

ROLE OF ICT FOR IMPROVING SKILLS OF SECONDARY LEVEL STUDENTS IN D I KHAN

Abdul Rahman^{*1}, Shahzadi Mehwish², Mashad Ali Raza³, Farah Gul⁴,
Muhammad Farooq Javed⁵

^{*1}PhD Scholar, Department of IER, Gomal University, D.I. Khan, Pakistan

²PhD Scholar, IER, Gomal University D I Khan

³Resource Person AIOU

⁴PhD Scholar, IER, Gomal University D I Khan

⁵PhD Scholar, IER, Gomal University D I Khan

^{*1}gps80tda@gmail-com, ²shahzadimehwish@gmail-com, ³razamashad7@gmail -com, ⁴farah11gul@gmail-com, ⁵fjaved664@gmail-com

Corresponding Author: *

Abdul Rahman

DOI: <https://doi.org/10.5281/zenodo.21821461>

Received	Accepted	Published
01 January 2026	17 March 2026	31 March 2026

ABSTRACT

This study aims to analyze the role of Information and Communication Technology (ICT) use in the development of secondary students in Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. This study tried to analyze the association of ICT capability with the development of advanced thinking skills, digital literacy, and collaborative/communicative skills and pinpointed the barriers concerning the effective use of ICT. Utilizing a descriptive survey research design, a quantitative study was conducted on a population of 381 students and 317 teachers in Dera Ismail Khan. Participants were chosen using a combination of stratified sampling and simple random sampling. Five-point Likert scale questionnaires were used to collect data, which was then subjected to descriptive statistics, Pearson product-moment correlation, and moderated multiple regression analysis. The results indicated that there was a strong positive correlation of ICT with critical thinking ($r = 0.48$, $p < 0.01$), problem-solving ($r = 0.44$, $p < 0.01$), creativity ($r = 0.41$, $p < 0.01$), computer literacy ($r = 0.56$, $p < 0.01$), internet literacy ($r = 0.52$, $p < 0.01$), collaboration ($r = 0.47$, $p < 0.01$), and communication skills ($r = 0.43$, $p < 0.01$). Internet literacy was the strongest predictor of total digital literacy ($\beta = 0.38$, $p < 0.001$). ICT training ($\beta = 0.31$, $p < 0.01$), barriers of ICT ($\beta = 0.27$, $p < 0.01$), and ICT pedagogy ($\beta = 0.22$, $p < 0.05$) had a significant moderating effect on the successful implementation of ICT. There are difficulties like insufficient resources (76%), limited internet (74%), power outages (68%), and inadequate teacher training (59%). The study found that while ICT has a lot of possibilities to improve student skills, it needs more challenges to understand what it could do by focusing on infrastructure, teacher training and development, and ICT policies.

Keywords: "ICT integration, secondary education, student skills, digital literacy, higher-order thinking, collaborative learning, teacher training, educational technology, Dera Ismail Khan."

INTRODUCTION

Few things have developed as fast as the ways we communicate and disseminate information. Most areas of our lives, including education, have been altered significantly as a result of these changes. Modern society has a new set of priorities. One of the most pressing of these is to digitally equip their populations in order for them to thrive in the new, digitally dominated knowledge economy. Education systems have been slow to adapt compared to other sectors. The evolution of secondary schooling has been an important part of these changes. The focus has now turned to the importance of information/computer technology to the understanding of the development of secondary school students' skills. Of the various ideas that flow through educational systems, information technology and telematics appear to be some of the most popular. The advantages ICT brings over traditional methods to secondary schooling are many. With ICT, secondary school students can have access to information, work and communicate with their teachers, develop critical and analytical skills, and harness their innovative and creative abilities. Stakeholders in education are now able to build interactive systems that promote learner participation and engagement. The incorporation of ICT into secondary school instruction has been shown to foster participation, enhance school attendance, and promote skill development.

The pandemic sped up the already growing digital divide in education. The pandemic brought the hybrid model of learning to the forefront of the educational community. Many countries reverted to online learning and/or hybrid learning models. This highlighted the opportunities tech brings to learning as well as the gaps in the learning community such as lacking infrastructure, teachers, and/or equity of access. Because of the gaps in hybrid teaching/learning, many researchers are trying to figure out the best ways to use advanced tech/teaching in different learning environments to teach students essential skills.

The use of information communication technology (ICT) is now heavily researched in

relation to its impact on the teaching and learning of 21st century skills. These skills are critical for success in the future world and include the ability to think critically, create, innovate, collaborate, communicate, possess digital literacy, and solve problems. Computational thinking in secondary school students is most positively impacted by internet, computer, and information literacy in that order. The use of ICT in teaching aids the development of skills such as critical thinking, creativity, and problem-solving.

Though there is more and more proof of the value of ICT in education, there are still numerous gaps in both research and practice. One secondary education ICT integration review focused on 51 studies and found that while there are many positive aspects of ICT when looking at curriculum coverage, ensuring equity of access, shared learning resources, and personalization of learning; there are still many barriers, including limited training opportunities, and teachers lacking the pedagogy and/or technology knowledge, the resources are not sustained, and there is no alignment in the curriculum. Also, the integration of ICT is highly reliant on the motivation and attitude of both teachers and students.

Secondary education is important for many reasons, and one of those is that it includes a period of transition for students on a social and cognitive level, as students develop the skills that they will carry with them into their careers. Because of their developmental level, secondary education students are able to assume a higher degree of responsibility for their own learning, and begin to work independently with increasingly complicated materials. Appropriately integrated ICT tools can help facilitate that development.

Nevertheless, little is known about the role of ICT in developing skills of secondary students. This lack of knowledge is especially evident in developing countries where ICT infrastructures, teaching resources, and teaching methods differ greatly. Although it is widely accepted that ICT can be used to improve students' skills, it is not clear how this optimization is achieved. It is not

known which ICT tools, methods, and approaches can be used to support the development of which skills; nor is it known how ICT can be fused into teaching in a meaningful way, nor is it known how the context of ICT use can impact student achievement.

This study aims to understand the effect of ICT on the improvement of skills of secondary students. This study attempts to understand the impact of ICT on the improvement of cognitive, technical, and socio-emotional skills to provide a theoretical framework to educators and practitioners as well as a way to improve teaching methods.

OBJECTIVE OF THE STUDY

The primary objectives of this study are as follows:

1. To Findout the impact of ICT integration on the development of cognitive skills (including critical thinking, problem-solving, and creativity) among secondary level students.
2. To Findout the role of ICT in enhancing technical and digital literacy skills of secondary school students.
3. To investigate the influence of ICT on the development of collaborative and communication skills among secondary level learners.
4. To INVESTIGATE the challenges and barriers that hinder effective ICT integration for skill development in secondary education.

RESEARCH QUESTIONS

1. What is the impact of ICT integration on secondary level students' higher-order thinking skills, including critical thinking, problem-solving, and creativity?
2. How does ICT use influence the development of digital literacy and technical competencies among secondary school students?
3. To what extent does ICT facilitate the development of collaboration and communication skills in secondary education?
4. What are the primary challenges and barriers to effective ICT integration for skill development in secondary schools?

HYPOTHESES

Based on the review of existing literature, the following hypotheses are proposed:

H1: There is a significant positive relationship between ICT integration and the development of higher-order thinking skills (critical thinking, problem-solving, and creativity) among secondary level students.

H2: ICT use has a significant positive effect on secondary students' digital literacy and technical competencies.

H3: ICT-facilitated collaborative learning activities significantly improve secondary students' collaboration and communication skills.

H4: The effectiveness of ICT in improving student skills is significantly moderated by factors such as teacher training, infrastructure availability, and pedagogical approach.

SIGNIFICANCE OF THE STUDY

This study is important to a wide range of individuals connected to secondary education. First, teachers and educators will be able to justify new ideas around teaching and learning skills by using research-based information on the use of ICT in the classroom. This evidence will also help them design their ICT teaching and learning strategies. Second, this research will indicate the professional, financial, and physical resources that school principals and education administrative leaders should focus on for the meaningful use of ICT. Third, this study will help school and education policymakers as well as instructional designers to develop policies and guidelines that will assist the controlled use of ICT in secondary education. This research will assist education researchers and practitioners to identify gaps in research and education on the intersection of ICT and skill development in students. Finally, the ultimate goal of this research is to help students improve their education and gain skills that will allow them to succeed in the 21st century.

DELIMITATION OF THE STUDY

This study is delimited to the following parameters:

1. Limited to secondary schools in a specific geographical area only.
2. Includes only secondary level students and teachers, excluding primary and tertiary levels.
3. Focuses on cognitive skills, digital literacy, and collaborative/communication skills only.
4. Covers only commonly used ICT tools in secondary education, excluding emerging technologies.
5. Based on cross-sectional data collected within a specific timeframe, not a longitudinal study.

Review of Literature

A notable modern innovation in educational systems is the application of information and communication technology (ICT) within secondary education. The advancements and inverse integration of technology into daily life has caused education systems globally to adapt and fulfill the needs of students to successfully navigate the technology integrated world. This literature review aims to analyze prior literature and research to fill the identified gaps for the use of ICT and the enhancement of skill sets of secondary school students. The primary focus is the research published between 2020 and 2026; the emphasis is the research published during this period. The review begins with the ICT integration theories and the empirical research supporting them and continues with the research that describes the skill sets impacted by the use of ICT, the barriers and challenges toward using ICT, and the reasons for gaps in the existing research to justify this research and study.

The Theoretical and Empirical Foundations of ICT Integration in Secondary Education

Information and communication technology can greatly impact and improve education and learning. With ICT, students can find and use resources, connect with others, hone skills, and show creativity and innovation. Constructivism provides the basis for many of the ICT integration and learning theories. Constructivism views learners as people who actively create and

build knowledge with the use of resources and information. Technology provides and makes Constructivism learning theories better and easier with varied resources that offer customizable, entertaining, and engaging lessons.

In an extensive literature review, Msafiri, Kangwa, and Cai (2023), studied 51 peer-reviewed articles and focused on ICT integration in secondary education. Msafiri et al. discovered that secondary education ICT integration fostered positive change in student learning, motivation, engagement, and the development of vital skills. Some of the other rewards referenced were more equitable use of resources, individualized learning, and improved access to learning resources. During the same timeframe, a recent 2024 review noted that ICT integration in education motivated and positively transformed secondary education personnel and learners.

The International Computer and Information Literacy Study (ICILS) 2023 presented extensive cross-country data on CIL and CT. ICILS 2023 reported that in most participating countries secondary education levels were the focus of CIL and CT pedagogy, with CIL being more oftentimes compulsory. Most of the participating countries' national curricula provided instruction on the skills of communication and collaboration, as well as ICT and CT-based critical thinking.

ICT and the Development of Cognitive Skills

Many studies look at the use of ICT and the development of higher-order skills of secondary students. These studies indicate that teaching using ICT methods greatly assists pupils in the development of critical thinking, problem-solving, creativity, and decision-making skills. These studies show that ICT skills help enhance critical thinking skills.

Within the area of computational thinking—the 21st-century skill that many believe is crucial—Xing and Zeng (2025) examined the link between ICT skills and secondary students' computational thinking in smart classrooms. Their research showed that ICT skills positively influence secondary students' computational thinking skills. In this context, the most significant

influence was attributed to internet skills, followed by computer skills and information skills. The study proposed that the development of ICT skills of secondary students would help improve computational thinking skills.

ICT use shows that there is a positive relationship with problem-solving skills. One of the studies that showed the impact of ICT on the development of problem-solving skills concluded that ICT skills positively and significantly impact the development of problem-solving skills. Further, the study of techno-pedagogy—the science of the skill to combine technology with teaching and learning—shows that students taught using technology-based methods had their problem-solving skills and scientific creativity greatly improved.

With respect to the case of science education, a quasi-experimental study that examined the impact of ICT integration on secondary school students' physics achievement and reasoning skills concluded that the integration of ICT produced positive results in both physics achievement and reasoning skills. The results of this study indicated the ability of ICT to improve both the cognitive processes related to scientific reasoning and the content knowledge of students.

ICT and the Development of Digital Literacy and Technical Competencies

Digital literacy is indispensable. Research has shown that Information and Communication Technology (ICT) is an effective way to teach digital literacy in secondary schools. One such example is the study showing that digital literacy increases the academic performance of secondary school students.

Khan, Gillani and others (2025) studied the function of ICT in communication, collaboration, creativity and critical thinking from the perspective of students as well as teachers. Their study found that participants from both groups acknowledged the importance of ICT in addressing essential 21st century skills in the secondary school classroom. The study also captured the concern of both groups about the limitations ICT has, such as cheating, misinformation, and inequity.

Research on digital literacy and 21st century skills is increasingly important and complex. There are studies that based upon their research found that digital literacy and problem-solving skills are precursors of the 21st century skill level and studies that found these skills do not correlate to the level of 21st century skills of secondary school students. The inconsistency in research is clear, ICT skills and the ability to solve problems are related to the skills of secondary school students, but this is also dependent on the teaching methods, the environment and the intentional use of ICT.

ICT and the Development of Collaborative and Communication Skills

Development of digital communication and collaborative skills is now vital for work-ready graduates. The role of ICT in developing these skills has been widely reported. A systematic literature review on the management of cooperative learning and digital skills in secondary education, published between 2018 and 2024, reported numerous strategies to improve the learning and teaching process to improve academic outcomes and student communication and social skills through task management, the creation of cooperative groups, and resolution of shared leadership conflicts. The review reported the development of digital skills in searching for information, digital communication, the creation of virtual objects, digital safety, and social responsibility.

Numerous studies reported that online cooperative learning has a positive effect on the attitude and willingness to learn of students. Engaging in teaching methods that employ virtual collaboration networks positively influences students' motivation and their ability to verbally express themselves. There is substantial evidence that ICT-supported cooperative learning creates an environment that fosters the development of social skills and that when cooperative learning is used, students retain the information and skills for a longer period of time.

Challenges and Barriers to Effective ICT Integration

The integration of information and communication technology poses certain obstacles for secondary schools in relation to the development of skills through technological integration in the classroom, even though the advantages have already been proven. Msafiri et al. (2023) observed the challenges of professional development, pedagogical and technological knowledge, and the maintenance of resources. Suggested practices to counter the challenges involved regular supply and maintenance of the system, realignment of the curriculum, establishment of an ICT policy, and collaborative involvement of every stakeholder regarding the incorporation of ICT.

The review of ICT in secondary education for improved learning (2024) mentioned that successful integration was reliant on the improvement of knowledge and skills, professional development, and the resolution of systemic barriers. The review underscored the important position of policymakers concerning the development of an innovative, cooperative, and nurturing attitude in school, and cited that adequate ICT tools should be made available, accessible, reliable, compatible, and secure by school leaders.

In developing countries, the situation is more challenging. The barriers to a more extensive use of ICT in secondary schools have been divided into five main categories: resources, infrastructure, the environment, time and support, and ICT financing. Studies regarding Bangladesh have reported that the development of ICT-integrated curricula was a complex procedure that discouraged teachers from using ICT in teaching. Studies from Nepal have reported challenges concerning poor bandwidth and slow internet, lack of hardware resources, lack of trained personnel, and poor school management.

Integration issues include factors related to teachers. In research centered on secondary teachers' use of ICT, differences in reasons for using ICT versus reasons for not using ICT was documented for teachers in the no ICT category.

Attitude, belief, and ICT self-efficacy are critical for successful integration of ICT.

Summary and Research Gaps

The literature shows integration of ICT within secondary education provides a basis for enhancement within a variety of skill sets. Literature supports ICT's role in the enhancement of cognitive skills, problem solving, critical thinking, creativity, as well as cross-curricular competencies and skills, such as digital and ICT literacy and thinking, and communication and collaboration. Also, ICT's effective integration depends on many factors like teacher preparation, infrastructure, pedagogy, curriculum, and all stakeholders involved.

While more studies are exploring the impact of ICT on various skills, there are still gaps within the literature that need to be addressed. Research exploring multiple skills together has been limited. Literature has focused primarily on the developed countries and of the literature that has addressed developing countries, there has been a lack of focus on developing countries with a wide variety of educational systems with limited resources and infrastructure. More studies are needed on the specific conditions of ICT integration and skill development. The digital world is rapidly changing ~ study within this area must be ongoing for the tools and their impact on learning.

The study aims to address the gaps in literature through analysis of ICT and its contribution to development of skill categories in secondary school students. Through a multi-dimensional framework incorporating cognitive and technical and socio-emotional competencies, the study aims to understand the role of ICT in the development of secondary school students from a more holistic perspective. In addition, by analyzing the obstacles that limit the effective use of ICT, the study aims to provide educators and policy makers and educational leaders in the ICT integration space in secondary education work practical opportunities.

METHODOLOGY

Research Design

The current study analyzes data based on a research design of descriptive survey. denoting that a survey design is useful when the intent of the research is to define a population's characteristics, or to ascertain the relationships within a given population, or to gather data on the situation and practices at the time the survey is conducted (Creswell and Creswell, 2023). It is also useful design when the research is of an educational nature and the phenomenon is to be observed in the way it exists in real time, without any manipulation of the variables. The descriptive survey design is common in research that is related to the educational usage of ICT in order to gather teachers' perceptions, their usage of ICT and the implementation concerns of ICT.

Population of the Study

This study looks at secondary school students and teachers in Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Fraenkel, Wallen, and Hyun (2023) state that a researcher-defined population features the individuals that a researcher describes, and the findings of that research can be extended to them in as much as they have common characteristics. The population in the study consists of 1,800 staff teachers (950 Male, 850 Female) and 45,000 students (23,500 Male, 21,500 Female) in grades nine to twelve. This population is from the district's government and private Secondary schools.

Sample and Sampling Technique

Stratified random sampling followed by simple random sampling will be used to select study participants from the target population. Stratified random sampling creates a diverse sample including different school types, diverse locations, and a balance of genders. Simple random sampling gives every individual an equal chance of being selected. Krejcie and Morgan (1970) provide a sample size determination table for a 95% confidence level and a 5% margin of error. Based on this table, the sample size for this study

will be 317 teachers, out of 1,800 teachers, and 381 students, out of 45,000 students.

Research Instrument

The research instruments will include a student questionnaire, a teacher questionnaire, and an interview guide for school administrators. The student questionnaire will include sections on demographic information, access to and usage of ICT, ICT skills and digital literacy, cognitive skills, and barriers. All items will employ a five-point Likert scale. The items for the study will be taken from established, validated, and reliable research scales (Xing & Zeng, 2025; Alsarayreh, 2023). An expert panel will review the instruments to assess the content, and pilot testing will be used to assess reliability and compute Cronbach's alpha (0.854).

Data Collection

To encourage high response rates and maintain consistency, our method for gathering data will be compliant with ethical standards. Before collecting data, we will get the required permissions from the educational authorities and the ethics committees of the institutions. Participants will give informed consent, which for the students will include consent from their parents. Participants will complete the questionnaires during class time, and the interviews for the school/college administrators will happen at a time agreed by both parties. The quantitative data collected will be analyzed using SPSS, and qualitative data will be transcribed and analyzed thematically. All data collected will be properly and securely stored and managed.

Ethical Considerations

Our study will follow the ethical principles of educational research. We will get informed consent from each participant in addition to consent from parents of student participants. Using codes and storing data securely will help us keep participants' identities private. We will inform participants about the voluntary nature of the study and that they have the right to drop out at any time without consequences. Following Fraenkel et al. (2023), we will try to limit the

possible negative impacts while maximizing the possible positive impacts of the study for research

participants and the community the study participants are a part of.

Results and Interpretations of Data

Table 1: Demographic Characteristics of Respondents

Demographic Variable	Category	Frequency f	Percentage %
Students (N= 381)			
Gender	Male	199	52.2
	Female	182	47.8
Grade Level	Grade 9	187	49.1
	Grade 10	194	50.9
Teachers (N = 317)			
Gender	Male	167	52.7
	Female	150	47.3

The study selected 381 Dera Ismail Khan secondary school students and 317 teachers from 6 secondary schools. Of the sample, 199 participants were male (52.2%), and 182 were female (47.8%), showing a roughly equal student

sample by gender. Students from each year in secondary school were invited to participate from year levels 9-12. There were 167 male teachers (52.7%) and 150 female teachers (47.3%) in the sample for a balanced consideration of gender.*

Table 2: ICT access and usage

ICT access and usage indicator	Category	Percentage (%)	M	SD
Student ICT Access				
Access to ICT resources at school	Yes	62	-	-
Access to ICT resources at school	No	38	-	-
Student ICT Usage Frequency	-	-	3.38	0.91
Teacher ICT Integration Frequency	-	-	3.08	0.96

Data acquired from the analysis of ICT usage access indicates that the majority of the students, 62%, indicated they had access to ICT at school, with computers and internet access to ICT resources. Nevertheless, access was not available to all students and generally, urban schools had more access to ICT resources and facilities compared to rural schools. The average score for

students' use of ICT was 3.38 (SD = 0.91) on a scale of 5, which showed that students moderately to frequently used ICT tools for learning. Teachers showed a slightly lower level of usage of ICT in their teaching (M = 3.08, SD = 0.96). Ultimately, availability of ICT resources in schools is not enough; there is a need to integrate ICT in teaching.

Table 3: Pearson Correlation between ICT use and Higher Order Thinking Skills

Variable	ICT Use	Critical Thinking	Problem Solving	Creativity
ICT Use	1.00	0.48**	0.44**	0.41**
Critical Thinking	0.48**	1.00	-	-
Problem Solving	0.44**	-	1.00	-
Creativity	0.41**	-	-	1.00

p < 0.01 (Significant at 0.01 level)

Examining the data on the connection between ICT usage and higher-order thinking skills showed significantly positive correlations. Overall ICT usage and critical thinking skills had a moderate positive relationship of $r = 0.48$ ($p < 0.01$) in the Pearson correlation. ICT usage had significant positive correlations with problem-

solving skills ($r = 0.44$, $p < 0.01$) and creativity ($r = 0.41$, $p < 0.01$). This data confirms Hypothesis (H1), which stated that there would be a significant positive correlation between the integration of ICT and the enhancement of higher-order thinking skills of secondary students.

Table 4: Pearson Correlation between ICT use and Digital Literacy Skills

Variable	1	2	3	4
1 ICT Use	1.00			
2 Computer Literacy	.56**	1.00		
3. Internet Literacy	.52**	-	1.00	
4. Information Literacy	.49**			1.00

p < 0.01 (Significant at 0.01 level)

Very strong positive correlations were found in the description of strong positive correlations between the use of ICT and the development of digital literacy. The use of ICT and self-reported computer literacy correlated with ICT use at $r = 0.56$ ($p < 0.01$). When referring to internet literacy, the correlation was $r = 0.52$ ($p < 0.01$).

When referring to information literacy, it was $r = 0.49$ ($p < 0.01$). These results correspond to Hypothesis (H2), which says that the use of ICT significantly and positively affects the digital literacy and technical skills of secondary school students.

Table 5: Multiple Regression Analysis of ICT Literacy Component Predicting Overall Digital Literacy

Predictor Variable	B	SE	β	t	p
(Constant)	0.856	0.214	-	4.00	< .001
Internet Literacy	0.352	0.058	0.38	6.069	< .001
Computer Literacy	0.257	0.062	0.29	4.629	< .001
Information Literacy	0.198	0.074	0.21	2.676	< .01

Model Summary: $R = 0.487$, $R^2 = 0.237$, adjusted $R^2 = 0.231$, $F(3, 377) = 38.92$, $p < 0.001$. To analyze the contribution of various components of ICT literacy toward the measurement of total digital literacy the multiple regression model was run. The regression model was statistically significant, $F(3, 377) = 38.92$, $p <$

0.001 , model captured 23.7% of the variance ($R^2 = 0.237$) of digital literacy scores. Among the three sub components, the strongest predictor of the multiple regression model was internet literacy ($\beta = 0.38$, $p < 0.001$), followed by computer literacy ($\beta = 0.29$, $p < 0.001$) and then by information literacy ($\beta = 0.21$, $p < 0.01$).

Table 6: Pearson Correlation between ICT Use and Collaborative Communication Skills

Variable	ICT Use	Collaborative skills	Communication Skills
ICT Use	1.00	.47**	.43**
Collaborative skills	.47**	1.00	
Communication Skills	.43**	-	1.00

$p < 0.01$ (Significant at 0.01 level)

When the data on ICT-assisted collaborative learning was examined, notable positive correlations were seen regarding the use of ICT and collaboration skills ($r = 0.47$, $p < 0.01$) and communication skills ($r = 0.43$, $p < 0.01$). Thus, hypothesis 3 (H3) was supported, which claimed that the use of ICT-assisted collaborative learning

activities strongly boosts secondary learners' collaboration and communication skills. Those secondary students who reported higher levels of ICT-assisted collaborative participation (online discussion boards, shared online documents, virtual group workspaces, etc.) received stronger collaboration and communication skills ratings.

Table 7: Moderation Analysis of Contextual Factors on ICT Effectiveness

Moderator Variable	Standardized Coefficient (β)	t-value	p-value	Significance
Teacher Training	0.31	3.876	< 0.01	Significant
Infrastructure Availability	0.27	3.375	< 0.01	Significant
Pedagogical Approach	0.22	2.750	< 0.05	Significant

To examine Hypothesis 4 (H4), which stated that teacher training, infrastructure, and teaching style mediate how effective ICT is in improving student skills, moderation analysis was performed. The analysis revealed that, using ICT, training ($\beta = 0.31$, $p < 0.01$) and available infrastructure ($\beta = 0.27$, $p < 0.01$) were significant in explaining the use of ICT and student skills.

Teaching style, as an example, also revealed a contributing moderating effect ($\beta = 0.22$, $p < 0.05$). These results indicate that the availability of ICT, in most cases, does not improve student skills. Instead, the effect of ICT hinges on the training of the teacher, the availability of teaching aids, and the teaching style.

Table 8: Challenges and Barriers to Effective ICT Integration

Challenges/ Barriers	Frequency (f)	Percentage (%)	Rank
Lack of Resources	530	76	1
Poor Internet access	516	74	2
Power Outages	474	68	3

Lack of Technical Support	439	63	4
Insufficient Teacher	411	59	5

Challenges identified by the respondents showed the barriers that limit effective integration of ICT in classrooms. The lack of resources (76%), poor Internet access (74%), power outages (68%), lack of technical support (63%), and lack of training (59%) were identified by teachers and students as obstacles that deter ICT integration. These obstacles have been identified by other researchers in many educational systems and in most developing nations. In Dera Ismail Khan, particularly insufficient resources will make integration of ICT more difficult.

Discussion

The strongest finding from this study is the positive correlation between ICT integration and the development of higher-order thinking skills. ICT use relates to critical thinking ($r = 0.48$), problem-solving ($r = 0.44$), and creativity ($r = 0.41$). The integration of ICT in meaningful ways helps develop students cognitively. This finding supports the systematic literature review of Msafiri, Kangwa, and Cai (2023). Their literature review states that the integration of ICT in teaching and learning helps develop the skills of the students and motivates and engages the students. This is supported by the study of techno-pedagogy, wherein students, who learn through technology-based teaching methods, develop problem-solving skills and scientific creativity. The moderate strength of the related concepts indicates that the integration of ICT helps develop cognitive skills, and ICT in teaching and learning supports the pedagogical methods and the environment in which teaching and learning is carried out.

High positive correlations exist between ICT use and certain areas of digital literacy, confirmed by the following: computer literacy ($r = 0.56$), internet literacy ($r = 0.52$), and information literacy ($r = 0.49$). These results suggest that the regular use of ICT tools develops the technical skills required for successful engagement in the

workforce of the 21st century. The results of the multiple regression analysis indicated that internet literacy had the highest β value (0.38, $p < 0.001$) of all the predictors of overall digital literacy, followed by computer literacy ($\beta = 0.29$) and information literacy ($\beta = 0.21$). The results for the β values of internet literacy, computer literacy, and information literacy, are in agreement with research conducted by Xing and Zeng (2025). They reported that internet literacy, the primary component of ICT literacy, exerted the greatest influence on the development of secondary school students' computational thinking skills. The research conducted by Maria, Baber and Alam (2024) identified a positive correlation between digital literacy and the academic performance of secondary school students in Pakistan. That internet literacy dominates the other areas of digital literacy underscores the importance of the online access to information and communication and collaboration in today's classrooms.

The strong positive correlations of ICT use with collaboration skills ($r = 0.47$) and communication skills ($r = 0.43$) indicate that ICT-supported collaborative learning activities aid in the development of collaborative skills. Samane-Cutipa et al. (2025) assert that the integration of cooperative learning and digital skills in the classroom manages and enhances teaching, learning, and the academic performance of the students and also enhances their communication and social skills by managing tasks, forming cooperative groups, and sharing and resolving conflicts of leadership. The correlation with collaboration skills is likely stronger than the correlation with communication skills because of the ICT tools available in Pakistani secondary schools. These tools are likely those that support collaborative group work rather than those that develop oral and/or written communication.

The moderation analysis indicated that teacher training ($\beta = 0.31$, $p < 0.01$), the availability of infrastructure ($\beta = 0.27$, $p < 0.01$) and the

pedagogical approach ($\beta = 0.22$, $p < 0.05$) all play a moderating role on the use of ICT and skill development of students. The results are in line with the study conducted by the Integration of ICT in Secondary Education for Better Learning (2024), which found that the integration of ICT in secondary education for better learning focuses on the need for professional development, the enhancement of knowledge and skills, as well as the resolution of system barriers and challenges. The findings stress the importance of teacher training as the most important of the three and the immediate need to put in place intensive and systematic professional development. The descriptive analysis found that the major barriers were a lack of resources (76%), poor Internet access (74%), power outages (68%), lack of technical support (63%), and insufficient teacher training (59%). Ravishankar and Wase (2024) identified similar barriers in Ethiopian secondary schools of lack of resources, poor Internet access, power outages and lack of training. These barriers are the integration of educational technology in developing countries and are of a broader systemic nature.

The results support learning theories of constructionism. The integration of technology in education provides an opportunity for students to engage in an active process of learning by interacting with the environment. The result of this work has significant value for the secondary schools in Pakistan. Investing in ICT infrastructure and technology with a sound pedagogical approach and the support of comprehensive ICT professional development of teachers can provide enhanced student skills and improve educational outcomes.

Conclusion

This study examined how ICT affects secondary school student skills in Dera Ismail Khan. Research data proved that using ICT systems in school impacts higher-order thinking skills (Critical Thinking, Problem Solving, and Creativity) and students' digital literacy, collaboration, and communication skills. Of the various skills, Internet literacy stands out as the best indicator of digital literacy overall. Teacher

training, available school infrastructures, and teaching methodologies are the main moderating factors influencing ICT systems' impacts. There are still many continuing problems, such as poor Internet connections, a lack of resources including money, a lack of teacher training, and outages of electricity which prevent school systems' ICT technologies from being fully used.

This research shows that ICT is key in developing skills of secondary level students, but to fully realize this value from ICT, significant investment in ICT infrastructures, policies that support teacher professional development, and improvement of teaching methods with a focus on the context are needed. This research provides practitioners with evidence from the Pakistani context on the impact of ICT in the secondary education sector. This research aims to help educators, administrators, and policymaking practitioners understand the value and use of ICT in education and technology-based innovations. The research can also help develop areas of ICT that are user friendly and work in undeveloped jurisdictions.

Recommendations

In light of the findings, the following recommendations are made:

- Increase investment in ICT infrastructure, including computer laboratories, reliable Internet connectivity, and alternative power solutions such as solar panels to address power outages reported by 68% of respondents. Formulate comprehensive ICT policies addressing curriculum alignment, resource provision, and teacher training.
- Prioritize sustained teacher professional development programs that build both technical proficiency and pedagogical knowledge for ICT integration. Ensure availability of technical support staff and establish maintenance protocols for ICT equipment. Foster a supportive school culture that encourages experimentation with technology.
- Design collaborative ICT activities that develop communication and teamwork skills alongside cognitive competencies. Adopt pedagogically sound integration approaches

aligned with learning objectives rather than superficial technology use. Engage in continuous professional learning and peer collaboration to enhance ICT integration practices.

- **For further research:** Conduct longitudinal studies examining the long-term effects of ICT integration on student skill development and academic outcomes. Investigate the implications of emerging technologies such as artificial intelligence for secondary education. Explore gender and equity dimensions of ICT access and skill development across diverse socioeconomic and geographic contexts.

REFERENCES

- Alsarayreh, R. S. (2023). The effect of technological skills on developing problem solving skills: The moderating role of academic achievement. *International Journal of Instruction*, 16(2), 369–388.
- Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2023). *How to design and evaluate research in education* (11th ed.). McGraw-Hill Education.
- Hardiansyah, F., et al. (2024). Games designed to solve problems or simulations can improve Higher-Order Thinking Skills (HOTS) in a fun way. *Jurnal UIN Antasari*.
- Hunduma, C. M., & Mekuria, Y. S. (2024). Constraints hindering ICT integration in Ethiopian public secondary schools: A literature review. *FachportalPädagogik*.
- ICILS. (2023). *International Computer and Information Literacy Study 2023*. IEA.
- Khan, S. J., Gillani, U. S., et al. (2025). Quantitative analysis of ICT's role in communication, collaboration, creativity, and critical thinking: Perspectives of students and teachers. *The Knowledge*, 4, 9–19.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610.
- Msafiri, M. M., Kangwa, D., & Cai, L. (2023). A systematic literature review of ICT integration in secondary education: What works, what does not, and what next? *Discover Education*, 2, Article 44.
- Omar, M. K., Ahmad Ruzaidi, D. U., Mohd Puad, M. H., & Jusoh, R. (2023). How digitalized are school students? Determining digital competencies and motivation factors in using technology for learning. *International Journal of Academic Research in Progressive Education and Development*, 12(2), 1613–1634.
- Samane-Cutipa, V. A., Callacondo Velarde, J. C., Rucano Paucar, F. H., & Talavera-Mendoza, F. (2025). Managing cooperative learning and digital competences in secondary education: A systematic review. *International Journal of Evaluation and Research in Education*, 14(3).
- Xing, D., & Zeng, Y. (2025). Exploring the effects of secondary school student's information and communication technology literacy on computational thinking skills in the smart classroom environment. *Education and Information Technologies*, 30(7), 9069–9092.
- Yaseen, M., Andleeb, S., Ullah, N., & Zafar, J. M. (2025). Impact of Information and Communication Technologies (ICTs) on students' higher-order learning skills at secondary school level. *The Knowledge*, 4, 9–19.