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Bridging the Theory–Practice Gap in ICT Integration: A Comparative Study of Pre-Service and In-Service Teachers

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Abstract
The integration of Information and Communication Technology (ICT) has emerged as a central component of contemporary educational transformation, aiming to enhance pedagogical effectiveness, learner engagement, and digital competency development. Despite increasing policy emphasis on digital pedagogy, a persistent gap continues to exist between teachers' theoretical understanding of ICT and its effective classroom implementation. The present study investigates and compares the theory–practice gap among pre-service and in-service teachers in relation to ICT integration.

The study employed a quantitative comparative survey research design involving 46 pre-service teachers and 50 in-service teachers. Data were collected using a structured questionnaire consisting of 22 Likert-scale items measuring six dimensions: theoretical knowledge, practical readiness, ICT skills, training and exposure, barriers, and perceived theory–practice gap. Reliability analysis indicated excellent internal consistency (Cronbach's Alpha = 0.90 for pre-service teachers and 0.88 for in-service teachers). Descriptive statistics and independent samples t-tests were utilized for data analysis.

The findings reveal that pre-service teachers demonstrate significantly higher levels of theoretical knowledge and ICT training exposure, whereas in-service teachers report greater barriers and a more pronounced theory–practice gap. No statistically significant differences were observed in practical readiness and ICT skills. The results suggest that although teacher education programmes provide conceptual preparedness, real-world institutional and infrastructural constraints hinder effective ICT implementation.

The study highlights the need for experiential learning opportunities, institutional support systems, continuous professional development, and context-responsive teacher preparation programmes to effectively bridge the gap between ICT theory and classroom practice.

Keywords: ICT Integration, Theory–Practice Gap, Pre-Service Teachers, In-Service Teachers, Digital Pedagogy, Teacher Education, TPACK.

1. Introduction

The rapid advancement of digital technologies has fundamentally transformed educational systems worldwide, making Information and Communication Technology (ICT) integration an essential component of effective teaching and learning. Contemporary classrooms increasingly rely on digital tools, online platforms, interactive learning resources, and blended learning environments to enhance learner engagement, facilitate personalized instruction, and promote 21st-century competencies.

Recent educational reforms, including the National Education Policy 2020, strongly emphasize digital education, technology-enabled pedagogy, and teacher preparedness for ICT integration. The policy advocates the development of technologically competent educators capable of integrating digital tools meaningfully within pedagogical practices. Similarly, post-pandemic educational transitions have accelerated the shift toward online and hybrid learning environments, further reinforcing the importance of ICT competency among teachers.

Despite increasing policy initiatives and technological advancements, a significant disconnect persists between teachers' theoretical understanding of ICT and their ability to implement technology effectively within actual classroom contexts. This disconnect, commonly referred to as the theory–practice gap, remains one of the major challenges in educational technology integration.

The theory–practice gap is particularly visible when comparing pre-service and in-service teachers. Pre-service teachers often receive structured academic training focused on digital pedagogy, ICT frameworks, and technology-enhanced learning approaches. However, their exposure to authentic classroom realities remains limited. In contrast, in-service teachers possess practical classroom experience but frequently encounter infrastructural limitations, workload pressures, institutional constraints, and inadequate professional support.

The challenge of ICT integration therefore extends beyond technological knowledge and involves pedagogical

adaptation, contextual understanding, institutional readiness, and continuous professional development. Effective ICT integration requires teachers to translate theoretical understanding into meaningful classroom practice within diverse educational environments.

The present study examines the theory–practice gap in ICT integration by comparing pre-service and in-service teachers across dimensions of theoretical knowledge, practical readiness, ICT skills, training exposure, barriers, and perceived implementation gaps. The study further explores how contextual realities influence technology integration within educational settings.

2. Review of Literature

The integration of ICT in education is best understood through the Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006). The framework emphasizes the interrelationship among technological knowledge, pedagogical knowledge, and content knowledge, suggesting that effective ICT integration requires the intersection of these domains rather than isolated technological proficiency.

Research consistently indicates that pre-service teachers often demonstrate strong theoretical understanding of ICT integration but possess limited practical exposure within authentic classroom settings. Conversely, in-service teachers develop contextual and practical teaching competencies over time but encounter significant institutional and infrastructural barriers affecting technology implementation.

Ertmer (2005) categorized barriers to ICT integration into first-order and second-order barriers. First-order barriers include infrastructural limitations, lack of digital resources, time constraints, and inadequate institutional support, whereas second-order barriers involve teachers' beliefs, attitudes, confidence, and resistance toward technology integration.

Studies by Hew and Brush (2007) further highlighted that barriers such as insufficient training, curriculum overload, lack of technical support, and limited access to digital infrastructure significantly affect ICT implementation in schools.

The European Commission's DigCompEdu Framework (Redecker, 2017) emphasizes the development of digital competence among educators and highlights the importance of continuous professional development in strengthening technology-enabled teaching practices. Similarly, UNESCO's ICT Competency Framework for Teachers (2018) advocates systematic teacher training and institutional support mechanisms to enhance ICT integration.

Research conducted during and after the COVID-19 pandemic further revealed that although teachers were compelled to adopt digital technologies rapidly, many struggled to translate theoretical ICT knowledge into effective online pedagogy. Studies on digital resilience and hybrid learning readiness suggest that contextual and institutional support significantly influence successful technology integration.

Recent studies also emphasize the importance of experiential and practice-based ICT training within teacher education programmes. Tondeur et al. (2017) observed that teacher beliefs and contextual experiences strongly shape technology integration practices. Similarly, Voogt et al. (2013) highlighted that ICT competency is most effectively developed through authentic classroom experiences and reflective practice.

Despite extensive research on ICT integration, comparatively fewer studies have specifically examined the theory–practice gap through comparative analysis between pre-service and in-service teachers within the Indian educational context. The present study seeks to address this gap by examining differences in ICT preparedness, barriers, and implementation experiences.

3. Conceptual Framework

The present study is grounded in the TPACK framework and theories of digital pedagogy and teacher professional development. The conceptual framework integrates the following dimensions:

- Theoretical Knowledge
- Practical Readiness
- ICT Skills
- Training and Exposure
- Barriers to ICT Integration
- Theory–Practice Gap

The framework proposes that theoretical knowledge, ICT skills, and training exposure positively influence teachers' readiness for ICT integration. However, institutional barriers, infrastructural limitations, workload pressures, and contextual constraints negatively affect the practical implementation of ICT.

The study further assumes that the theory–practice gap emerges when teachers possess conceptual knowledge but encounter challenges translating this knowledge into effective classroom practice.

The conceptual model therefore highlights the interaction between teacher preparedness and contextual realities in shaping ICT integration outcomes.

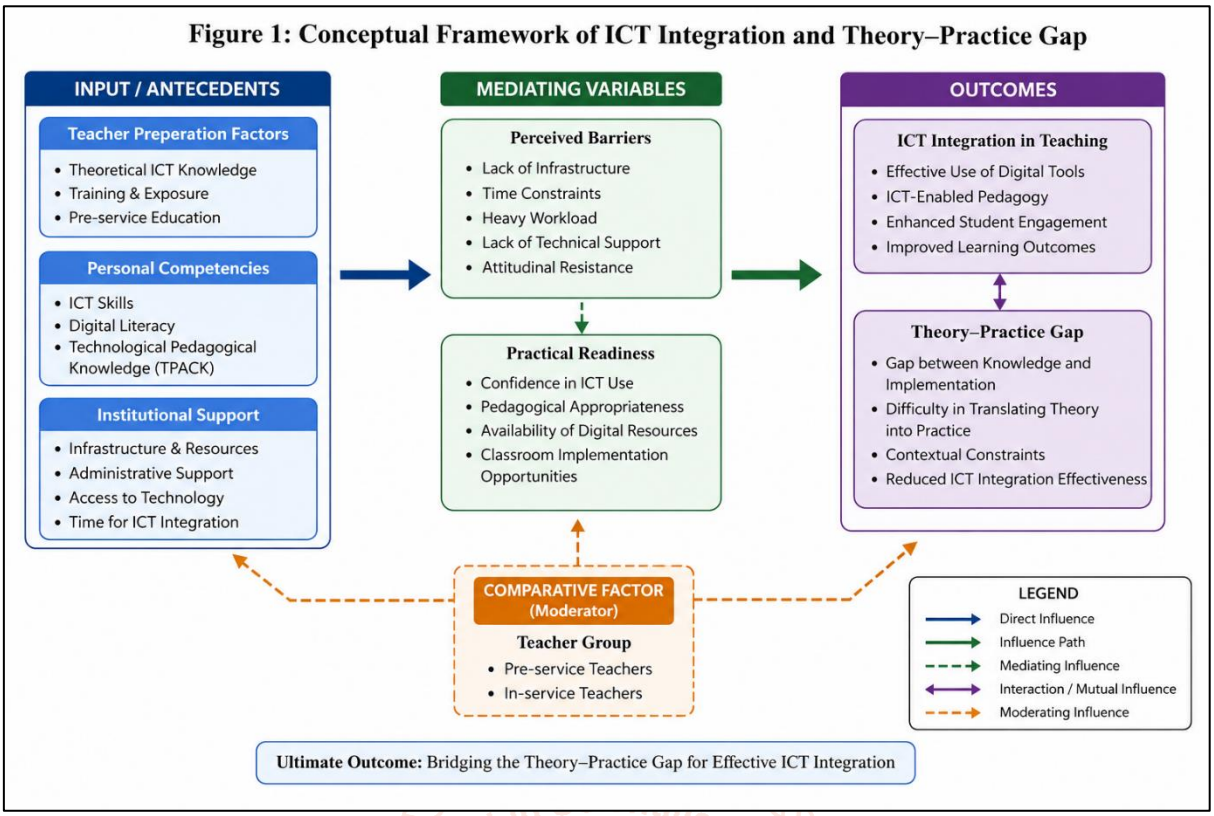

Figure 1: Conceptual Framework of ICT Integration and Theory–Practice Gap

4. Objectives of the Study

1. To assess ICT knowledge among pre-service and in-service teachers.
2. To compare readiness for ICT integration.
3. To identify barriers affecting ICT implementation.
4. To examine the theory–practice gap.
5. To analyze differences statistically.
6. To examine the relationship between teacher preparation and contextual barriers.

5. Research Questions

1. What is the level of ICT knowledge among pre-service and in-service teachers?
2. How prepared are teachers to integrate ICT into teaching practices?
3. What barriers affect ICT implementation?
4. Is there a significant theory–practice gap in ICT integration?
5. How do institutional and contextual factors influence ICT integration?

6. Hypotheses

H1: Pre-service teachers possess higher theoretical ICT knowledge than in-service teachers.

H2: In-service teachers demonstrate higher practical engagement in ICT integration.

H3: There is a significant difference in perceived barriers between pre-service and in-service teachers.

H4: A significant theory–practice gap exists in ICT integration.

7. Methodology

7.1 Research Design

The study adopted a quantitative comparative survey research design to examine differences between pre-service and in-service teachers regarding ICT integration and theory–practice gaps.

7.2 Sample

The sample consisted of:

- Pre-service teachers: 46
- In-service teachers: 50

Participants were selected using convenience sampling based on accessibility and voluntary participation.

7.3 Instrument

A structured questionnaire consisting of 22 Likert-scale items was used for data collection. The instrument measured six dimensions:

- Theoretical Knowledge
- Practical Readiness
- ICT Skills
- Training and Exposure
- Barriers
- Theory–Practice Gap

Responses were recorded on a five-point Likert scale ranging from:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

7.4. Validation and Reliability of the Tool

The questionnaire underwent expert validation to ensure content relevance, clarity, and alignment with research objectives. Necessary modifications were incorporated based on expert suggestions.

Reliability analysis using Cronbach's Alpha indicated excellent internal consistency.

Group	Cronbach's Alpha	Interpretation
Pre-service Teachers	0.90	Excellent reliability
In-service Teachers	0.88	Excellent reliability

Inference

The high reliability coefficients indicate strong internal consistency of the research instrument, confirming that the questionnaire reliably measures perceptions related to ICT integration and theory–practice gaps.

7.5. Ethical Considerations

Participants were informed regarding the academic purpose of the study, and voluntary participation was ensured. Confidentiality and anonymity of responses were maintained throughout the research process.

7.6. Data Analysis Techniques

Data were analyzed using:

- Descriptive Statistics (Mean and Standard Deviation)
- Independent Samples t-test

Statistical analysis was conducted using SPSS software.

8. Data Analysis and Results

8.1 Descriptive Statistics

Table 1: Descriptive Statistics

Dimension	Group	N	Mean	Std. Deviation
Theoretical Knowledge	Pre-service	46	4.20	0.45
	In-service	50	3.85	0.50
Practical Readiness	Pre-service	46	4.16	0.42
	In-service	50	4.05	0.48
ICT Skills	Pre-service	46	4.21	0.44
	In-service	50	4.10	0.46
Training & Exposure	Pre-service	46	4.25	0.40
	In-service	50	3.78	0.52
Barriers	Pre-service	46	3.97	0.49
	In-service	50	4.30	0.51
Theory–Practice Gap	Pre-service	46	3.55	0.53
	In-service	50	4.12	0.55

Interpretation

The descriptive statistics reveal that pre-service teachers demonstrate comparatively stronger theoretical preparedness, ICT skills, and training exposure. These findings suggest that teacher education programmes are increasingly incorporating digital pedagogy and technology-focused training.

In contrast, in-service teachers report higher barriers and a more pronounced theory–practice gap. This indicates that contextual realities such as infrastructure limitations, workload pressures, and institutional constraints significantly affect practical ICT implementation within schools.

The relatively high mean scores for ICT skills across both groups further suggest that technological awareness alone may not ensure effective classroom integration unless supported by enabling conditions and experiential practice.

8.2. Inferential Analysis (Independent Samples t-test)

Table 2: Independent Samples t-test

Variable	Mean (Pre)	Mean (In)	t-value	df	Sig.
Theoretical Knowledge	4.20	3.85	2.92	94	0.004
Practical Readiness	4.16	4.05	1.15	94	0.25
ICT Skills	4.21	4.10	1.08	94	0.28
Training & Exposure	4.25	3.78	3.25	94	0.002
Barriers	3.97	4.30	-3.05	94	0.003
Theory–Practice Gap	3.55	4.12	-3.52	94	0.001

Interpretation

The t-test results indicate statistically significant differences in theoretical knowledge, training exposure, barriers, and perceived theory–practice gap.

Pre-service teachers significantly outperform in-service teachers in theoretical ICT preparedness and training exposure, suggesting stronger academic orientation toward digital pedagogy.

In contrast, in-service teachers report significantly higher barriers and greater theory–practice gaps, indicating that institutional and contextual realities substantially influence ICT implementation.

No statistically significant differences were observed in practical readiness and ICT skills, suggesting that both groups perceive themselves as relatively competent in using ICT tools. However, practical implementation remains constrained by contextual challenges.

9. Discussion of Findings

The present study examined the theory–practice gap in ICT integration by comparing pre-service and in-service teachers across dimensions of theoretical knowledge, practical readiness, ICT skills, training exposure, barriers, and implementation gaps. The findings reveal a complex interaction between teacher preparedness and contextual realities.

The significantly higher levels of theoretical knowledge and training exposure among pre-service teachers indicate that teacher education programmes increasingly emphasize ICT integration and digital pedagogy. This finding aligns with the TPACK framework proposed by Mishra and Koehler (2006), which emphasizes the importance of integrating technological, pedagogical, and content knowledge.

The results further suggest that pre-service teachers are academically well-prepared and familiar with digital teaching frameworks. However, theoretical preparedness alone may not guarantee effective classroom implementation. This observation supports previous research by Voogt et al. (2013), which highlighted that authentic classroom experiences and contextual understanding are essential for meaningful ICT integration.

The absence of statistically significant differences in practical readiness and ICT skills is particularly noteworthy. Although both groups reported relatively high ICT competency, actual implementation experiences differed considerably. This suggests that self-perceived technological competence may not necessarily reflect practical classroom effectiveness.

One of the most significant findings of the study is the substantially higher barriers and theory–practice gap reported by in-service teachers. These barriers include infrastructural limitations, time constraints, administrative workload, inadequate institutional support, and limited opportunities for professional development.

The findings strongly align with Ertmer's (2005) classification of first-order and second-order barriers affecting ICT integration. While teacher education programmes may successfully develop theoretical competency, real-world educational settings often lack the institutional conditions necessary for sustained technology integration.

The findings further reinforce the argument that ICT integration is context-dependent and influenced by systemic educational realities. In-service teachers, despite practical teaching experience, frequently struggle to translate ICT knowledge into effective classroom practice due to contextual limitations.

The study also highlights an important disconnect between teacher preparation programmes and actual classroom environments. Pre-service teachers receive structured ICT instruction within relatively controlled academic settings, whereas in-service teachers encounter unpredictable classroom conditions, resource constraints, and institutional pressures.

This disconnect ultimately contributes to the widening theory–practice gap observed among practicing teachers. The findings therefore emphasize the need for experiential learning opportunities, realistic ICT integration experiences during internships, and institutional support systems within schools.

Overall, the study demonstrates that effective ICT integration requires more than technological knowledge alone. Successful implementation depends on the interaction among teacher preparedness, contextual realities, institutional support, and continuous professional development.

10. Educational Implications

The findings of the study have important implications for teacher education institutions, schools, policymakers, and curriculum developers.

- Teacher education programmes should integrate experiential and practice-based ICT training rather than relying solely on theoretical instruction.
- Internship programmes should provide authentic opportunities for technology integration within real classroom settings.
- Schools should strengthen digital infrastructure, technical support systems, and access to ICT resources.
- Continuous professional development programmes should be organized to enhance digital pedagogy among in-service teachers.
- Institutional leadership should provide time allocation, encouragement, and policy support for ICT integration.
- Teacher education curricula should incorporate reflective digital pedagogy and context-responsive technology integration strategies.

11. Recommendations

1. Strengthen experiential and classroom-based ICT training within teacher education programmes.
2. Incorporate simulation-based and internship-oriented digital pedagogy experiences.
3. Organize continuous professional development programmes for in-service teachers.
4. Improve school-level digital infrastructure and technical support.
5. Provide institutional encouragement and administrative support for ICT integration.
6. Develop collaborative teacher learning communities for sharing digital teaching practices.
7. Promote reflective and context-sensitive ICT integration strategies.
8. Align teacher education programmes with emerging digital competency frameworks such as DigCompEdu and TPACK.

12. Limitations of the Study

- The study was limited to a relatively small sample size.
- Convenience sampling limits the generalizability of findings.
- The study relied on self-reported responses, which may involve subjective bias.
- The research primarily focused on quantitative analysis and did not include extensive qualitative exploration.

13. Conclusion

The present study explored the theory–practice gap in ICT integration by comparing pre-service and in-service teachers across dimensions of theoretical preparedness, practical readiness, ICT competency, barriers, and implementation challenges.

The findings reveal that pre-service teachers demonstrate comparatively stronger conceptual preparedness and training exposure, whereas in-service teachers encounter substantial contextual and institutional barriers affecting ICT implementation. Although both groups reported relatively high ICT competency, practical classroom integration remains constrained by infrastructural limitations, workload pressures, and insufficient institutional support.

The study highlights that the challenge of ICT integration is not rooted in lack of technological awareness alone, but in the inability to translate theoretical knowledge into meaningful classroom practice within complex educational environments.

Bridging the theory–practice gap therefore requires a systemic approach involving experiential teacher preparation, supportive institutional environments, continuous professional development, and context-responsive digital pedagogy. Strengthening these dimensions can significantly enhance sustainable ICT integration and improve the quality of teaching and learning in contemporary education.

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