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Teachers' Perception of Use of ICT in Environmental Education

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Abstract

The present study aimed to examine teachers' perceptions regarding the use of Information and Communication Technology (ICT) in Environmental Education at the preparatory stage and to compare these perceptions across selected demographic variables. A descriptive research design was employed, and the sample consisted of 112 primary school teachers from government and private schools in the Delhi region. Data were collected using a self-developed, validated questionnaire comprising 33 items across five dimensions of ICT use in Environmental Education. Descriptive and inferential statistical techniques, including mean, standard deviation, percentage, and independent samples *t*-test, were used for data analysis. The findings revealed that teachers generally held a favorable perception toward the use of ICT in Environmental Education. A significant difference was found with respect to gender, with female teachers demonstrating more positive perceptions, while no significant differences emerged based on academic or professional qualifications. The study underscores the need for targeted professional development and institutional support to strengthen effective ICT integration in Environmental Education.

Keywords: Teachers' Perception, Environmental Education, ICT, Educational Technology

Introduction

The contemporary world is confronted with unprecedented environmental challenges such as climate change, biodiversity loss, pollution, and unsustainable consumption patterns. Addressing these challenges requires not only scientific and technological solutions but also informed, responsible, and environmentally conscious citizens. Education plays a pivotal role in cultivating environmental awareness, values, and sustainable behaviors, as emphasized by global frameworks like the United Nations' 2030 Agenda for Sustainable Development (United Nations, 2015) and UNESCO's focus on environment and biodiversity education (UNESCO, 2023). Environmental Education (EE), therefore, has emerged as a critical component of school curricula worldwide, aiming to develop learners' knowledge, attitudes, and competencies for sustainable development (Hnatyuk et al., 2024; Komatsu et al., 2023).

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Parallel to this growing emphasis on environmental sustainability is the rapid integration of Information and Communication Technology (ICT) in education. ICT has transformed teaching–learning processes by enabling access to digital content, interactive learning environments, simulations, virtual fieldwork, and collaborative platforms. Research suggests that technology-enhanced learning can make abstract and complex environmental concepts more concrete and engaging, thereby improving learners' understanding and attitudes towards environmental issues (Buchanan et al., 2019; Fauville et al., 2013; Lay, 2019). Digital tools such as videos, geographic information systems, online datasets, educational games, and virtual laboratories are particularly well-suited to Environmental Education, which often relies on real-world contexts and experiential learning.

Despite the potential of ICT to enrich Environmental Education, its successful integration largely depends on teachers. Teachers act as key agents in curriculum enactment, mediating between policy intentions, technological tools, and classroom practices. Studies consistently highlight that teachers' beliefs, attitudes, and perceptions strongly influence their willingness and ability to integrate ICT meaningfully into instruction (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2007). Positive perceptions often lead to innovative pedagogical practices, while negative or apprehensive attitudes can limit ICT use to superficial or administrative purposes (Abel et al., 2022).

In the Indian context, educational policies strongly advocate both environmental education and ICT integration. The National Education Policy 2020 underscores the use of technology for improving learning outcomes and explicitly promotes education for sustainable development (Ministry of Education, 2020). Curriculum frameworks such as NCF 2005, NCF–Foundational Stage 2022, and NCF–School Education 2023 emphasize experiential, interdisciplinary, and technology-enabled learning, with environmental awareness as a core curricular concern (NCERT, 2005, 2022, 2023). However, the actual classroom implementation of these policy visions depends significantly on teachers' perceptions, preparedness, and contextual realities.

Against this backdrop, understanding teachers' perceptions of ICT use in Environmental Education becomes crucial. Exploring these perceptions can provide insights into the opportunities, challenges, and support mechanisms required for effective technology integration in EE. The present study seeks to examine teachers' perceptions regarding the use of ICT in Environmental Education, thereby contributing to the growing discourse on sustainable, technology-enhanced teaching–learning practices.

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Review of Related Literature

Research on ICT integration in education highlights teachers' perceptions as a decisive factor influencing classroom practices. Ertmer and Ottenbreit-Leftwich (2010) emphasize that teachers' knowledge, beliefs, and school culture collectively shape technology adoption. Similarly, Tondeur et al. (2007) report a persistent gap between curriculum goals advocating ICT use and actual classroom practices, often attributable to teachers' attitudes and perceived constraints.

Several studies have examined teachers' perceptions of ICT integration in general teaching–learning contexts. Abel et al. (2022) found that teachers with positive perceptions of ICT were more likely to use technology to support student-centered and innovative instructional strategies. A systematic review by Akram et al. (2022) revealed that while teachers generally acknowledge the pedagogical value of ICT, challenges such as lack of training, time constraints, and insufficient infrastructure negatively influence their perceptions. Studies conducted in the Indian context also report moderately positive attitudes among teachers, with variations based on access, experience, and institutional support (Chauhan & Sharma, 2023; Das et al., 2023).

With specific reference to Environmental Education, research indicates that ICT has the potential to enhance environmental knowledge, attitudes, and engagement. Fauville et al. (2013) discuss the role of emerging ICT tools in enabling inquiry-based and participatory environmental learning. Buchanan et al. (2019) demonstrate that digital technologies can effectively promote environmental understanding among primary school students. Baierl et al. (2022) further report significant improvements in learners' environmental attitudes and knowledge through technology-supported informal environmental education.

Empirical studies across different contexts highlight both opportunities and challenges in integrating ICT in EE. Hus (2011) and Jardin (2023) observed that ICT use in environmental studies promotes experiential learning and student motivation. Emma et al. (2023) and Kiwonde (2020) found that ICT can support environmental learning even in rural and resource-constrained settings, though infrastructural limitations remain a concern. Conversely, Shadreck (2015) and Dike (2018) identified challenges such as limited access to digital resources, inadequate teacher training, and poor technical support as barriers to effective ICT integration in environmental classrooms.

The literature also points to broader systemic issues such as the digital divide, which affects equitable access to ICT and shapes teachers' perceptions and practices (van Dijk, 2006). Moreover, Kirkwood and Price (2014) caution that technology integration does not

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automatically enhance learning unless it is pedagogically aligned with curricular goals. Recent studies, including Krouska et al. (2025), highlight innovative approaches such as digital games and escape rooms for environmental education, reinforcing the need for teacher readiness and acceptance.

The review of literature reveals that while ICT holds considerable promise for enhancing Environmental Education, teachers' perceptions remain a critical determinant of its effective integration. However, focused empirical studies examining teachers' perceptions of ICT specifically in Environmental Education—particularly within school contexts—are relatively limited, indicating a clear research gap.

Need of the Study

The integration of ICT in Environmental Education is strongly emphasized in contemporary educational policies; however, its effective classroom implementation largely depends on teachers' perceptions. Understanding teachers' perceptions of ICT use in Environmental Education is essential to assess the extent to which technology supports environmental teaching–learning processes. Moreover, teachers are a heterogeneous group, and their perceptions may vary across demographic variables such as gender, academic qualification, and professional qualification. Examining these differences is necessary to identify specific gaps, challenges, and strengths among teacher subgroups. The findings of this study can inform targeted professional development, equitable policy implementation, and context-sensitive strategies for strengthening ICT-enabled Environmental Education.

Objectives

1. To assess the level of teachers' perception toward the use of ICT in Environmental Education.
2. To compare teachers' perceptions of ICT use in Environmental Education in relation to demographic variables such as Gender (Female and Male), Academic qualification (UG and PG), and Professional qualification (D.El.Ed. and B.Ed.).

Hypotheses

H_{o1}: There is no significant difference in teachers' perception of the use of ICT in Environmental Education with respect to gender (Female and Male).

H_{o2}: There is no significant difference in teachers' perception of the use of ICT in Environmental Education with respect to academic qualification (UG and PG).

H_{o3}: There is no significant difference in teachers' perception of the use of ICT in Environmental Education with respect to professional qualification (B.Ed. and D.El.Ed.).

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Methodology

The present study adopted a descriptive research design to examine teachers' perceptions of the use of Information and Communication Technology (ICT) in teaching Environmental Education (EE) at the preparatory stage. The population comprised primary school teachers, from which a sample of 112 teachers (male and female) from government and private schools of the Delhi region was selected. Data were collected using a self-developed questionnaire based on an extensive review of related literature. The tool consisted of five dimensions related to ICT use in Environmental Education and employed a five-point Likert scale. After expert validation and pilot testing on 42 teachers, 33 items were finalized, and the scale showed high reliability (Cronbach's alpha = 0.911). Data were collected online using Google Forms. Descriptive statistics (mean, standard deviation, percentage) and inferential statistics (independent samples *t*-test) were used for data analysis.

Results

Table 1: Descriptive of the Teachers' Perception

N	Mean	SD	Min	Max
112	110.54	14.396	79	140

Table 1 presents the descriptive statistics for the teachers' overall perception scores regarding the use of Information and Communication Technology (ICT) in Environmental Education (EE). The results show that the overall perception score (M = 110.54, SD = 14.40) out of a possible range of 79 to 140 indicates a favorable attitude among teachers toward the integration of ICT in EE. The minimum observed score was 79, and the maximum was 140, suggesting considerable variability among respondents, but with a general inclination toward the positive end of the scale.

These descriptive statistics demonstrate that most teachers hold positive and moderately consistent perceptions of the role, significance, and effectiveness of ICT in teaching Environmental Education. The small variability and near-normal distribution further imply that favorable perceptions toward ICT use are widely shared among the teaching population surveyed.

Table 2: Level of Perception of Teachers

Level	Range	Frequency	Percentage
Least Favorable	79 to 81	5	4.46
Less Favorable	82 to 95	13	11.61
Moderately Favorable	96 to 124	77	68.75

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More Favorable	125 to 138	14	12.50
Most Favorable	139 to 140	3	2.68

Table 2 presents the categorical distribution of teachers based on their overall perception levels toward the use of Information and Communication Technology (ICT) in Environmental Education (EE). The data reveal that a majority of teachers fall within the "Moderately Favorable" category (n = 77, 68.75%), indicating that most teachers hold a positive but balanced view regarding ICT integration in EE.

A smaller proportion of teachers demonstrated "More Favorable" perceptions (n = 14, 12.50%) and "Most Favorable" perceptions (n = 3, 2.68%), suggesting that while enthusiasm for ICT use is evident among some teachers, only a limited number exhibit very strong positive attitudes. Conversely, a minority of participants were found to have "Less Favorable" (n = 13, 11.61%) and "Least Favorable" (n = 5, 4.46%) perceptions, implying that unfavorable attitudes toward ICT use are relatively uncommon.

Taken together, the results indicate that the overall teacher population exhibits a predominantly favorable perception toward the use of ICT in Environmental Education, with very few expressing resistance or negativity. This pattern aligns with the descriptive findings (Table 1), reinforcing that most teachers recognize the pedagogical value and potential of ICT in fostering meaningful environmental learning experiences for students.

Table 3: Comparison of Teachers' Perception in relation to Gender

Gender	N	Mean	SD	t	df	Sig.
Female	67	113.60	14.256	2.823	110	0.006
Male	45	106.00	13.514			

Table 3 presents the comparison of teachers' overall perception scores toward the use of Information and Communication Technology (ICT) in Environmental Education (EE) based on gender. The results revealed a statistically significant difference between male and female teachers, $t(110) = 2.82$, $p = 0.006$. The computed p value is less than convenient p value (=0.05). Therefore, the null hypothesis is rejected. Further, female teachers (M = 113.60, SD = 14.26) reported more favorable perceptions toward the use of ICT in Environmental Education compared to their male counterparts (M = 106.00, SD = 13.51).

This finding suggests that female teachers tend to exhibit greater enthusiasm and positive attitudes toward integrating ICT tools in environmental teaching–learning processes. The observed difference may be attributed to variations in teaching approaches, adaptability to digital pedagogy, or differing levels of engagement with ICT-based classroom innovations. The results indicate that gender plays a significant role in shaping teachers' perceptions of

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ICT use in Environmental Education, with female teachers demonstrating a comparatively higher level of acceptance and positivity toward ICT integration.

Table 4: Comparison of Teachers' Perception in relation to Academic Qualification

Academic Qualification	N	Mean	SD	t	df	Sig.
PG	59	112.71	13.552	1.695	110	0.093
UG	53	108.13	15.042			

Table 4 presents the comparison of teachers' overall perception scores toward the use of Information and Communication Technology (ICT) in Environmental Education (EE) based on their academic qualification. The results showed no statistically significant difference in perception scores between PG (M = 112.71, SD = 13.55) and UG (M = 108.13, SD = 15.04) teachers, t(110) = 1.70, p = 0.093. Here, the computed p value is greater than the convenient p value (=0.05), therefore, researcher failed to reject the null hypotheses in relation to teachers' Professional qualification. Although the mean score of PG teachers was slightly higher, suggesting a more favorable inclination toward ICT use in Environmental Education, the difference was not significant at the 0.05 level.

This indicates that teachers' perceptions of ICT use are broadly similar across educational qualifications, implying that positive attitudes toward ICT integration are not necessarily dependent on higher academic attainment. Both UG- and PG-qualified teachers appear to recognize the pedagogical relevance and potential of ICT in fostering environmental awareness and learning among students. While postgraduate teachers show a marginally stronger preference for ICT, the results suggest a generally uniform acceptance of ICT's role in Environmental Education across qualification levels.

Table 5: Comparison of Teachers' Perception in relation to Professional Qualification

Professional Qualification	N	Mean	SD	t	df	Sig.
B.Ed.	58	110.91	11.776	0.28	110	0.78
D.El.Ed.	54	110.15	16.870			

Table 5 presents the comparison of teachers' perception scores toward the use of Information and Communication Technology (ICT) in Environmental Education (EE) based on their professional qualification. The analysis revealed no statistically significant difference between the two groups, t(110) = 0.28, p = 0.78. This indicates that the computed p value is greater than the convenient p value (=0.05), therefore, researcher failed to reject the null hypotheses in relation to teachers' Professional qualification. Teachers with B.Ed. qualifications (M = 110.91, SD = 11.78) and those with D.El.Ed. qualifications (M = 110.15,

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SD = 16.87) reported nearly identical mean scores, indicating a similar level of positive perception toward the use of ICT in Environmental Education.

This suggests that teachers, irrespective of their professional training level, share a common understanding and appreciation of ICT's pedagogical value in enhancing environmental awareness and classroom learning. The absence of significant difference further implies that both B.Ed. and D.El.Ed. training programs may be equally effective in fostering awareness and readiness for ICT-based teaching. The results indicate that professional qualification does not significantly influence teachers' perceptions of ICT use in Environmental Education, reflecting a consistent and broadly favorable attitude across both professional groups.

Discussion

The findings of the present study reveal that teachers at the preparatory stage hold an overall favorable perception toward the use of ICT in Environmental Education. This result aligns with earlier studies reporting positive teacher attitudes toward ICT integration in classroom instruction (Abel et al., 2022; Akram et al., 2022; Chauhan & Sharma, 2023). Similar to the present findings, Das et al. (2023) observed that teachers generally recognize the pedagogical value of ICT, particularly in enhancing engagement and conceptual understanding.

The predominance of moderately favorable perceptions supports research suggesting that while teachers appreciate ICT's potential, its use is often tempered by practical constraints such as time, infrastructure, and training (Ghavifekr et al., 2016; Kiwonde, 2020). The favorable perceptions reported in this study are also consistent with studies emphasizing ICT's effectiveness in promoting environmental knowledge, attitudes, and experiential learning (Buchanan et al., 2019; Fauville et al., 2013; Baierl et al., 2022).

The significant gender difference observed, with female teachers showing more favorable perceptions, resonates with findings that demographic factors can influence teachers' technology-related beliefs and practices (Abel et al., 2022). However, the absence of significant differences based on academic and professional qualifications supports earlier evidence that positive ICT perceptions are not solely dependent on formal qualifications but are shaped by beliefs, experience, and contextual support (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2007).

The findings reinforce existing literature that teachers' perceptions play a critical role in the effective integration of ICT in Environmental Education and highlight the need for sustained professional support to translate positive perceptions into consistent classroom practice.

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Conclusion

The present study concludes that teachers at the preparatory stage generally hold favorable perceptions toward the use of ICT in Environmental Education, recognizing its potential to enhance engagement, understanding, and experiential learning. The significant gender-based difference indicates that female teachers exhibit relatively stronger positive attitudes toward ICT integration, while academic and professional qualifications do not significantly influence perceptions. These findings suggest that positive perceptions of ICT are widely shared among teachers, irrespective of formal qualifications. To translate these favorable perceptions into effective classroom practices, sustained professional development, adequate infrastructural support, and pedagogically aligned ICT resources are essential. Strengthening these aspects can contribute meaningfully to the effective integration of ICT in Environmental Education and support broader sustainability-oriented educational goals.

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