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Marine environmental education learning system recommendation model based on student needs analysis in Indonesian coastal areas

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Abstract

This paper presented the development of the Dick and Carry model steps 1 to 4 of, namely the identification of educational objectives, educational analysis, analysis and context of the learner, and the formulation of performance objectives. The study was conducted from January to April 2020. The participants in this study were high school students from the coastal region of North Jakarta. The sampling technique used in this study was random sampling. The instruments used to collect the research data are the questionnaire/questionnaire, observation, and interview. The data were analyzed in a qualitative description. The results of this study indicate that the formulation of the learning objectives is that students should receive marine education that is integrated with natural science learning in schools, students should be taught using methods of learning that are contextual within the daily problems in the student's home environment, i.e. problem-based learning / problem-solving models, students should be taught using interactive learning aids such as media based on information technology such as mobile learning, the assessments to be developed include 3 aspects namely cognitive, affective and psychomotor.

Keywords: Marine environment education, Indonesian coastal areas, Problem-solving, Mobile learning, Student assessment.

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1. Introduction

Indonesian Territorial Sea is 12 miles measured from the baselines of the Indonesian archipelago and 65% of Indonesia's 467 regencies/cities are located on the coast. In 2018, Indonesia's population will reach over 265 million people and it is expected to grow to 271,066.40 by 2020, where over 80% live in coastal areas (Badan Pusat Statistik, 2019). Indonesia has strategic value for planet Earth. Indonesia sits between the Indian and Pacific Oceans, which makes Indonesia rich in food sources for marine life. According to (Spalding, Kainuma and Collins, 2010), Indonesia's mangrove forests cover an area of approximately 3,189,359 hectares, reaching almost 60% of the total mangrove area of Indonesia. 'southeast Asia. Indonesia has 139,000 square kilometers of marine protected areas. Another bountiful wealth of Indonesia is the world's third-largest producer of fishery products, after China and Peru. But as Indonesia's fish production increases, which is also happening in all countries of the world, Indonesia is threatened with a decline due to a double crisis of degradation of marine ecosystems and overfishing (World Resources Institute, 2019). Managing the wealth of coastal biological resources and protected areas remains a major challenge. According to research by the Oceano Research Center, 7% of Indonesian corals are classified as very good. While 27.18% were classified as good, 37.25% were in good condition and 30.45% were in poor condition (World Resources Institute, 2011) and the last half-century of degradation of coral reefs in Indonesia has dropped from 10% to 50% (Salinas-de-León, 2013).

Causes of damage to marine natural resources include development in coastal areas, disposal of wastes from various activities on land and sea, sedimentation due to damage to upstream areas and in watersheds, mining, destructive fishing using cyanide and prohibited fishing gear, bleaching of corals due to climate change and exploitation of coral reefs. Indonesia has lost most of its mangroves. Besides, sea damage is also caused by climate change. The global climate is warming, causing bleaching conditions that have occurred in tropical seas every year for the past 30 to 50 years. Coral bleaching occurs when algal plants that live in reefs out of the network if exposed to a slight increase (1 to 2 0C) (Dove, Hoegh-Guldberg & Ranganathan, 2006). Indonesia is the second-largest plastic bin in the oceans after China. Plastic waste landfills in Indonesia are estimated to reach 24,500 tonnes per day, or 8.96 million tonnes per year (Putri, Fujimori & Takaoka, 2018).

The state of a healthy Indonesian sea is highly anticipated due to several functions or roles of the sea for Indonesia, among others: The sea produces great marine natural resources both in quantity and diversity of its outcomes, center economic growth, source of animal protein very beneficial for the human body, source of foreign exchange, expanding employment opportunities, as a water transport route, as a water reserve, as an object of educational research and research (World Resources Institute, 2019). But this is not supported by the behavior of the people who live on the coast.

The importance of the ocean and coastal conditions to global conditions is reflected in National Standards for Science Education, which include content standards related to the role of the oceans in natural systems, climatic conditions, the diversity of life, and the geological history of the Earth. One of the programs in Georgia State consists of conservation-based rehabilitation, research, and education missions capable of reducing the level of damage to the marine environment (Martin et al., 2015). One very successful program uses the marine environment as an integrated context between disciplines and subjects (McDonnell, 2001) and the other used the relationship explored between marine science standards and scientific content (New Jersey Sea Grant College Program, 2000). Mifsud and Verret (2015) produced a model linking continuing education to local marine conservation aimed at fostering a sense of belonging within the community by encouraging their involvement in the management of local marine areas. conservation, as the marine environment is a central component of Malta's local environment. and their ecosystem services play an important role in supporting the economy and human well-being. In line with research by (Stepath, 2004), there is a learning relationship related to awareness, attitudes, and skills for participatory action in the context

of community education programs regarding the marine environment. As environmental awareness increases and attitudes increase, minimal changes in the skills of environmental actions will follow.

Marine education is a part of environmental education that aims to increase general awareness about the environment and marine issues. The weakness of basic education and the lack of popular scientific publicity and educational activities have meant that the level of awareness of Indonesians living in the maritime area is low. The school's curriculum approach, centered on learning, aims to contribute to the mitigation and adaptation of damage caused by the sea to support environmental conservation, especially at sea (Jay & Jones, 2019). Besides, the need to provide human resource (HR) development from an early age to the younger generation of seafarers so that they are motivated to love the sea and make it easier to explore marine science. Education can be done formally through the world of education as well as informally for the community. Tsai et al. (2017) proves that specially designed educational materials are very useful in increasing student creativity and scientific reasoning. Mobile learning is a type of learning where students obtain learning materials using portable wireless devices such as cell phones, personal digital assistants (PDAs), wireless laptops, personal computers, and tablets that can be used anytime and anywhere. Educational materials packed in a learning car or on a smartphone can increase learning motivation to increase learning outcomes. Smartphone apps can also be a cellular learning lab (Ong & Poljak, 2019).

Marine education should be given to children from an early age so that future generations will understand the potential of Indonesia’s marine resources. The current unresolved problem related to marine education is that education is currently still limited and the focus of the existing curriculum tends to be land-oriented so that students are less interested in marine science. Marine materials are part of the National Maritime Curriculum which should also be compiled by the Curriculum Center of the Ministry of Education and Culture.

The main contribution of this study is to increase public understanding of the existence and function of coastal habitats, which is one of the factors that hurt coastal and marine ecosystems. Increasing the understanding of a matter, in this context, is marine, which has always been proven to increase awareness and awareness of this matter. Science or natural science subjects in junior high school are known to be closer to the discussion of marine literacy than the social field. So that through the integration of marine insight with natural science subjects, it is hoped that it can increase the environmental awareness of people living in coastal areas of Indonesia.

By paying attention to the different opinions above, in the effort to achieve the goals of marine environmental education, a marine education program is needed to transfer maritime knowledge and critique all Indonesian maritime issues that have arisen over the century. 21 in particular. It is certain that the development of a based marine education program online smartphone-should increase the awareness of the maritime environment among students in Indonesia so that they can live in the maritime area. In the same vein, marine education program has created a smartphone to educate students about maritime environments.

2. Methodology

Research is a preliminary study that includes steps 1 to 4 of development, research and development (R&D) procedure Dick and Carry’s, namely the identified educational objectives, conducting an educational analysis, analyze learners and context) and write performance Objectives (Brinkerhoff, 2001). The study was conducted from January to April 2020. The participants in this study were high school students from the coastal region of North Jakarta. The sampling technique used in this study was random sampling. The instrument used to collect the research data was a questionnaire/questionnaire. The data were analyzed qualitatively in stages: tabulation, coding, and description related to the object of the study. The step of this research can be seen in Figure 1. The first step is to review and select the data related to the important problem. The second step,

grouping data or information according to aspects of needs and problems. The third step, the tabulation of data, to reveal the class, nature, type, and frequency of the data, which facilitates reading, categorization, and analysis. The fourth step, the analysis of qualitative data. The fifth step, interpret the results of the analysis according to the research problem and conclude.

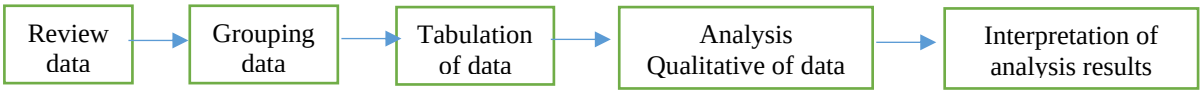

Figure 1: Methodology of research

3. Results and Discussion

3.1. Identification of Instructional Goals

Objectives are identified through syllabus analysis and RPP of environmental pollution material in integrated science learning in junior high schools in the coastal areas of North Jakarta. The results of the analysis can be presented in **Table 1**.

Based on the analysis relating to RPP / syllabus and material, the formulation of learning objectives is as follows:

a. Students need to get an education in the marine environment integrated with science learning in schools

b. Students need to be taught to use learning methods that are contextual in daily problems in the student's home environment, namely problem-based learning models / problem solving.

c. Students need to be taught to use interactive learning media such as information technology-based media such as mobile learning.

d. The assessment that must be developed includes 3 aspects, namely cognitive, affective and psychomotor.

Table 1. *Identification of Learning Devices*

No.	Analysis Phase	Analysis Results
1	Needs Analysis (Material and Curriculum)	The curriculum used at the Jakarta Coastal Region Junior High School is the 2013 curriculum. The science learning undertaken is integrated science learning, which is a holistic approach combining the fields of science studies into a single unit of discussion. The environmental pollution learning material is in the seventh grade class even semester. Assessments made include cognitive, affective and psychomotor assessments. But the learning method used has not used a scientific approach and the media used are limited to student textbooks. Environmental pollution material still looks very general and not contextual based on the problems of students in the Jakarta coastal area. The frequency of teachers using instructional media is 19.67 always, 10.6 often, 42.9 sometimes, 28.3 never.
2	Needs Analysis (Assessment System)	Through the questionnaire given to students, information was obtained that there were still students who were not familiar with the problem of environmental pollution in the Jakarta coastal area. The analysis showed that 45% of students did not understand the concept of the sea in Indonesia, 37% of students

did not know that the Jakarta coast had the potential for natural resources but there was also environmental pollution in the form of garbage and waste. This is because 37.3% of students have never learned about marine environmental education integrated with learning in schools. As much as 86.07% of students feel the need is marine environmental education in coastal areas especially Jakarta according to their place of residence.

3.2. Results of Conduct Instructional Analysis

At this stage obtained several instructional objectives regarding the skills that are relevant and needed by students to achieve competencies or learning objectives. Students need to get a marine environmental education that is integrated with science learning in schools, so the RPP of environmental pollution material is designed to include content of Jakarta's coastal marine environmental problems in integrated science learning in seventh grade even semester. In preparing the lesson plan the selection of learning methods is to use a problem-based learning model / PBL and to use learning media based on mobile learning that can be accessed by students through smartphones their respective. The assessment that must be developed includes 3 aspects, namely cognitive, affective and psychomotor. Cognitive aspects were assessed based on students' marine insight, attitude and psychomotor aspects were measured through attitude questionnaires and behavior questionnaires.

3.3. Results of Analyze Learners and Contexts

The results of character analysis of junior high school students in the North Jakarta Coastal Areas are:

a. Student Internal Factors

Table 2. *Student Internal Factors Analysis*

No	Factors that influence	Results
1	Physical Conditions of Students	▪ 1.01% have permanent body defects ▪ 3,03% have serious illness ▪ 6.06% have diseases related to the five senses
2	Interest	▪ Lazy: 37% of students feel lazy working on science questions ▪ Bored: 15% feel bored with learning science in school ▪ 48% of students chat with friends while learning science
3	Motivation	▪ 22.01% motivation to learn science is still low
4	Cognitive Ability	▪ 74% of the results of the Natural Sciences test are still below the minimum completeness criteria ▪ 49% of students still feel slow working on science questions given by the teacher ▪ 59% of students feel understanding about science is still low
5	Curiosity	▪ 18.17% have low curiosity
6	Confidence	▪ 71% of students lack confidence, like when students communicate the results of the discussion in front of the class
7	Adaptation with	▪ 27% of students are not good at adapting to friends

	Friends

b. Student External Factor

Table 3. *Analysis of Student External Factors*

No	Factors	Results
1	Parents	29.3% of students received less attention and support from parents both in the form of learning motivation and learning infrastructure
2	Teacher	▪ 40% of students think that teacher preparation in teaching is still lacking ▪ 30% of the ability of teachers to explain learning is still low so it is not understood by students ▪ 37% of teachers explained that they were not coherent and contextual ▪ 53% of teachers with less class answering questions from students
3	School Facilities and Infrastructure	46.5% of schools have adequate infrastructure such as laboratories
4	School Comfort	▪ 93% of schools have adequate air ventilation ▪ 35% of students still feel the large number of students in class makes it uncomfortable ▪ 50% of students feel garbage around the school makes students uncomfortable
5	Rules that apply in the School	45% of students feel schools have upheld the rules of discipline

3.4. Results of the Stages of the Formulation of Special Objectives/ Write Performance Objectives

From this stage obtained several formulations of specific learning objectives regarding the awareness of the marine environment that students must have, including the following:

a. Students are skilled in using smartphone applications about education of the marine environment

b. Students are able to solve contextual marine environmental problems

c. Students have marine insight

d. Students behave to preserve the marine environment

e. Students behave pro marine environment

Based on the research results above, students need to get an education in the marine environment integrated with science learning in schools. This is consistent with the results of (Bramasta, 2018), the environmental education taught at the school is able to foster students' caring attitude towards the environment. The formation of the character of students who have an attitude of caring for the environment should be done early on. In delivering material on issues of population and environment in an integrative way by incorporating population and environmental issues into almost all subjects, so students have rational knowledge, attitudes and behavior and are responsible for population and environmental problems.

For this reason, it is necessary to have an integrated program in all disciplines and other subjects connecting marine science and science content. Teachers do not need to jump right into the

ocean to teach students about the sea. Learning media can be used to facilitate it. People who live in the mountains of Indonesia far from the coast can also learn about the sea because Indonesia is an archipelagic country that consists of 70% of sea water (Cleary et al., 2015). Martin et al. (2015) describes efforts to educate local students, the Georgia Sea Turtle Center develops science education programs that are integrated with marine conservation. The implication is that now the Georgia Sea Turtle Center is the official field trip location for all third classes at this location.

Efforts to integrate Population Education and the Environment in learning in schools, especially intended for subjects that pay attention to the environment on one side and population on the other side as a synergistic educational program. There are a number of things that need to be understood to better understand the concepts of Population Education and the Environment, where two of them, namely the environment and population science are in direct contact with its integration in the context of learning. Based on the analysis of education stakeholders said they support the existence of environmental education that can be included in local content and implemented in daily life at school. Analysis of the percentage of mastery of knowledge, attitudes and behavior of elementary school students have fully understood about environmental education behaves to protect the school environment. Ali (2018) explained that social studies material for junior high schools can also be integrated into environmental education through student competency standards to be developed into basic competencies that can describe and apply the results of the material obtained to produce outcomes and outputs. Outcome of the results of the application of environmental education students can have a behavior will care about the environment from aspects of knowledge, attitudes and skills to be able to respond to caring for and preserving the surrounding environment. The output of the application of environmental education students has the skills to make trash bins or sort organic and non-organic waste. In addition, students are also equipped with knowledge about waste recycling that can be used for environmental preservation and has an economical price. So that researchers believe that the curriculum that has been developed at this time both at the level of elementary school / junior high school is very appropriate in integrating environmental education into other subjects thematically. However, integration requires a special design instructional guideline in the implementation of learning so that environmental education can be delivered correctly and the expected outcomes can be achieved.

In the environmental education learning process, students must be actively involved (involved in their mental processes) in constructing their knowledge, attitudes and skills. The philosophy that must be used in learning is constructivist with problem-based learning (PBL) approaches, contextual learning, inquiry, and value clarification. The emphasis of learning is not on mastering concepts but changing students' attitudes and mindsets to be more concerned with environmental issues, able to apply the principles of sustainability and environmental ethics. Therefore, in the development of environmental education programs it must be aimed at aspects of human behavior, especially human interaction with the environment and the ability to solve environmental problems. Thus, the teacher is not enough just to have an understanding of the environment, but also must have a basic understanding of humans. In these ways students are expected to gain more meaningful knowledge, attitudes and skills, be able to apply in everyday life and transmit it to the family environment and the surrounding community. In this way a community that has a positive attitude, cares for the environment and is able to play an active role in solving environmental problems will be formed and be able to apply the principles of sustainability and environmental ethics in their lives.

Yanto (2018) explains that the effect of problem-based learning models on students' critical thinking skills and science learning competencies in the cognitive, affective and psychomotor domains. Overall problem-based learning models can improve critical thinking skills and student learning competencies. Based on these results, the model of learning based on marine environment problems in Indonesia needs to be recommended so that students are trained to think critically and behave well toward the environment.

El Batri et al. (2019) explain the active involvement of students in the study of local and tangible environmental problems contributing to significantly increasing the acquisition of environmental knowledge related to the science syllabus and also its motivation for adopting environmentally friendly behavior. The active learning method emphasizes the active involvement of students in learning. Thus, it is highly recommended that the active learning model and IT / digital-based media about environmental education not only contain images but also audio in the form of documentary films about the problems of the sea around students (Indonesia) so that they can be motivated to adopt environmentally friendly behavior. Students need to be taught to use interactive learning media such as information technology-based media such as mobile learning. Cellular technology has significant potential to support learning and teaching. The use of smart phones related to pedagogy becomes a new innovation in the development of learning materials. Research conducted by (Lu & Liu, 2015), the concepts of digital game-based learning to design innovative marine learning programs that integrate augmented reality (AR) with physical and virtual learning material so as to encourage students to engage in an interactive learning environment that makes learning become fun and interesting. This program introduces marine ecology and water resources in Taiwan to students in the School. The results show students are very confident with learning activities, students gain knowledge and innovative learning programs specifically help students who are underachieving in their learning performance. Game technology, through virtual means, allows players anywhere at any time to explore areas they might not have, if not experience, and many experience scenarios to benefit from global involvement in marine conservation. New game platforms are being developed to teach science, and better connect people with nature, especially the marine environment (Colleton et al., 2016).

Ameerbakhsh et al. (2019) creating online games based on mathematical simulations of fisheries management, modeling fish populations growing and shrinking with the transfer of stocks through fishing. The results show a significant benefit to both the teaching approach, and many prefer the combination of expert demonstrations with exploration of games. Other research is developing a mobile learning management system to overcome the difficulties of outdoor learning activities. The results showed that the mobile learning model with the system developed by this study had a positive and significant effect on students' cognitive achievement (Lai et al., 2015). Fauville et al. (2018) mapped the European landscape in barriers to teaching children aged 12-19 years about the sea, through application, collective intelligence, facilitation methodology and problem solving. The influence map shows 8 themes: Perceived Awareness and Knowledge; Policy and Strategy; Involvement, formal education sector; Ocean itself; Collaboration; The connection between humans and the ocean and the Blue Economy, has the greatest influence and impact on marine education. "Knowledge, Awareness and Perception" in Phase 1, provides the highest level of overall influence in teaching children ages 12-19 about the ocean. This map and study serve as a road map for policy makers to implement mobilization actions that can reduce barriers to teaching about the ocean. Examples of such actions include free marine education learning resources such as e-books, virtual laboratories or handson experiments.

Ibe and Abamuche (2019) examines the content of audio-visual technology that has been integrated and tried in the teaching and learning process and improvement in achievement and interest is noted, teachers must try to use audio-visual material during Biology teaching and learning. Learning and using new technology will provide a way out for Nigeria to join and catch up with developed countries – that Science and Technology has become their dominant culture. Finally, curriculum planners must encourage and integrate the use of audio visual in the curriculum for teaching and learning because it involves students who actively participate in lessons and manipulate learning equipment.

In addition to learning models and media, student assessments that must be developed include 3 aspects, namely cognitive, affective and psychomotor. The aspect of human psychology, namely cognitive abilities, is positively related to the environment. Empirical estimates show that

when cognitive abilities increase to one standard deviation, awareness about climate change increases by about 19%. A person's cognitive ability turns out to be able to grow environmental awareness (Salahodjaev, 2018). Environmental education learning is the formation of attitudes, personalities, behaviors, and the real participation of every human being in efforts and efforts to protect / save the environment. Problem solving can help students how to transfer their knowledge to understand problems in real life Problem solving can help students to develop new knowledge and be responsible for the learning they are doing. Besides problem solving can provide opportunities for students to apply the knowledge they have in the real world (Rickinson, 2001).

Ardan (2016) found that product learning tools developed in the form of lesson plans, class X biology textbooks with local wisdom for teachers and students Student Activity Sheet, Micro Learning media materials for biodiversity, power points for biodiversity, ecology and science materials the environment, Media Puzzle maps and biodiversity of ecosystems can significantly improve student learning achievement before and after the use of developed learning tools. The results of attitudes to increase student desires in preserving the environment show that there is a change in the attitude of students to be better at preserving the environment both before and after the use of learning tools. Plans for environmental pollution learning materials that incorporate the content of Jakarta's coastal marine environmental issues in class VII integrated science learning namely the selection of learning methods is to use problem-based learning / PBL models and use-based learning media mobile learning that can be accessed by students through smartphones their respective into a recommendation model in learning the marine environment of the Jakarta coastal area with student assessments covering 3 aspects namely cognitive, affective and psychomotor.

Based on the results of the analysis of the character of junior high school students in the North Jakarta Coastal Region caused by internal and external factors, the factor of student interest is one of the causes of students to get involved in environmental preservation. Niankara and Zoungrana (2018) explained students' interest in ecosystem services and sustainability explained their awareness and optimism about environmental issues such as air pollution, water shortages and greenhouse gas emissions in 50 countries around the world. The study found that in addition to factors such as age, sex, immigration status, and economic, social and cultural status, interest in the biosphere was a significant determinant of students' environmental awareness and optimism. One's environmental awareness will increase when one's interest in ecosystem services also increases. For this reason, in developing students' interests, learning concepts that are integrated and interesting for students are needed.

Hartley, Thompson and Pahl (2015) research suggests that basically, students are quite worried about marine trash and recognize some of the causes and effects of the problem. Students are also reported to take a number of actions to help solve problems. After the intervention, students are significantly more concerned, have a better understanding of causes and negative impacts, and report engaging in more actions to reduce the potential causes of marine trash. Understanding students' perceptions and behavior is very important because they represent current and future actors and potentially important sources of social influence among their peers, parents and community.

So, based on the analysis above, we obtained some formulation of special learning objectives regarding the awareness of the marine environment that students must have, including the following: Students are skilled in using smartphone applications about marine environmental education, Students are able to solve marine environment problems contextually, and students have marine insight. Friedlander (2018) examines the loss of local wisdom that can reduce community awareness and society. The current global downturn in marine health requires innovative solutions that can benefit from indigenous knowledge and practices, which in the past have led to sustainable use of marine resources. Heery et al. (2018) explained that increasing urbanization in the tropics and subtropics, understanding urban coral reefs may be important to anticipate conservation challenges

in the future. This research is a reference to provide marine insight in urban coastal areas in Indonesia such as Jakarta, Bali, Manado and other large cities in Indonesia.

Stepath (2004) discusses that community education programs have placed a large focus on increasing environmental awareness, while related changes in ecological participatory action skills have failed to materialize. To increase the awareness or knowledge of stakeholders in the community it is important to realize that there is a problem, but this change does not seem to have much effect on improving ecological problems. As environmental awareness increases and attitudes increase, small changes in ecological action skills will follow. Mei, Wai and Ahmad (2016) examine the exploration of the need for socio-psychological factors among Malaysians in qualifying levels of awareness and environmental behavior. The results indicate the current level of environmental awareness and behavior, according to four categories; water pollution, air pollution, waste management, and climate change are still low.

Gough (2017) examines environmental concerns about marine pollution and ecotoxicology, among other environmental challenges, should be included in environmental education. Locritani et al. (2019) stated that students changed their perceptions about the causes of coastal waste and its derivative problems, and increased their knowledge about the main sources of marine waste and the role of the sea in the transport and sedimentation of waste along the coast.

4. CONCLUSIONS AND RECOMMENDATION

Based on the identification of instructional objectives, instructional analysis, identification of student characteristics, and the formulation of specific objectives it can be concluded the formulation of learning objectives is that students need to get an marine environmental education integrated with science learning in schools, students need to be taught using learning methods that are contextual in their daily problems in a student's home environment, which is a problem-based learning model / problem solving, students need to be taught using interactive learning media such as information technology-based media such as mobile learning, assessments that must be developed include 3 aspects namely cognitive, affective and psychomotor. So, the recommended model of environmental learning is that the selection of learning methods is to use problem-based learning models, the use of learning media based on mobile learning, cognitive aspects assessment is assessed based on students 'marine insights, also aspects of attitude and psychomotor in growing awareness of students' marine environment. For future research, we will focus on creating a learning application called '"EduSea". This application contains material, videos, discussion materials, practice questions and student discussion sheets about marine insight for students on the coast.

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