complex concepts, particularly when used in interactive formats, such as digital storytelling or gamified learning modules (AlMaazmi, 2023). However, ICT implementation in educational systems is challenging, especially in developing countries, where disparities in infrastructure, resources, and teacher readiness persist (Antoninis, 2023). For instance, in Pakistan, ICT integration varies significantly by region, with rural schools often lacking the resources available to urban schools. Additionally, teacher training and beliefs about technology influence how ICT is utilized in the classroom, impacting the quality and consistency of students' ICT learning experiences (Atika et al, 2022).

Studies have also explored the gender-specific impacts of ICT engagement, as gender differences in digital literacy often emerge in adolescence, shaping students' perception and use of technology. Albahiri et al (2023) emphasizes that early exposure to ICT can help bridge this gap, as primary school is an optimal time to encourage equitable engagement with digital tools. While research on gender dynamics in ICT engagement primarily focuses on secondary education, understanding primary students' experiences with ICT can help address these disparities early, fostering a more inclusive approach to digital education (Masood, Asim & Manzoor, 2021).

Despite its potential, the effective integration of ICT in primary education remains inconsistent, with a significant need for structured policies and training programs that support teachers and improve infrastructure (Liang et al, 2023). In Pakistan, recent educational initiatives in Punjab highlight efforts to incorporate

ICT into primary school curricula, yet these efforts often lack consistency and are not universally accessible. Consequently, while ICT holds the promise of enhanced engagement and learning outcomes, its impact in Pakistani primary schools has not been thoroughly investigated. This study aims to fill this gap by exploring the effects of ICT interventions on primary students' learning and engagement, providing insights that may inform the development of equitable and effective ICT strategies in primary education.

Problem Statement

Despite the growing emphasis on integrating information and communication technology (ICT) in education, research on its specific impacts on primary school students' learning outcomes and engagement remains limited. Primary education is foundational, not only for academic skills but also for cultivating lifelong learning attitudes. However, in countries like Pakistan, the application and effectiveness of ICT in primary education are hampered by inconsistent access to resources, insufficient teacher training, and disparities in student engagement, especially between urban and rural settings (Rehman, Zhang & Iqbal, 2021; UNESCO, 2022 as cited in Antoninis et al, 2023). Additionally, while ICT offers the potential to make learning more interactive and inclusive, challenges such as the digital divide and insufficient educational policies on ICT integration create barriers that may prevent many students from experiencing its benefits fully (Masood, Asim & Manzoor, 2021; Suman et al, 2023).

ICT integration can significantly enhance student engagement by introducing innovative learning methods that motivate young learners and improve comprehension, especially in STEM subjects (Albahiri & Alhaj, 2023; AlMaazmi, 2023). However, there is limited research focused on primary school students' specific experiences with ICT interventions. Additionally, disparities in ICT access and utilization have been shown to influence student engagement

levels, with significant gender differences in digital literacy and comfort with technology use emerging even at young ages. These differences often lead to a skewed perception of ICT skills, where male students report higher confidence in their abilities than female students, a gap that could be reduced by introducing inclusive ICT interventions at the primary level (AlMaazmi, 2023; Suman et al, 2023).

In Pakistan, particularly in Punjab, government and private schools face contrasting realities in ICT accessibility and utilization. Government schools often lack the infrastructure and training resources required for effective ICT integration, leading to an "implementation gap" where technology is present but underutilized in daily classroom instruction (Qazi et al, 2022). Research indicates that educators in private institutions are more receptive to ICT, with these schools generally being better equipped and more adaptable to the requirements of digital learning (Atika et al, 2022). Nonetheless, most studies concentrate on ICT in secondary and tertiary education, creating a gap in understanding how primary school students perceive and engage with technology in the classroom and the influence this engagement has on their learning outcomes.

This study seeks to address these gaps by investigating the experiences and perceptions of primary school students regarding ICT interventions, specifically focusing on how these tools affect their learning and engagement. By examining factors influencing ICT engagement—such as access disparities, gender differences, and teacher readiness—this research aims to inform more equitable and effective ICT strategies for primary education in Pakistan. The results will not only contribute to the existing literature on ICT in education but also provide practical insights for educators and policymakers striving to develop policies that support digital literacy and active learning from early education levels.

Purpose of the Study

This study has two primary objectives: first, to explore the experiences and perceptions of both public and private middle school students in Punjab regarding their use of information and communication technology (ICT) within educational settings; and second, to provide a platform for these students to articulate their experiences and perceptions, contributing to a deeper understanding of ICT integration in middle schools and highlighting areas for improvement in ICT implementation strategies (Rehma, Zhang & Iqbal, 2021; Masood, Asim & Manzoor, 2021).

A key component of this investigation is to examine the self-perceptions of female students regarding their abilities to engage with ICT resources. The study aims to identify factors that influence these students' self-assessment and attitudes toward ICT use, given that gender disparities in technology confidence and usage often emerge during the middle school years and may impact long-term engagement with digital tools and STEM fields (Albahiri & Alhaj, 2023; Suman et al, 2023). By focusing on these influential factors, this research seeks to provide insights that can support school leaders and policymakers in designing technology integration plans that address gender-based challenges and build more inclusive learning environments (Antoninis et al, 2023).

The study will focus on a specific middle school site in Punjab, where a structured ICT program, including the use of tablets, was introduced in grades five through eight. Unlike most ICT research, which tends to focus on high school or college-level students, this research addresses a notable gap by examining ICT use and perceptions within a middle school setting. Such exploration is critical for understanding early perceptions of ICT among young students and identifying any disparities that may arise due to factors such as school type, socio-economic background, or gender. Furthermore, findings from this study will serve as

valuable insights for administrators and educators in both public and private middle schools across Punjab as they work toward developing effective, equitable ICT integration strategies that align with the needs and capacities of students at this pivotal educational stage (Rehman, Burki & Khan, 2022; UNESCO, 2022 as cited in Antoninis et al, 2023).

Operational Concepts

Information and Communication Technology (ICT)

ICT refers to tools and platforms that enable the processing, communication, and sharing of information. This includes social media sites, email systems, and digital reference resources. ICT encompasses a range of devices and technologies such as computers, mobile phones, radio, television, and the Internet, all which support information exchange and digital learning.

Elementary School Level

In this study, the elementary school level refers to the educational grades that separate primary or basic education from secondary education. Specifically, it includes grades 6, 7, and 8, which typically comprise students aged 11 to 14, although age may range from 10 to 15 years in some cases. This stage represents a critical period for foundational learning and is essential for establishing students' academic skills and attitudes toward technology.

Research Questions

1. To explore the perceptions and experiences of students at the elementary school level in Punjab regarding their use of information and communication technology (ICT) in educational settings.
2. To identify the factors that influence the usage of ICT by elementary school students in Punjab.

Research Design

This study employs a mixed-methods approach, which integrates both quantitative and qualitative research methodologies for a comprehensive exploration of the topic. The quantitative phase serves two primary objectives. First, a survey was conducted to assess the availability, experiences, perceptions, and interests of students regarding their use of information and communication technology (ICT). This survey aims to gauge the overall attitude toward ICT among both female and male students. To facilitate this, a modified version of the Access, Interest, and Experience Survey was utilized to measure students' self-perceptions, capabilities, engagement, and confidence in using ICT.

Descriptive statistics were employed to provide a current depiction of the perceptions of female students in comparison to their male counterparts across the three elementary school grades (grades 6, 7, and 8). The second objective of the quantitative phase was to identify potential participants whose perceived abilities in using ICT are similar, thereby creating an appropriate focus group for further qualitative analysis.

To gain a deeper understanding of female students' experiences and their engagement with technology in Punjab elementary schools, focus group discussions were deemed essential. These discussions facilitated an in-depth exploration of the motivating factors behind both the positive influences and barriers to students' engagement with ICT. Conducting interviews with this group allowed for an emic perspective—providing insight into the lived experiences and views of students at the elementary school level.

Additionally, this research incorporates triangulation to enhance the credibility of the findings by examining the phenomenon from multiple viewpoints. This was achieved through the use of various data collection instruments, including surveys and focus group discussions. According to

qualitative research principles, such an approach aims to elucidate cultural contexts through emic perspectives.

The quantitative survey established a baseline understanding of perceived technology competencies among all students, informing and guiding the focus group discussions with female students. By emphasizing storytelling techniques (Stake, 2005), the research provides a platform for female students to articulate their experiences and perceptions regarding the use of ICT.

Restrictions, Delimitations, and Assumptions

This research study faced several limitations. Firstly, the timeframe allocated for the investigation restricted the number of focus group discussions and the duration of observations conducted in classrooms and computer labs, where students interacted with information and communication technology (ICT). Secondly, my position as the researcher influenced the study, as I am currently employed at the site of the research. This dual role could lead to potential bias in my perceptions regarding the integration of ICT. Additionally, I have previously taught some of the participants, which may further affect the objectivity of my observations.

Delimitations of this research include the selection of the school site. By choosing my own school as the research base, other educational institutions were excluded, which might have provided a broader representation of participants whose experiences and perceptions regarding technology could differ from those at my chosen site. Consequently, this choice may impact the generalizability of the findings.

An underlying assumption of this study is that there are discernible differences in perceived ICT capabilities among students, as indicated by the research. However, these assumptions are not grounded in empirical research conducted within the school and primarily reflect my experiences as their teacher.

Population and Sampling

The research was conducted in public and private schools located in the rural regions of Punjab. The selected school consists of multiple buildings, including an elementary center, a north wing, a west wing, and a south wing. Each building is equipped with computer labs that house two to five computers, all hardwired to the Internet and furnished with software tailored for various grade levels. Additionally, each teacher is assigned a computer, which they can use both at school and at home. Currently, there are no established guidelines regarding technology usage for students or educators; however, a technology committee is in the process of developing integration standards for each grade level.

The school caters to a total of 194 students, ranging from kindergarten through eighth grade. There is one teacher assigned to each grade, along with an aide in the kindergarten, first, and second-grade classrooms. The middle school operates under a departmentalized structure, involving at least five different teachers. Although the school is governed by a religious organization, its administration is primarily managed by lay people, and there are no teachers associated with religious orders. The school has undergone various administrative changes that have led to the development of a technology integration strategy.

For the quantitative segment of this study, the participants were selected from among the grade teachers at different rural schools. While there could have been potential sampling errors based on the researcher's criteria, the selection criteria for this investigation were stringent: participants were required to be (1) teachers at the elementary school level, (2) employed in Punjab institutions, and (3) nearly half of the selected participants were female students. Although the sampling may not yield results that can be broadly generalized, the purpose of this phase was to compare perceptions of ICT usage capabilities between male and female students at two major private schools. Since this study aimed to explore the

experiences of female students in a private school setting at the elementary school level, the participants met the necessary criteria for this stage of the research.

Methodology of the Study

This mixed-methods study was designed to employ a cross-sectional survey to provide a descriptive account of perceptions regarding ICT capabilities among both female and male elementary school students. Data collected from this survey served as a foundation for selecting participants for the subsequent phase of the research. The second phase involved conducting focus groups, which offered an in-depth exploration of students' experiences with ICT and the various factors influencing these experiences.

This mixed-methods approach, characterized as a scientific mixed-methods design by Gay, Mills, and Airasian (2009), enabled the researcher to gather comprehensive data reflecting the current perceptions of both male and female students while also delving deeply into the effects and potential influencing factors on these perceptions, particularly in relation to the students' experiences. Given that this study specifically aimed to examine the perspectives of students, the focus groups consisted exclusively of female students.

Data Collection Tool

The primary data collection occurred at the school during a period when all study participants were present. Given that the school employs a departmentalized elementary program, students were together as a class only during designated times throughout the day. Consequently, the survey was administered to each grade at different intervals. Participants were allotted approximately 40 minutes to complete the survey, with an additional 10 minutes provided for those who required extra time.

The instrument utilized in this phase of the research was an adapted version of the Access, Interest, and Experience Survey (see Appendix A), originally

employed to investigate the relationships between access to tools and student experiences in creative production activities in fifth grade. The primary focus of this instrument was to gather information about students' perceptions and experiences with ICT and to explore its connections with creativity and collaboration.

For the purposes of this study, only the sections addressing perceptions and experiences were included (see Appendix A). Out of the 14 original sections of the Access, Interest, and Experience Survey, ten sections were deemed adequate for measuring nominal data related to students' understanding and views of ICT. The excluded sections (I and XI) did not pertain specifically to ICT but instead addressed broader goals and general perceptions of individuals. Additionally, sections X and XIV focused on collaboration and student creativity, which were not relevant to this research.

As a result of this refinement, students were asked to respond to a total of 27 questions, categorized into three distinct areas: nominal data, experience with ICT, and perceptions about ICT. The first section of the survey prompted students to identify their typical ICT usage in various settings (e.g., frequency of computer use at home, school, library, etc.) and the types of access they have to ICT (e.g., the number of functioning computers in their households). This approach enabled participants to provide a comprehensive overview of their ICT engagement.

Data Analysis and Results

In qualitative research, the process of deriving meaning and significance from the collected data involves interpreting and connecting the findings to the issues faced by users. This data often manifests as records of discussions and meetings, but its scope is not limited to these forms. Through iterative engagement with the data and complex activities such as organizing, restructuring, or thoroughly analyzing it, the researcher seeks to identify patterns and insights that

are critical to the primary research questions. These insights are then utilized to address the needs of the users.

The purpose of analyzing data is to extract actionable and valuable information. Regardless of whether the data is qualitative or quantitative, the research may involve several activities, including:

- Describing and outlining the data
- Identifying relationships between variables
- Examining factors
- Recognizing the complexity among variables
- Predicting outcomes

Quantitative Analysis and Interpretations

The quantitative section focuses on the analysis and interpretation of the data. The primary instrument used for data collection in this study was a questionnaire, and the analysis was conducted using SPSS 24 (Statistical Package for Social Sciences). This software was employed to perform analyses such as frequency counts, percentages, and graphical representations. The interpretation of the data was guided by these analytical outputs.

Table 1. *Questions regarding computer/laptop status of students*

Sr.	*Questions*	*Variables*	*N (%)*
	Do you have a computer/laptop that you call your own?	Yes	35%
		No	38%
		I used to	27%
	Do you have a computer that you use in your room?	Yes	39%
		No	38%
		I used to	23%
	How many working computers does your family have in the	None	42%
		1	22%

place(s) where you live?	2	20%
	3+	16%
What sort of Internet access do you have at home?	Do not have	49%
	I do have	19%
	Dail up	19%
	DSL/Cable	13%
Other computer hardware your family has?	Printer	17%
	Wireless Internet	16%
	Web Cam	16%
	Scanner	13%
	None	38%

The table 1 indicated that a significant portion of respondents, 35%, reported having a personal computer that they consider their own, implying that they are the primary users and others must seek permission to use it. Conversely, 38% of respondents disagreed with this statement, while 27% indicated that they used to have a personal computer.

Regarding the availability of computers in their rooms, 39% of respondents affirmed that they have access to a computer in their room, including laptops. However, a comparable percentage, 38%, disagreed, and 23% stated that they used to have such access.

In terms of the number of working computers within their households, a notable 42% of students reported that their families have no functional computers at home. Additionally, 22% indicated that there is one working computer, 20% reported having two, and 16% stated that their families possess three or more working computers.

The findings also reveal that nearly half of the respondents, 49%, do not have internet access at home. Among those with internet access, 19% were unsure

about the type they had, while another 19% reported using dial-up connections. Additionally, 13% indicated having DSL or cable internet access.

Lastly, regarding additional computer equipment, 38% of students reported that their families do not own any extra devices. Among those who do have additional equipment, 17% mentioned having a printer, 16% indicated the presence of wireless devices, and another 16% reported owning a camera. Thirteen percent of respondents stated that their families have a scanner.

Table 2. *Perception of students regarding their ability of usage and interest towards computers*

Sr.	*Statements*	*Strongly Disagree*	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*
		(%)				
1.	I feel confident about my ability to use computers	22	22	21	18	17
2.	Computers are interesting to me	22	21	21	19	17
3.	Learning about what computers can do is fun	22	21	21	20	16
4.	I am not the kind of person who works well with computers	12	29	25	18	16
5.	I am good with computers	14	32	28	14	12
6.	It is important to	21	30	27	11	11

	my friends that I am knowledgeable about computers					
7.	I like the idea of taking computer classes	19	35	25	11	10
8.	It is important to my parents that I am knowledgeable about computers	22	29	24	13	12
9.	It is important to my teachers that I am knowledgeable about computers	14	26	25	18	17
10.	It is important to me that I am knowledgeable about computers	27	35	16	12	10

The Table 2 revealed a general trend of disagreement among students regarding their interest in and confidence with computers. Specifically, 36% of students expressed a desire to learn more about computers, but a larger portion, 42%, disagreed with this sentiment, indicating a lack of interest in furthering their computer knowledge. Additionally, 22% of students were unable to respond, suggesting uncertainty in their feelings toward computer learning.

Confidence levels in using computers were similarly low, with only 35% of students feeling confident about their abilities, while 44% disagreed, reflecting a prevalent lack of self-assurance in their computer skills. Again, 21% of students did not provide a response.

When asked about the enjoyment of learning what computers can do, only 36% agreed that it is fun, while 43% disagreed, reinforcing the notion that most students do not find computer learning engaging. This trend continues with responses regarding their compatibility with computers; 34% agreed they do not work well with computers, compared to 41% who disagreed, indicating that a majority do not see themselves as proficient users.

Regarding self-perception in computer skills, only 26% of students considered themselves good with computers, while 46% disagreed. Similarly, when asked about the importance of being knowledgeable about computers to their peers, 22% agreed, but a substantial 51% disagreed, suggesting that most students do not feel pressure from their friends regarding computer literacy.

The perceived importance of computer knowledge to family and educators also showed significant disagreement. Only 25% of students agreed it is important to their parents that they are knowledgeable about computers, while 51% disagreed. In terms of teacher expectations, 35% felt it was important for their teachers that they possess computer knowledge, yet 40% disagreed. Lastly, when students reflected on the importance of being knowledgeable about computers for themselves, 22% agreed, while a striking 62% disagreed, indicating that most do not prioritize computer literacy for their own personal development.

Overall, these results highlight a pervasive sentiment of disinterest and lack of confidence in computer usage among students, as well as a minimal perception of the importance of computer knowledge in their social and educational contexts.

Table. 3. *Student perceptions regarding their frequency of their usage of computers*

Sr.	*Questions*	*Variables*	*%*
	How often do you use a computer at home?	Never	35%
		Once a month	38%
		Once a week	27%
	How often do you use a computer at school during class?	Never	39%
		Once a month	38%
		Once a week	23%
	How often do you use a computer at school on your own time?	Never	42%
		Once a month	22%
		Once a week	20%
		Several time a day	16%
	How often do you use a computer at In an after school program/club	Never	49%
		Once a month	19%
		Once a week	19%
		Several time a day	13%
	How often do you use a computer at a relative's house?	Never	23%
		Once a month	22%
		Once a week	21%
		Several time a day	34%
	How often do you use a computer at a friend's house?	Never	22%
		Once a month	20%
		Once a week	39%
		Several time a day	19%
	How often do you use a computer at the library?	Never	22%
		Once a month	22%
		Once a week	25%
		Several time a day	31%

How often do you use a computer at a community center, like the Boys and Girls Club?	Never	22%
	Once a month	21%
	Once a week	35%
	Several time a day	22%

The table 3 indicated a generally low frequency of computer usage among students in various settings. When asked about their computer use at home, 35% of students reported never using a computer, while 38% used it only once a month, and 27% utilized it once a week. This suggests that a significant portion of students have minimal access to computers in their home environment.

Similarly, at school during class time, 39% of students stated they never use a computer, with 38% using it once a month, and 23% once a week. This reflects a concerning lack of integration of computer usage into their academic activities. Furthermore, when considering computer use during their own time at school, 42% reported never using a computer, while 22% used it once a month, 20% once a week, and a mere 16% several times a day. This highlights a significant gap in opportunities for students to engage with technology outside of structured class time.

In after-school programs or clubs, 49% of students indicated they never use a computer, while 19% reported usage once a month, 19% once a week, and only 13% several times a day. This suggests that after-school resources may not be effectively promoting computer engagement among students.

Regarding computer usage at relatives' houses, 23% of students stated they never use a computer, with 22% using it once a month, 21% once a week, and 34% using it several times a day. This indicates a varied reliance on technology in social contexts, although a substantial number still report minimal engagement.

The results show a similar trend at friends' houses, with 22% never using a computer, 20% using it once a month, 39% once a week, and 19% several times a

day. This further illustrates the inconsistency in students' access to computers in informal social settings.

Library usage reflects a pattern of limited engagement as well; 22% of students never use a computer there, while 22% use it once a month, 25% once a week, and 31% several times a day.

Finally, at community centers such as the Boys and Girls Club, 22% of students reported never using a computer, while 21% used it once a month, 35% once a week, and 22% several times a day. This shows that while some students have opportunities to use computers in community settings, a notable portion remains disengaged.

Overall, these results indicate a prevalent trend of limited computer usage across various environments, with a substantial number of students reporting infrequent or no access to computers, which may hinder their technological proficiency and engagement.

Qualitative Analysis and Interpretation

The qualitative analysis of the findings related to the perspectives of female middle school students in Punjab regarding their capacity to utilize Information and Communication Technology (ICT) reveals several key themes, reflecting both the benefits and challenges of e-learning. The participants expressed a generally positive outlook on e-learning, acknowledging its accessibility and convenience. One respondent noted, "*E-learning gives us the opportunity to learn from anywhere, at any time, which is invaluable for our education.*" This sentiment illustrates a recognition of the flexibility that e-learning offers, allowing students to tailor their learning experiences to their individual needs.

However, despite the advantages, there were significant concerns about the monotony of e-learning courses. One participant expressed frustration, stating, "*Many e-learning courses are incredibly boring; it feels like I'm just clicking through slides*

without really engaging with the material." This observation underscores a common criticism of e-learning, where traditional formats like PowerPoint can lead to disengagement and a lack of motivation among students. The challenge of maintaining student interest and participation in online learning environments is critical to consider.

Additionally, the need for quality content in e-learning was emphasized, with one respondent asserting, "*For e-learning to be effective, it has to be engaging. It can't just be text and images; we need videos, interactive elements, and real-life examples to make the learning process more enjoyable*." This highlights the importance of integrating diverse multimedia resources to enhance the learning experience and keep students actively involved.

Participants also acknowledged the role of instructors in facilitating e-learning. One respondent remarked, "*Having a good teacher who can guide us through the e-learning process is essential. It's not just about the technology; it's about having support*." This indicates that while technology is a powerful tool, the presence of skilled educators is crucial in optimizing its use for effective learning.

Moreover, the findings suggest a potential shift toward blended learning models, as one participant noted, "*I think a combination of in-person and online learning could be the best approach. It allows for interaction and engagement, which is often missing in purely online formats.*" This sentiment suggests an emerging preference for hybrid learning environments that combine the strengths of both traditional and digital methods.

Despite the potential of e-learning, there are concerns about accessibility and equity. One participant pointed out, "*Not everyone has the same access to technology at home, which can create a divide among students. We need to address these gaps to ensure*

everyone benefits from e-learning." This highlights the necessity for educational policies that promote equitable access to technology, particularly in underprivileged areas. Finally, the future of e-learning was viewed with optimism, with one student stating, "*I believe e-learning will continue to evolve and become a significant part of our education system. It's the future, and we need to embrace it.*" This forward-looking perspective underscores the belief that as technology advances, so will the opportunities for students to engage in meaningful learning experiences.

In summary, the qualitative analysis reveals a complex landscape where the benefits of e-learning are recognized, but challenges related to engagement, instructor involvement, and equitable access remain prominent. The insights provided by the respondents reflect a desire for more dynamic and interactive learning experiences that can better prepare them for future educational endeavors.

Findings of the Study

This study aimed to investigate the capacity to utilize Information and Communication Technology (ICT) among female middle school students in Punjab and to identify the factors influencing their engagement with ICT. Through a combination of quantitative and qualitative analyses, the findings reveal both the potential benefits and existing challenges related to e-learning within this demographic.

1. **Attitudes Toward E-Learning**: Most respondents expressed a lack of enthusiasm toward learning about computers and utilizing e-learning platforms. Many participants indicated that they felt more inclined to disagree with statements related to their confidence in using computers and the importance of computer knowledge among peers, parents, and teachers. This suggests a general ambivalence towards ICT and e-learning among female students at this educational level.

2. **Frequency of Computer Use**: The data showed that a significant portion of students reported minimal engagement with computers both at home and in school settings. A large percentage indicated that they rarely or never used computers for educational purposes, highlighting a concerning gap in ICT utilization.
3. **Perceived Benefits and Challenges of E-Learning**: Although e-learning was recognized for its flexibility and accessibility, participants also reported significant frustrations. Many described online courses as monotonous and disengaging, often linked to the traditional presentation formats prevalent in e-learning. Respondents emphasized the need for more interactive and dynamic content, such as videos and practical applications, to enhance their learning experiences.
4. **Role of Instructors**: The importance of skilled instructors in guiding students through e-learning processes was frequently mentioned. Respondents noted that a supportive teacher could significantly improve their engagement and learning outcomes in ICT contexts.
5. **Equity and Access**: The study highlighted disparities in access to technology, particularly among students from underprivileged backgrounds. Participants expressed concern about the digital divide, which could hinder equitable learning opportunities and exacerbate existing educational inequalities.
6. **Future Perspectives on E-Learning**: Despite the challenges identified, respondents showed optimism regarding the future of e-learning. Many indicated that advancements in technology could enhance their learning experiences and make education more accessible. There was a growing interest in blended learning approaches that combine traditional and online formats to create a more engaging and effective educational environment.

Conclusion

The findings of this study underscore the complexities of implementing ICT and e-learning among female middle school students in Punjab. While there is a clear recognition of the benefits of e-learning, including flexibility and accessibility, significant challenges remain in terms of engagement, content quality, and equitable access.

Considering the Research Questions posed, the study reveals that:

1. **Understanding Capacity**: The current capacity to utilize ICT is limited by students' attitudes and experiences, indicating a need for enhanced computer literacy programs and support systems.
2. **Engagement with E-Learning**: To foster greater engagement, educational institutions must focus on developing dynamic, interactive learning materials that address the interests and needs of students, moving beyond traditional presentation formats.
3. **Teacher Support**: The presence of knowledgeable and supportive instructors is critical to guiding students in their ICT learning journeys, suggesting a need for professional development in digital teaching methodologies.
4. **Equity in Access**: Addressing the digital divide is imperative to ensure that all students have the opportunity to benefit from e-learning, particularly in under-resourced areas.
5. **Future Directions**: Embracing blended learning models could provide a more effective educational framework that capitalizes on the strengths of both traditional and online learning environments.

   In conclusion, the study highlights a significant need for educational reform and investment in ICT training, content development, and teacher support to empower female middle school students in Punjab to fully engage with

the opportunities presented by e-learning. By addressing these challenges, stakeholders can better facilitate meaningful and equitable educational experiences that harness the potential of technology for all students.

Discussion and Recommendations

In reviewing the literature surrounding Information and Communication Technology (ICT) utilization among students, particularly in the context of e-learning, several key themes emerge that are worth exploring. This discussion will compare and contrast past findings with the new insights gleaned from this study on female middle school students in Punjab, drawing from various cited works and research studies.

1. Student Engagement and Attitudes Toward E-Learning

Previous research has consistently highlighted a growing enthusiasm for e-

2. Frequency and Context of Computer Use

Earlier studies indicated that students who regularly used computers at home and in school environments exhibited better academic performance and higher levels of digital literacy (Albahiri & Alhaj, 2023). The expectation was that increased computer use would naturally lead to enhanced engagement with ICT tools. However, the findings from this study reveal a concerning trend: many female students reported minimal computer use both at home and in school. A significant percentage indicated that they rarely or never engaged with computers for educational purposes. This suggests that while access to technology has increased globally, the actual engagement and meaningful use of these tools remain lacking, particularly in certain demographics and geographic regions. This contrasts sharply with previous assumptions about the automatic benefits of increased computer availability.

3. Quality of E-Learning Experiences

Literature often praises e-learning for its potential to provide diverse learning resources and to cater to various learning styles (AlMaazmi, 2023). Many studies have reported on the effectiveness of multimedia elements in enhancing learning outcomes. In this study, students highlighted the monotonous nature of many e-learning courses, primarily due to traditional presentation styles like PowerPoint slides. Respondents emphasized the need for more interactive and engaging content, such as videos and practical applications. This critique aligns with recent discussions in educational technology that emphasize the importance of learner-centered design and interactive elements in online courses (Alghamdi, 2024). Therefore, while past research celebrated the advantages of e-learning, this study illustrates a critical gap in the actual execution of these concepts.

4. Role of Instructors in E-Learning

Research has long recognized the significant role that instructors play in facilitating successful e-learning environments (Rehman, Zhang & Iqbal, 2021). Effective instructors can enhance student motivation and engagement through their guidance and support. The current study reaffirms this point, with participants noting that the presence of knowledgeable and supportive teachers was vital for their engagement in e-learning. Respondents articulated the importance of having instructors who can effectively utilize technology to facilitate learning. This finding is consistent with prior research but highlights the urgent need for professional development to equip educators with the necessary skills to engage students in a digital context.

5. Equity and Access to Technology

Many studies have documented the digital divide, emphasizing how socioeconomic factors influence access to technology and, consequently, educational outcomes (Qazi et al, 2022). Research has indicated that students from disadvantaged backgrounds are often at a significant disadvantage in terms of accessing ICT resources. This study corroborates the existence of a digital divide among female middle school students in Punjab, where respondents expressed concerns about limited access to technology, particularly in underprivileged areas. This issue aligns with earlier research but underscores a persistent challenge that continues to affect students' educational experiences. The findings stress the importance of addressing these disparities to ensure equitable access to ICT tools, thereby promoting inclusivity in education.

To effectively enhance the utilization of Information and Communication Technology (ICT) among female middle school students in Punjab, it is essential to prioritize the development of engaging and high-quality e-learning materials. Educational stakeholders should focus on creating interactive content that incorporates multimedia elements, such as videos, simulations, and gamified assessments, to foster student engagement. Training programs for educators should emphasize instructional design principles that promote active learning and cater to diverse learning styles. By adopting a learner-centered approach, educational institutions can ensure that e-learning experiences are not only informative but also stimulating, encouraging students to participate actively in their learning processes.

Moreover, addressing the digital divide is crucial for ensuring equitable access to technology among students. Policymakers and educational leaders must work collaboratively to improve technological infrastructure in schools,

particularly in underserved areas. This may involve increasing the availability of computers and internet access and providing financial support or subsidies for low-income families to acquire necessary devices for home use. Additionally, community initiatives, such as partnerships with local organizations, could facilitate after-school programs that offer students opportunities to engage with technology in a supportive environment. By tackling these disparities, educational systems can create a more inclusive landscape that promotes ICT utilization across all demographics.

Finally, ongoing research and evaluation of e-learning programs are vital to understanding their effectiveness and identifying areas for improvement. Educational institutions should implement regular assessments of e-learning tools and methodologies to gather feedback from students and educators. This data can be invaluable for refining instructional practices, enhancing course materials, and ensuring that the needs of all learners are met. Furthermore, fostering a culture of continuous improvement within educational settings will help educators remain responsive to the changing landscape of technology and education, ultimately leading to better learning outcomes for students. Through these comprehensive recommendations, stakeholders can facilitate a more effective integration of ICT in education, significantly impacting students' learning experiences and achievements.

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