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**DIFFERENTIAL IMPACTS OF BLENDED LEARNING ON ACADEMIC
ACHIEVEMENT, ENGAGEMENT, AND PROFESSIONAL COMPETENCY:
AN EMPIRICAL STUDY OF TEACHER EDUCATION TRAINIES IN
JAMKHANDI TALUK**

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<i>Keywords</i>	<i>Abstract</i>
Blended Learning, Teacher Education, Academic Achievement, Learner Engagement, Mixed-Methods Research, Professional Competency, Hybrid Instruction, TPACK.	Teacher education instructions are undergoing significant pedagogical transformation amid global shifts toward hybrid learning environments. This empirical study investigates the differential impacts of blended learning-integrating online and offline instruction—on academic achievement, learner engagement, and professional competency development among teacher education trainees in colleges of education in Jamkhandi Taluk, Karnataka, India. A convergent mixed-methods design was employed with 312 trainees across four institutions. Quantitative data were gathered through pre-test/post-test instruments and standardized learning outcome evaluations (Cronbach's $\alpha = 0.847$ and 0.812 , respectively), while qualitative data were obtained through semi-structured interviews with 45 trainees and 16 faculty members. One-way ANOVA



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revealed statistically significant differences across instructional modalities: $F(2, 309) = 23.54$, $p < .001$, $\eta^2 = 0.13$ (large effect). Blended instruction yielded the highest post-test performance ($M = 82.09$, $SD = 8.14$), significantly outperforming offline ($M = 79.02$, $SD = 8.48$) and online-only modes ($M = 73.88$, $SD = 9.58$); Tukey HSD confirmed all pairwise differences ($p < .05$). Cohen's effect sizes were 0.92 (blended vs. online, large) and 0.37 (blended vs. offline, medium). Engagement scores mirrored this pattern: Blended ($M = 4.2/5$), Offline ($M = 3.8/5$), and Online ($M = 3.1/5$). Humanities trainees demonstrated greater achievement gains (8.7%) than STEM trainees (5.2%) in blended settings. Thematic analysis of interview data yielded seven themes: flexibility advantages, practical skill necessity, infrastructure challenges, faculty development needs, social-relational value, subject-specific differences, and assessment alignment. Findings indicate that optimal learning outcomes in teacher education require contextualized, discipline-specific hybrid models rather than uniform single-modality implementation. Policy recommendations include a 60:40 blended instructional ratio, investment in offline laboratory infrastructure, and TPACK-focused faculty development with 80% institutional coverage.

INTRODUCTION

The Teacher education institutions globally are witnessing a paradigm shift in pedagogical approaches, moving rapidly from traditional face-to-face instruction toward hybrid and blended learning models. This transition, accelerated by recent global educational disruptions, has necessitated a critical re-evaluation of instructional efficacy within teacher preparation programs. In the context of India, specifically within rural and semi-urban settings like Jamkhandi taluk in Karnataka, this shift presents unique challenges and opportunities. With over 1,200 teacher trainees currently enrolled across four major institutions in the region, understanding the differential impacts of instructional modalities is no longer merely academic but essential for institutional policy and practice.

The problem addressed in this study lies in the ambiguity surrounding the effectiveness of these emerging modalities. While blended learning is often touted as a "best of both worlds" approach, empirical evidence regarding its specific impact on professional competency development in teacher education—particularly in resource-constrained environments—remains fragmented. Jamkhandi Taluk, characterized by a mix of rural and semi-urban infrastructure with approximately 45% internet coverage and variable digital access, offers a critical testing ground for these models. The region's context is further complicated by the deep-seated cultural tradition of Guru-Shishya parampara, which emphasizes direct, personal interaction between teacher and student, potentially making pure online instruction feel depersonalized and culturally dissonant.



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This study is significant as it provides empirical data to inform policy decisions for teacher education institutions operating in similar developing contexts. By systematically comparing online, offline, and blended modalities, this research aims to identify optimal pedagogical strategies that balance technological integration with the development of essential teaching competencies.

LITERATURE REVIEW

Online and Offline Learning in Teacher Education: Traditional offline pedagogy has long been the bedrock of teacher education, providing the immediate feedback and social modeling essential for developing complex teaching skills. However, the rigid temporal and spatial constraints of traditional models have increasingly been challenged by the flexibility offered by online learning. Research indicates that while online learning affords greater accessibility and self-directed learning opportunities, it often struggles to replicate the social presence required for effective teacher training (Means et al., 2023). In the context of teacher education, where interpersonal skills are paramount, the limitations of purely online instruction have been particularly evident.

Blended Learning and TPACK Framework: Blended learning, defined as the strategic integration of face-to-face and online instructional activities, has emerged as a promising alternative. Theoretical support for this approach is found in the Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006). TPACK suggests that effective 21st-century teaching requires the intersection of technological, pedagogical, and content knowledge. Blended learning models potentially offer a platform for developing this multifaceted competency by requiring trainees to navigate both physical and digital learning spaces.

Contextual Gaps in Research: While international studies (Dziuban et al., 2018) have documented the general efficacy of blended learning, there remains a paucity of research focused on rural Indian contexts. Most existing literature draws from urban, resource-rich environments that do not reflect the infrastructural realities of Jamkhandi. This study seeks to bridge this gap by examining how blended learning functions within a specific socio-economic and infrastructural context, using a mixed-methods approach to capture both outcomes and experiences.

RESEARCH OBJECTIVES

The study was guided by the following five objectives:

1. To assess and compare learning outcomes among teacher trainees undergoing offline, online, and blended modes of instruction (N = 312).
2. To examine how subject specialization (humanities, sciences, commerce) moderates the effectiveness of these instructional modalities.
3. To evaluate the impact of each modality on specific professional competencies, including theoretical knowledge, pedagogical skills, and reflective practice.



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4. To identify institutional and student-level barriers hindering effective implementation of hybrid learning models.
5. To develop context-specific recommendations for optimizing instructional delivery in colleges of education.

HYPOTHESES

Based on the literature review and objectives, the following directional hypotheses were formulated:

- H1: Blended learning will yield significantly higher academic achievement scores compared to online-only or offline-only modes.
- H2: Engagement levels will differ significantly across instructional modalities, with blended learning showing superior engagement metrics.
- H3: Subject specialization will moderate the effectiveness of instructional modes, with humanities subjects showing greater adaptability to online components than science subjects.
- H4: Offline instruction will demonstrate superiority specifically in the domain of pedagogical competency development compared to online instruction.

METHODOLOGY

Research Design: This study employed a convergent mixed-methods design, collecting and analyzing quantitative and qualitative data concurrently to provide a comprehensive understanding of the research problem. This approach allowed for the statistical rigor of experimental comparison to be contextualized by the lived experiences of the participants.

Population and Sample: The target population comprised over 1,200 teacher trainees enrolled in four colleges of education within Jamkhandi taluk. A stratified random sampling technique was utilized to select a sample of 312 trainees, ensuring representation across gender (52% female, 48% male) and residential status (72% rural, 28%urban). The sample was divided into three instructional groups: Online only (n = 104), Offline Only (n = 102), and Blended (n = 106), with the blended group receiving a 60% offline and 40% online instructional mix. Additionally, a qualitative sub-sample of 45 trainees and 16 faculty members was selected for in-depth interviews.

Instruments and Tools: Three primary instruments were used for data collection:

1. Learning Outcome Assessment Tool (LOAT): A standardized 50-itemtest measuring Theoretical Knowledge, Pedagogical Competency, and Reflective Practice. The instrument demonstrated high internal consistency (Cronbach's $\alpha = 0.847$).
2. Engagement Assessment Scale (EAS): A 20-item scale assessing cognitive, behavioral, affective, and emotional engagement (Cronbach's $\alpha = 0.75-0.82$ across subscales).
3. Semi-Structured Interview Protocols: Separate protocols were developed for trainees (20 questions) and faculty (12 questions) to explore perceptions, challenges, and experiences.



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Data Collection Procedures: The study was conducted over a 20-week period from January to May 2026. Following the administration of pre-tests to establish baseline equivalence, the intervention was implemented across the three groups. Post-tests were administered immediately following the intervention period. Interviews were conducted concurrently during the final weeks of the study. Ethical protocols, including informed consent and anonymity, were strictly adhered to throughout the process.

RESULTS

Quantitative Findings: One-way Analysis of Variance (ANOVA) was conducted to compare academic achievement across the three groups. The results revealed statistically significant differences in post-test scores, $F(2, 309) = 23.54$, $p < .001$, with a large effect size ($\eta^2 = 0.13$). The Blended learning group achieved the highest mean score ($M = 82.09$, $SD = 8.14$), significantly outperforming both the Offline group ($M = 79.02$, $SD = 8.48$) and the Online group ($M = 73.88$, $SD = 9.58$). Tukey HSD post-hoc tests confirmed that all pairwise differences were statistically significant at the $p < .05$ level.

Analysis of effect sizes using Cohen's d indicated a large effect for Blended vs. Online instruction ($d = 0.92$) and a medium effect for Blended vs. Offline instruction ($d = 0.37$). The difference between Offline and Online modes also showed a medium effect size ($d = 0.56$), favoring offline instruction.

Engagement levels also varied significantly by modality, $F(2, 309) = 93.15$, $p < .001$. On a 5-point scale, the Blended group reported the highest engagement ($M = 80.4\%$ converted to equivalent metric: $M = 4.2/5$), followed by Offline ($M = 3.8/5$) and Online ($M = 3.1/5$).

A significant interaction effect was observed between instructional mode and subject specialization ($p = .029$). Humanities trainees in the blended group showed an 8.7% improvement over their offline counterparts, whereas STEM trainees showed only a marginal 1.1% improvement. Domain-specific analysis further revealed that while Online instruction was slightly more effective for acquiring Theoretical Knowledge ($M = 37.4$), it was significantly less effective for Pedagogical Competency ($M = 31.6$) compared to Offline instruction ($M = 40.8$).

Qualitative Findings: Thematic analysis of interview data from 45 trainees and 16 faculty members yielded seven key themes:

1. Flexibility vs. Procrastination: While 42 out of 45 trainees appreciated the flexibility of online components, many noted it led to procrastination without structured deadlines.
2. Practical Skill Necessity: An overwhelming majority (43/45) emphasized that face-to-face interaction is indispensable for developing practical teaching skills and classroom management techniques.
3. Infrastructure Challenges: Digital inequality was a major theme, with 38% of participants reporting frequent connectivity issues and 22% lacking reliable home internet access.



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4. Faculty TPACK Gaps: Faculty interviews revealed that 7 out of 16instructors had received no formal training in hybrid pedagogy, highlighting a gap in Technological Pedagogical Content Knowledge.
5. Social-Relational Value: Participants highlighted the "human element"—peer support and mentor guidance—as a critical component of motivation that was often diluted in purely online formats.
6. Subject-Specific Differences: Faculty noted that humanities subjects were more easily adapted to asynchronous online formats, where as science subjects required physical laboratories for effective demonstration.
7. Assessment Alignment: Both students and faculty expressed concerns that current assessment models were not fully aligned with hybrid instructional delivery.

DISCUSSION

The findings of this study strongly support the efficacy of blended learning over single-modality approaches, aligning with global research while highlighting specific contextual nuances. The superior performance of the blended group suggests that the integration of online self-paced learning with offline social interaction creates a synergistic effect that enhances overall achievement. The online component appears to support the acquisition of theoretical concepts through flexibility and resource accessibility, while the offline component remains critical for the development of complex pedagogical skills and professional socialization.

The significant interaction between subject specialization and instructional mode underscores that a "one-size-fits-all" approach is ineffective. Humanities disciplines, which rely heavily on discourse and text, adapt well to online forums, whereas science education's reliance on physical experimentation necessitates a stronger face-to-face component. This finding challenges the uniform implementation of hybrid models often seen in policy directives.

Culturally, the results reflect the enduring importance of the Guru-Shishya tradition. The lower engagement and achievement in the online-only group can be partly attributed to the loss of direct mentorship and the depersonalization of the learning process. Blended learning appears to bridge this cultural gap by preserving the mentor-mentee relationship within the offline component while leveraging technology for content delivery.

CONCLUSION

This study concludes that optimal learning outcomes in teacher education within the Jamkhandi context are best achieved through a contextualized hybrid model rather than uniform adherence to either traditional or fully online methods. Blended learning offers a robust framework for professional development, but its success is contingent upon addressing infrastructural disparities and faculty competency gaps. The study validates the necessity of maintaining a strong offline



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component for pedagogical skill acquisition while utilizing online platforms to enhance theoretical understanding and flexibility.

RECOMMENDATIONS

Based on the empirical findings, the following recommendations are proposed for policy and practice:

1. **Differentiated Modality Ratios:** Institutions should adopt subject-specific blended ratios. A 60:40 (online:offline) ratio is recommended for Humanities, while Sciences should maintain a 20:80 ratio, and Commerce a 30:70 ratio to accommodate discipline-specific needs.
2. **Faculty Development:** Mandatory TPACK-focused training programs should be implemented, targeting 80% faculty coverage to ensure instructors are competent in hybrid pedagogy.
3. **Infrastructure Investment:** Significant investment is required in campus Wi-Fi and offline computer laboratories to mitigate the digital divide experienced by rural trainees.
4. **Assessment Reform:** Assessment strategies must evolve to include multiple modes such as digital portfolios, online quizzes, and direct classroom observations to align with hybrid instruction.

AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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