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Enhancing Environmental Literacy Through Experiential and Joyful Learning-Marine Edutourism: Implementation in Indonesia and Malaysia

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Abstract: Enhancing Environmental Literacy Through Experiential and Joyful Learning Marine Edutourism: Implementation in Indonesia and Malaysia. Objectives: Low environmental literacy among students necessitates innovative methodologies in environmental education. One effective approach is the development of an environmental learning model designed to enhance environmental literacy. Indonesia and Malaysia, both rich in marine resources, also possess significant potential for marine tourism. Marine tourism sites can be utilized as valuable resources for marine environmental learning, thereby improving environmental literacy in the domain of issue analysis. Environmental education is integrated into tourism, called marine edutourism. Marine edutourism developed a learning model by combining joyful and experiential learning concepts, which was then referred to as Experiential and Joyful Learning Marine Edutourism (EJoy-ME). This research aims to develop and implement the EJoy-ME learning model to enhance students' environmental literacy in Indonesia and Malaysia. **Methods:** The research method is Design and Developmental Research consisting of six phases: (1) problem identification; (2) objectives description; (3) design & develop the artifact; (4) artifact test (implementation); (5) evaluate; (6) results communication. **Findings:** This research successfully implemented the EJoy-ME learning model in Wakatobi National Park, Indonesia; Mangrove Point, Klang River, Malaysia; and Kuala Selangor Nature Park, Malaysia. The results show that this model enhances students' environmental literacy in the domain of issue analysis, both in Indonesia and Malaysia; however, implementation in Wakatobi showed the most significant improvement in increasing environmental literacy. The issue analysis skills of 160 trial subjects increased with moderate criteria in the EJoy-ME model but remained low in the PBL model. The N gain score showed that the increase in issue analysis was quite effective in the EJoy-ME model. Student responses to the seven assessed aspects were also very good, namely experiential learning, joyful learning, understanding of the material, environmental education, learning motivation, and practicality of the model. **Conclusion:** The implementation indicates that EJoy-ME is a feasible environmental education learning model, effective in enhancing environmental literacy in the domain of issue analysis.

Keywords: marine edutourism, environmental literacy, joyful learning, experiential learning.

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INTRODUCTION

Innovation of learning methodology in environmental education needs to be done. Environmental education aims to increase environmental literacy (Santos et al., 2018). The fact shows that Indonesian students' environmental literacy is still in the medium-low category and lacks environmental knowledge (Voronkova et al., 2025). PISA score also revealed that the environmental science and geoscience performance aspects of Indonesian students were below average, ranking 51st out of 57 OECD countries (OECD, 2009). The most significant defect of marine ecosystems caused by human activities is the low level of environmental literacy. Indonesia and Malaysia are rich in marine biodiversity due to their location in the Coral Triangle, and Indonesia is even considered the epicenter of world biodiversity (Asaad et al., 2020). However, the biodiversity of these two countries is threatened by ongoing marine damage, particularly due to plastic pollution in the marine environment (Omeyer et al., 2022), resulting from environmentally illiterate human activities. One of the significant challenges in Malaysia is the issue of marine debris (Masud et al., 2014). Malaysia was once ranked 28th for the highest plastic pollution in the world, and 30-45% of its plastic waste is on the beach . In Wakatobi, one of the world's marine national parks with the highest biodiversity, destructive fishing, illegal fishing, the utilization of protected animals, and sand mining by the surrounding community have been reported (Nelson et al., 2018; Roth et al., 2018). The results of the Focus Group Discussion with biology teachers in Wakatobi, Southeast Sulawesi, confirmed that the low level of student literacy is mainly due to the lack of effective environmental education methodologies in improving environmental literacy. Education concerning students' environmental literacy remains low (Shellock et al., 2024). Therefore, it is necessary to develop an effective environmental education methodology to improve environmental literacy (Sezen-Barrie et al., 2025).

Marine tourism offers a range of objects and attractions that have potential as educational resources for environmental learning. It can be implemented by integrating marine tourism into environmental education (Elliott et al., 2025). The integration called marine edutourism (ME) was design to enhance students' environmental literacy (Hayati, 2017). Students can study marine ecosystems directly with various enjoyable learning experiences, so we develop ME that combines joyful and experiential learning concepts. The name of the learning model developed is Experiential and Joyful Learning-Marine Edutourism (EJoy-ME). EJoy-ME enables students to learn about marine tourism ecosystems, biodiversity, environmental issues, and conservation efforts in an engaging manner. This research aims to develop and implement the EJoy-ME learning to enhance environmental literacy in the issue analysis domain.

The EJoy-ME learning model has been developed for marine tourism objects in Indonesia and Malaysia. In Indonesia, the model development was carried out in the Wakatobi National Park. Meanwhile, in Malaysia, model development was carried out at the Kuala Selangor Nature Park and Mangrove Point Klang River. The three locations are a marine tourist area. Based on the results of observations, the facts in the field show that the three marine tourism objects have not been optimally utilized as a means of environmental education. Many tourists visit to refresh themselves. In fact, the biodiversity and marine culture of the two locations can be objects of biology learning to deliver tourists to have marine environmental literacy. Both tourist locations also lack the necessary equipment and toolkit to implement marine edutourism for high school students. So far, tourists who visit have not been provided with information on

biodiversity, conservation, or other fun educational activities. It is essential for environmental sustainability to integrate environmental education at natural tourism sites and in marine protected areas (Zorrilla-Pujana & Rossi, 2014). The EJoy-ME model, based on the local potential of these three locations, will be developed to become a model for other marine tourism objects in developing marine edutourism as an alternative environmental learning activity in marine tourism locations that can increase environmental literacy. It can also prevent damage to the marine ecosystem.

Improving environmental literacy in the domain of issue analysis skills is the main goal of implementing the EJoy-ME model. The implementation of the EJoy-ME model was conducted to determine whether the environmental education model developed was more effective than the Problem-Based Learning model, which is typically used in environmental learning. The Framework for Assessing Environmental Literacy by the North American Association for Environmental Education (NAAEE) was used to develop an instrument to measure environmental literacy. Issue analysis skills refer to the ability to analyze a problem and apply scientific knowledge to explain the causes of the problem and make predictions about its consequences (Hollweg et al., 2011). Analytical skills are one of the high-level cognitive thinking domains needed in the 21st century (Kwangmuang et al., 2024). Analysis involves thinking and logic to examine various aspects, such as identifying the cause of something, determining a flow, grouping, and sequencing. Analytical skills must be taught through contextual methods that direct students to think at a high level. The current environment has complex problems that require analytical skills to find solutions (Sigit et al., 2024). Analytical skills are an essential part of problem-solving so that students can make the right decisions. Analytical skills are trained to identify the cause of problems faced every day and then find ways to solve them (Misiaszek, 2020). Environmental issue analysis skills are needed so that someone can play a role in taking action in solving environmental problems (Maurer & Bogner, 2020). Experiential learning based on outdoor activities has been shown to improve students' environmental problem-solving skills (Hahn et al., 2022). In addition to environmental literacy, students' responses need to be known to consider the practicality and efficiency of the EJoy-ME learning model.

METHOD

The development and implementation of EJoy-ME learning model is a development research. Development research aims to develop, determine the effectiveness, and produce a product evaluation formulation. The outcome of this research is the Experiential & Joyful Learning-Marine Edutourism (EJoy-ME) learning model, designed to enhance environmental literacy. This study used the Design and Developmental Research (DDR) instructional design approach. DDR is an approach to developing new procedures, techniques, and tools based on specific case analysis. DDR functions to draw conclusions or make legal statements that can be generalized or generate context-specific knowledge to solve problems (Richey & Klein, 2005). This approach consists of six phases to develop the EJoy-ME learning model, namely (1) problem identification; (2) objectives description; (3) design & develop the artifact; (4) artifact test (implementation); (5) evaluate; (6) results communication (Ellis & Levy, 2010).

Problem Identification and Objectives Description

In the analysis stage, an assessment was conducted to determine whether the developed model was truly needed. Secondary data were reviewed on the low environmental literacy of high school students and the causes of this. A focus group discussion (FGD) was also conducted with

biology teachers regarding the biology learning process, which includes environmental education, how teachers can improve students' environmental literacy, and whether the developed model was needed by teachers. An analysis of potential ecotourism locations was also conducted through a preliminary study at tourist attractions, including interviews with managers and observations of the attractions.

Design & Develop the Artifact

In the Designing and Developing a Learning Model stage, the model and product were designed and developed. The components of the learning model were developed based on a plan based on a theoretical foundation. The resulting products were: (1) Materials; (2) Lesson Plans (RPP); (3) Learning Strategies; (4) Learning Model Components; and 5) Models and Products Supporting the Implementation Model that had been tried.

Validation was conducted at this stage on the environmental literacy measurement instrument for the issue analysis aspect. A product pilot test was also conducted at this stage. This stage was used to determine whether the model was capable of improving environmental analysis literacy. Furthermore, at this stage, observers, teachers, guides, and students involved in the implementation phase assessed the practicality of the developed learning model and the resulting product. A summative evaluation was conducted to determine the product's usefulness and to make recommendations for further product development. The improved product developed through this evaluation constitutes the final research product, which is expected to be used in the implementation model developed at marine tourism sites.

Artifact Test (Implementation)

In the Model Testing Phase is determine the effectiveness of the developed model and product is determined. The results of the model and product trials are explained to determine whether the model has an impact on environmental literacy in the aspects of issue analysis. During the artifact phase test, a questionnaire and a quasi-experimental method were employed to assess student responses and the effectiveness of the EJoy-ME model.

Participants

The trial subjects consist of three classes of Grade X Senior High School students from the Wakatobi National Park area in Indonesia, and four classes of Grade X Senior High School students in Sekolah Indonesia Kuala Lumpur, Malaysia. In the trial model, research subjects consist of 140 students. Before the implementation of EJoy-ME, to ensure the protection and well-being of all participants, ethical procedures were followed. Formal approval from the administrative authorities of the participating senior high school was first obtained. Following institutional permission, the research objectives, procedures, and the voluntary nature of participation were clearly explained to both the teachers and the parents or legal guardians of the student participants. A consent letter from the participants' parents was obtained prior to implementation. It is also for ensuring that they understood the purpose of EJoy-ME and willingly agreed to participate in the implementation process. All personally identifiable information (PII) was replaced with unique identification codes throughout the data analysis and reporting process to guarantee participant confidentiality.

Implementation

The implementation of the learning model was carried out in three locations, namely Wakatobi National Park, Southeast Sulawesi, Indonesia; Kuala Selangor Nature Park, Selangor, Malaysia; and Mangrove Point, Klang River, Malaysia. The EJoy-ME implementation

at each location is a day program. Facilitators, in this case, biology teachers and guides, were prepared and conducted three days of preparation. The facilitators received four hours of training on the EJoy-ME learning model before the preparation. A quasi-experiment using the Pretest-Posttest Group Design was carried out to determine whether the EJoy-ME model was able to improve environmental literacy in the aspect of issue analysis. The learning model used as A comparison is Problem-Based Learning (PBL). The basis for comparing the EJoy-ME model to PBL is that this learning model is firmly rooted in constructivist theory and is intrinsically problem-based. PBL places students at the center of learning, where they construct their own knowledge and understanding through problem-solving experiences. PBL is widely recognized and used by teachers to construct new knowledge through investigation and collaboration (Bergstrom et al., 2016). Real-world problems can be used as a starting point for learning to spark students' curiosity and motivation (Kimble, 2014). PBL also fosters interdisciplinary learning, as environmental issues often require understanding from multiple disciplines. The research design to implement the learning model can be shown in Table 1.

Table 1. Research design

Group	*Pre-Test*	*Treatment*	*Post-Test*
Experimental Class	O	X1	O
Control Class	O	X2	O

Description:
X1: Learning with the EJoy-ME model.
X2: Learning with the PBL model
O: Environmental literacy measurement test at the beginning and end

Instrument

The environmental literacy measurement instrument is a multiple-choice test that was developed from the environmental literacy indicators of NAAEE. Additionally, student responses were collected through a Likert scale questionnaire to assess the feasibility of the EJoy-ME learning model and to evaluate the implementation of indicators of joyful and experiential learning. A questionnaire for students and an observation by the teacher were conducted. Both instruments have also been declared valid in terms of construct, content, and empirically as a measurement tool for environmental literacy in the issue analysis domain. The instrument for measuring environmental literacy in the issue analysis aspect was empirically validated. A total of 46 questions were piloted to 40 high school students. The students' work results were analyzed using the Rasch model with the QUEST application. The analysis found that the item reliability value was 0.87 and the subject reliability was 0.69. This indicates that the quality of the items in the reliability aspect of the instrument is good, but the consistency of answers from students as subjects is still weak. The parameter used was the INFIT MNSQ, with an acceptable range of 0.77-1.30 (Adam & Khoo, 1996). All items in the environmental literacy instrument in the issue analysis aspect were declared fit with the model.

Evaluation

The phase of Testing Results Evaluation assesses the model development process and its outcomes, including model feasibility and effectiveness. Data analyze using the N-Gain score and MANOVA test. The prerequisite test for MANOVA has been conducted and met. The assumptions are met with a Kolmogorov-Smirnov

significance value of 0.20, which is greater than 0.05, indicating a normal distribution. The correlation value is 0.862, which is greater than 0.05, indicating no correlation between the pre-test and post-test data. Student response data from the EJoy-ME model questionnaire instrument is qualitative, which is then converted into quantitative data. The average of each aspect is calculated and then qualitatively classified according to the provisions as seen in Table 2.

Table 2. Criteria for changing quantitative values to qualitative values

Score Range	Category
$X \geq 4$	Very good
$3.33 < X \leq 4$	Good
$2.67 < X \leq 3.33$	Enough
$2 < X \leq 2.67$	Less
$X \leq 2$	Very less

Results Communication

Ultimately, the Communicating Results and Conclusions Phase entails summarizing the model's results and disseminating the model itself. Dissemination is aimed at those who will use the learning model.

■ RESULT AND DISCUSSION

Results of Problem Identification and Objectives Description

Local Potential of Wakatobi National Park, Indonesia

Wakatobi National Park is one of seven Indonesian Marine National Parks, managed by the Ministry of Environment and Forestry. One of the reasons for choosing this location because this National Park is a natural marine ecosystem that functions as a nature conservation area, managed with a zoning system for research, education, cultivation, culture, and tourism purposes (Clifton, 2013). The potential of Wakatobi National Park as a learning resource was identified through literature studies, observations, and in-depth interviews with the *Bajo* Tribe and staff of the Wakatobi National Park office. Identifying the edutourism potential of Wakatobi, focusing on the mangrove ecosystem, the coral reef ecosystem, the beach ecosystem, seagrass ecosystem. *Bajo* Tribe's local wisdom and seaweed farming. One of the main innovations in the development of the EJoy-ME model is local wisdom-based education; in this case, the local wisdom of marine environmental management in the *Bajo* Wakatobi Tribe is packaged into a learning resource for environmental education. The location of potential identification in the education and tourism zone of the four major islands in Wakatobi, which are Wangi-wangi, Kaledupa, Tomia, and Binongko. Location selection aims to guarantee students' safety and security for implementation.

The potential identification process showed Wakatobi to be suitable as a learning resource for environmental education through the EJoy-ME learning model. Wakatobi has a complete range of marine ecosystems, and each type of ecosystem has high biodiversity. Wakatobi National Park was named as the national park with the highest biodiversity in Indonesia (Roth et al., 2018), and based on the results of the WWF assessment in the 2003 Rapid Ecological Assessment, Wakatobi National Park was concluded to have the best ecosystem conditions in the world (Nelson et al., 2018). Based on literature studies and direct observations of natural resources, ecosystems that have the potential to be learning resources for environmental education are mangrove ecosystems, seagrass beds, coral reefs, and beaches. Each ecosystem has characteristics or ecosystem specialties, high biodiversity, and environmental cases that can be used as learning in environmental education. Deep interviews found that cases in the *Bajo* Tribes in Wakatobi potential to be used as local wisdom learning resources for environmental education. There are many values and marine activities of the *Bajo* society that focus on marine sustainability.

Based on the Wakatobi potential, six topics are defined as student learning activities for implementing EJoy-ME on each island of

Wakatobi. Each topic uses EJoy-ME syntax, which consists of six stages as shown in Figure 2. Student learning activities: Learning Activity I. Mangrove Ecosystem and Its Conservation; Learning Activity II. Seagrass Ecosystem and Its Conservation: Learning Activity III. Coastal Ecosystem and Its Conservation: Learning Activity IV. Coral Reef Ecosystem and Its Conservation: Learning Activity V. Local Wisdom of the *Bajo* Tribe: Learning Activity VI. Seaweed Cultivation. Each learning activity asks students to identify environmental problems within each ecosystem being studied, and then find alternative solutions to these problems using EJoy-ME syntax. The implementation of the EJoy-ME learning model in Wakatobi is guided by several learning tools, which include a manual book for teachers, EJoy-ME Learning Model Book, EJoy-ME worksheets for students, and a materials book about Marine Ecosystems to improve students' environmental literacy.

Education based on the local wisdom of the *Bajo* tribe pedagogically contributes significantly to improving environmental literacy through the EJoy-ME learning model. This approach also offers a profound ethical and spiritual dimension to the environment, something often overlooked by purely objective scientific approaches. *Bajo* environmental education does not take place in formal classrooms, but rather through a unique pedagogical process directly integrated with the marine ecosystem. This process effectively builds environmental literacy holistically. *Bajo* local wisdom does not view the ocean in fragmented terms (e.g., biology, chemistry, and physics separately). *Bajo* society very well understood that the health of coral reefs can affect fish populations, and then it can affect their well-being. This understanding is the top of environmental literacy, where people are able to understand the complex interconnections within an ecosystem (Yemini et al., 2025). The *Bajo* tribe's approach fundamentally provides a spiritual and ethical perspective that pure science lacks. Even in modern science, its objective methods and empirical, tend to view nature as an object, a system to be measured, analyzed, managed, and then exploited. Science is often silent about "why" people should care on a spiritual and moral level. Purely scientific perspective, environmental stewardship is often driven by pragmatic reasons, such as preventing ecological disaster and economic sustainability. For the *Bajo*, protecting the ocean is spiritual and an ethical obligation to maintain harmony between the natural, human, and spirit world. It is a responsibility that transcends personal interests or the interests of the current generation. In short, if science provides us with "maps" and "tools" for managing the environment, the local wisdom of the *Bajo* provides a "moral compass" and "spiritual reasons" for undertaking that journey with respect and wisdom.

Local Potential of Kuala Selangor Nature Park, Malaysia

Kuala Selangor Nature Park (KSNP) is one of the coastal areas in Selangor, Malaysia. It consists of two main areas there are 201-hectare tropical rainforest and a swamp forest. KSNP is well managed by the Malaysian Nature Society (MNS) (ELTurk et al., 2018). KSNP is also determined to be a significant mangrove ecosystem in Malaysia. This ecosystem consists of over 90 hectares of mangrove area with hosts 19 main types of flora. Dominant mangrove species in this ecosystem are Avicennia, Rhizophora, and Bruguiera (Hossain et al., 2008). It is also known as a bird park, boasting at least 156 bird species, 57 of which migrate from regions like Russia and Siberia. Birdlife International appointed KSNP as an Important Bird Area (IBA) (Latif et al., 2020). KSNP is home to various wildlife, such as smooth otters, silver-leaf monkeys, mangrove tiger butterflies, and pangolins. The biodiversity and healthy mangrove cover in this ecosystem have the potential t be an environmental learning resource.

Based on observations, it indicates that KSNP's mangrove ecosystem is potentially utilized for environmental education through EJoy-ME. Potential learning topics include: I. Coastal Ecosystems; II. Components of the coastal ecosystem; III. Coastal biodiversity; IV. Interactions within the Ecosystem; V. Roles and functions of coastal ecosystems; VI. Threats to the ecosystem, and VII. Preservation efforts. The threats and damage facing the coastal ecosystem can be explored through case studies, encouraging students to seek solutions. Direct observations of the ecosystem provide valuable learning experiences. Besides the coastal area, other attractions such as interesting fauna like monkeys and salamanders, and scenic beach views are opportunities for exploration within the ecosystem. EJoy-ME learning model can incorporate tourist attractions alongside educational activities, such as planting mangrove seedlings, conducting observations, engaging in case studies, and interviewing residents.

Local Potential of Mangrove Point Klang River

Mangrove Point Klang River is located in Klang Port, Selangor, Malaysia. This ecosystem is adjacent to and part of the Klang River. This ecosystem has been selected to be packaged as learning resources for environmental education because one of the ecotourism areas that aims to mangrove conservation centre, targeting the preservation of mangrove for the future in Malaysia (Asaad et al., 2020). This ecotourism very the potential to be packaged as learning resources for environmental education. Mangrove Point Klang has enough biodiversity for introducing to students. It has been found that this ecosystem has terrestrial vertebrates such as mammals, birds, and herpetofauna total of 68 species (57 species of birds, eight species of mammals, and three species of reptiles). Klang mangrove is also an important habitat for migratory birds (Hattam et al., 2021). Mangrove Klang has 10 species of three families, namely Rhizophoraceae, Avicenniaceae, and Meliaceae. *Rhizophora apiculata* was the most dominant tree species (Norhayati et al., 2009).

Klang River has a history of bringing technology to clean up the pollution along the river. Menteri Besar Selangor Incorporated (MBSI) manages this ecotourism and serves the Klang River educational trip package to build awareness on pollution and makes much effort to remove trash that ends up in the river. Tourism can observe the mechanisms behind the river cleaning (log booms and interceptors) and can be able to witness firsthand how essential the river is to the livelihoods as well as for the survival of the biodiversity. This ecotourism also provides a mangrove conservation package for environmental action and education, such as mangrove cleanup, mangrove planting, upcycle precious plastic workshop, and other mangrove education programs. It can be learning resources through real experiences of the EJoy-ME model, which can enhance student environmental literacy.

Design & Develop EJoy-ME Learning Model

This stage has successfully developed a marine edutourism learning model by integrating the experiential learning model syntax from David Kolb (Kolb & Kolb, 2017) and the joyful learning strategy, then this learning model is called Experiential and Joyful Learning-Marine Edutourism (EJoy-ME). This model packages local potential in marine tourism locations for environmental learning with the scope of material: mangrove ecosystems, seagrass, beaches, coral reefs, marine local wisdom, and seaweed cultivation. When developing the syntaxes of this learning model, it refers to constructivism theory, which provides students with new experiences while still paying attention to their initial knowledge and the context of their daily lives. The EJoy-ME learning model is rooted in the constructivist

paradigm, a learning theory that states that knowledge is not something passively absorbed from a teacher, but rather something actively constructed by individuals (Pande & Bharathi, 2020). Students are active subjects, not passive objects, of the learning process. The concepts of "active learning" and "direct experience" from constructivism are the essence of Experiential Learning (Smith et al., 2018). Natural environments, such as marine ecosystems, cannot be understood solely through textbooks; they must be experienced and interacted with directly. Experiential learning has been reported to effectively increase students' success (Hueck et al., 2025). Furthermore, the concepts of "creating a creative and relevant learning environment" and "collaborative and friendly learning environments" are the foundation of Joyful Learning. The synthesis of Experiential Learning and Joyful Learning in the EJoy-ME model creates a powerful causal mechanism for environmental literacy. Direct Experience in Nature (Experiential Learning) triggers Positive Emotions (Joyful Learning), which build Emotional Affinity and Connectedness to Nature, ultimately predicting environmental literacy.

Three important concepts that are used for the components of this learning model namely environmental education, indigenous education (local potential and wisdom for learning resources), and marine ecotourism. Figure 1 describes the EJoy-ME components.

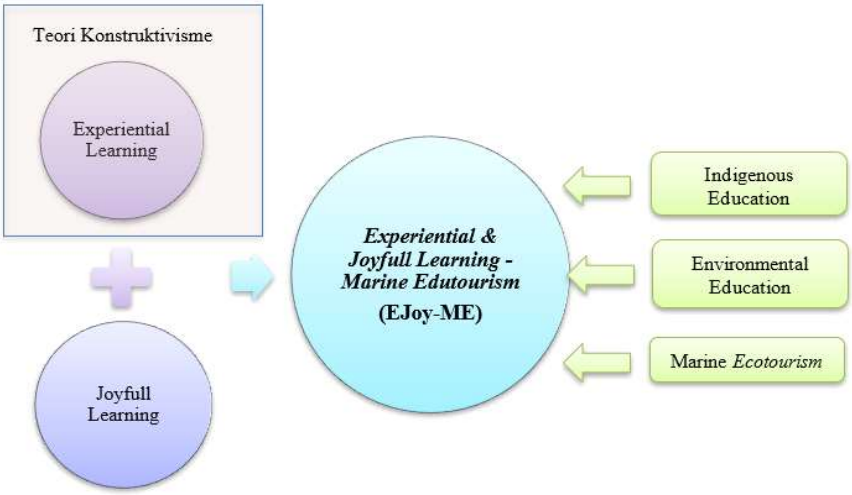

Figure 1. EJoy-ME learning model components

EJoy-ME consists of 6 steps in the syntax. Syntax describes the learning order and activities in the marine tourism area. The steps are illustrated in Figure 2. First, students are given fun activities to build learning motivation and positive emotions towards nature, such as snorkeling, canoeing, photography, and so on. Second, direct experience is given to students, such as environmental observation, identification of diversity, community interviews, discussions with guides, environmental case studies, and so on. Third, students reflect on the learning experiences they have gained, for example, realizing environmental problems. Fourth, students identify the causes of environmental problems. Fifth, students provide solutions to solve environmental problems and express pro-environmental actions that they can take as part of the solution to environmental problems. Finally, students are given other cases in the environment to enrich the experience they have gained.

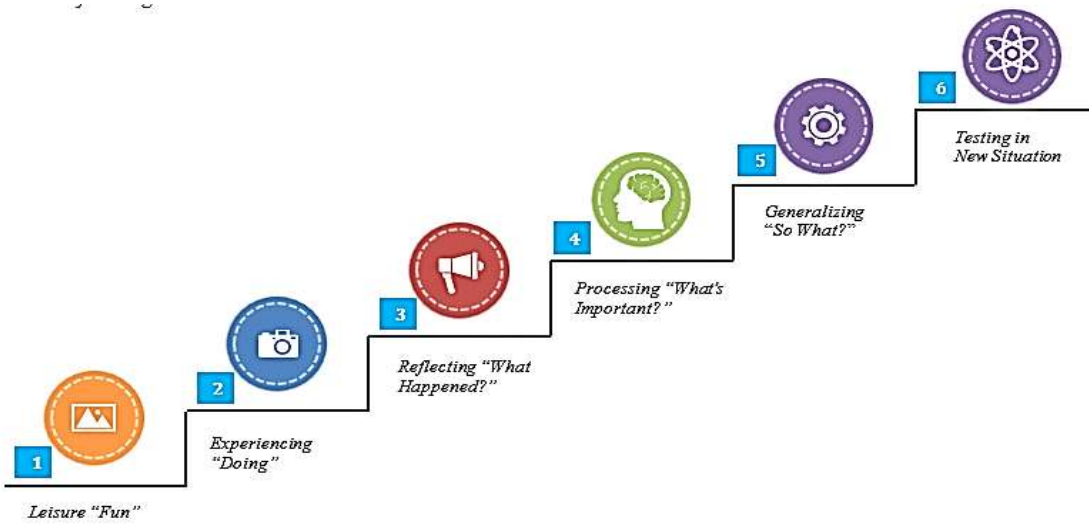

Figure 2. Syntax of the EJoy-ME learning model

Table 3. Syntax mapping of the Joy-ME model with david kolb's learning cycle (Morris, 2020)

EJoy-ME Model Syntax	Kolb Cycle Stage	Mapping Justification
1. Leisure	Concrete Experience	This step serves as an effective and physical preparation phase. It builds an informal and enjoyable foundation that is important for learner openness, which is a prerequisite for Kolb's *Concrete Experience.*
2. Experiencing	Concrete Experience	This is the core of the direct experience, where students are actively involved in real-world activities such as observations and interviews. This is the "feeling and doing" that defines *Concrete Experience*.
3. Reflecting	Reflective Observation	There is a direct correspondence. Both steps focus on reflecting on and observing experiences from multiple perspectives, with the goal of understanding what has happened.
4. Processing	Abstract Conceptualization	This is a sub-stage of Kolb's *Abstract Conceptualization*. This step focuses on the internalization, analysis, and processing of raw data or observations from the reflection phase, which is a prerequisite for generalization.
5. Generalizing	Abstract Conceptualization	This is the second sub-stage of Kolb's *Abstract Conceptualization*. Here, learners conclude and formulate abstract concepts or theories based on the information they have processed. This is the core of *conceptualization*.
6. Testing in the new situation	Active Experimentation	There is a direct correspondence. Both involve applying newly acquired knowledge or theories to practical situations to test their validity and make decisions.

Implementation Results

EJoy-ME Implementation Based on Local Potential of Wakatobi National Park, Indonesia

Below is an example of EJoy-ME implementation in the coral reef ecosystem using EJoy-ME syntax. Students directed by the teacher to study in one spot of the coral ecosystem in Wakatobi, for example, Sombu Coral Spot in Wangi-Wangi Islands. First step is Leisure "Fun", students get joyful attraction to gain focus and a new experience by snorkeling or diving. The second step is experiencing "Doing", students accompanied by a guide to identify hard and soft corals, observe biodiversity in coral ecosystems while diving or snorkeling, find bleaching or damaged corals, collect waste that is found in coral ecosystems, coral transplantation simulation, and have a deep interview with the *Bajo* society about how they utilize coral ecosystem components. The third step is reflecting "What Happened", students in groups discuss to identify and analyze problems found in the coral ecosystem. The fourth step is Processing "What is Important", still in groups, students discuss the cause of problems that were discussed in the third step before, discuss the benefits of coral reef ecosystems, and identify the consequences if the problem continues. The fifth step is Generalizing "So What", students discuss solutions to the problems that they discussed before. The last step is Testing in a New Situation, where students give a case study about some problems of the coral reefs ecosystem in another location, for example bleaching case in corals and damage coral reef ecosystem because of bomb fishing. All stages of EJoy-ME are guided by the teacher using worksheets.

EJoy-ME Implementation based on Local Potential of Kuala Selangor Nature Park, Malaysia

It is an example of EJoy-ME implementation in the coastal ecosystem KSNP using EJoy-ME syntax. Students directed by the teacher to study in one spot of KSNP, for example, the mangrove trail, where students can still see the ocean. First step is Leisure "Fun", students get a joyful experience through mangrove planting in the coastal area, KSNP. Students start to know the meaning of a coastal ecosystem through their feet, feeling the mud in the tidal area. Next step is Experiencing "Doing", students travel from the mainland, then explore the KSNP mangrove area via the mangrove trail towards the sea, and return to the mainland. Throughout the journey, students identify components of the coastal ecosystem, observe its biodiversity, differentiate between true and derived mangrove types, observe coastal areas polluted by waste, observe the damaged mangrove ecosystem, and observe interactions between ecosystem components. The third step is reflecting "What Happened", students start discussing in groups to identify and analyze problems found in the coastal ecosystem. The fourth step is Processing "What is Important", still in groups, students discuss the cause of problems in the coastal area, the benefits of mangrove ecosystems, and identify the consequences if the problem continues. The fifth step is Generalizing "So What", students discuss solutions to the problems that they discussed before. The last step is Testing in a New Situation, where students were given a case study of coastal issues such as mangrove illegal logging and the use of coastal areas for ponds. Worksheets guide students to do each step of EJoy-ME.

EJoy-ME Implementation based on Local Potential of Mangrove Point Klang River

It is an example of EJoy-ME implementation in Mangrove Point Klang using EJoy-ME syntax. Students were directed by the guide and the teacher to take a trip to the Mangrove Point Klang area. First step is Leisure "Fun", students get a joyful experience through the River Educational Trip, which has destinations

to Jetty Mangrove Point, Fisherman Jetty Sungai Sireh, and Fisherman Jetty Sungai Delek. Next step is Experiencing "Doing", students during the river trip can explore how mechanisms of river cleaning work through observation in Interceptor 002, Log Boom Sungai Pinang, Water Quality Monitoring Station Sungai Udang, and Interceptor 005. After the river trip, students can walk through the mangrove trail. Students can observe the mangrove ecosystem: observe the characteristics of mangrove ecosystems, identify biodiversity, differentiate between true and derived mangrove types, and observe the pollution of mangrove ecosystems by waste. The third step is reflecting "What Happened", students start discussing in groups to identify and analyze problems found in the mangrove and river ecosystem. The fourth step is Processing "What is Important", still in groups, students discuss the cause of problems in ecosystems, the benefits of waste management in the Klang River, the benefits of mangrove ecosystems, and identify the consequences if the problem continues. The fifth step is Generalizing "So What", students discuss solutions to the problems that they discussed before. The last step is Testing in a New Situation, where students give a case study about some problems of river and mangrove ecosystems, such as plastic waste and tourism impact on ecosystems. The EJoy-ME learning model implementation in this area is guided by teachers and students' discussion, help by e-worksheets.

Evaluation Results

Implementation of EJoy-ME Enhancing Environmental Literacy

The EJoy-ME learning model in a trial step proved to be quite effective in improving environmental literacy in the issue analysis aspect. This is shown by increasing the environmental literacy score for the issue analysis aspect of students' pre-test and post-test measurements. The results of the extensive trial can be seen in Table 3 and the graphs in Figures 3 and 4. The issue analysis skills of 160 students who were trial subjects increased with moderate criteria in the EJoy-ME model and low in the PBL model. The N gain score showed that the increase in issue analysis was quite effective in the EJoy-ME model and ineffective in the PBL model. Although it was included in the low and ineffective gain criteria, the average value of students' issue analysis skills in the PBL class still showed an increase. Based on N Gain comparison, the most effective in increasing environmental literacy is EJoy-ME implementation in Wakatobi Island, Indonesia. This is possible because Wakatobi, Indonesia, has the most potential sources of environmental education learning. The types of ecosystems that students can learn are many more, namely mangrove ecosystems, seagrass beds, coral reefs, beaches, to the *Bajo* community, who have local wisdom for students to learn. While KSNP and Mangrove Point in Klang, Malaysia, only provide coastal and mangrove ecosystems as sources of environmental education learning. This also proves how the role of nature as a source of learning has an impact on students' environmental literacy. The differences in initial student characteristics (prior knowledge and motivation) between students in Wakatobi and those in Malaysia are certainly distinct. This is reflected in pre-test scores. Therefore, N Gain is used to measure the increase in environmental literacy scores. In addition to being seen from the gain score, the MANOVA test also proved that the EJoy-ME model was more effective in improving environmental literacy when compared to the PBL model. It is show in Table 4.

It is proven that EJoy-ME is more effective in improving students' issue analysis skills compared to the PBL model. The ability to analyze environmental problems involves the interpretation and use of scientific knowledge to determine environmental problems, causes,

Table 4. Average environmental literacy score and gain score in the trial step

Treatment	Location of Implementation	Environmental Literacy Score		N Gain Score	Gain Criteria
		Pre-test	Post Test		
EJoy-ME	Wakatobi Island, Indonesia	30.17	73.92	0.63	Moderate, Quite Effective
	KSNP, Malaysia	48.33	77.12	0.58	Moderate, Quite Effective
	Mangrove Point, Malaysia	50.00	78.93	0.56	Moderate, Quite Effective
PBL	Controlled Class	34.92	53.08	0.29	Low, Not Effective

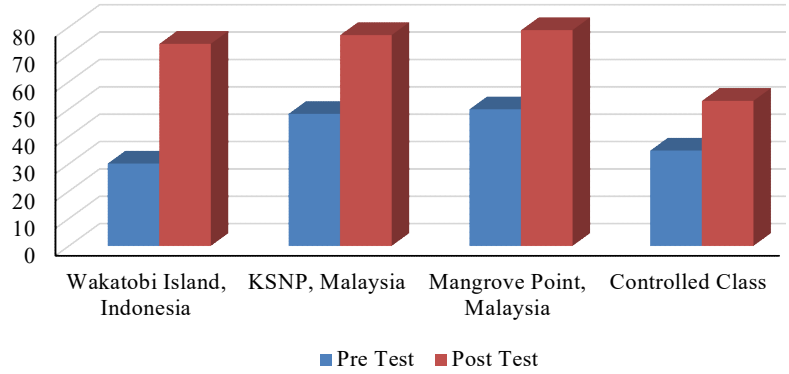

Figure 3. Graph of increasing environmental literacy score and comparison graph of experimental class (EJoy-ME Model) implemented in wakatobi, ksnp, mangrove point, and controlled class (PBL Model)

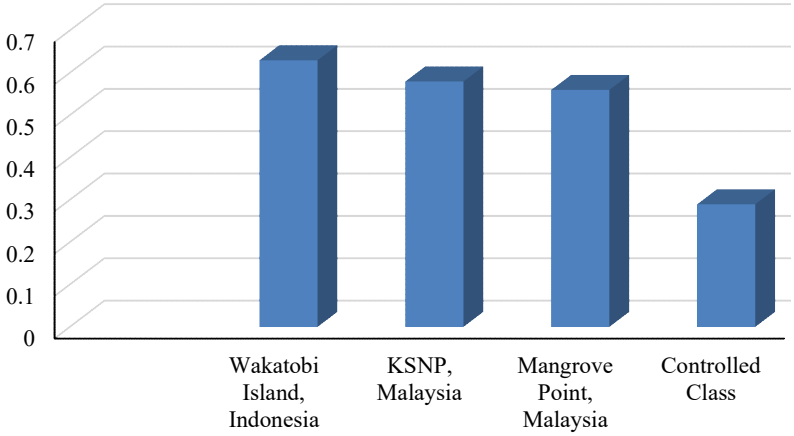

Figure 4. Comparison graph of N-Gain score

Table 5. Pairwise comparisons MANOVA test

Dependent Variable	(I) Learning Model	(J) Learning Model	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Environmental Literacy	EJoyME	PBL	20.833*	1.972	0.000	16.927	24.739
	PBL	EJoyME	-20.833*	1.972	0.000	-24.739	-16.927

geographic scope, manifestations, and possible consequences (Hollweg et al., 2011). Analytical skills are trained to find the cause of problems faced every day and then find ways to solve them (Kwangmuang et al., 2024). Analytical skills are an important part of problem-solving so that students can make the right decisions and take action in solving environmental problems. Indicators of environmental issue analysis skills in this study include: (1) identifying the causal factors (roots) of environmental problems; (2) explaining the causes of environmental problems; (3) making predictions about the effects of environmental problems or predicting possible consequences if the problem is left alone; (4) identifying alternative solutions to environmental problems. Although both use the case study method in both learning models, the PBL model is only implemented in class; there is no direct experience at the environmental case location, like the EJoy-ME model. Enhancing environmental literacy through experiential learning is more effective when it is conducted outdoor learning (Guerrero & Sjöström, 2025). Outdoor learning, such as field studies or field trips, has proven can enhance students' environmental awareness (Szczytko et al., 2018), so EJoy-ME fits this concept. Travel can enrich knowledge about culture and history; it is believed to foster enlightenment, growth, and broaden horizons (Yang & Lau, 2019). A closer relationship with nature was developed through interaction with the environment. Someone who has a good relationship with nature will take pro-environmental action.

The EJoy-ME learning model, based on the local potential of Wakatobi Island, KSNP, and Mangrove Point Klang River, has proven to be effective in increasing students' environmental literacy in Indonesia and Malaysia. The positive results of this model cannot be separated from the characteristics of the EJoy-ME learning model. EJoy-ME syntax was developed by integrating joyful learning strategies and experiential learning models. The experiential learning model successfully nurtures deep learning (Hayes et al., 2019) in students by providing real-world experiences (Gandolfi, 2024). Through discovery and exploration, students seek continuity between past and present experiences, so that their decisions will maintain continuity by either rejecting new information or updating their previous understanding. Students constructing meaning by actively engaged in posing problems, questions, investigating, solving problems, looking for solutions, or assuming responsibility (Do et al., 2023). Students through EJoy-ME will interact with the environment and be exposed to environmental problems. It will instill in their memory a sense of environmental responsibility and influence their pro-environmental decisions. It also helps students to explore environmental problems (Oktavianto et al., 2024) and try to solve the problem on their own (Anggoro et al., 2024). Outdoor activities in the EJoy-ME learning model, such as observation, deep interview, discussions, case studies, guided inquiry, and simulations, can increase environmental knowledge (Hendratno et al., 2024; El-Aasar et al., 2024), attitude (Goldenberg et al., 2024; Kalafatis et al., 2019; Ne'matullah et al., 2024). In addition, experiential learning in EJoy-ME can facilitate students' bonding or connection with nature (Wang, 2025) to increase their environmental literacy. The second and third syntax, experiencing and reflecting, have a significant impact. Direct field experience through various meaningful activities and reflecting on the knowledge gained from direct experience has the maximum impact on environmental literacy. Reflection is a key component of learning that needs to bridge knowledge, understanding, and practical experiences (Radoviæ et al., 2023).

Besides experiential learning, joyful learning in EJoy-ME also has a positive impact on students.. Joy in the learning process can increase

internal motivation. Joyful learning starts by creating a pleasant environment in learning (Rajesh Raj et al., 2015). EJoy-ME utilizes marine tourism attractions to provide joyful learning experiences, such as snorkeling, diving, mangrove planting, fauna interaction, and photography. These activities can push positive emotions, remove stress and anxiety (Sundaram & Ramesh, 2022), and then students feel happy in learning. People in happiness tend to do better in life (Lucardie, 2014). Besides that, through joyful activities in EJoy-ME, students feel like playing but are actually doing meaningful learning. The beauty of ecosystems and biodiversity in marine tourism also makes students feel amazed and curious about marine ecosystems, even to the point of making students want to protect the environment. Feeling the need to protect encourages pro-environmental action, which in turn increases environmental literacy.

Self-Determination Theory (SDT) by Deci and Ryan states that humans have three basic psychological needs, namely "autonomy" that individuals need to feel that they have choices, can act according to their values, and are not controlled by external forces, "competence", namely the need to feel effective and capable in interacting with the environment, and "relateness", namely the need to feel connected, belonging, and cared for by others (Kalungwizi et al., 2020; Li et al., 2024). EJoy-ME, with its experience-based and fun nature, is inherently designed to meet these three basic psychological needs of students, which in turn will foster intrinsic motivation to learn about the marine environment. The fun activities in EJoy-ME give students a feeling of freedom and choice, which is the essence of autonomy. Students will feel free to explore. EJoy-ME's collaborative and nature-based activities effective in building connetedness, namely teamwork, connection with nature, and positive interaction with teachers and guides.

Students' Response to EJoy-ME Learning Model

Based on the students' responses to the questionnaire, the EJoy-ME learning model received good criteria responses in terms of active student involvement (student-centered) and very good in aspects of joyful learning, experiential learning, material understanding, environmental education, learning motivation, and the practicality of the EJoy-ME model. Student response data are presented in Table 6.

Table 6. Student response data to the EJoy-ME model

Rated aspect	Score	Criteria
Student Centered	3.8	Good
Joyful Learning	4.3	Very Good
Experiential Learning	4.2	Very Good
Material Understanding	4.2	Very Good
Environmental Education	4.3	Very Good
Learning Motivation	4.1	Very Good
Model Practicality	4.3	Very Good

The positive responds of the EJoy-ME learning model are a reinforcement that this learning model is suitable for applied in environmental education to enhance environmental literacy. Seven aspects assessed by students include: student-centered, experiential learning, joyful learning, understanding of the material, environmental education, learning motivation, and practicality of the model. Very good responses to the seven aspects indicate that: (1) EJoy-ME can optimize student activity in the learning process; (2) EJoy-ME can foster a sense of joy

in the learning process, students learn without burden; (3) students get a very positive environmental learning experience in the marine ecosystem; (4) students get additional understanding of the material about the marine ecosystem and its conservation; (5) students apply environmental ethics during the implementation of EJoy-ME and feel the results of environmental education; (6) students grow motivation to learn about the environmental ecosystem and its conservation; (7) students feel that the EJoy-ME syntax is very practical to implement as a learning process.

The seven assessment aspects mentioned above are significantly interconnected. Excellent student understanding of the material is strongly supported by strong learning motivation and the experiences gained. Excellent student experiences are also attributed to the highly valued student-centered approach. Excellent student motivation is also influenced by the joyful atmosphere during the learning process.

This study still has limitations in its implementation, namely the relatively small sample size to represent both countries and the non-randomization of the sample, which limits the generalizability of the results. Furthermore, there is potential for researcher bias, as the researcher also acted as a model developer. Although the intervention period was deemed sufficient, a longer intervention period would certainly have produced more representative research results.

CONCLUSION

The EJoy-ME learning model can enhance students' environmental literacy in the issue analysis aspects, both in Indonesia and Malaysia. The implementation of EJoy-ME in the Wakatobi Islands, Indonesia, showed the best results in increasing environmental literacy compared to implementations in KNSP and Mangrove Point, Klang River, Malaysia. Student responses to the seven aspects assessed were also very good, namely experiential learning, joyful learning, understanding of the material, environmental education, learning motivation, and practicality of the model. Whether students respond to student-centered aspects of EJoy-ME is a good criterion. The implementation also indicates that EJoy-ME is feasible as be environmental education learning model that is effective in enhancing environmental literacy in the domain of issue analysis. The broader implications of using EJoy-ME for this maritime nation are to transform ecotourism assets into living laboratories for environmental education. Potential further research from the development of this research includes conducting longitudinal studies to measure the long-term impact of EJoy-ME on students' pro-environmental behavior and testing the adaptation of the EJoy-ME model in non-marine ecosystems (such as forests, mountains, and others).

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