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Optimizing Smartphone Use in Outdoor Learning Activities for Coastal Conservation Education

[1]Khusnul Basriyah*, [2]Rama Dona
Corresponding Author: *khusnulbasriyah01@gmail.com
[1] SMA Negeri 1 Rangsang Barat, Riau, Indonesia
[2] SMA Santo Yosef Pangkal Pinang, Bangka Belitung, Indonesia

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ABSTRACT

Coastal environmental degradation has become an increasingly urgent issue in many suburban and peripheral areas. However, environmental learning in schools is often conducted theoretically and lacks direct student engagement with real ecological problems. This best practice article describes the implementation of smartphone-assisted outdoor learning activities aimed at improving students' awareness and understanding of coastal conservation. The activity was conducted in a suburban coastal area involving secondary school students through field observation, environmental documentation, digital reporting, and reflective discussion. Smartphones were utilized as tools for photographing environmental conditions, recording observations, accessing digital information, and creating conservation campaigns. The results indicated increased student participation, stronger environmental awareness, improved collaboration, and higher learning motivation. Students demonstrated better understanding of coastal ecosystem problems such as plastic pollution and shoreline degradation. Furthermore, the integration of mobile technology into outdoor learning created a more contextual, interactive, and student-centered learning environment. This article highlights the potential of smartphones as accessible educational tools in environmental education and recommends broader implementation of technology-supported outdoor learning for sustainability education in coastal communities.

Keywords
Coastal Conservation
Environmental Education
Mobile Learning

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Outdoor Learning Smartphone-Assisted Learning	

Introduction

Environmental degradation in coastal regions has become a significant challenge in many developing countries [1],[2]. Coastal ecosystems are increasingly threatened by pollution, plastic waste, abrasion, mangrove destruction, and human activities that reduce environmental sustainability [1],[2]. Educational institutions have an important role in building environmental awareness and encouraging sustainable behavior among students [3],[4]. However, environmental education in schools is frequently delivered through conventional classroom instruction that emphasizes theoretical understanding rather than direct environmental engagement [3],[5].

Outdoor learning has emerged as an effective approach to contextualize environmental education [6][7]. Through direct interaction with natural environments, students are able to observe ecological problems, analyze environmental conditions, and develop emotional connections with nature. Outdoor learning also supports experiential learning by allowing students to learn through authentic experiences and reflection [6].

At the same time, smartphones have become highly accessible among students and provide opportunities to support innovative learning practices. Smartphones can function as tools for documentation, observation, information access, communication, and digital creativity [8],[9]. In environmental education, smartphones may support students in recording environmental issues, collecting field data, producing digital reports, and promoting conservation campaigns through social media platforms.

The integration of smartphone technology into outdoor learning activities can create more interactive and meaningful learning experiences [9]. Particularly in suburban and peripheral coastal areas, smartphone-assisted outdoor learning may help students connect classroom knowledge with local environmental realities. Therefore, this article presents a best practice of optimizing smartphone use in outdoor learning activities for coastal conservation education.

The learning activity was implemented in a secondary school situated in a suburban coastal area SMAN 1 Rangsang barat where environmental problems had become increasingly visible in everyday life. The surrounding coastal environment was characterized by issues such as plastic waste accumulation, shoreline pollution, unmanaged household garbage, and gradual ecosystem degradation caused by human activities [10]. In several parts of the coastal area, students could easily observe scattered plastic bottles, food packaging, damaged vegetation, and polluted waterways flowing into the sea. Although these environmental

problems were located very close to the students' living environment, many students demonstrated limited awareness regarding the importance of coastal conservation and sustainable environmental practices. Preliminary classroom observations conducted by teachers revealed that students tended to perceive environmental issues as distant academic topics rather than urgent local concerns that directly affected their communities and future living conditions. Many students understood environmental concepts theoretically from textbooks, yet they rarely connected those concepts with the actual environmental conditions surrounding them. This gap between theoretical understanding and real-life environmental awareness became one of the major concerns in the teaching and learning process.

The educational situation in the school also reflected several pedagogical limitations that reduced opportunities for meaningful environmental learning experiences. Environmental education was still largely dominated by textbook-oriented instruction in which teachers explained concepts verbally inside classrooms while students passively received information. Lessons regarding pollution, ecosystem conservation, and environmental sustainability were often delivered through lectures, reading activities, and written assignments without providing students with opportunities to observe environmental phenomena directly. As a result, students frequently memorized environmental concepts for academic purposes without deeply understanding their practical relevance. The learning process lacked contextual and experiential dimensions that could encourage students to critically examine environmental problems within their own communities. Furthermore, students rarely participated in outdoor or field-based learning activities because classroom instruction remained the primary mode of teaching. School activities were mostly centered on indoor academic achievement, leaving minimal space for exploration-based learning that connected students with their natural surroundings. Consequently, many students had limited experience in conducting environmental observation, identifying ecological problems, or participating in conservation-oriented activities.

Another important issue identified by teachers involved students' use of smartphones in daily life. Most students already possessed smartphones and actively used them during and outside school hours. However, smartphones were predominantly utilized for entertainment purposes such as social media browsing, online gaming, video streaming, and casual communication [11]. Teachers observed that students rarely viewed smartphones as educational tools capable of supporting learning activities, critical inquiry, or environmental documentation. In many cases, smartphone use inside schools was considered disruptive because students often became distracted during lessons. Nevertheless, teachers recognized that smartphones also possessed significant educational potential if integrated appropriately

into contextual learning activities. Features such as cameras, video recording, internet access, note-taking applications, and digital communication platforms could support active learning, especially in outdoor educational settings. This realization encouraged teachers to reconsider the role of smartphones in the learning process and explore strategies for transforming digital devices into instruments of environmental education rather than merely sources of distraction.

In addition, students lacked opportunities to engage directly with local environmental issues through meaningful participation and community-based learning experiences. Although they lived near coastal environments facing serious ecological challenges, students had rarely been invited to investigate environmental problems systematically or contribute to conservation efforts [12]. Their involvement in environmental programs was generally limited to occasional school cleaning activities that did not necessarily foster critical understanding or long-term ecological responsibility. Teachers therefore identified the need for a more engaging and participatory educational approach capable of connecting students with authentic environmental realities. These conditions ultimately encouraged educators to design a contextual outdoor learning activity integrating smartphone utilization with direct coastal exploration. The initiative aimed to increase environmental awareness, strengthen students' emotional connection with coastal ecosystems, and encourage active participation in conservation education. Through field observation, environmental documentation, collaborative investigation, and reflective discussion, students were expected to develop deeper ecological understanding while simultaneously learning how technology could be used productively for educational and environmental purposes. The integration of outdoor learning and smartphone-assisted activities was therefore designed not only to improve students' environmental knowledge but also to transform their attitudes, participation, and sense of responsibility toward the sustainability of coastal ecosystems in their local communities.

Implementation Methods

Table 1 presents the stages and implementation process of smartphone-assisted outdoor learning activities designed to support coastal conservation education. The table illustrates how the learning program was systematically organized into four major stages, namely learning design, preparation stage, outdoor learning activities, and reflection and digital presentation. Each stage was developed to encourage active student participation, contextual environmental learning, and meaningful integration of smartphone technology into educational activities.

Table 1. Stages and processes of smartphone-assisted outdoor learning for coastal conservation education.

Stage	Activities	Description	Expected Learning Outcomes
Learning Design	Outdoor learning and smartphone-assisted exploration	The learning activity integrated outdoor learning principles with smartphone-supported environmental exploration. Students participated in field observation, environmental documentation, group discussion, digital reporting, and conservation reflection activities. Students were divided into groups and assigned to observe specific coastal locations.	Students develop environmental awareness, collaborative skills, and contextual understanding of coastal conservation issues.
Preparation Stage	Orientation and learning preparation	Before field activities, teachers provided orientation regarding coastal ecosystem issues, safety instructions, observation guidelines, and ethical smartphone use during learning activities. Students were instructed to use smartphones responsibly for educational purposes.	Students understand activity procedures, environmental objectives, safety measures, and responsible digital behavior.
Outdoor Learning Activities	Field observation and environmental investigation	Students explored coastal areas to identify environmental problems. Smartphones were used to take photographs of polluted areas, record short videos, document waste types, search for information about coastal ecosystems, and record observational notes. Students observed plastic accumulation, shoreline erosion, damaged vegetation, and human activities affecting the environment.	Students gain direct environmental experience, improve observation skills, and connect theoretical concepts with real environmental conditions.
Reflection and Digital Presentation	Reflection and digital conservation campaign	After field observations, students organized their findings into digital presentations and conservation campaigns. Groups created digital posters, short videos, environmental reports, and social media content promoting coastal cleanliness. Reflection sessions discussed causes of environmental degradation, human responsibility toward nature, and conservation actions.	Students strengthen critical thinking, communication skills, environmental responsibility, and digital creativity in conservation education.

The first stage focused on the overall learning design by combining outdoor learning principles with smartphone-assisted exploration. Students participated in field observation, environmental documentation, collaborative discussion, digital reporting, and conservation reflection. This stage emphasized student-centered learning and experiential engagement with real environmental conditions. The preparation stage highlighted the importance of providing orientation before conducting field activities. Teachers introduced students to coastal ecosystem issues, safety procedures, observation guidelines, and ethical smartphone use to ensure responsible and productive learning experiences.

The outdoor learning activity stage represented the core implementation process in which students directly explored coastal areas to identify environmental problems. Smartphones functioned as educational tools for taking photographs, recording videos, documenting waste types, accessing environmental information, and recording field observations. Through direct interaction with polluted coastal environments, students

developed stronger ecological understanding and observation skills. The final stage focused on reflection and digital presentation, where students transformed their field findings into digital conservation products such as posters, videos, reports, and social media campaigns. Reflection discussions encouraged students to critically analyze environmental degradation, recognize human responsibility toward nature, and propose conservation actions. Overall, the table demonstrates that smartphone-assisted outdoor learning can effectively support contextual environmental education while improving students' digital literacy, collaboration, and environmental awareness.

Results and Discussion

A. Increased Student Engagement

Students demonstrated significantly higher enthusiasm and participation during outdoor learning activities compared to conventional classroom instruction. This finding is consistent with previous studies indicating that outdoor learning can increase student engagement, motivation, and active participation through authentic learning experiences and direct interaction with real-world environments [3],[9]. The integration of smartphones into field-based learning created a familiar and motivating learning environment because students were able to use technology in meaningful educational contexts rather than solely for entertainment. Research has also shown that mobile learning technologies can enhance student engagement and support more interactive learning experiences [5].

During coastal exploration activities, students actively observed environmental conditions, discussed findings with peers, documented evidence using photographs and videos, and presented potential solutions to environmental problems. The learning process became more interactive and student-centered as students engaged directly with authentic environmental issues surrounding their communities. Several students expressed positive responses toward the activity. One student stated, "Learning outside the classroom made us feel more connected to the real environmental problems." Another student commented, "Using smartphones for environmental observation was more exciting than only reading textbooks." Teachers also observed that students who were usually passive during classroom lessons became more communicative and collaborative during field activities. These findings indicate that smartphone-assisted outdoor learning can increase student motivation, participation, curiosity, and active involvement in environmental education processes, supporting previous findings regarding the educational benefits of outdoor and technology-supported learning environments [3],[5]. The implementation of outdoor learning encourages active collaboration among students. As illustrated in Fig. 1, students engage in group discussions to analyze the data collected through their smartphones, which enhances their critical thinking skills during the coastal conservation activity.



Fig. 1. Student discussion about using smartphones

B. Improved Environmental Awareness

Direct exposure to coastal environmental problems helped students develop stronger awareness regarding the importance of environmental conservation and sustainability. Through field observation activities, students witnessed real ecological issues such as plastic accumulation, polluted shorelines, damaged vegetation, and irresponsible human behavior affecting coastal ecosystems. These direct experiences enabled students to connect theoretical environmental concepts with real-world conditions in their local communities. Many students expressed concern and emotional responses after observing the environmental damage firsthand. One student stated, "I never realized that the beach near our school was this polluted until we observed it directly." Another participant commented, "Seeing plastic waste everywhere made me understand that humans contribute greatly to environmental destruction." Several students also admitted that they had previously ignored environmental problems because they considered them normal parts of daily life. However, participation in the outdoor learning activity encouraged reflection and increased their sense of responsibility toward environmental protection. Teachers observed positive behavioral changes as students became more concerned about waste management, coastal cleanliness, and sustainable environmental practices after the program was completed.

Direct exposure to coastal environmental problems helped students develop stronger awareness regarding the importance of environmental conservation and sustainability. Previous studies have shown that direct environmental experiences play an important role in fostering ecological awareness, environmental responsibility, and pro-environmental behavior among students [14],[15]. Through field observation activities, students witnessed real ecological issues such as plastic accumulation, polluted shorelines, damaged vegetation, and irresponsible human behavior affecting coastal ecosystems. These direct experiences enabled

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Teachers observed positive behavioral changes as students became more concerned about waste management, coastal cleanliness, and sustainable environmental practices after the program was completed. These outcomes suggest that smartphone-assisted outdoor learning can effectively contribute to the development of environmental awareness and sustainability-oriented behavior among students [17],[18]. Beyond theoretical knowledge, the program emphasizes direct environmental action. As depicted in Fig. 2, students actively collect plastic trash along the coastline to understand the tangible impact of marine pollution on coastal ecosystems. Direct participation in beach-cleaning activities can provide students with experiential environmental education that strengthens their knowledge, awareness, and intentions toward pro-environmental behavior [17]. Furthermore, the field observation highlights the critical environmental challenges and ecological solutions in the coastal area. As shown in Fig. 3, severe beach abrasion has eroded parts of the coastline at Tanjung Motong Beach. Conversely, Fig. 4 illustrates the nearby mangrove vegetation, which serves as a natural barrier to mitigate such erosion and stabilize the coastal ecosystem [19].



Fig. 2. Students collect the plastic trash



Fig. 3. Abrasion in Tanjung Motong Beach



Fig. 4. Mangrove vegetation

C. Development of Digital and Collaborative Skills

The implementation of smartphone-assisted outdoor learning activities also contributed to the development of students' digital literacy and collaborative skills [20],[21]. Students learned how to use smartphones productively for educational purposes, including organizing digital data, documenting environmental conditions, creating environmental awareness content, and communicating ideas visually through digital presentations. Previous research indicates that mobile technology in outdoor learning can support observation, documentation, reflection, and student collaboration [22]. The activity encouraged students to work collaboratively in groups while conducting field investigations and discussing environmental findings. Students divided responsibilities among group members, such as taking photographs, recording videos, collecting information, and preparing presentations. This collaborative process strengthened communication skills, teamwork, and collective problem-solving abilities, which are important components of twenty-first-century learning [20],[23]. One student explained, "We learned how to work together while creating environmental reports and digital posters." Another student stated, "I realized smartphones can be useful learning tools, not only for social media." Teachers also observed improvements in students' confidence when presenting environmental findings to classmates. The integration of outdoor exploration and digital technology created student-centered learning experiences where students became active participants rather than passive recipients of information [22],[24]. As a result, the activity supported both environmental education objectives and twenty-first-century learning competencies. To support the digital literacy aspect of the learning program, students utilize technology for creative publication. As demonstrated in Fig. 5, students actively use their smartphones to compile and analyze field data. Subsequently, this information is transformed into a creative output, as exemplified by the digital poster in Fig. 6, which serves as an educational tool to raise public awareness about coastal conservation.



Fig. 5. Student Using Smartphone



Fig. 6. Digital Poster

D. Challenges Encountered

Despite producing many positive outcomes, the implementation of smartphone-assisted outdoor learning activities also encountered several challenges. One of the major issues involved students becoming distracted by non-educational smartphone use during field activities. Some students occasionally attempted to access entertainment applications or social media unrelated to the learning objectives. In addition, internet connectivity in several coastal areas was unstable, limiting students' ability to access online environmental information during observation activities. Teachers also faced difficulties related to supervision and time management because outdoor learning required careful coordination to ensure student safety and active participation. Weather conditions occasionally disrupted field observation activities, especially when rain or strong winds affected the coastal environment. One teacher stated, "Outdoor learning requires more preparation and supervision compared to classroom instruction." A student also commented, "Sometimes the internet signal was weak, so we had difficulty uploading our documentation." To address these challenges, teachers implemented monitoring strategies, established clear learning rules, and provided structured activity guidelines before fieldwork began. These preventive measures helped maintain focus, improve discipline, and ensure that smartphones were used responsibly for educational purposes throughout the learning process. The field activity is structured systematically to ensure effective data collection and management. Initially, students are captured as they headed to the beach to begin their field observation, as shown in Fig. 8**.** Following the investigation, students utilize the designated platform to document their findings, with Fig. 7 illustrating the process where students upload data obtained from the coastal environment.



Fig. 7. Student uploads data



Fig. 8. Student headed to the beach

E. Educational Implications

Table 2 illustrates the educational implications of smartphone-assisted outdoor learning in coastal conservation education. The findings indicate that integrating smartphones into contextual environmental activities promotes experiential learning, ecological awareness, and active student participation. Students were able to connect theoretical knowledge with real environmental conditions through direct observation and digital documentation. The approach also supported sustainability education by encouraging students to become active participants in conservation efforts rather than passive learners.

Table 2. Educational implications of smartphone-assisted outdoor learning in coastal conservation education.

Educational Implications	Description	Expected Impact
Promoting Experiential Learning	Smartphones support direct environmental observation and field-based learning experiences.	Students gain contextual understanding through real-life environmental interaction.
Increasing Ecological Awareness	Outdoor exploration helps students recognize environmental problems affecting coastal ecosystems.	Students develop stronger environmental responsibility and conservation awareness.
Encouraging Student Participation	Smartphone-assisted activities increase engagement, collaboration, and active involvement in learning.	Students become more motivated and participatory during environmental education activities.
Connecting Learning with Real-World Problems	Learning activities are linked to authentic environmental issues in local coastal communities.	Students connect theoretical concepts with practical environmental realities.
Supporting Sustainability Education	The approach encourages students to participate in conservation actions and sustainable behavior.	Students become active contributors to environmental protection efforts.
Applicability for Coastal Schools	The strategy can be adapted by schools in environmentally vulnerable or coastal regions.	Schools strengthen contextual environmental education programs and community engagement.

Conclusion

Optimizing smartphone use in outdoor learning activities provides meaningful opportunities for coastal conservation education. The integration of mobile technology with direct environmental exploration creates interactive, contextual, and engaging learning experiences. Students not only improve their environmental understanding but also develop digital literacy, collaboration, and social responsibility. This best practice suggests that smartphone-assisted outdoor learning can become an effective alternative approach for environmental education, particularly in suburban coastal communities. Future implementations may integrate citizen science, digital mapping, or community-based conservation projects to further enhance learning outcomes and environmental engagement.

Conflict of Interest

The authors declare no conflict of interest.

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Authors



Khusnul Basriyah, M.Pd. is a dedicated Physics teacher at SMA Negeri 1 Rangsang Barat, Riau. She was born in Segomeng on April 1, 1995, and holds a Master's degree (M.Pd.) in Physics Education, graduated from Universitas Ahmad Dahlan, Indonesia. Passionate about science education, she actively contributes to the development of innovative teaching methods in her school. (email: khusnulbasriyah01@gmail.com).



Rama Dona, S.Pd., M.Si. received his Master of Science (M.Si.) degree in Physics from Institut Teknologi Sepuluh Nopember (ITS), Indonesia. He currently serves as a Physics teacher at Santo Yosef High School in Pangkalpinang, Bangka Belitung. Born in Sangku on February 28, 1995, his research interests include material physics, with a focus on advanced materials, and science education through experimental approaches in physics teaching. (email: ramadonad28.d28@gmail.com).