

Digital Information and Communication Technology (ICT) Integration in Maritime Literacy and Coastal Protection for Sustainable Coastal Tourism

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Abstract: Digital Information and Communication Technology (ICT) has emerged as a valuable tool for strengthening environmental awareness and supporting sustainable tourism initiatives. This study explored how digital ICT integration enhances maritime literacy and coastal protection in promoting sustainable coastal tourism. A qualitative interpretive descriptive research design was employed involving purposively selected 15 coastal tourists with experience using digital ICT platforms related to coastal tourism and environmental information. Data were collected through semi-structured interviews and analyzed using reflexive thematic analysis. Six themes emerged: Awareness, Engagement, Learning, Participation, Innovation, and Collaboration. The findings revealed that digital ICT enhanced environmental awareness, expanded learning opportunities, encouraged participation in coastal protection initiatives, and promoted collaborative efforts toward sustainable tourism. Participants also emphasized the importance of innovative digital platforms and multi-stakeholder partnerships in strengthening maritime literacy and environmental stewardship. The study highlights the significant role of digital ICT integration in fostering informed, environmentally responsible, and sustainable coastal tourism practices.

Keywords: digital ICT integration, maritime literacy, coastal protection, sustainable coastal tourism, environmental awareness, qualitative research

1. INTRODUCTION

Digital Information and Communication Technology (ICT) has become an important driver of sustainable tourism by transforming how environmental information is accessed, shared, and utilized across tourism destinations. The integration of digital technologies, including mobile applications, online information platforms, geographic information systems, social media, virtual learning resources, and digital communication tools, has strengthened public awareness of environmental sustainability while improving engagement in conservation initiatives. In coastal tourism, digital ICT facilitates the dissemination of information on marine ecosystems, responsible tourism practices, and environmental protection measures, enabling tourists to make informed decisions that support sustainable coastal development. As tourism destinations increasingly adopt digital innovations, ICT has emerged as an essential tool for promoting environmental awareness and encouraging responsible tourism behavior (Buhalis, D., & Amaranggana, A. 2015).

Maritime literacy and coastal protection are fundamental components of sustainable coastal tourism. Maritime literacy extends beyond understanding marine ecosystems by fostering environmental values, responsible behaviors, and active participation in ocean stewardship (Wang et al., 2025; McKinley et al., 2022). Likewise, coastal protection encompasses conservation initiatives, sustainable resource management, and community participation that preserve coastal ecosystems while supporting tourism development (Drius et al., 2019; Franzen et al., 2024). Together, these concepts contribute to maintaining ecological integrity and ensuring that coastal tourism remains environmentally sustainable for future generations.



Recent developments in digital technology have expanded opportunities to strengthen maritime literacy and coastal protection through ICT-enabled communication and environmental education. Digital platforms allow tourism stakeholders to disseminate conservation campaigns, provide real-time environmental information, promote sustainable tourism practices, and encourage public participation in coastal conservation activities. Studies have shown that environmental education, stakeholder engagement, and digital communication contribute to greater environmental awareness and stronger support for marine conservation initiatives (Ardoin et al., 2020; Shang et al., 2025; Tezcan & Yilmaz, 2023). Furthermore, tourists who possess greater environmental knowledge are more likely to engage in responsible tourism practices and support conservation-oriented destinations (Chiu et al., 2014; Lee & Jan, 2019). These findings suggest that digital ICT can serve as an important medium for strengthening environmental learning and promoting sustainable tourism behaviors.

In the Philippines, coastal tourism plays a vital role in economic development, with numerous destinations depending on healthy marine ecosystems to sustain tourism activities and local livelihoods. However, challenges such as marine pollution, biodiversity loss, climate change, and unsustainable tourism practices continue to threaten the long-term sustainability of coastal destinations (Necesar, 2024; Busalla, 2025). Although previous studies have examined maritime literacy, coastal protection, environmental awareness, and tourism trust, limited qualitative research has explored how digital ICT integration enhances these efforts in promoting sustainable coastal tourism. Existing studies have primarily focused on environmental stewardship and conservation practices while giving less attention to the role of digital technologies in strengthening environmental education, stakeholder engagement, and sustainable tourism management.

Addressing this gap, the present study explores how digital ICT integration enhances maritime literacy and coastal protection in promoting sustainable coastal tourism. Understanding stakeholders' perspectives on the use of digital technologies may provide valuable insights into how ICT supports environmental awareness, encourages conservation participation, and strengthens sustainable tourism initiatives. The findings are expected to contribute to the development of technology-driven environmental education strategies, digital coastal management initiatives, and sustainable tourism policies that balance tourism development with marine ecosystem conservation.

2. METHODS

Research Design

This study employed a qualitative interpretive descriptive research design to explore how digital Information and Communication Technology (ICT) integration enhances maritime literacy and coastal protection in promoting sustainable coastal tourism. Interpretive description is appropriate for generating practice-oriented knowledge by examining participants' perspectives and interpretations of real-world phenomena (Thorne, 2016). This design enabled the researcher to obtain comprehensive insights into how digital ICT supports environmental awareness, coastal conservation, and sustainable tourism practices within coastal destinations.

Participants and Sampling

The study involved 15 coastal tourists who had visited selected coastal tourism destinations in the Philippines and had experience using digital ICT platforms related to tourism or environmental information. Participants were selected through criterion-based purposive sampling, which identifies information-rich individuals who possess firsthand knowledge of the phenomenon under investigation (Palinkas et al., 2015). To qualify for participation, individuals had to (1) be at least 18 years old, (2) have visited a coastal tourism destination within the previous twelve months, (3) have utilized digital ICT tools such as mobile tourism applications, social media platforms, online environmental information resources, digital maps, QR code systems, or destination websites during their visit, and (4) voluntarily agree to participate in the study.

Instrument

Data were collected using a researcher-developed semi-structured interview guide consisting of open-ended questions aligned with the research objective. The interview guide was subjected to expert validation by specialists in tourism management, environmental education, and qualitative research to establish content validity. A pilot interview was likewise conducted with individuals who met the inclusion criteria but were not included in the actual study to improve the clarity, sequence, and relevance of the interview questions.

Table 1. Interview Guide Questions

Research Objective	Interview Question
To explore how digital ICT integration enhances maritime literacy and coastal protection in promoting sustainable coastal tourism.	

Data Gathering Procedure

Prior to data collection, permission to conduct the study was secured from the appropriate authorities whenever necessary. Participants were informed about the purpose of the study, and informed consent was obtained before the interviews commenced. Individual interviews were conducted either face-to-face or through online communication platforms, depending on participants' availability and preference. Each interview lasted approximately 30 to 45 minutes and was audio-recorded with participants' permission. Field notes were also maintained to document contextual observations that supported data interpretation.

Data Analysis

The interview transcripts were analyzed using reflexive thematic analysis following the framework proposed by Braun and Clarke (2021). The analysis involved familiarization with the interview data, systematic coding of meaningful responses, identification of recurring patterns, development and refinement of themes, and interpretation of the findings in relation to the research objective. Representative participant quotations were incorporated to substantiate the identified themes and enhance the credibility of the findings.

Ethical Considerations

The study adhered to established ethical principles for research involving human participants. Participation was entirely voluntary, and informed consent was obtained from all participants prior to data collection. Participants were assured that their identities would remain confidential through the use of pseudonyms, while all interview recordings, transcripts, and related research materials were securely stored and used solely for academic and research purposes.

3. RESULTS

Research Objective

To explore how digital ICT integration enhances maritime literacy and coastal protection in promoting sustainable coastal tourism.

Interview Question 1. What are your perspectives on the integration of digital Information and Communication Technology (ICT) in promoting maritime literacy and coastal protection?

Theme 1. Awareness

Ten participants perceived digital ICT integration as an effective platform for increasing awareness of marine ecosystems, coastal conservation, and responsible tourism practices. They explained that digital media, educational websites, and social networking platforms provided accessible information that enhanced their understanding of environmental issues affecting coastal destinations.

"Through social media and online campaigns, I learned more about protecting coral reefs and marine life before visiting coastal destinations." (Participant 4)

"Digital platforms make environmental information easier to understand and reach more people." (Participant 11)

The findings indicate that digital ICT serves as an important educational medium that strengthens public awareness of maritime literacy and coastal protection.

Theme 2. Engagement

Five participants emphasized that digital ICT encouraged greater participation in coastal conservation by connecting individuals with environmental campaigns, volunteer activities, and sustainability programs. They noted

that online platforms facilitated communication between tourism stakeholders and the public, encouraging collective involvement in environmental initiatives.

7) *"I discovered coastal clean-up activities through Facebook and immediately joined the program."* (Participant 7)

13) *"Digital campaigns encourage more people to participate because information spreads quickly."* (Participant 13)

These responses suggest that digital ICT promotes active engagement in environmental stewardship through accessible communication platforms.

Interview Question 2. In what ways has digital ICT integration supported your awareness and participation in maritime literacy and coastal protection initiatives?

Theme 1. Learning

Seven participants shared that digital ICT expanded their learning opportunities by providing educational videos, virtual seminars, online articles, and interactive environmental resources related to marine conservation. These digital learning materials helped them better understand sustainable tourism practices and the importance of protecting coastal ecosystems.

"Watching online documentaries helped me understand why marine conservation is important." (Participant 2)

"I attend webinars about coastal tourism that I found through online platforms." (Participant 9)

The findings demonstrate that ICT supports continuous environmental learning beyond formal educational settings.

Theme 2. Participation

Eight participants reported that digital ICT made it easier to participate in conservation initiatives by providing timely information on environmental activities, volunteer opportunities, and community-based coastal programs. They appreciated the convenience of registering for activities and communicating with environmental organizations through digital platforms.

"Most volunteer activities are now announced online, making it easier to participate."

(Participant 6)

"I can communicate with environmental groups through social media whenever there are coastal activities." (Participant 15)

These findings indicate that ICT facilitates greater community participation by improving access to environmental programs and collaborative initiatives.

Interview Question 3. What recommendations would you suggest to improve the integration of digital ICT in strengthening maritime literacy, coastal protection, and sustainable coastal tourism?

Theme 1. Innovation

Nine participants recommended developing more innovative digital platforms that provide interactive environmental education, virtual coastal tours, real-time environmental updates, and mobile applications dedicated to sustainable coastal tourism. They believed that technology should become more engaging to encourage wider public participation.

"An application showing marine conservation areas and environmental reminders would help tourists become more responsible." (Participant 3)

"Interactive digital activities can encourage young people to learn more about protecting the ocean." (Participant 10)

The participants emphasized that technological innovation can strengthen environmental education and promote sustainable tourism practices.

Theme 2. Collaboration

Six participants highlighted the importance of collaboration among government agencies, tourism organizations, educational institutions, local communities, and environmental groups in developing effective digital ICT initiatives. They believed that coordinated efforts would improve the quality, accessibility, and impact of environmental information disseminated to tourists.

"Government and tourism offices should work together to provide reliable digital information for visitors." (Participant 5)

"Schools and environmental organizations should create online programs that teach tourists how to protect coastal areas." (Participant 12)

These findings suggest that collaborative ICT initiatives can strengthen maritime literacy, support coastal protection, and promote sustainable coastal tourism.

4. DISCUSSION

The findings revealed that digital Information and Communication Technology (ICT) plays a significant role in enhancing awareness and engagement in maritime literacy and coastal protection. Participants perceived digital platforms as accessible channels for acquiring knowledge about marine ecosystems, responsible tourism practices, and environmental conservation. Through social media, online campaigns, and educational websites, ICT expanded opportunities for environmental learning and strengthened public understanding of sustainable coastal tourism. These findings are consistent with McKinley et al. (2022), who emphasized that ocean literacy extends beyond knowledge acquisition by fostering environmental awareness, stewardship, and responsible behavior. Similarly, Tezcan and Yilmaz (2023) highlighted that digital communication and educational initiatives have become increasingly important in promoting maritime literacy and encouraging public engagement in marine conservation. The present study extends these perspectives by demonstrating that digital ICT serves as an effective medium for broadening environmental awareness while encouraging greater participation in coastal protection initiatives.

Another important finding indicated that digital ICT strengthened learning and participation by providing continuous access to environmental education and facilitating involvement in conservation activities. Participants explained that online seminars, educational videos, virtual learning resources, and digital communication platforms enhanced their understanding of coastal ecosystems and encouraged active participation in community-based environmental programs. This finding supports Ardoin et al. (2020), who reported that environmental education contributes significantly to conservation-oriented behaviors and strengthens public commitment to environmental sustainability. Likewise, Wang et al. (2025) found that greater maritime literacy promotes stronger conservation behavior and encourages individuals to participate in protecting marine ecosystems. The findings of the present study suggest that integrating digital ICT with environmental education creates more accessible and engaging opportunities for individuals to develop maritime literacy and contribute to coastal conservation efforts.

The study further revealed that participants recommended strengthening innovation and collaboration to maximize the contribution of digital ICT to sustainable coastal tourism. They emphasized the need for interactive digital platforms, mobile applications, real-time environmental information systems, and stronger collaboration among government agencies, tourism organizations, educational institutions, local communities, and environmental groups. These findings are aligned with Franzen et al. (2024), who emphasized that sustainable coastal tourism requires stakeholder engagement, green skills, and collaborative governance to achieve long-term environmental sustainability. Similarly, Shang et al. (2025) argued that integrating stakeholder perspectives into environmental management enhances the effectiveness of sustainable tourism initiatives and strengthens ecological resilience in coastal destinations. These findings further suggest that digital ICT integration becomes more effective when technological innovation is supported by coordinated partnerships that promote shared responsibility for coastal protection and sustainable tourism development.

Overall, the study demonstrates that digital ICT integration serves as an important catalyst for strengthening maritime literacy and coastal protection by enhancing environmental awareness, supporting continuous learning, encouraging public participation, and promoting collaborative sustainability initiatives. The findings highlight that digital technologies are not merely communication tools but strategic resources that facilitate environmental education, stakeholder engagement, and responsible tourism practices. Consequently, integrating ICT into coastal tourism management can contribute to more informed, environmentally responsible, and sustainable tourism destinations while fostering stronger public commitment to marine conservation.

5. CONCLUSION

This study explored how digital ICT integration enhances maritime literacy and coastal protection in promoting sustainable coastal tourism. The findings revealed that digital ICT strengthens environmental awareness, supports continuous learning, encourages active participation in coastal conservation initiatives, and fosters innovation and collaboration among tourism stakeholders. Participants recognized digital technologies as valuable tools for disseminating environmental information and promoting responsible tourism practices that contribute to the sustainability of coastal destinations.

Overall, the study underscores the importance of integrating digital ICT into maritime literacy and coastal protection initiatives to advance sustainable coastal tourism. Strengthening digital platforms, enhancing environmental education, and promoting multi-stakeholder collaboration can contribute to more informed, environmentally responsible, and resilient coastal tourism destinations while supporting the long-term conservation of marine ecosystems.

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