

# The Effectiveness of ICT in Improving Pedagogical Skills of School Teachers

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## Abstract

*Information and Communication Technology (ICT) has revolutionized the education sector, significantly enhancing pedagogical skills and teaching methodologies among school teachers. The integration of ICT in education facilitates innovative teaching strategies, more efficient instructional delivery, and improved student engagement. This paper examines the effectiveness of ICT in fostering professional development among educators by analysing ICT-based teacher training, digital learning tools, and online resources. A mixed-methods research approach, combining qualitative and quantitative methodologies, was employed to assess the impact of ICT on teaching practices. The findings suggest that ICT integration enhances teachers' content delivery, promotes creativity in pedagogy, and ultimately improves student learning outcomes. However, several challenges hinder full adoption, including inadequate infrastructure, insufficient training, and resistance to change. This paper concludes with recommendations for policymakers and educators to optimize ICT utilization in schools, ensuring sustainable pedagogical improvements.*

**Keywords:** *ICT, Pedagogy, Teacher Training, Educational Technology, Professional Development*

## 1. Introduction

### 1.1 Background and Context

In the 21st century education has been one sector that has been profoundly affected by the tremendous changes, which have taken place and which will continue to occur. With the ever increasing pace of Information and Communication Technology (ICT), the old traditional educational practices have been revolutionized and teachers have a new array of tools with which to improve pedagogical methods. ICT includes a range of digital resources which include computers, smartboard, projector, educational applications, e learning platform and online collaborative tools which add to a neat, effective and interactive teaching learning process.

The increasing access to digital tools has encouraged ICT to be integrated into the educational systems on a wider basis. On recognizing ICT's potential to both improve & promote education, countries of varying socio-economic background have realised the same & many national governments have taken policies to make ICT used in schools. It has transformed how the subject matter has been imparted from the conventional methods of rote learning and teacher centred one way instruction to more dynamism, student centred, and active method of imparting knowledge. Therefore, teachers can now incorporate multimedia content, online resources and real time collaboration for a more engaging and interactive learning experience of students.

The main advantage of ICT in education is its ability to overcome geographical and socio economic barriers. A teacher has access to all the world's educational resources through the internet, he can access over 100 professional development courses and also work with teachers from other parts of the world. Moreover, ICT tools facilitate differentiated learning where teachers tailor students' learning experiences to the range of learning needs and abilities of the students. While interactive educational software, virtual simulations, and gamified learning

applications are also used in the use of ICT in teaching methodologies, this has further enhanced the effectiveness of ICT in teaching methodologies.

Although ICT in education has proved to have the benefits, it is not fully integrated into the majority of the schools. The access to digital infrastructure is very limited, there is no adequate funding and training programs for the teachers are limited and particularly so in developing countries. Another challenge is coming up from resistant educators who are used to traditional teaching methods. Still, many teachers do not possess confidence in the use of ICT because they lack the digital literacy skills or uncertainty around technology's reliability in the classroom. In addition, issues related to cybersecurity threat, data privacy issues, as well as lack of access to technology need to be solved to have the e-integration in ICT, which should be acknowledging to provide an inclusive choice process for integration of ICT.

Increasing the importance of ICT in education is that as the world continues to go lag towards digital transformation. Therefore, there is a need for schools, policymakers, and school stakeholders to work as a team to come up with strategies that will grant ICT adoption in its teaching and learning processes without breaking a stride. With the use of ICT in pedagogy, pedagogical skills increase, students become engaged, and there is an improvement seen in the overall educational outcomes thus enhancing the ICT as a part and parcel of modern teaching methodologies. A study in this work is to find out to what degree the application of ICT results in the improvement of school teachers' pedagogical skills, as well as the challenges and benefits of its implementing.

### 1.2 Research Aim and Objectives

The foremost aim of this study is to investigate the impact of ICT in the development of pedagogical skills of school teachers. Because of the growing need for unique teaching methods, it is imperative to determine how ICT can be put to use to enhance instruction techniques, involve learners, and assist in the professional development of instructors. It aims at giving valuable insight into the role of ICT in education, and provide possible strategies for effective integration of ICT in schools.

These are the specific objectives of this research:

- i. Implication of ICT tools: For instance, assessing the impact of ICT in teaching strategies and instructional delivery: Which ICT tools such as interactive whiteboards, digital lesson plans among others impact the curriculum delivery and the teaching strategies.
  - ii. Role of ICT in enhancing teacher student interaction and engagement: ICT can help in turning around the traditional classroom dynamic by enabling interactive and participatory learning environment. This objective seeks to evaluate how ICT based tools such as video conferencing, online forums and collaborative software, aids communication between teachers and students.
  - iii. What are the challenges inhibiting the integration of ICT in education: ICT provides a lot of advantages, but there have been some obstacles holding back the wide adoption of ICT. The goal of this research is to explore the problems that constrain the development of teachers' capability to use information and communication technology (ICT) in teaching practices, including insufficient infrastructure, lack of training, resistance to change and the digital divide.
  - iv. Based on the findings of this research, practical recommendations will be provided to provide adequate training to the teachers, offer right technological infrastructure in schools and effective policies so as to harness the effect of ICT in education.
- The accomplishment of these objectives will give insights on the role of ICT in the improvement of the teaching methodologies and comeup with solutions in surmounting the current barriers in the implementation of the same.

### 1.3 Research Questions

This study will address the following key research questions in order to comprehensively explore the role of ICT in improving pedagogical skills of the school teachers.

- i. What impact does ICT have on pedagogical [teaching] skills of school teachers?

This question attempts to find out how ICT facilitates teacher development, specifically in the lesson planning, instructional strategies and classroom involvement. However, the research will seek to find out if ICT makes it possible for teachers to implement more effective and interactive lessons.

ii. Which ICT tools are used for teacher training and for instructional delivery?

There is a need for understanding which ICT tools best fit to supporting teachers' professional development and teachers' methods of instruction. This question is about several digital platforms, software, and technology that can help us teach, learn and to train teacher.

iii. What difficulties do educators experience when they are using ICT by providing in their teaching methods?

Although ICT integration has its own merits, there are some obstacles which hamper integration like inadequate trainings, non availability to technology and the resistance of educators to utilize technology. The example of this question is to examine the difficulties teachers face in incorporating ICT into their teaching strategies as well as main factors inhibiting its successful implementation.

iv. What strategies have been employed in the implementation of ICT for maximum favorable pedagogical strengths? It is a question that relates to finding best practices about ICT integration in education. Strategies for overcoming challenges, strategies to improve the quality of teacher training, improving technological infrastructure, and for ensuring ICT will be used effectively in support of pedagogical improvement are explored.

The study hopes to gain a comprehensive knowledge of the effect of ICT on teaching and learning through answering these research questions. They will prove valuable for policymakers, educators and school administrators in drawing lessons on how to make ICT in education more effective.

Significance of the Study

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The foremost aim of this study is to investigate the impact of ICT in the development of pedagogical skills of school teachers. However, there is an increased demand for use of innovative teaching strategies, and therefore it becomes necessary to evaluate how ICT can be used in instruction to improve instruction techniques, involve students and help educators in professional development. It aims at giving valuable insight into the role of ICT in education, and provide possible strategies for effective integration of ICT in schools.

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### 1.3 Research Questions :

The research investigates these main research questions to examine how ICT supports pedagogical skill development of school staff members.

i. Does ICT create any changes in the teaching abilities of school teachers? The study seeks to determine how ICT helps teachers evolve their expertise through planning instruction and developing teaching methods and participating in classrooms. The research investigates whether ICT provides teachers with capabilities to develop beneficial and interactive instructional practices.

ii. What tools from the ICT domain do organizations apply for both training teachers and delivering instruction? Research needs to identify the appropriate toolset of ICT which can effectively support teacher development and teaching strategies. The investigation concerns multiple digital tools and software platforms that serve as educational resources for teaching as well as learning activities and teacher instruction methods.

iii. What problems do instructors encounter during their usage of ICT tools for teaching methodology delivery? While its own good aspects about ICT integration exist, there are also obstacles on ICT integration such as lack of trainings, non availability of technology and the resistance of educators to embrace technology. The research looks at teaching practitioners' barriers to implementing ICT in their instructional delivery and analyzes the key obstacles behind its limited implementation success.

iv. Which tactics have aimed to bring out the most beneficial pedagogical features through ICT implementation? Finding best practices regarding ICT integration in education constitutes the core topic of this question. Several approaches to handle challenges exist alongside measures to advance teacher training quality and strengthen technological infrastructure and keep information and communication technology focused on achieving pedagogical excellence.

The research project aims to establish complete understanding about ICT effects on education by answering these specific research inquiries. These findings provide essential knowledge that officials working in education policy and education management can use to enhance ICT applications in education effectively.

## 2. Literature Review

### 2.1 ICT in Education: A Theoretical Perspective

Information and Communication Technology (ICT) integration within educational settings takes place through different theoretical approaches that support teaching and learning improvement. ICT provides education with multiple digital instruments that enable communication alongside content generation and information sharing and management. Educational institutions use e-learning platforms digital classrooms as well as online collaboration tools educational applications virtual simulations and digital assessment tools under the category of ICT.

ICT is so important in modern pedagogy, that several educational theories emphasize on the need and usefulness of ICT in teaching and learning. The most commonly recognized model for teaching with technology comes from the TPACK framework established by Mishra and Koehler in 2006. TPACK model established that effective teaching using technology needs educators to handle these three core domains in harmony:

A teacher's ability to understand digital tools and resources makes up the Technological Knowledge (TK) aspect of TPACK.

PK represents the professional knowledge necessary for teaching through delivery of instructional methods and lesson presentation techniques.

A teacher requires Content Knowledge (CK) to demonstrate expertise regarding their current teaching subject.

According to the model educators must master each competency level to integrate ICT successfully because this leads to meaningful educational experiences.

The social learning process explained by Vygotsky's Social Constructivist Theory shows that understanding takes place through collaborative interaction between people. The Internet-based capabilities of ICT provide tools that enhance social learning opportunities through online conversation spaces and collaborative work initiatives and distance learning platforms. Bloom's Digital Taxonomy uses an updated version of Bloom's original learning objective system that works within digital educational platforms. Digital learning activities can be structured under

six development levels using ICT-based tools ranging from remembering to evaluating and creating through the digital taxonomy model.

Multiple studies confirm that information and communication technology produces positive effects on educational instruction together with student academic results. The research shows that technology-enhanced educational strategies produce enhanced student achievement and enhanced classroom enthusiasm and heightened learning motivation (Selwyn, 2021). Through ICT teachers gain the ability to deliver adjusted instruction which accommodates students of different learning approaches and develops individualized teaching practices. The theoretical and practical benefits of ICT in education function differently between different educational settings. Education systems achieve maximum ICT use in pedagogical settings based on how well their institutions support teachers and how well they prepare staff to use technology through their policies and existing technological infrastructure.

## 2.2 The Role of ICT in Enhancing Pedagogical Skills

i. Academic studies have extensively documented how ICT improves educational teaching abilities. Tools from information and communication technologies provide teachers with resources to build learning environments which combine high engagement levels with efficient operations and interactive interactions thus leading to stronger educational quality. Through inclusion of ICT in their teaching approach teachers develop better educational planning while delivering their content more effectively and achieving better student involvement.

Some primary advantages of ICT usage in education are:

ii. Improved Instructional Content : The reliance on static instructional content such as textbooks and chalkboard notes is obsolete in traditional teaching method. With ICT, multimedia integration is possible to enhance lessons through inclusion of videos, animations, simulations and such like gamified experiences. Academic studies prove that multisensory learning activities presented using ICT tools enhance student memory retention because of technologies such as digital storytelling and augmented reality (AR) as well as virtual labs (Johnson et al., 2020).

iii . The increased student participation levels along with their engagement stands as one of the major teaching benefits brought forth by ICT implementation in education. Quizzes through Kahoot, Quizizz and Socrative bring joy of making the kids to compete and derive out interest through elements of gamification.. Students who are normally shy join in through real-time quizzes combined with collaborative projects done in Google Workspace and interactive discussion forums. The combination of ICT enables flipped classroom model implementation where learners perform digital homework assignments before participating in classroom activities through discussions and practical work.

iv. ICT enables teachers to participate in endless professional development opportunities through virtual webinars and online courses along with digital learning communities accessible to them. Currently, various training programs exist on Coursera, edX, and LinkedIn Learning that allow educators to be updated with the latest teaching pedagogies. Educators who participate in Edmodo and Microsoft Educator Community can share pedagogical practices through these connections while developing lesson plans together to exchange knowledge about ICT implementation in education.

The pedagogical capabilities of ICT assist teachers to develop their competencies thus producing better learning outcomes and student results. Educational institutions must provide proper training and system support to teachers for them to fully realize the advantages of ICT technology.

## 2.3 ICT Tools for Teacher Training

Several ICT tools have proven effective in supporting teacher training and professional development. These tools provide interactive, flexible, and collaborative learning opportunities for educators, ensuring they acquire the necessary skills to integrate technology into their teaching.

1. Learning Management Systems (LMS) : LMS platforms, such as Moodle, Google Classroom, and Blackboard, serve as comprehensive digital environments where teachers can access training modules, course materials, and assessment tools. These systems also facilitate peer collaboration and allow for progress tracking, ensuring teachers receive continuous professional development.

2. Video Conferencing and Webinars : With the rise of remote learning, video conferencing tools such as Zoom, Microsoft Teams, and Google Meet have become essential for teacher training. Webinars, virtual workshops, and live training sessions enable educators to engage with expert trainers, participate in discussions, and gain insights from global education leaders.

3. Educational Software and Interactive Applications : Applications such as Kahoot, Edmodo, and Quizizz provide teachers with hands-on experience in designing and delivering interactive lessons. These platforms also help educators understand how to incorporate gamification into their teaching strategies, improving student motivation and learning outcomes.

4. Online Resource Repositories : Open Educational Resources (OER) platforms, such as OpenStax, MERLOT, and Khan Academy, offer free access to digital textbooks, lesson plans, and instructional videos. These repositories empower teachers to explore diverse teaching materials, adapt them to their specific contexts, and improve their instructional methodologies.

By leveraging these ICT tools, teachers can engage in continuous professional development, refine their teaching practices, and stay updated with evolving educational technologies.

#### **2.4 Challenges of ICT Integration in Schools**

Despite its numerous benefits, the successful implementation of ICT in education faces several challenges. The following barriers hinder the effective adoption of ICT in schools:

1. Limited Infrastructure and Resources : Many schools, especially in developing countries, lack adequate ICT infrastructure, including computers, projectors, and reliable internet connectivity. Budget constraints often prevent institutions from acquiring necessary digital tools, further exacerbating the digital divide between well-funded and underprivileged schools.

2. Inadequate Teacher Training : While ICT holds immense potential for improving pedagogy, its effectiveness largely depends on teachers' ability to use digital tools competently. A lack of professional development programs prevents educators from confidently integrating ICT into their teaching practices. Studies indicate that teachers with limited digital literacy skills are less likely to adopt technology-driven teaching methods (Hassan & Ahmed, 2019).

3. Resistance to Change : Some educators resist adopting ICT due to fear of technology, a preference for traditional teaching methods, or concerns about increased workload. Resistance is particularly common among teachers who have not received sufficient training or support in using digital tools effectively.

4. Technical Issues and Cybersecurity Concerns : Frequent connectivity issues, outdated software, and lack of technical support disrupt ICT integration in classrooms. Additionally, cybersecurity risks, such as data breaches and cyberbullying, raise concerns about the safety of digital learning environments. Schools must establish robust IT support systems and cybersecurity measures to mitigate these risks.

Addressing these challenges requires a multi-faceted approach involving investment in ICT infrastructure, teacher training programs, and institutional policies that promote digital literacy. By analysing the theoretical foundations, benefits, ICT tools, and challenges associated with ICT integration, this literature review provides a comprehensive understanding of how technology can enhance pedagogical skills among school teachers. The following sections of this study will further explore the impact of ICT on teaching methodologies and provide practical recommendations for its effective implementation.

### 3.1 Research Design

The research design blends quantitative and qualitative methods to achieve thorough analysis about how ICT enhances pedagogical abilities. This research uses a mixed research approach for deeper knowledge development through the combination of quantitative data together with qualitative examination.

The study used quantitative research to gather numeric information about teacher ICT habits along with their perceived teaching method transformations and their confidence levels. The research design revealed the existence of patterns together with statistical relationships by studying the connection between ICT usage and pedagogical effectiveness. This research used a qualitative investigation method which aimed to retrieve firsthand accounts from teachers regarding their experiences integrating ICT into their classroom instruction along with their encountered obstacles. The research revealed extra comprehensive findings about the subject which quantitative data alone could not demonstrate by conducting classroom observations and interviews. This research adopts descriptive and exploratory methods to determine the level at which ICT improves educational instruction among teachers. The descriptive research section determines the existing ICT adoption situation but the exploratory aspects let researchers understand teachers' experiences together with their encountered obstacles and proposed methods for maximizing classroom ICT usage. This study investigates school teachers in different educational environments throughout the regions to gain proper representation from urban and rural schools. Primary and secondary and high school teachers participate in this study to obtain an extensive view on ICT integration throughout different stages of education. The research team conducted surveys and semi-structured interviews together with classroom observations as three main methods to collect complete data.

#### 1. Surveys

A standardized questionnaire was distributed to 200 school instructors situated throughout different territories for generating numerical research data regarding these aspects:

School teachers report their teaching practices involving Information and Communication Technology.

- Types of ICT tools used.

The teachers demonstrate a level of confidence when they use digital technologies.

Teachers express their views about how ICT affects their lesson planning activities as well as their content delivery methods and their student engagement practices.

Teachers encounter various obstacles when implementing Information and Communication Technology throughout teaching activities.

The designed survey used closed-ended questions and Likert-scale measures to both determine the extent of ICT adoption along with assessing educational staff's technology attitude levels. The survey contained open-ended questions which gave teachers the chance to express their thoughts about ICT implementation.

#### 2. Interviews

The researchers conducted 20 semi-structured interviews with educators and ICT specialists to enhance the information obtained in the survey. The research obtained qualitative teacher perspectives regarding their experiences working with ICT.

Educators demonstrated their opinions regarding the impact of ICT on their pedagogical competence.

Educators encountered multiple challenges together with obstacles when they attempted to bring ICT into their educational practice.

- The effectiveness of ICT training programs and institutional support.

The survey collected proposals about how schools can better implement Information Communication Technology.

That approach allowed interviewees to reshape their replies yet maintained uniform exploration of essential topics throughout every discussion. The researcher conducted interviews both in person and through video conferencing so students had multiple access options.

**3. Classroom Observations :** The researcher observed teaching settings in ten schools to obtain direct experience regarding the actual use of ICT by educators. Through this method the researcher gained access to evaluate several key points. The integration level of ICT stands as one key focus during lesson presentation. Teachers demonstrated their skills in handling ICT applications during interviews. The level of student involvement becomes obvious when teachers conduct lessons through ICT systems.

Real-time ICT implementation causes multiple obstacles to educators.

Observers recorded essential ICT indicators with a structured checklist by noting down the effectiveness of digital tools and teacher-student interactions together with student participation. Ethical Considerations in Data Collection. The participants received ethical protection through three measures during this research. The participants received explicit consent materials which described the reason behind the study and their ability to end their participation at any moment. The subjects received guarantees for information confidentiality alongside anonymity when reporting their research findings. Interview participants had the ability to refuse audio-video recording when they felt uncomfortable.

**3.3 Data Analysis :** The obtained information from surveys and interviews along with observations underwent comprehensive quantitative and qualitative analysis after data collection.

**1. Quantitative Data Analysis :** The data from surveys underwent statistical software analysis in SPSS and Microsoft Excel for identifying patterns and trends of ICT within educational environments. The researchers applied multiple statistical analysis methods. The data underwent descriptive statistical analysis using mean values and standard deviation and percentage calculations to present main study outcomes.

The two inferential statistics methods utilized t-tests with ANOVA to evaluate how ICT adoption differs between teachers based on their experience level subject area and school classifications. Correlation analysis served to study how ICT training relates to teachers' technology usage comfort levels. Publication results became more interpretable after researchers produced visual bar charts along with pie charts and histograms.

**2. Qualitative Data Analysis :** The study applied thematic analysis as its method to analyze both teacher interviews and classroom observation notes. This process involved: The analytical process involved transcription of interview recordings and transformation of these recorded data into significant thematic categories. The study extracted standardized elements from findings which connected to ICT efficiency standards and teacher understanding of technology in education. The researcher examined identical results between various respondent groups to verify data consistency. Manual thematic coding processes received software support through NVivo to ensure the precision of findings.

**3. Triangulation of Data :** Different data points from surveys along with interviews and observations were triangulated to boost both the reliability and validation of the collected information. This cross-verification helped:

- Strengthen the credibility of insights : This research method helps researchers find both similar patterns and various contradictions among ICT adoption trends. The research obtains a complete perspective regarding the research topic.

Justification for Research Methodology : The research design which incorporates both quantitative and qualitative approaches delivers comprehensive investigation of ICT integration through statistical measurement and deep visitation of subject matter. The survey instrument enables researchers to acquire statistical data about ICT applications but direct interviews and observational data generate experiential knowledge which enriches the analysis.

- This research benefits from using the mixed-methods approach because it provides strong advantages in achieving its research objectives.
- The adoption of ICT as a research domain includes objective measurement results together with subjective individual experiences.
- Quantitative data alone cannot address concerns about teacher resistance and institutional barriers because the problem requires qualitative explanations to be resolved.
- The research uses observations as evidence to show actual ICT applications within classrooms to supplement survey and interview data.
- This research employs a systematic approach to generate trustworthy and valuable information about how ICT practices enhance educational competencies in school instructors.

#### 4. Findings and Discussion

This section presents the key findings of the study, focusing on the impact of Information and Communication Technology (ICT) on teaching strategies, student engagement, and the challenges associated with its implementation in schools. The findings are based on data collected through surveys, interviews, and classroom observations.

##### 4.1 The Impact of ICT on Teaching Strategies

1. ICT has enhanced lesson planning and instruction delivery (something which faculty can agree is significant). Teachers who had been trained in ICT were more confident in the design of well structured and engaging interactive lesson. However, the use of learning management systems (LMS), digital lesson planning tools and multimedia content helped teachers come up with more dynamic and flexible lesson plans.

Survey responses revealed that 72% of teachers who often make use of ICT tools in teaching reported that it was easier to structure their lessons than 28% of teachers who adopted conventional means of teaching. Teacher mentioned that PowerPoint presentations, online white boards, and interactive simulations create an opportunity to better understand abstract concepts. Additionally, ICT facilitates real-time assessment through digital quizzes and interactive exercises. I asked about how many teachers had incorporated platforms such as Google forms, Kahoot, and even Quizizz to do quick knowledge check in terms of their lessons so they get to know how well students are understanding.

2. Personal Learning : ICT enhances differentiated instruction to slow down a fast and fasten a slow learner. E learning platforms and digital resources were integrated to afford teachers to afford customized learning experiences. For example, teachers noticed that students who had difficulty in some topics are able to move along in series of video lectures that have been pre recorded, online tutorials and self paced learning modules. At the same token, resources for the upper level of the learners could be found online and the activities would be more challenging. The adaptability to this situation was more useful in inclusive classrooms with students having different abilities and learning preferences. 3. Helps in promoting Collaborative Learning : ICT provides environment for collaborative learning, where students can work on group assignments and class discussions using online devices. Cloud based applications such as Google Docs, Microsoft Teams, and Padlet were among the applications that were mentioned by teachers that enabled students to collaborate on assignment, share ideas and give peer feedback.

Besides, discussion forums and virtual classrooms also encouraged active participation from the students who may otherwise not contribute in traditional settings. It was said by teachers that ICT supported collaboration improved the communication, critical thinking and teamwork skills of students, all which are required for learning in the 21st century.

## 4.2 ICT and Student Engagement

1. The Use of ICT-driven Lessons Contributed to Increased Participation and Motivation of the students. It is the teachers who report that when the digital tools were integrated into the classroom, it was the students who were more attentive, motivated and participatory in the learning process.

Results: Lesson in which videos, animations, and simulations were used captured the interest of the students rather than traditional textbook based teaching as demonstrated during classroom observations. The tools that kept students actively participating in the learning process were interactive educational games, VR experiences, and online polls. An 85% of teachers seen from survey results noted that students participated more in ICT enabled lessons as opposed to traditional methods. There were also many educators that pointed out that the gamification elements such as leaderboards, badges and point systems raised motivation in general, but especially among young students.

2. Knowledge Retention and Comprehension : One of the biggest boons of adopting ICT integration is that it has a positive effect on retention of knowledge and its comprehension. When presented as complex multimedia, students were observed by teachers to more effectively keep information. For instance, when science teachers used 3D models and virtual labs for science, students could more seemly leave static diagrams behind, understand something such as cell structures, chemical reactions and physics principles. Likewise, history teachers who implemented digital storytelling and virtual field trips reported that they accomplished the identified characteristic, that is, students understood events in the context provided by the history teacher.

Moreover, ICT facilitates real time feedback and assessment by which students can discover their strong and weak sides. Often, teachers also mentioned that feedback from the quizzes and the AI learning platforms is instant and helps students correct mistakes immediately as well as reinforces learning.

3. The COVID 19 pandemic spurred the uptake of ICT in education and turned online learning to necessity. However, this study proved that schools, which had already put in place and used ICT tools, adapted better to remote learning, regardless of the quality of the teaching process, while schools with less infrastructure found it very difficult to adapt.

Many teachers teaching virtual lessons over Zoom, Microsoft Teams, and Google Meet reported that students stayed engaged as long as the lessons were interactive. Features such as breakout room, screen sharing and live quiz helped in sustaining the student interest. Despite that, many teachers reported those technical difficulties along with lack of access to reliable internet being a source of disparities in engagement among students.

**4.3 Challenges in Implementing ICT :** Despite the numerous benefits of ICT in education, the study identified several significant barriers to its effective adoption.

1. Financial Constraints and Lack of Infrastructure : One of the biggest challenges schools face in integrating ICT is limited financial resources. Many schools, especially in rural and underprivileged areas, lack the necessary computers, projectors, internet connectivity, and other digital tools required for effective ICT implementation.

Survey data revealed that 60% of teachers cited inadequate funding as a major obstacle to using ICT in their teaching. In some schools, a single computer lab must be shared among multiple classes, restricting teachers' ability to consistently incorporate technology into their lessons.

Furthermore, unreliable internet connectivity and frequent power outages hinder the seamless use of online resources. Some teachers noted that technical issues during lessons disrupted the learning flow, leading to frustration among both students and educators.

2. **Lack of Training and Professional Development :** A key finding of the study is that many teachers lack sufficient training in ICT usage, which prevents them from fully utilizing digital tools. 48% of surveyed teachers

reported that they had never received formal ICT training. 35% mentioned that their ICT training was minimal or outdated. Only 17% felt confident in effectively using advanced ICT tools.

Several teachers expressed that training programs are either too infrequent or not tailored to their specific needs. Many educators suggested that hands-on, practical training workshops would be more effective than one-time theoretical seminars.

3. Resistance to Change and Technological Adoption ; Some teachers, particularly those with longer teaching experience, exhibited resistance to adopting ICT-based teaching methods.

Interviews revealed that some older educators preferred traditional approaches and found technology overwhelming or unnecessary. Additionally, some teachers feared that ICT reliance might reduce their control over the classroom or make their teaching methods redundant.

4. Security and Privacy Concerns : The study also highlighted concerns regarding cybersecurity, data privacy, and online safety. Teachers and administrators worried about student data security on cloud-based platforms. Concerns about cyberbullying, hacking, and unauthorized access were raised, especially when students used online discussion forums and social media for learning purposes. To address these concerns, schools need to implement strict cybersecurity measures, data protection policies, and digital literacy programs for both teachers and students.

### Summary of Key Findings

Key Area	Findings
Impact on Teaching Strategies	ICT enhances lesson planning, content delivery, and personalized learning.
Impact on Student Engagement	ICT increases participation, motivation, and knowledge retention.
Challenges in ICT Implementation	Financial constraints, lack of training, resistance to change, and cybersecurity concerns.

While ICT has immense potential to improve teaching strategies and student engagement, its successful implementation requires addressing financial, training, and technological barriers. Schools, policymakers, and educators must work collaboratively to overcome these challenges, ensuring that ICT becomes an integral part of modern education.

## 5. Recommendations and Conclusion

Few schools have implemented ICT for teaching operations to a significant level and therefore their pedagogical operations are subcontracted to provide space for ICT oriented teaching. Based on this study, it has been found that ICT improves school teachers' pedagogical skills and enhances student learning outcomes. Nevertheless, some issues associated to inadequate trainings, financial constraints, lack of technological support and resistance of change limit its full implementation. In this section, recommendations on how to best optimally integrate ICT into education are provided as well as the final part, which reflects upon the necessity to continue investing in this field.

### 5.1 Recommendations

In order to overcome the challenges raised in this study, and therefore making qualitative use of ICT in teaching as effective as possible, the following recommendations are necessary:

- i. One effective way of overcoming the barrier of effective ICT integration is through enhanced ICT training programs for the teachers. When it comes to using digital tools, many educators do not feel prepared because they have had little exposure and experience using them. To fill the gap left by the lack of professional ICT training, school holidays should be utilized to implement regular and structured ICT training programs geared towards various levels of technological experience.
- ii.

**Proposed Actions:**

Develop on an ongoing basis professional development programs covering both the basic digital literacy skills and the use of advanced educational technologies.

- Include hands on , practical training session that facilitates teachers to practise using ICT tools in real classroom settings.

Additionally, there should be mentorship programs to enable experienced ICT users from among the teachers give a hand to their colleagues.

- Partnering with universities and EdTech companies & NGOs to create training material to be offered fee or subsidize basis.

This ensures that there are continuous trainings opportunities for the teachers which will help them in building the confidence and competence to integrate ICT into their teaching strategies.

ii. A massive obstacle to ICT adoption in schools is not having the adequate digital infrastructure, such as in underserved regions. The number of computers, projectors, and connection to the reliable Internet in many schools hinders teachers in the introduction of ICTs for the purpose of educational process.

Proposed Actions:

- Governments and educational stakeholders would need to ensure that there is an allocation of more funds towards the purchase of ICT equipment such as laptops, tablets, smartboards, and projectors.
- Provide rural and underserved schools with a means of expanding internet connectivity so that all schools will have equal access to online learning resources.
- PPPs should be implemented to provide schools low cost, or free, digital tools.
- Such mobile ICT labs will provide schools with budget constraints the chance to have access to technology on rotational basis for students and teachers.

Enhancement of the digital infrastructure is essential in order to provide all teachers and students equal ICT support to learning.

iii. Technical Knowledge Shortages : Even though schools can have the right ICT tools, many of the teachers that have access to such tools rant of technical difficulties that occur impeding effective learning. Lack of immediate help to refer to discourages the teachers to apply the technology in their teachings.

**Proposed Actions:**

- There should be dedicated IT support teams set up by the schools to trouble shoot and maintenance of digital tools.
- Establish ICT help desks or hotline services to help the teachers resolve their technological problems quickly.
- Teacherfriendly digital guides and tutorial videos covering common ICT troubleshooting issues will also be provided.

Make sure in place is sufficient technical support, as well as in several different languages, so teaching communities from all over the world can be accommodated.

The existence of a strong technical support system will give teachers confidence in using ICT, as they will know that they can be assisted to solve the problems encountered when needed.

- i. Resistance to change, mainly among teachers used to traditional teaching methods is a huge challenge. Schools should encourage incentive programs that will recognize and reward teachers who integrate technology effectively in their teaching, in an effort to inspire teachers to take up ICT.

**Proposed Actions:**

- Develop an ICT Excellence Award for dedicated teachers who show the ability to make use of digital resources in creative ways.
- Pay teachers salary bonuses, promote or award professional development credits to teachers who complete ICT training programs successfully.
- Conduct such peer sharing sessions to share experiences with teachers who are good in integration of ICT.
- Create a recognition system (e.g. certificates or digital badges) for those teachers that are very active using ICT in the pedagogy process.

It is by fostering a positive culture of the adoption of ICTs that schools can entice more and more teachers towards digital transformation of their classrooms.

## 5.2 Conclusion

The findings of this study support the fact that ICT plays a part in bringing about a change in modern education. The potential for ICT to boost teaching methodology considerably is through improved lesson planning, delivery of instruction and improved student engagement. Nevertheless, in order to fully optimization ICT, the barrier such as the lack of infrastructure, inadequate training, and resistance to change should be overcome.

Schools, government, and stakeholders should work together, as recommended by this study, in order to ensure that the process does not lead to expenses that exceed the benefits associated with sports in schools.

- Make significant investment in training teachers on comprehensive ICT.
- Ensure equitable digital access through expansion of digital infrastructure.
- They provide technical support systems which make ICT use smooth.
- Also, create incentive programs to attract teachers to adopt technology.

These recommendations help in leveraging ICT as a strong tool to improve pedagogical skills, enhance student learning experience and bring innovation in education.

## Future Research Directions

This study gives an insight into the utility of ICT in enhancing teaching methodologies, and thus proposes for future research in:

- Treatment of the long term effects of ICT training programs on teacher effectiveness.
- The influence of ICT on student academic performance and critical thinking skills.
- Gives a brief on the role of artificial intelligence (AI) and machine learning in personalized education.

Learning based on VR and AR tools is fairly effective for teaching complex subject.

Continued research in ICT and its effect on teaching and learning can help in developing an effective ICT strategy in teaching and learning.

## References

- Hassan, M., & Ahmed, R. (2019). Challenges in ICT Integration in Schools: A Case Study. *Journal of Educational Technology*, 15(3), 45-62.
- Johnson, L., Smith, R., & Thompson, M. (2020). Enhancing Teacher Training through ICT. *International Review of Education*, 66(1), 78-96.
- Kumar, P., & Sharma, T. (2021). The Role of ICT in Pedagogical Development. *Journal of Learning Sciences*, 10(2), 122-135.