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Transforming Teacher Education in Odisha through ICT Integration: A Study on Transaction Modalities

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Abstract

The synergy of ICT with teacher education has predominantly emerged as a transformative ally to develop the pedagogical practices and to improve learning outcomes. In states like Odisha where educational disparities and infrastructural challenges exists, ICT can play a vital role in modernizing the education system and ensuring equitable access to education. The study examines the integration of Information and Communication Technology (ICT) within teacher education programmes, focusing on teacher trainees' access to resources, digital competencies, and pedagogical practices. Findings revealed an inconsistent access to ICT infrastructure, with many trainees reporting only occasional use of essential tools such as personal computers and interactive whiteboards. While basic ICT tools, including multimedia and email, are utilized frequently, the engagement with advanced applications, such as video conferencing and collaborative platforms, is notably limited. Furthermore, a significant disparity exists in the digital competencies of trainees, underscoring the necessity for training programmes that prioritize the pedagogical application of ICT rather than mere operational proficiency. The study also identifies barriers to effective ICT integration, including inadequate infrastructure, insufficient technical support, and time constraints. Teacher trainees express the need for enhanced access to quality equipment and structured pedagogical training to facilitate meaningful technology use. In conclusion, this research highlights the critical need for teacher education institutions to address infrastructural, policy, and professional development challenges to adequately prepare future educators for the demands of digitally enriched learning environments, thereby improving the overall quality and relevance of education.

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Introduction

The rapid evolution of digital technologies has brought significant transformation to the field of education, positioning technology as a central factor in transforming teaching and learning methods (Hennessy et al., 2022). Studies emphasize the importance of integrating ICT into teaching, underscoring the need for educators to develop a deep, personal understanding of technology (Bai et al., 2021; Greenwood et al., 2021). This understanding goes beyond merely knowing how to use technology; it involves comprehending the rationale behind ICT integration and applying it thoughtfully during instructional practices. ICT has been widely adopted in education for its ability to enhance the effectiveness of instructional methods for both learners and instructors (Churchill et al., 2016). Research highlights its role in boosting student motivation (Alshahrani et al., 2019), fostering collaboration and engagement among learners (Chinganotto & Cuccurullo, 2019), and improving the overall quality of teaching (Churchill et al., 2016). These benefits illustrate the critical importance of technology in education as an essential element for advancing learning in the 21st century.

Information and Communication Technology (ICT) in education involves the use of digital tools to support, enhance, and optimize the delivery of information to learners. ICT encompasses a range of technologies, including computers, software, networks, and satellite links, which collectively enable users to access, analyze, create, exchange, and utilize data and knowledge in ways previously unimaginable. The rapid proliferation of these technologies has shifted human society from the information age to the knowledge age, affecting almost every sector (Barakabitze et al., 2015). Despite the transformative potential of ICT in education, its application in some classroom contexts remains limited. This is particularly concerning in the realm of teacher education, where ICT plays a crucial role in preparing future teachers to integrate technological tools effectively into their teaching practices (Nago et al., 2022). In India, the integration of ICT in teacher education is vital not only for improving teaching methodologies but also for equipping students to thrive in a digitally connected world (Pandey, 2018). Modern educational demands require teachers to adopt ICT tools early in their careers, enabling them to meet the needs of contemporary learners (Nadif et al., 2024). Therefore, fully integrating technology into teacher education programmes is foundational for fostering effective and reflective instructional practices. ICT has been widely recognized for its potential to enhance student learning and transform teaching approaches. However, research consistently indicates that teacher trainee incorporates digital tools into their lessons less frequently than might be expected (Al-Ruz & Khasawneh, 2011; Dawson, 2008; Liu, 2012). A common limitation identified in teacher education programmes is their focus on imparting ICT knowledge without adequately teaching how to integrate it effectively into curriculum (Oblinger & Obliger, 2005; Wachira & Keengwe, 2011). Several studies have highlighted that this limited use of ICT in teacher preparation systems (Albirini, 2006; Liu, 2012; Scheeler, 2008) contributes to the insufficient digital competencies among teacher trainees. This lack of practical ICT integration skills can result in their inability to utilize technology effectively in classroom settings.

In light of these challenges and the varied impacts identified by researchers, the present

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study aims to explore key aspects of ICT integration within teacher education programmes. Specifically, the research aims to address the following questions: (1) What is the current state of infrastructure for Information and Communication Technology (ICT) in teacher education programmes? (2) What are the skills and competencies of teacher trainees in utilizing ICT? (3) What ICT-enabled teaching practices are being adopted by teacher trainees? (4) What barriers and challenges hinder the effective integration of ICT by teacher trainees? (5) How are teacher educators integrating ICT into the teaching-learning process? (6) What suggestions do teacher trainees offer for improving the effectiveness of ICT integration in their courses?

Review of Literature

Several studies have examined the adoption and integration of ICT in teaching and learning contexts. Mohalik (2020) observed that only 20 percent of trainees use digital devices for creating PowerPoint presentations, developing digital learning materials, and offering feedback to students during their internships. Andoh (2019) and Nadif et al., (2024) identified several barriers to ICT integration, including inadequate infrastructure, low competency levels, insufficient leadership support, and negative attitudes towards ICT. Nasreen and Chaudhary (2018) highlighted that teacher educators and trainees perceive a lack of infrastructure as a key obstacle to integrating ICT into teacher education programmes. Pandey (2018) and Nago et al., (2022) emphasized the critical role of ICT in enhancing theoretical instruction within teacher education. Angadi (2016) noted that the availability of computers and ICT resources in teacher education institutions is limited, with a primary focus on teaching ICT skills. According to Aslan and Zhu (2016), both pre-service teachers and novice teachers require additional training to achieve proficiency in utilizing ICT for educational purposes. Ghavifekr and Rosdy (2015) concluded that technology-based teaching and learning methods are more effective than traditional approaches in teacher education institutions.

Teacher education in India encompasses both pre-service and in-service training programmes designed to cultivate multitalented teachers who are capable of critical thinking and proficient in integrating technology within learner-centered teaching environments. Despite the acknowledged importance of Information and Communication Technology (ICT) in enhancing educational practices, many teacher education institutions in India encounter significant challenges in effectively implementing ICT-based curricula. This study aims to examine the current state of ICT integration in teacher education programmes across India, focusing on several key areas: the availability of infrastructural resources, the competencies of teacher trainees and teacher educators, the quality of ICT-enabled teaching practices, and the barriers hindering effective integration. Furthermore, the study will propose strategies to improve ICT integration in these programmes, thereby contributing to a more effective teacher training ecosystem in the country.

Objectives of the Study

1. To assess the existing infrastructure for Information and Communication Technology (ICT) in teacher education programmes.
2. To evaluate the skills and competencies of teacher trainees in effectively utilizing ICT.
3. To investigate the ICT-enabled teaching practices by teacher trainees.
4. To identify barriers and challenges hindering effective ICT integration byteacher trainees.
5. To examine the integration of ICT by teacher educators in the teaching-learning process.

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6. To explore teacher trainees' suggestions for improving the effectiveness of ICT integration within their courses.

Methodology of the Study

Research Design

The study employs a descriptive survey research design to quantify the existing ICT infrastructure, skills, competencies, and challenges in teacher education programmes. This design facilitates the systematic collection of data from a defined population to describe the current state of ICT integration in teacher education.

Sample

The sample of the study has comprised of 190 participants, including 165 pre-service teachers and 25 teacher educators, drawn from five teacher education institutes across Odisha. Stratified random sampling technique was being used to ensure a representative and diverse sample from the target population within the state of Odisha.

Instrument

Two self-developed instruments were used to collect data on ICT integration in teacher education programmes in Odisha, targeting pre-service teachers and teacher educators. Each instrument was meticulously designed to align with the study's objectives and ensure comprehensive data collection.

Questionnaire for Teacher Trainees

Questionnaire for teacher trainees consists of 45 items organized into five sections, each addressing a critical aspect of ICT integration. The first section focused on evaluating access to ICT by assessing the availability of infrastructure and resources. The second section measured the skills and competencies of pre-service teachers in using various ICT tools, while the third section examined how these teachers utilized ICT in their teaching and learning practices. The fourth section aimed to identify the barriers and challenges that hinder effective ICT integration and the final section gathered perceptions regarding the importance of different strategies to enhance ICT integration in their teaching environment.

ICT Integration Scale for Teacher Educators

ICT integration scale for teacher educators contained 20 items, distributed across five dimensions that reflect the core areas of ICT integration. These dimensions include proficiency in using ICT tools, access to essential ICT resources, the extent of ICT integration in teaching, the pedagogical use of ICT to enhance teaching and learning outcomes, and a commitment to ongoing professional development. Respondents were asked to rate each item on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), providing an in-depth evaluation of ICT usage and integration within teacher education programmes.

Reliability and Validity

Validity and reliability of the instruments were ensured by establishing content validity through expert review, which confirmed that the items accurately captured the intended

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dimensions of ICT access, skills, and integration practices. A pilot study was conducted to refine question clarity and ensure alignment with study aims. The reliability of the questionnaires was measured using Cronbach's alpha, yielding coefficients of 0.85 for the teacher trainee's questionnaire and 0.82 for the teacher educators' questionnaire, indicating high internal consistency.

Result and Discussion

Existing ICT Infrastructure

The analysis of access to various ICT infrastructures among pre-service teachers reveals variations in the frequency of use of different technological tools within teacher education programmes. The results are presented in Table 1 below.

Table 1

Perceptions of Teacher Trainees on Access to ICT Infrastructure (N = 165)

Item	Frequently	Occasionally	Rarely
Personal computers	32%	52%	15%
Interactive whiteboards	31%	54%	14%
Video conferencing systems	21%	43%	35%
Learning management systems	18%	41%	40%
Audio equipment (including software)	28%	56%	14%
Digital cameras (including editing software)	24%	53%	22%
Projection systems	41%	43%	15%
Total Average	**28%**	**57%**	**22%**

The findings indicate that access to ICT infrastructure among pre-service teachers is characterized by a predominance of occasional usage. On average, 28% of pre-service teachers reported having frequent access to these technologies, while a significant majority (57%) indicated occasional access. Notably, only 22% of the respondents reported rarely using these tools. Personal computers and interactive whiteboards are among the most frequently accessed resources, with 32% and 31% of pre-service teachers using them regularly, respectively. However, a majority still utilizes these tools only occasionally, suggesting a lack of consistent engagement. Video conferencing systems and learning management systems are less frequently accessed, with only 21% and 18% of respondents indicating regular use. This is concerning, as 40% of the sample reported rarely using learning management systems, indicating limited integration of these platforms into their training program makes. Projection systems showed the highest frequency of access, with 41% of respondents using them regularly, while audio equipment is predominantly accessed occasionally, as indicated by 56% of the respondents. Overall, the analysis reveals a trend of occasional use of ICT tools among pre-service teachers, with underutilization of certain technologies like video conferencing systems and learning management systems.

Skills and Competencies of Teacher Trainees in Effectively Utilizing ICT

The findings, summarized in Table 2, indicate that the frequency of usage of ICT tools

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varies significantly among the teacher trainees.

Table 2

Skills and Competencies of Teacher Trainees in Effectively Utilizing ICT (N = 165)

Working With	**Frequently**	**Occasionally**	**Rarely**
Word processor	36%	45%	17%
E-mail	43%	42%	25%
World wide web	44%	43%	12%
Graphic software	28%	36%	34%
Database	32%	41%	26%
Spreadsheet	34%	44%	21%
Multimedia	45%	44%	10%
Language software	32%	40%	27%
Learning website	34%	46%	18%
Blogging	32%	43%	24%
Wiki	40%	48%	11%
Online discussion group	24%	44%	31%
Video conferencing	23%	47%	28%
Slide share	30%	50%	20%
e-Pathsala	33%	42%	24%
Total	**34%**	**44%**	**22%**

Notably, a substantial percentage of teacher trainees demonstrated proficient use of essential ICT tools, with multimedia achieving the highest frequent usage rate at 45%. This was closely followed by email and world wide web usage, reported at 43% and 44%, respectively. On average, 34% of the trainees frequently utilized the available ICT tools, while a considerable 44% accessed them occasionally. However, 22% of the respondents reported rarely engaging with these resources, which raises concerns about their overall competency in effectively leveraging ICT in educational settings. Certain tools, such as graphic software (28%) and video conferencing (23%), exhibited lower frequency usage among the trainees.

Views of Teacher Trainees Regarding ICT-Enabled Teaching Practices

The analysis of teacher trainees' perspectives on ICT-enabled teaching practices reveals their engagement levels with various technological tools during instructional processes. The results are presented in Table 3.

Table 3

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Views of Teacher Trainees Regarding ICT-Enabled Teaching Practices (N = 165)

Item	**Always**	**Sometimes**	**Never**
Search internet to collect information to prepare lesson plan	33%	48%	17%
Search internet to collect resources to be used in teaching	32%	47%	20%
Use PPT for teaching	30%	53%	16%
Create ICT learning materials for students	37%	50%	12%
Prepare exercises and tasks for students	31%	55%	13%
Use of ICT for providing feedback to students regarding lessons	37%	45%	16%
Use different online libraries for subject-related information	34%	48%	16%
Share notes and clips with students online	37%	40%	22%
Total	**34%**	**48%**	**16%**

The findings show that, on average, 34% of teacher trainees consistently utilize ICT-enabled practices in their teaching. A majority, at 48%, use these practices occasionally, while only 16% report never using these technologies. Notably, the highest engagement was seen in creating ICT learning materials (37%) and using ICT for providing feedback (37%).However, the use of PowerPoint presentations (30%) and internet searches for lesson preparation (33%) indicate a moderate level of consistent engagement, suggesting opportunities for further integration of ICT tools in teacher training. Overall, these results highlight the varying degrees of ICT adoption among teacher trainees, emphasizing the need for enhanced training and resources to facilitate more effective integration of technology in teaching practices.

Views of Teacher Trainees Regarding Barriers and Challenges Hindering Effective ICT Integration

The analysis of barriers and challenges faced by teacher trainees in integrating ICT into their educational practices reveals significant obstacles that hinder effective usage. The findings are summarized in Table 4.

The results revealed, a significant percentage of teacher trainees identify various barriers to effective ICT integration. The most prominent barrier is the lack of resources at the institution, reported by 71% of respondents. Additionally, the absence of technical support (65%) and pedagogical support (68%) are considerable challenges that need to be addressed. Moreover, 67% of the trainees expressed that the pressure to prepare for examinations hinders their ability to integrate ICT effectively. Insufficient time (57%) and lack of skills (54%) also contribute to the challenges faced. Overall, the data suggests that overcoming these barriers is crucial for enhancing the integration of ICT in teacher education programmes.

Table 4

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Barriers and Challenges Hindering Effective ICT Integration (N = 165)

Barriers	**Yes**	**No**
Insufficient time	57%	42%
Lack of skills	54%	45%
Lack of resources at the institute	71%	28%
Lack of interest	55%	44%
Problems in internet access	54%	45%
Lack of technical support	65%	34%
Lack of pedagogical support	68%	31%
Pressure to prepare for examinations	67%	32%
Total	**61%**	**37%**

ICT Integration among Teacher Educators

The results, as shown in the table 5, provide an overview of teacher educators' performance across these dimensions.

Table 5

ICT Integration among Teacher Educators (n=25)

Dimension	**Mean**	**S D**	**Minimum**	**Maximum**
Proficiency	12.52	1.43	10	15
Access	12.04	1.64	9	15
Integration	12.04	1.74	9	15
Pedagogical Use	12.24	1.57	9	15
Professional Development	11.88	1.81	8	15
Total Score	**60.72**	**7.15**	**49**	**75**

The results indicate that proficiency in using ICT tools for teaching yielded a mean score of 12.52 (SD = 1.43), suggesting that teacher educators are generally confident in their ability to utilize these technologies, though some variability exists. Access to ICT resources had a slightly lower mean of 12.04 (SD = 1.64), indicating that while many educators have access to essential ICT infrastructure, there are disparities in resource availability across the group. ICT integration into teaching practices recorded a mean score of 12.04 (SD = 1.74), reflecting moderate levels of ICT use in instructional activities. The relatively high standard deviation suggests that some educators are more adept at incorporating ICT into their teaching than others. Pedagogical use of ICT, with a mean of 12.24 (SD = 1.57), shows that educators are employing ICT to facilitate collaborative and critical thinking activities, but variability remains in the extent of this use. Professional development received the lowest mean score at 11.88 (SD = 1.81), indicating that many educators need more opportunities or motivation to stay up-to-date with the latest ICT trends and tools. The overall total score of 60.72 (SD = 7.15) suggests that, while teacher educators are moderately integrating ICT into their teaching, significant areas for improvement remain, particularly in terms of professional development and ensuring equitable access to ICT resources.

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The variation across different areas highlights that, while some teacher educators demonstrate strong proficiency and effective use of ICT, others face challenges in terms of access and ongoing professional development. These findings point to the need for targeted strategies to support more uniform and effective ICT integration in teacher education programmes.

Suggestions of Teacher Trainees for ICT Integration in Teacher Education

Table 6

Suggestions of Teacher Trainees for ICT Integration (N = 165)

Items	**Quite Great Importance**	**Little Importance**	**No Importance at All**
Better Access to ICT Equipment	58%	23%	17%
Reliability of ICT Equipment	46%	28%	24%
Availability of High-Quality Equipment	45%	32%	22%
Training in Pedagogical Use of ICT	64%	24%	11%
Policies on ICT Usage Across Curriculum	56%	29%	10%
Dedicated Time in Courses for Preparation and Development	54%	33%	23%
Technological Support	55%	22%	22%
Total	**54%**	**27%**	**18%**

The data from Table 5 underscores key areas identified by teacher trainees to optimize ICT integration within educational courses. Predominantly, teacher trainees advocate for structured training in the pedagogical use of ICT (64%) and greater access to equipment (58%), reflecting a strong emphasis on both practical exposure and skill development in educational technology. Reliable ICT equipment and dedicated support emerge as crucial factors, as 46% and 55% of respondents respectively prioritize these to enhance integration efforts. The perceived necessity for high-quality equipment, supportive policies, and dedicated preparation time further indicates the holistic infrastructure expected to facilitate effective ICT use, with 54% on average rating these factors as highly important. However, varied perspectives are evident, as around 27% view these areas as moderately important and 18% as non-essential, suggesting that while there is overall support for ICT integration, some trainees perceive certain elements as peripheral to the primary goals of ICT training. This distribution of responses underscores the nuanced and diverse requirements of teacher trainees in ICT-related professional development.

Discussion

Findings of the present study reveal critical insights into the current state of ICT integration within teacher education programmes, highlighting both strengths and areas for improvement. Access to ICT infrastructure remains inconsistent, with pre-service teachers showing a predominant trend of only occasional access to essential resources, such as personal computers

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and interactive whiteboards, as well as less frequent usage of video conferencing systems and learning management systems. This trend aligns with previous research by Angadi (2016), which reported limited access to ICT resources in teacher education institutions. These limitations potentially affect the quality of ICT utilization in instructional practices, necessitating better infrastructural support to foster comprehensive and consistent use (Nasreen & Chaudhary, 2018).

The study also underscores the varying skills and competencies of teacher trainees in effectively using ICT tools. While a substantial proportion of trainees demonstrate frequent use of basic tools, such as multimedia and email, other critical digital resources like video conferencing and graphic software see limited engagement. This disparity in ICT skills is similarly noted by Liu (2012), who observed that pre-service teachers often lack practical skills in integrating technology within curriculum applications. Consequently, this points to the need for training programmes that prioritize pedagogical applications of ICT, rather than focusing solely on operational skills (Wachira & Keengwe, 2011).

Furthermore, the findings on ICT-enabled teaching practices reveal a moderate level of consistent ICT adoption, with certain activities like lesson preparation using online resources and feedback provision using ICT tools being relatively high. However, the lack of consistency in using advanced ICT applications, such as online libraries and collaborative platforms, reflects an underutilization of the technology's full potential, echoing the concerns of Dawson (2008) regarding the limited application of ICT for student-centered learning experiences. Additionally, identified barriers, including inadequate infrastructure, lack of technical and pedagogical support, and time constraints, resonate with Andoh's (2019) findings on the common obstacles to effective ICT integration in teacher education in Odisha.

Teacher trainees' suggestions for enhancing ICT integration emphasizing pedagogical training, access to high-quality equipment, and institutional policies on ICT usage reiterate the need for a supportive infrastructure that bridges these identified gaps. The strong call for pedagogical training reflects the importance of moving beyond technical ICT skills towards fostering a reflective, purposeful approach to technology use in teaching, as also highlighted by Al-Ruz & Khasawneh (2011) and Ahmad et al. (2016). These findings collectively underscore the urgency of designing teacher education programmes that holistically integrate ICT, addressing both infrastructural and pedagogical needs to prepare educators capable of leveraging technology effectively in contemporary classrooms.

Implication of the Study

The findings of this study reveal several important educational implications for enhancing ICT integration in teacher education programmes. First, there is a clear need to improve ICT infrastructure within these institutions. Greater investment in technology and reliable internet access would allow teacher trainees to engage more consistently with ICT tools, preparing them for the digital demands of modern classrooms. Additionally, the moderate ICT skills observed among teacher educators indicate the importance of continuous professional development, specifically in digital pedagogy. Regular training programmes could not only improve basic ICT skills but also enhance the effective integration of digital tools in teaching practices. Furthermore, establishing clear policies for ICT integration across teacher education curricula would create standardized practices, addressing barriers such as limited time for ICT-related activities and the

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pressure of exam preparation. Such policies would help position ICT use as a core component in teacher training programmes. Equally important is providing structured support and targeted ICT training for teacher trainees. A learner-centered approach would empower trainees with the necessary skills to incorporate technology meaningfully into their future classrooms. Overall, these implications suggest that addressing infrastructure, policy, and training needs in teacher education can foster a generation of educators well-prepared for digitally enriched teaching environments.

Conclusion

This study highlights the existing gaps and opportunities in ICT integration within teacher education programmes, revealing moderate levels of ICT use among both teacher trainees and educators. The implications underscore the importance of bolstering infrastructure, policy, and professional development to bridge these gaps effectively. By addressing these areas, teacher education institutions can better prepare future educators for the demands of digitally enriched learning environments, ultimately enhancing the quality and relevance of education.

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