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Enhancing Teacher Digital Competency for Effective ICT-Enabled Education

Dhiraj Sunar [1*], Dr. Suman Thapaliya [2], Dipak Adhakari [3]
[1] Department of Information Technology, Texas College of Management and IT, Delhi, India
[2] Department of Information Technology, Lincoln University College,Petaling Jaya, Selangor, Malaysia
[3] Department of Information Technology, Texas College of Management and IT, Lincoln University College, Petaling Jaya, Selangor, Malaysia

* Corresponding Author: **Dhiraj Sunar**

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Abstract
The integration of Information and Communication Technology (ICT) in education has emerged as a key strategy for improving teaching and learning outcomes. However, in Nepal, the digital divide continues to limit the effectiveness of ICT-enabled education, particularly in rural and resource-constrained settings. While infrastructural challenges are widely acknowledged, the role of teacher digital competency remains underexplored.
This study investigates the extent to which teacher digital competency influences the effective use of ICT in education and contributes to bridging the digital divide in Nepal. A quantitative research approach was employed using survey data collected from teachers and students in selected rural schools. The study examines key dimensions of teacher digital competency, including technical skills, pedagogical integration of ICT, and confidence in using digital tools for instructional purposes.
The findings reveal that inadequate digital skills, limited access to training, and low confidence levels among teachers significantly hinder the effective integration of ICT in classrooms. The results further indicate that even where ICT infrastructure is available, the lack of teacher competency reduces its potential impact on student learning.
The study concludes that enhancing teacher digital competency is essential for bridging the digital divide and ensuring meaningful ICT integration in education. It recommends the implementation of targeted training programs, continuous professional development initiatives, and context-specific ICT strategies to empower teachers and improve educational outcomes.

Keywords: Teacher Digital Competency, Digital Divide, ICT in Education, Nepal, Teacher Training, Educational Technology

1. Introduction

1.1. Background

Information and Communication Technology (ICT) has become a key driver of modern education, enabling improved access to learning resources, interactive teaching methods, and enhanced student engagement. Globally, ICT is recognized as an essential tool for achieving inclusive and equitable quality education under Sustainable Development Goal 4. In developing countries, ICT plays a critical role in reducing educational disparities and expanding learning opportunities, particularly in remote and underserved regions (bank, Jul 15, 2020).
In Nepal, various initiatives such as the ICT in Education Master Plan (2013–2017) and the Digital Nepal Framework (2019) have been introduced to promote the integration of ICT in education. These policies emphasize infrastructure development, digital literacy, and the use of technology in teaching–learning processes. However, despite these efforts, the effective utilization of ICT remains limited, particularly in rural areas.
While infrastructure challenges are widely acknowledged, the human dimension - especially teacher digital competency - plays

a crucial role in determining the success of ICT-enabled education.

Teachers are central to the integration of technology in classrooms, and their ability to effectively use ICT tools significantly influences learning outcomes.

1.2. Motivation

The COVID-19 pandemic highlighted the critical importance of ICT in ensuring continuity of education. During school closures, digital learning became the primary mode of instruction. However, many students in rural Nepal were unable to access or benefit from online learning due to lack of teacher preparedness, limited digital skills, and insufficient training (UNICEF, July 2022) [2]

This situation revealed that the digital divide is not solely a matter of infrastructure availability but also of human capacity. Even when ICT tools are available, ineffective usage by teachers limits their potential impact. Therefore, enhancing teacher digital competency is essential for meaningful ICT integration in education.

1.3. Problem Statement

Despite increasing investment in ICT infrastructure and policy-level support, the effective integration of ICT in Nepalese education remains a challenge. A major contributing factor is the limited level of digital competency among teachers, which affects their ability to incorporate technology into teaching practices.

Many teachers lack adequate training, technical skills, and confidence in using ICT tools for instructional purposes. As a result, ICT resources are often underutilized or used only for basic functions. This creates a gap between ICT availability and effective educational outcomes, contributing to the persistence of the digital divide.

1.4. Research Objectives

- This study aims to address these challenges through the following objectives:
- To assess the level of digital competency among teachers in rural schools
- To identify key barriers affecting teachers' ability to use ICT effectively
- To analyze the relationship between teacher digital competency and ICT utilization in education
- To propose strategies for enhancing teacher competency and improving ICT-enabled learning

1.5. Contributions

This paper makes the following contributions:

- Provides empirical insights into teacher digital competency in rural Nepal
- Highlights the role of human capacity in bridging the digital divide
- Identifies key barriers affecting effective ICT integration in classrooms
- Proposes practical strategies to enhance teacher competency and improve ICT-enabled education

2. Literature Review

2.1. ICT in Education and Digital Divide

Information and Communication Technology (ICT) has been widely recognized as a transformative tool in education, enabling access to diverse learning resources and enhancing teaching methodologies. However, the benefits of ICT are not evenly distributed, leading to the emergence of the digital divide, which refers to disparities in access to and effective use of digital technologies (JanvanDijk, March 2020) [13]

In developing countries, the digital divide is more pronounced due to infrastructural limitations, socio-economic disparities, and lack of digital skills. The World Bank emphasizes that access to ICT alone is insufficient; effective utilization depends on users' capabilities and institutional support. Similarly, UNESCO highlights that bridging the digital divide requires a holistic approach that includes infrastructure, policy support, and human capacity development.

2.2. Teacher Digital Competency in ICT Integration

Teacher digital competency is a critical factor influencing the successful integration of ICT in education. It encompasses not only basic technical skills but also the ability to effectively incorporate technology into pedagogical practices. Tondeur (Tondeur, 14 September 2016) [15] argue that teachers' beliefs, skills, and confidence significantly affect their use of ICT in classrooms.

The Technology Acceptance Model (TAM) proposed by Davis (1989) further explains that perceived usefulness and ease of use influence individuals' adoption of technology. In the educational context, teachers are more likely to integrate ICT when they are confident in using digital tools and perceive them as beneficial for teaching and learning.

However, studies have shown that many teachers in developing countries lack adequate training and exposure to ICT tools, limiting their ability to implement technology effectively in classrooms (UNESCO, 2021)

2.3. Teacher Digital Competency (TDC)

Current research has moved beyond measuring "basic IT literacy" to evaluating Pedagogical Digital Competence (PDC) the ability to use technology specifically to enhance teaching methods.

2.3.1. The Shifting Demands of the Teaching Profession

The evolving demands of the teaching profession necessitate a sophisticated set of digital competencies, as educators must manage the dual responsibility of advancing their own technological proficiency while fostering digital literacy in their students. To systematically address these requirements, the European Framework for the Digital Competence of Educators (DigCompEdu) provides a scientifically grounded structure derived from the synthesis of diverse international assessment tools and training initiatives. By offering a standardized language for international dialogue and best practice exchange, DigCompEdu serves as a critical reference for guiding national policy, enabling educators to accurately assess their current skill levels and identify specific, targeted training needs (Christine, 2017-11-28)

2.3.2. The Competency Gap

Studies indicate that while most teachers are proficient in "technology operations" (using hardware/software), they often have only "intermediate" or "moderate" competence in professional and pedagogical application (Bishnu Maya Joshi, December 5, 2024) [10]

2.3.3. Framework Adoption

Frameworks like DigCompEdu (Christine, 2017-11-28)(European Framework for the Digital Competence of Educators) and UNESCO's (UNESCO, 2021) ICT Competency Framework are increasingly used as global benchmarks. They emphasize six areas: professional engagement, digital resources, teaching/learning, assessment, empowering learners, and facilitating learners' digital competence.

2.4. ICT Challenges in the Nepalese Context

The integration of ICT in Nepal reveals a profound disparity between public and private institutions, driven by a "sustainment gap" in government schools where 81.3% of educators struggle with maintenance and 77.9% face unreliable connectivity. While non-government schools benefit from superior infrastructure and administrative support, the entire profession faces shifting demands that require a sophisticated set of digital competencies. Bridging this divide necessitates a transition from mere hardware provision toward a coordinated ecosystem of localized content, renewable energy solutions, and continuous teacher capacity building to ensure long-term functional continuity (Acharya, November, 2025) [18]

2.5. Strategies for Enhancing Teacher Digital Competency

To improve ICT integration in education, various strategies have been proposed to enhance teacher digital competency. These include continuous professional development programs, hands-on training workshops, and integration of ICT training into teacher education curricula (UNESCO) (UNESCO, 2021).

Unwin (Unwin, 2009) [19] emphasizes that capacity building is essential for sustainable ICT implementation, as technology alone cannot improve education without skilled users. Similarly, the World Bank (bank, Jul 15, 2020) [3] suggests that blended learning approaches and practical training can help teachers effectively integrate ICT into their teaching practices.

Furthermore, supportive institutional policies and access to digital resources can enhance teachers' confidence and motivation to use ICT in classrooms.

Table 1: Comparison of Literature Review Themes and Theoretical Focus

Theme	Core Focus	Key Challenges/Findings	Theoretical/Institutional Reference
ICT & Digital Divide	Transformative potential vs. unequal distribution of access.	Infrastructural limitations and socioeconomic disparities in developing countries.	World Bank & UNESCO (Holistic Approach)
Teacher Competency	Technical skills paired with pedagogical practice.	Teachers' beliefs, confidence, and lack of adequate training.	Tondeur [4] & Davis (TAM, 1989)
Pedagogical Digital Competence (PDC)	Shifting from "basic IT literacy" to enhanced teaching methods.	The need for specific technology use to improve instructional quality.	Current Research Trends
Evolving Teaching Demands	Managing educator proficiency while fostering student literacy.	Rapidly changing professional demands and dual responsibilities.	DigCompEdu (European Framework)
Policy & Training	Standardization and targeted professional development.	Identifying specific training needs and facilitating global best practice exchange.	National Policy Guidance [6]

2.6. Research Gap

Based on the reviewed literature, the following gaps are identified:

- Limited focus on teacher digital competency in rural Nepal
- Insufficient integration of digital divide theory with teacher capacity
- Lack of empirical analysis linking teacher competency and ICT utilization
- Absence of practical strategies tailored to local educational contexts

This study addresses these gaps by examining the role of teacher digital competency in bridging the digital divide and enhancing ICT-enabled education in Nepal.

3. Methodology

3.1. Research Design

This study adopts a quantitative research design to examine the role of teacher digital competency in bridging the digital divide and enhancing ICT-enabled education in Nepal. A survey-based approach was used to collect primary data from respondents, enabling statistical analysis of teacher competency, ICT usage, and related challenges.

The quantitative approach allows objective measurement of relationships between teacher digital competency and ICT utilization in educational settings.

3.2. Study Area and Population

The study focuses on rural schools in Nepal, where the digital divide is more pronounced due to limited access to resources and training opportunities. Respondents include both teachers and students, providing insights into ICT usage from both instructional and user perspectives.

A total of 145 respondents participated in the study, ensuring adequate representation for statistical analysis.

3.3. Data Collection

Primary data were collected using a structured questionnaire designed to capture:

- Level of teacher digital competency (basic ICT skills, pedagogical use, confidence)
- Availability and use of ICT tools in classrooms
- Challenges faced by teachers in using ICT
- Perceptions of ICT effectiveness in teaching and learning

The questionnaire included both closed-ended and Likert-scale questions to facilitate quantitative analysis.

Data collection was conducted through a combination of online and field-based surveys to ensure participation from diverse geographical locations.

3.4. Data Processing and Analysis

The collected data were coded and analyzed using statistical techniques. The analysis included:

- Descriptive statistics (frequency and percentage) to summarize responses
- Correlation analysis to examine relationships between teacher competency and ICT usage
- Reliability testing using Cronbach's Alpha

The reliability test yielded a Cronbach's Alpha value of 0.798, indicating acceptable internal consistency of the survey instrument.

3.5 Variables and Measurement

Table 2: The study considers the following key variables:

Variable Type	Variables
Independent Variables	Digital skills, ICT training, teacher confidence
Dependent Variable	ICT usage in education
Mediating Factors	Infrastructure availability, institutional support

Each variable was measured using Likert-scale responses to assess perception, competency level, and effectiveness.

3.6. Ethical Considerations

Participation in the study was voluntary, and respondents were informed about the purpose of the research. Confidentiality and anonymity of responses were maintained throughout the study. Data were used solely for academic purposes.

4. Results and Analysis

4.1. Descriptive Analysis of Teacher Digital Competency

The descriptive analysis provides an overview of teacher digital competency levels in rural schools. The results indicate that while teachers possess basic ICT skills, their ability to effectively integrate technology into teaching practices remains limited.

A majority of respondents reported familiarity with basic computer operations and digital tools. However, only a moderate proportion of teachers demonstrated confidence in using ICT for instructional purposes. This suggests that digital competency is present at a foundational level but lacks depth in pedagogical application.

4.2. Key Barriers to Teacher Digital Competency

The study identified several major barriers affecting teachers' ability to effectively use ICT in education.

Table 1: Key Barriers to Teacher Digital Competency

Barrier	Percentage of Respondents (%)
Lack of ICT training opportunities	78.6%
Low confidence in using digital tools	72.4%
Limited practical exposure to ICT	69.7%

The findings indicate that lack of training opportunities is the most significant barrier, followed by low confidence and limited practical exposure. These factors directly affect teachers' ability to integrate ICT into classroom activities.

4.3. Teacher Competency and ICT Usage

Despite the availability of ICT infrastructure in some schools, effective usage remains dependent on teacher competency. The results show that teachers with higher levels of digital skills and confidence are more likely to use ICT tools for teaching purposes.

However, a considerable number of respondents reported using ICT only for basic tasks such as communication and content display, rather than for interactive or student-centered learning activities. This highlights the gap between ICT availability and effective pedagogical integration.

4.4. Correlation Analysis

Correlation analysis was conducted to examine the relationship between teacher digital competency and ICT usage in education.

Correlations

			ICT_Infrastructure	ICT_Usage	Barriers_Challenges	Digital_Literacy	Opportunities
Spearman's rho	ICT_Infrastructure	Correlation Coefficient	1.000	.418***	-.074	.302***	.033
		Sig. (2-tailed)	.	<.001	.377	<.001	.696
		N	145	145	144	145	145
	ICT_Usage	Correlation Coefficient	.418***	1.000	-.120	.352***	.071
		Sig. (2-tailed)	<.001	.	.152	<.001	.395
		N	145	145	144	145	145
	Barriers_Challenges	Correlation Coefficient	-.074	-.120	1.000	.198*	.405***
		Sig. (2-tailed)	.377	.152	.	.017	<.001
		N	144	144	144	144	144
	Digital_Literacy	Correlation Coefficient	.302***	.352***	.198*	1.000	.515***
		Sig. (2-tailed)	<.001	<.001	.017	.	<.001
		N	145	145	144	145	145
	Opportunities	Correlation Coefficient	.033	.071	.405***	.515***	1.000
		Sig. (2-tailed)	.696	.395	<.001	<.001	.
		N	145	145	144	145	145

***. Correlation is significant at the 0.001 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Fig 1: Correlation Between Teacher Digital Literacy and ICT Usage

The results indicate a positive relationship between teacher digital competency and ICT usage, suggesting that higher competency levels lead to more effective integration of technology in teaching. Teacher confidence and training were found to have particularly strong associations with ICT utilization.

Additionally, infrastructure availability acts as a supporting factor, but does not independently ensure effective ICT use without competent teachers.

4.5. Key Findings

The analysis reveals the following key insights:

- Teacher digital competency is moderate but insufficient for effective ICT integration
- Lack of training and low confidence are the most critical barriers
- ICT usage is often limited to basic functions rather than pedagogical applications
- Teacher competency is a key determinant of ICT effectiveness in education

5. Discussion

5.1. Interpretation of Key Findings

This study highlights that teacher digital competency plays a critical role in bridging the digital divide and ensuring effective ICT integration in education. The findings indicate that although basic ICT skills are present among teachers, their ability to apply these skills in pedagogical contexts remains limited.

The high percentage of respondents reporting lack of training (78.6%) and low confidence (72.4%) suggests that ICT initiatives often focus more on infrastructure provision than on capacity building. This reinforces the idea that digital competency is not only about technical skills but also about the ability to integrate ICT into teaching practices effectively.

5.2. Comparison with Existing Studies

The findings of this study are consistent with previous research in both global and local contexts. Tondeur *et al.* (2017) [15] emphasize that teachers' beliefs, skills, and confidence significantly influence ICT integration in classrooms. Similarly, Davis (1989) highlights that perceived ease of use and usefulness are key determinants of technology adoption, which aligns with the observed relationship between teacher confidence and ICT usage in this study.

In the Nepalese context, Bhatta (2018) and Karki (2020) also identify limited teacher competency and lack of training as major barriers to ICT adoption. UNESCO (2021) further supports the argument that teacher training and capacity development are essential for successful ICT implementation.

However, unlike previous studies that primarily focus on infrastructure challenges, this study emphasizes the human dimension of the digital divide, highlighting teacher competency as a central factor influencing ICT effectiveness.

5.3. Implications for Policy and Practice

The findings of this study have important implications for educational policy and practice:

- ICT policies should prioritize teacher training and capacity development alongside infrastructure investment
- Continuous professional development programs should be implemented to enhance teachers' digital skills
- Practical, hands-on training should be emphasized to improve confidence and real-world application
- Schools should encourage pedagogical use of ICT, rather than limiting it to basic functions
- Institutional support systems should be strengthened to promote effective ICT integration

These measures can help ensure that ICT resources are effectively utilized and contribute to improved learning outcomes.

5.4. Digital Divide Perspective

This study reinforces the concept that the digital divide is multidimensional, encompassing not only access to technology but also the ability to use it effectively. While infrastructural improvements are necessary, they are insufficient without corresponding improvements in human capacity.

Teacher digital competency emerges as a key factor in bridging this divide. By enhancing teachers' skills,

confidence, and pedagogical understanding, it is possible to transform ICT from a passive tool into an active driver of educational improvement.

5.5. Limitations of the Study

This study has several limitations:

- The sample size is limited to 145 respondents, which may not represent all regions of Nepal
- The study focuses on rural areas, limiting comparison with urban educational settings
- Data are based on self-reported responses, which may introduce bias
- The analysis is limited to descriptive and correlation methods without advanced statistical modeling

Future research can address these limitations by incorporating larger datasets, comparative studies, and more advanced analytical techniques.

6. Conclusion

This study examined the role of teacher digital competency in bridging the digital divide and enhancing ICT-enabled education in Nepal. The findings reveal that while basic ICT skills are present among teachers, their effective application in teaching and learning remains limited due to lack of training, low confidence, and insufficient practical exposure. The results highlight that the digital divide is not only a matter of access to technology but also of the ability to use it effectively. Even where ICT infrastructure is available, inadequate teacher competency reduces its impact on educational outcomes. Therefore, improving teacher digital skills is essential for maximizing the benefits of ICT in education.

To address these challenges, the study emphasizes the importance of targeted training programs, continuous professional development, and practical ICT integration strategies tailored to local contexts. Strengthening teacher digital competency can significantly enhance the effectiveness of ICT-enabled education and contribute to reducing educational disparities in Nepal.

Overall, this study provides valuable insights into the human dimension of the digital divide and offers practical recommendations for improving ICT integration in resource-constrained educational environments.

7. Future Work

Future research can build upon this study in several directions:

- Conduct large-scale studies covering diverse geographical regions of Nepal
- Perform comparative analysis between rural and urban teacher digital competency
- Apply advanced statistical models to examine causal relationships between competency and ICT effectiveness
- Evaluate the impact of teacher training programs on ICT integration in real classroom settings
- Explore the role of emerging technologies such as AI-based learning tools in enhancing teacher competency

These directions can further strengthen understanding of the relationship between teacher competency and digital learning, supporting the development of more effective ICT-enabled education systems.

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