THE KNOWLEDGE | RESEARCH ARTICLE

Impact of Information and Communication Technologies (ICTs) on Students' Higher-Order Learning Skills at Secondary School Level

Muhammad Yaseen [1]   Shazia Andleeb [2]   Naeem Ullah [3]   Jam Muhammad Zafar [4]

Abstract

The study entitled, "Impact of Information and Communication Technologies (ICTs) on Students' Higher-Order Learning Skills at Secondary School Level". The integration of Information and Communication Technologies (ICT) in education is reshaping traditional classrooms, especially in the promotion of higher-order learning (HOL) skills such as critical thinking, problem-solving, creativity, and decision-making. The research objectives of the study were to analyze the impact of information and communication technologies (ICTs) on students' higher-order learning skills at secondary school level, to identify the challenges of information and communication technologies (ICTs) for students' higher-order learning skills at secondary school level and to recommend certain measures about using ICTs for students higher order learning at secondary school level. The study was survey and descriptive in nature. The mixed-method study was conducted in public schools of Rahim Yar Khan, Pakistan. Guided by the TPACK and SAMR models, the research highlights how ICT-enhanced teaching methods contribute significantly to the cultivation of HOL skills. Using SmartPLS 4.0, the authors quantitatively analyzed ICT implementation, while performing qualitative thematic analysis to gauge how much it contributed to deeper learning. The research indicates that using ICT well helps students become more engaged, better thinkers, and more creative. Problems such as not having the necessary resources, untrained teachers, and unequal access were also found. It adds to what is known in digital pedagogy by showing how ICT can be used in the classroom to help students develop skills related to thinking, understanding, and memory. Those findings can be used by educators, policymakers, and curriculum designers who are aiming to improve future skills in learners.

Key Words

Information and Communication Technologies, Higher-Order Learning, TPACK, SAMR

Corresponding Author

Muhammad Yaseen: PhD Scholar, Department of Education, Khwaja Fareed University of Engineering and Information Technology (KFUEIT) Rahim Yar Khan, Punjab, Pakistan. Email: muhammadyaseeniub@gmail.com

Introduction

In the digital age, many countries are now shifting their education systems in favor of learning that uses technology (Barnes & Gearin, 2022). Education now aims to develop higher-order learning (HOL) abilities by teaching people

[1] PhD Scholar, Department of Education, Khwaja Fareed University of Engineering and Information Technology (KFUEIT) Rahim Yar Khan, Punjab, Pakistan. Email: muhammadyaseeniub@gmail.com

[2] Assistant Professor, Institute of Humanities and Social Science, Khwaja Fareed University of Engineering and Information Technology (KFUEIT) Rahim Yar Khan, Punjab, Pakistan. Email: shazia.andleeb@kfueit.edu.pk

[3] Assistant Professor, Department of Education, Punjab, Pakistan. Khwaja Fareed University of Engineering and Information Technology (KFUEIT) Rahim Yar Khan, Punjab, Pakistan. Email: dr.naeemullah@kfueit.edu.pk

[4] Assistant Professor, Department of Education Khwaja Fareed University of Engineering and Information Technology (KFUEIT) Rahim Yar Khan, Punjab, Pakistan. Email: dr.zafar@kfueit.edu.pk

how to think critically, use creativity and solve problems (Arshad et al., 2024). The use of Information and Communication Technologies (ICT) is now viewed as an important way to help achieve these outcomes. With multimedia content, interactive simulations and educational software, students can learn in ways that move past just memorizing facts (Saleem, Ullah & Zafar, 2024., Naz & Zafar, 2023; Rasheed et al., 2024).

In Pakistan, at the secondary level, ICT is used rather irregularly and is mostly for showing videos or keeping PowerPoint presentations (Akram et al., 2022; Khan, 2023). In an age where technology is growing rapidly, there is a real need to see how ICT influences higher-order learning. Reddy's (2021) work examines the link between ICT use and HOL growth using both real data and theory. The approach looks at how using technology in education allows students to actively shape and put their knowledge into action.

Nowadays, learning focuses not only on understanding subjects but also making sure students can use, assess and create original ideas. These skills are categorized as higher-order learning (HOL), covering critical thinking, problem-solving, creativity and making choices (Li et al., 2024; Mumtaz et al., 2024). Relying greatly on reading and memorization from textbooks is not a good way to help students develop these skills. Indeed, using ICT tools at school helps encourage students to participate actively and learn in detail.

Integrating ICT into education means teachers and students are using computers, smartboards, online courses and mobile applications. They allow lessons to be more interacting, visual and simpler for students to access, thanks to simulations, videos and instant response (Shehbaz., et al., 2024; Mohiman et al., 2024). These technologies to solve challenges and put what they learn into action. While digital education efforts are gaining ground in Pakistan, secondary schools are still struggling with sticking to ICT well. Evidence indicates that many teachers feel unequipped with the proper guidance, skills and equipment to really use ICT (Anjum & Zafar, 2022; Rawal, 2024). So, the chances ICT offers for HOL are hardly realized.

The TPACK and SAMR models help us understand how much and how well ICT is being used in education. The models indicate that instead of replacing standard tools, ICT should influence the type of learning activity, pushing students to involve more of their thinking abilities (Li et al., 2024). When combined well with teaching goals, ICT can mediate the effects of different teaching methods on students' teaching (Zafar et al., 2023; Bhuttah et al., 2024).

The ICT integration in education is better understood when analyzed in terms of known models that show how technology, pedagogy and content work together to help meaningful learning process (Abedi, 2024). This study is founded on two major frameworks: The Technological Pedagogical Content Knowledge (TPACK) model and the SAMR model. Mishra and Koehler (2006) introduced the TPACK model which is an intersection between three core domains: Contend knowledge (CK), Pedagogical Knowledge (PKs) and Technological Knowledge (TK). Effective ICT integration takes place when a teacher is able to connect subject content with appropriate pedagogies alongside the use of technical tools, as held by the model. For example, a science teacher could use TK (simulation) with CK (complex concept) to teach PK (inquiry based learning). Deep student engagement and understanding (Maitlo et al., 2024; Maitlo et al., 2025), is made possible through this synergy required for higher order learning.

The ICT integration was categorized using SAMR model (Nair & Chuan, 2021) as four levels namely: Substitution, Augmentation, Modification and Redefinition. The lower levels tap basic enhancement (e.g. replacing paper with digital worksheets); the upper levels are transformational (e.g. as students use technology to make new knowledge). For instance, redefinition means collaborative global projects or interactive multimedia presentations which incite critical thinking and creativity (Ali et al., 2024; Hassan et al., 2024). These frameworks are brought together to support a structured understanding for how ICT can transform classrooms from traditional teaching to student-centered higher order learning environments. In addition to offering a selection of teaching techniques,

they also direct teachers as they plan, assess and refine their digital teaching methods (Bhutto et al., 2023). Using TPACK and SAMR this study evaluates if ICT is present in classrooms but also the extent to which it mediates teaching practice and promotes the development of cognitive skill.

The review covers a wide range of studies that demonstrate the potential of ICT to support cognitive development in secondary students. Three main areas are addressed: ICT integration practices, higher order learning skills, theoretical frameworks to encourage ICT use and empirical evidence on the effect of ICT on learning outcomes. It also deals with things like teacher readiness, infrastructure and digital equity (Pittman et al, 2021). In this section, findings from national and international research are synthesized to both establish what is known and to scaffold an identification of how gaps occur and create a more nuanced understanding of how technology mediates the teaching--learning process. This review substantiates the aim of the article: to investigate the mechanism in which ICT use foster the creation of higher order learning skills in secondary education settings.

The meaningful use of digital tools like computers, smartboards, mobile apps and online platforms; in support of teaching and teach (Lone et al., 2011). Such integration is even more important in secondary schools where there is an expectation that students address deeper, more complex concepts and where students are expected to demonstrate more sophisticated skills, rather than simply memorizing information. The ability for such tools to provide lessons that are more interactive and accessible and closer to real world applications is realised by digital tools (Zafar & Ullah 2020).

Many of the education systems all over the world had adopted ICT policies which are directed at enriching the academic experience (Ahmad et al., 2025) For example, active learning has been encouraged through promotion of, for example, blended and flipped classroom models. They enable students to use digital content outside the classroom and use higher level activities in the classroom (Yousaf et al., 2021). Consequently, researchers demonstrated that ICTs play a significant role in motivating and engaging student's two gravely essential factors that lead to improvement of higher orders thinking (Seyi, 2021).

Integration of ICT in Secondary schools, however, is inconsistent in Pakistan. Digital resources are better available in urban schools than in rural schools who do not have digital devices, dependable internet and trained teachers. However, funding deficiencies and low implementation have continued to undermine government initiatives even in the face of the 'Digital Pakistan Vision'. Moreover, many teachers are still using ICT for trivial tasks such as using PowerPoint to show slides or play videos, instead of linking those tools to student centric pedagogy (Ahmad et al., 2022). As a result, the transformative potential of ICT is limited; ICT is used to reinforce traditional teacher-centered practices. Writing Oyedoyin et al. (2024), ICT is valuable not because it is new, but because of the impact it has on how students learn, think and apply knowledge. Available literature clearly demonstrates that wide availability of ICT tools does not translate in pedagogical integration. One thing that the teachers need is the continuous professional development and schools need policies that foster the use of ICT in not just information transfer, but also for deeper learning (Adeniyi et al., 2024).

Understanding Higher-Order Learning Skills

Higher-order learning (HOL) skills represent advanced cognitive functions that enable learners to analyze, evaluate, and create rather than simply remember or understand. These include critical thinking, problem-solving, creativity, decision-making, and the ability to apply knowledge in real-world contexts (Ramzan et al., 2023). At the secondary education level, students are transitioning from basic knowledge acquisition to more sophisticated learning. This shift is crucial for preparing them for university, work, and social responsibilities.

The concept of HOL is rooted in Bloom's Taxonomy, particularly its revised version, which classifies learning

into six levels remembering, understanding, applying, analyzing, evaluating, and creating. The last three levels are considered higher-order because they demand more complex and integrative thinking. For example, while "understanding" may involve summarizing a science concept, "analyzing" would require comparing different theories, and "creating" might involve designing a new experiment based on those theories. ICT can significantly support HOL skills. As a result, using applications such as software simulations, digital storytelling platforms and collaborative apps force the students to interpret information, draw conclusions and produce their own work. The activities including the use of multimedia content, coding as well as project-based learning has proved to be the medium that improves the skills like logical reasoning and innovative thinking (Ahmad et al., 2023).

Additionally, it encourages personalized learning paths. Videos, interactive quizzes and online resources are used so students can explore those topics at their own pace. The autonomy in the system empowers learners for metacognition of their learning and critical problem solving. This change of gears to HOL, however, requires teachers to reorient their lesson design away from necessitating students to simply recall knowledge to creating opportunities in which students ask more and enable themselves to be more creative.

Theoretical Models Supporting ICT Use

In order for ICT to work well in schools, teachers must use a thoughtful framework for using technology to achieve educational goals. Many people agree that Technological Pedagogical Content Knowledge (TPACK) and the SAMR (Substitution, Augmentation, Modification, Redefinition) models provide helpful guidance on how to integrate technology for better learning.

This model points out the strong relationship between content, teaching and technological knowledge. The theory explains that effective technology-based teaching means understanding the things taught (CK), how they are taught (PK) and how technology improves and supports instructions (TK). The combined regions of each domain produce TPACK and are the site for powerful educational instruction. An example is a teacher using simulation software to guide students through a science topic by enabling them to experiment, experience different outcomes and build better knowledge (Javed et al., 2020).

Pontederia developed the SAMR model which allows users to see a continuum of ICT integration. Previously, technology would replace simple tools and skills that students already learned (typing is an example). At this level, it helps you improve by supplying instant feedback with quizzes available online. Modification lets teachers remodel lessons (such as using Google Docs to work together) and redefinition makes impossible-seeming activities possible (such as students creating a global digital documentary). It is particularly at the modification and redefinition stages of SAMR that analysis, creation and synthesis are needed for higher-order learning. Both models support educators in going past just using ICT a little. TPACK helps use technology so that it supports learning objectives, whereas SAMR encourages teachers to invent new ways of doing things. They work together to create a guide for how ICT can make education more effective and useful. Effective use of these models helps students become active, fully involved learners and has a direct effect on how they develop their thinking skills. Without these theories, it's difficult to see how ICT can serve as a link, not just a simple tool, in improving upper-level learning in class.

Empirical Evidence Linking ICT and HOL

Many empirical studies were conducted on the ICT effect on higher order learning (HOL) skills with different education contexts (Wang et al., 2022). It is clear that when used meaningfully, ICT improves children's ability to critically think, problem solve and creatively engage content. In the secondary schools of Pakistan showed that students who used the ICTs digital storytelling tools became better at supporting analytical thinking and creativity. In addition to understanding the narrative structure these students could evaluate content, construct arguments

and create original presentations. It is reported that student performance in conceptual understanding and problem solving in both science subjects is better in the ICT integrated classroom in comparison with the traditional classroom.

These findings have international support. One example is Ng and Yunus (2021), who discovered that Malaysian secondary students who used interactive educational software achieved significant improvement in decision making and reasoning. However, that ICT facilitated project based learning had positive effect on student engagement and metacognitive skills in a South African context. Research also highlights how specific ICT tools foster HOL. For instance, platforms like Kahoot and Quizizz support reflective thinking by providing instant feedback and allowing learners to identify gaps in their understanding. Tools like Canva, Prezi, and Padlet have been used effectively in literature and social studies classrooms to help students present arguments, compare perspectives, and create meaningful content.

Moreover, the use of simulations and virtual labs in science education has been particularly effective. The students who conducted digital experiments demonstrated higher retention and deeper conceptual understanding compared to those who relied solely on textbooks. However, it is also important to recognize that the success of ICT in fostering HOL is highly dependent on how technology is used. Researchers emphasize that merely using ICT tools does not guarantee improved learning outcomes unless they are embedded within appropriate pedagogy (Väätäjä & Ruokamo, 2021).

Research Objectives

The research objectives of the study were:
- To analyze the impact of information and communication technologies (ICTs) on students' higher-order learning skills at secondary school level
- To identify the challenges of information and communication technologies (ICTs) for students' higher-order learning skills at secondary school level
- To recommend certain measures about using ICTs for students higher order learning at the secondary school level

Research Questions

Following were the research questions:
1. What is the impact of information and communication technologies (ICTs) on students' higher-order learning skills at the secondary school level?
2. Which factor of information and communication technologies (ICTs) are involved in students' higher-order learning skills at the secondary school level?
3. Which measures may be necessary for students' higher-order learning at the secondary school level?

Research Methodology

"The research methodology is the procedure which is used by the researchers to gather data for resolving problems of investigation" (Ahmad et al., 2022, p.524). The study was survey and descriptive in nature. The quantitative as well as qualitative (QUAN-qual.) design was adopted. The explanatory sequential approach was adopted to solve the problem focusing on how ICT use affects the development of higher order learning skills (HOL) of secondary school students. In all the research was conducted in public secondary schools of Tehsil Rahim Yar Khan Pakistan with a sample of 100 secondary school teachers and 100 students. To ensure representation across gender and urban -rural divides a stratified sampling technique was used.

Sampling Chart

Cluster	Respondents	Urban		Rural		Total
		Girls	Boys	Girls	Boys	
Tehsil Rahim Yar Khan	Headteachers	12	12	12	12	48
	SSTs	36	36	36	36	144
	Students	120	120	120	120	480
Total		168	168	168	168	672

Data Collection Tools

The data was collected through a structured questionnaire that fit the TPACK and SAMR frameworks. The perceptions of ICT integration and its influence on HOL skills such as critical thinking, creativity, and problem-solving, among others, were measured through close-ended statements. Open-ended interview questions were collected to allow a deeper exploration of classroom experiences.

Pilot Study

Validity: The instrument was reviewed by field experts to ensure its content validity. The Content Validity Ratio (CVR) and Content Validity Index (CVI) were obtained. Based on expert suggestions we edited for clarity and relevance.

Reliability: A small subset of participants were then part of our pilot study. The internal consistency and reliability of the questionnaire items were high as supported by Cronbach's Alpha of 0.82.

Data Analysis

The quantitative data were analysed using SmartPLS 4.0 and in particular path and mediation analysis were analyzed. Thereafter, patterns of ICT use and higher-order learning outcomes are elicited using thematic analysis applied to qualitative responses.

Findings

- The results revealed a significant positive relationship between ICT use and the development of higher-order learning skills among secondary school students(Li et al., 2023). Quantitative analysis using SmartPLS 4.0 confirmed that ICT integration positively influenced students' critical thinking, creativity, and problem-solving abilities, supporting the study's primary hypothesis.
- The mediation analysis showed that ICT acted as a significant mediator between teaching practices and student learning outcomes. This implies that when teachers used student-centered pedagogical approaches enhanced by digital tools, students demonstrated deeper levels of understanding and higher cognitive engagement. Teachers who actively used interactive platforms, simulations, and digital storytelling reported higher instances of students analyzing, evaluating, and creating content in innovative ways.
- The qualitative data echoed these findings. Teachers noted that ICT improved student engagement, encouraged collaborative learning, and supported self-paced exploration of complex topics. Students described digital tools as more motivating and visually stimulating, which helped them reflect more critically on content. However, many participants also highlighted challenges such as limited access to devices, unreliable internet, and lack of advanced training for teachers.

Discussion

The study's findings reinforce the role of ICT as a transformational tool in promoting higher-order learning (HOL) in secondary education (Yuniarti et al., 2024). The positive correlation between ICT use and HOL skills aligns with

the principles of TPACK and SAMR models, suggesting that when technology is used purposefully within a pedagogical framework, it goes beyond information delivery to actively shape learning experiences.

The observed mediating role of ICT indicates that technology does not act in isolation but bridges teaching strategies with learning outcomes (Liu et al., 2022). Teachers who employed digital tools as part of inquiry-based or collaborative tasks saw greater student involvement in analyzing, creating, and solving real-world problems. This supports previous findings of many researchers who emphasized the transformative power of ICT when used to reframe traditional classroom practices. However, the study also highlights the contextual limitations of ICT integration in Pakistan. Infrastructural gaps, insufficient training, and digital inequity remain persistent challenges, especially in rural settings (Onoja & Ajala, 2022).

Conclusion

This study concludes that the effective integration of ICT significantly enhances higher-order learning (HOL) skills such as critical thinking, creativity, and problem-solving among secondary school students. ICT helps join improve teaching methods with better learning outcomes when it is applied within frameworks such as TPACK and SAMR. According to the research, when technology is part of teaching, it brings classrooms to life and makes them more exciting. Even so, challenges such as too little training, poor infrastructure, and inequality in access to the internet stop the sector from achieving its goals. It points out that to become truly valuable in education, ICT needs better policies, better infrastructure, and better teachers. As a whole, using ICT the right way can prepare students for the challenges of today's world, making sure all students are included.

Recommendations

The following recommendations were drawn on the basis of findings and conclusions:

- The ongoing training focused on using ICT may be provided in the schools for inquiry-based and creative learning tasks.
- Access to reliable internet, digital tools, and technical support to the authorities may be provided in all schools, especially rural ones.
- The curriculum planners may embed ICT activities to promote analysis, evaluation, and creation into classroom instruction.
- The policies may be aimed at minimizing gaps in student access to devices and online learning resources.
- The adoption of models like TPACK and SAMR may guide teachers in aligning technology with pedagogy effectively.

These measures may be helpful to ensure that ICT is not used only for convenience in teaching, but is taken up as a strategic tool for developing students' higher-order cognitive skills.

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