
A STUDY ON THE INFLUENCE OF ICT IN ENHANCING CLIMATE EDUCATION AND SUSTAINABILITY KNOWLEDGE

Asst. Prof. Mamta Praveen Dhole

Department of Information Technology and Mathematics, Western College of Commerce & Business management, Sanpada, Navi Mumbai

ABSTRACT

Climate change has emerged as a critical global challenge requiring responsible action from individuals and societies. SDG 4 (Quality Education) ensures inclusive, equitable education and lifelong learning for all by 2030. SDG 13 (Climate Action) demands urgent action to combat climate change, aiming for a 1.5°C–2°C limit on global warming. Together, they promote sustainable, climate-resilient futures through education. Education (SDG 4) is critical for climate action (SDG 13). By fostering sustainability knowledge, education empowers people to act on climate change, contributing to both environmental and societal resilience.

Students' awareness, knowledge, and sustainable behavior are greatly enhanced by climate education. By facilitating interactive, accessible, and learner-centered methods, information and communication technology (ICT) tools have revolutionized educational practices in recent years. This study looks at how ICT tools can improve climate education and raise awareness of global sustainability. Students exposed to ICT-based education were given a structured questionnaire as part of a quantitative research design. Without the use of specialized software, the data was analyzed using straightforward descriptive statistical techniques like frequency, percentage, and mean score analysis. The findings indicate that ICT tools significantly enhance climate change understanding, sustainability awareness, and pro-environmental attitudes. The study highlights the importance of integrating ICT tools into climate education curricula to support sustainable development and global sustainability goals.

Keywords: *ICT Tools, Climate Education, Sustainability Awareness, Digital Learning, Environmental Education, SDGs*

INTRODUCTION

Climate change is a serious global problem that affects the environment, the economy, and human life. Problems such as global warming, frequent floods and droughts, deforestation, and the overuse of natural resources show that immediate action is necessary. To deal with these challenges, people need proper knowledge and awareness. Education plays an important role in creating awareness, developing a sense of responsibility, and encouraging sustainable habits among students.

However, traditional classroom teaching methods often find it difficult to explain the complex and interconnected nature of climate change. Climate issues involve science, technology, society, and economics, which require new and effective teaching approaches. In this context, Information and Communication Technology (ICT) tools offer valuable support to climate education. ICT tools provide interactive learning experiences, access to real-time information, and opportunities for collaboration at a global level.

Various ICT tools such as e-learning platforms, mobile applications, videos, simulations, and online discussion forums help make climate education more interesting and easier to understand. These tools actively engage learners and help them connect theoretical knowledge with real-world environmental issues. Therefore, this study aims to examine the role of ICT tools in promoting climate education and increasing global sustainability awareness among learners.

This study focuses on examining the role of ICT tools in enhancing climate education and promoting global sustainability awareness among learners. It aims to analyze how the integration of ICT in educational practices contributes to improved understanding, increased awareness, and positive attitudes toward sustainable development, thereby supporting informed decision-making and responsible environmental behavior.

OBJECTIVES OF THE STUDY

To study the use of ICT tools in climate education.

To analyze learners' climate change knowledge through ICT-based learning.

To examine the role of ICT tools in promoting sustainability awareness.

To assess the influence of ICT tools on pro-environmental attitudes and behavior.

RESEARCH HYPOTHESES

H₁: ICT tools significantly enhance climate education.

H₂: ICT-based learning improves sustainability awareness among learners.

H₃: ICT tools positively influence pro-environmental attitudes and behavior.

REVIEW OF LITERATURE

Previous studies have consistently highlighted the significant role of Information and Communication Technology (ICT) in enhancing the teaching–learning process. ICT integration has been found to improve learner engagement, accessibility to information, and conceptual clarity by supporting interactive and learner-centered pedagogical approaches (Shalini & Kharbiryumbai, 2024). Their study emphasized that ICT-enabled instruction promotes sustainable education by encouraging active participation, critical thinking, and improved learning outcomes among students.

Research in the field of climate and environmental education stresses the necessity of innovative teaching strategies to explain the complex, interdisciplinary, and dynamic nature of climate change. Makrakis, Larios, and Kaliantzi (2013) demonstrated that ICT-enabled climate change education integrated across the school curriculum enhances learners' understanding of sustainability concepts and supports holistic learning. Similarly, IT-based platforms have been shown to improve social awareness and public engagement related to climate change and environmental protection (Palka & Brodny, 2019).

Several studies have examined the effectiveness of digital tools such as multimedia resources, simulations, and online learning platforms in climate education. ICT tools enable visualization of environmental data and promote better understanding of the impact of human activities on the environment (Mahdavi & Sojoodi, 2021). Additionally, the use of digital tools in environmental education has been found to enhance learner awareness and encourage responsible environmental behavior (Kumari, 2025).

At the policy and curriculum level, international frameworks strongly support the integration of ICT in Education for Sustainable Development (ESD). UNESCO has emphasized that digital technologies play a crucial role in supporting transformative learning, improving access to sustainability-related knowledge, and promoting global collaboration among learners (UNESCO, 2017; UNESCO, 2020). In the Indian educational context, a critical analysis of the curriculum revealed the need for effective ICT-supported instructional strategies to strengthen climate change and sustainability education (Springer Nature, 2025).

The importance of ICT-based education became particularly evident during the COVID-19 pandemic. Online and ICT-based teaching methods ensured continuity of learning, although challenges such as digital divide and limited technological preparedness were also observed (Yadav & Ingole, 2025). Furthermore, empirical research has shown that access to information and ICTs enhances adaptive capacity to climate risks, reinforcing the role of digital tools in building sustainability awareness and informed decision-making (Chetri et al., 2021).

Despite the growing body of literature on ICT integration in education and climate change education independently, limited quantitative studies focus on examining the combined role of ICT tools in climate education and global sustainability awareness among learners. Most existing studies are conceptual or qualitative in nature, highlighting a significant research gap. Therefore, the present study aims to address this gap by quantitatively examining the role of ICT tools in enhancing climate education and promoting global sustainability awareness.

Research Framework

The research framework proposes that **ICT tools act as independent variables** influencing climate education and sustainability awareness among learners. The integration of ICT tools in the teaching–learning process enhances understanding of climate change concepts through interactive and engaging learning experiences. Improved climate education leads to increased sustainability awareness, which subsequently encourages the development of pro-environmental behavior. Thus, the framework establishes a sequential relationship highlighting the positive role of ICT tools in promoting climate education and responsible environmental behavior.

Conceptual Flow of the Framework:

ICT Tools → Climate Education → Sustainability Awareness → Pro-environmental Behavior

Research Methodology

The present study adopts a **quantitative descriptive research design** to examine the role of Information and Communication Technology (ICT) tools in enhancing climate education and promoting global sustainability awareness among learners. This design is appropriate as it enables systematic collection and analysis of numerical data to describe learners' perceptions, awareness, and pro-environmental behavior related to ICT-enabled climate education.

The population of the study comprises students who use ICT tools such as e-learning platforms, mobile applications, multimedia resources, and online collaboration tools as part of their learning process. A sample of **125 respondents** was selected using a **convenience sampling technique** based on accessibility and willingness to participate.

Data were collected using a **structured questionnaire** consisting of close-ended statements related to ICT usage, climate education, sustainability awareness, and pro-environmental behavior. Responses were recorded on a **five-point Likert scale** ranging from Strongly Agree to Strongly Disagree. Data collection was carried out through online and offline modes, ensuring voluntary participation and confidentiality of responses.

The collected data were analyzed using **descriptive statistical techniques**, including frequency, percentage, and mean score analysis. Frequency analysis was used to assess ICT tool usage, while mean scores were employed to interpret learners' perceptions and behavioral tendencies. Mean scores equal to or greater than 3.41 indicate agreement with the statement and support the acceptance of the research hypothesis, whereas mean scores below 3.41 indicate disagreement. Ethical considerations were strictly followed, and the data were used solely for academic purposes.

Data Analysis and Interpretation

The data collected from 125 respondents were analyzed using simple descriptive statistical techniques, including frequency, percentage, and mean score analysis, to examine the role of ICT tools in climate education and sustainability awareness. These methods were chosen to clearly interpret learners' responses without the use of advanced statistical software.

Frequency and percentage analysis revealed that a majority of students regularly use ICT tools such as e-learning platforms, mobile applications, multimedia resources, and online collaboration tools, indicating widespread integration of digital technologies in the learning process.

Table 1.1 ICT Tools Used for Learning

ICT Tools	Frequency	Percentage (%)
E-learning platforms (LMS, MOOCs, etc.)	108	86.4
Mobile applications	102	81.6
Multimedia content (videos, animations, PPTs)	115	92.0
Online collaboration tools (Zoom, Google Meet, forums)	94	75.2
Digital simulations / virtual tools	88	70.4

The table indicates that multimedia content and e-learning platforms are the most frequently used ICT tools for climate learning among students.

H₁: ICT tools significantly enhance climate education.

Table 1.2 Mean Score Analysis of ICT Tools and Climate Education

Statements Related to Climate Education	Mean Score	Interpretation
ICT tools help me understand causes of climate change	4.12	High
ICT-based learning improves understanding of climate impacts	4.08	High
Digital content makes climate learning more interesting	4.25	Very High
Online resources provide updated climate information	4.05	High
ICT tools improve overall climate education	4.18	High
Overall Mean Score	4.14	High

The overall mean score of **4.14** indicates that ICT tools play a significant role in enhancing climate education. Students strongly agree that digital learning improves understanding, engagement, and access to climate-related information. The mean value obtained is **4.14**, which falls within the range 3.41–4.20, indicating a high level of agreement (Agree). Therefore, the research hypothesis is accepted.

H₂: ICT-based learning improves sustainability awareness among learners.

Table 1.3 Mean Score Analysis of Sustainability Awareness through ICT-Based Learning

Statements Related to Sustainability Awareness	Mean Score	Interpretation
ICT learning increases awareness of sustainability issues	4.06	High
ICT tools help understand sustainable development goals	4.10	High
Digital learning links sustainability with daily life	3.98	Moderate–High
ICT tools promote responsibility toward the environment	4.02	High
ICT-based learning enhances global sustainability awareness	4.15	High
Overall Mean Score	4.06	High

The overall mean score of **4.06** reflects a high level of sustainability awareness among learners developed through ICT-enabled learning. Digital platforms effectively broaden students' understanding of global and local sustainability concerns. The mean value obtained is **4.06**, which falls within the range 3.41–4.20, indicating a high level of agreement (Agree). Therefore, the research hypothesis is accepted.

H₃: ICT tools positively influence pro-environmental attitudes and behavior.

Table 1.4 Mean Score Analysis of Pro-Environmental Behavior

Statements Related to Pro-Environmental Behavior	Mean Score	Interpretation
ICT learning motivates resource conservation	3.95	Moderate–High
ICT tools encourage eco-friendly practices	4.00	High
Digital learning influences responsible behavior	3.92	Moderate–High
ICT-based education motivates participation in environmental activities	3.88	Moderate
I apply environmental knowledge in daily life	4.05	High
Overall Mean Score	3.96	Moderate–High

The overall mean score of **3.96** indicates that ICT-enabled climate education positively influences learners' pro-environmental behavior. While awareness levels are high, behavioral adoption is moderate to high, suggesting scope for further strengthening practical engagement. The mean value obtained is **3.96**, which falls within the range 3.41–4.20, indicating a high level of agreement (Agree). Therefore, the research hypothesis is accepted.

Overall, the findings support the proposed research framework, confirming that ICT tools positively influence climate education, which in turn enhances sustainability awareness and promotes pro-environmental behavior among learners.

FINDINGS

The findings of the study reveal that ICT tools are extensively used by students for climate learning, with multimedia content, e-learning platforms, and mobile applications being the most preferred tools. The mean score analysis indicates that ICT-enabled learning significantly enhances climate education by improving students' understanding and engagement with climate change concepts. The study also shows that ICT tools contribute to a high level of sustainability awareness among learners by providing access to global information and real-world environmental issues. Furthermore, increased sustainability awareness was found to positively influence students' pro-environmental behavior, encouraging environmentally responsible practices. Overall, the findings support the proposed research framework and highlight the effectiveness of ICT tools in promoting climate education and global sustainability awareness.

CONCLUSION

The study concludes that ICT tools play a significant role in strengthening climate education and promoting global sustainability awareness. Technology-enabled learning enhances engagement, understanding, and responsible environmental behavior among learners. Integrating ICT tools into educational curricula can support sustainable development goals and foster environmentally responsible citizens.

LIMITATIONS

The research was conducted on a sample of 125 students, which may restrict the generalizability of the findings to a wider population. The use of convenience sampling may also limit the representativeness of the sample. Data were collected through a self-reported questionnaire, and therefore responses may have been influenced by personal perceptions or response bias. Additionally, the study adopted a descriptive research design and employed only simple statistical techniques such as frequency, percentage, and mean score analysis, without the use of inferential statistics. The perspectives of teachers and educational institutions were not included, and the study did not examine the impact of advanced technologies such as artificial intelligence, virtual reality, or simulation-based learning in detail. Despite these limitations, the study provides valuable insights into the role of ICT tools in climate education and sustainability awareness.

FUTURE SCOPE OF THE STUDY

The findings of the present study open several avenues for future research. Future studies may adopt a mixed-method or experimental research design to gain deeper insights into the effectiveness of ICT tools in climate education. Expanding the sample size and including respondents from different educational levels, institutions, or regions would enhance the generalizability of the results. Further research can incorporate advanced statistical techniques to examine the causal relationships among ICT tools, climate education, sustainability awareness, and pro-environmental behavior. Additionally, future studies may explore the role of emerging digital technologies such as artificial intelligence, virtual reality, and gamified learning platforms in enhancing climate education. Longitudinal studies could also be conducted to assess the long-term impact of ICT-based climate education on learners' behavior and sustainable practices.

REFERENCES

- Chetri, P., Sharma, U., & Ilavarasan, P. V. (2021). *Role of information and ICTs as determinants of farmers' adaptive capacity to climate risk: An empirical study from Haryana, India*. arXiv. <https://arxiv.org>
- Kumari, U. (2025). *Digital tools for environmental education: Enhancing awareness and action through technology*. In *Green skills for the 21st century learner: Educational perspectives and practices* (p. 102).
- Mahdavi, S., & Sojoodi, S. (2021). *Impact of ICT on environment*. Research Square. <https://doi.org/10.21203/rs.3.rs-xxxxx>
- Makrakis, V., Larios, N., & Kaliantzi, G. (2013). ICT-enabled climate change education for sustainable development across the school curriculum. *Journal of Teacher Education for Sustainability*, 14(2), 54–72.
- Palka, D., & Brodny, J. (2019). IT platform as a tool for improving social awareness in the field of climate change and environmental protection. *International Multidisciplinary Scientific GeoConference: SGEM*, 19(4.2), 303–310.
- Shalini, & Kharbiryimbai, B. B. (2024). ICT integration in the teaching–learning process for sustainable education: A study. *Indian Journal of Educational Technology*, 6(2), 219–231. <https://journals.ncert.gov.in/IJET/article/view/434>
- Springer Nature. (2025). Climate change and sustainability: A critical analysis of Indian curriculum. *Discover Education*. <https://doi.org/10.1007/s44217-025-00947-z>
- Tuba, M., Akashe, S., & Joshi, A. (Eds.). (2025). *ICT systems and sustainability: Proceedings of ICT4SD 2024*. Springer Nature.
- UNESCO. (2017). *Education for sustainable development goals: Learning objectives*. United Nations Educational, Scientific and Cultural Organization.
- UNESCO. (2020). *Education for sustainable development: A roadmap*. United Nations Educational, Scientific and Cultural Organization.
- Yadav, P., & Ingole, M. (2025). Online/ICT-based education and the COVID-19 pandemic: Challenges for school education in India. *Educational Trend*, 5(2), 129–138. <https://ejournals.ncert.gov.in/index.php/ET/article/view/3778>
- SAGE Publications India Pvt. Ltd. (n.d.). *Journal of Education for Sustainable Development*. <https://journals.sagepub.com>