The development of learning model for natural science based on environmental in conservation area of Bengkulu University

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Abstract. Research on development of a learning model for Natural Science base on conservation area in Bengkulu University has been conducted. The research methods were referred to the standard steps of Research and Development. Stage activities were (a) analysis of needs, (b) observation of the ecological aspects of conservation area as a learning resource, and (c) instructional design based on conservation area for secondary school students. The observation results on the ecological aspects revealed that the diversity of plants and animals, at the conservation area were sufficient as a source for learning. The instructional design was prepared in three phase activities namely Introduction-Exploration-Interpretation (IEI), and then it was compiled in a teaching material Based on Surrounding Natural Environment” (BSNE). The results of a limited scale trial at secondary school students in two districts of Bengkulu province showed that, the students who learned using the IEI model at the conservation area have a good performance and critical thinking. The product from the research is a book named BSNE that can be used for teachers and conservation practitioners in doing the learning activities on environmental conservation which involved public participation.

1. Introduction

The learning process by making use of the natural environment provides an opportunity for students to acquire the ability in various forms of skills in observing, clarifying, predicting, measuring, summarizing, and communicating as the basic skills of a scientific process and the ability of science [1]. The skills associated with the learning objectives of Natural Science were formulated in the curriculum of elementary and secondary education. Natural science subjects contains about events or phenomena of nature, the process of identification and formulation of the problem of the observation of natural phenomena as well as a way to find the answers and to solve the problems. Students can analyze a fact from natural phenomena. The use of the environment as a learning resource has an important meaning for students and teachers as it contributes to the physical and mental development of children. Learning science with natural settings around can improve the learning capacity of children, where they can learn more deeply through the object and observed directly. Sites such as parks, gardens, forests, or conservation areas are ideal for learning resources. Information and research data from conservation areas and protected forest areas are very helpful in the process of natural science learning based on the natural environment around.
The University of Bengkulu has developed a conservation area for several local plants and animals on campus. The objectives of the conservation program are as follow: (1) to provide the quality of teaching and learning, (2) to conduct research and science development under Natural Conservation Education for a Better Life, (3) to carry out community service for strengthen the insight of Natural Conservation Education for a Better Life, and (4) to carry out the 3G Green Teacher, Teaching Green, Green School. Conservation activities are used as research and education facilities for students from elementary, secondary, and university level [2-4].

The use of conservation areas as a learning resource for elementary and secondary school students does not have optimal yet. Observations showed that the process of learning science in elementary and secondary school was still predominantly on textbook oriented, lecture methods, and most dominant on discussion [5]. These conditions were due to (1) the existing curriculum was limited to the depth of the content and the wide of the scope of the study, (2) The teachers were limited by the desire to teach on the demands of the content to be tested, so that learning was more content oriented, and (3) The teachers were lack of ability in developing learning with the setting of the natural environment around [6]. Developing learning based natural science that is effective and efficient need to be assessed through a comprehensive study. Teachers need to be trained and given insight in developing learning with the approach of the natural environmental around [5]. Technically, the facilities in the conservation area are quite safe and comfortable as a place to study for elementary and secondary school students [7].

2. Methods
This research development study referred to Research and Development [8,9]. In general, the steps of development are (1) review the curriculum for science subjects, (2) observe the ecological aspects of conservation area as a learning resource, and (3) design instructional based on the conservation area for secondary school students, and (4) limited trial on two middle schools namely SMPN 1 Ujang Mas Kepahiang and MTsn Kota Bengkulu, with the number of students each class 20-25 students. The lesson is done through two sessions, namely the first session, held in the classroom (indoor) to provide an introduction and to look the initial knowledge about the concept of ecosystems and the diversity of living things. The second session, held outdoor classroom focus on exploration activities, namely observations ecological aspects in the conservation area.

Parameters of students’ achievement that were measured in this study were the ability of students’ thinking critically and students’ performance. They consisted of the ability to observe, measure, process data, communicate and inferring. The instruments that were used to measure students' skills in using practicum equipment used observation sheets, while to measure students' critical thinking skills used written test. The data of the research were analyzed using descriptive analyzing. The findings in the lesson were used as materials for evaluation and revision of the development of learning model.

3. Results and Discussion
3.1. Learning Model Design
The 2013 National Curriculum describes learning with scientific approach. It means as a learning process which is designed to enable the learners to actively construct the concepts, laws, or principles through observing stages, formulating problems, proposing or formulating hypotheses, collecting data, analyzing data, drawing conclusions and communicating concepts, laws or principles that are "discovered". The scientific approach is intended to provide understanding to learners in knowing, understanding the various materials using a scientific approach. Learning with a scientific approach encourages learners in finding out from various sources.

Referring to the scientific approach, the development of an outdoor learning framework with the IEI stage with its spreading steps, has fairly close relationship with the learning activities of the scientific approach. Each of the outdoor learning step with the IEI stage is based on the learning steps of the problem based learning, discovery and inquiry models. The design of outdoor learning using the
environmental around is done with several learning stages. The design of outdoor learning is divided into three phases namely, Introduction, Exploration, and Interpretation (IEI) as illustrated in the following diagram.

![Diagram of IEI learning stages]

**Figure 1.** Outdoor learning design based on the natural environmental around as a learning resource

At each phase of IEI learning consists of stages that describe learning activities: (1) Introduction stage, the main activity at this stage is to provide an introduction. The phase of activities at this stage consists of, (a) exploring the initial knowledge relating to the material to be observed is discussed, (b) inventory of environment problems, in this phase, students are directed to inventory problems often found in students around, especially those related to the problematic natural environmental around, (c) exploring the key concepts relating to the material that will be observed during the exploration stage, (d) preparation of exploration, which is preparing the completeness of equipment and explain the procedures and provide motivation to students to work carefully with attention to safety, and precise in doing observations, (2) Exploration stage, activities at this stage is to observe the natural environmental around, such as pond ecosystem. (a) environmental orientation, is the first step before doing an observation, students are given general information about the environment which is the location will be observed, (b) observation and data collection, that is observation activity to the object around, (c) data processing, field observation data recorded and analyzed, analytical procedures adapted to the objectives to be achieved in accordance with the level of cognitive development of students, (d) Making conclusion, in this step students are guided to make conclusions based on the results of his observations. (3) Interpretation stage, activity at this stage is to provide explanation and give important concepts that obtained at the exploration stage. The learning steps in this phase include, (a) verification and clarification, observational data and analysis results presented for discussion to get the accuracy of concepts from the fact and theoretically (b) provide reinforcement, the important concepts that are obtained by the student in the learning stage previously are given emphasis to be understood comprehensively by students, (c) Applying concepts, guiding and directing students to associate concepts acquired with phenomena found in the surrounding environment, (d) Reflection, reflect on the benefits gained after doing the learning activities so that learning is more meaningful.

The design of outdoor learning model based on the natural environment, can encourage learning environmental insight ("Teaching Green") in which the teacher who has the ability to develop lessons that create good relationships between students and the environment, and cultivate environmental awareness [10]. Environmental-oriented learning results in "Green Teacher" in which the teachers who have an understanding of the environment and have a positive attitude towards the environment. As a "Green Teacher", a teacher is able to develop sustainable environmental education and participate in environmental activities and its preservation as a form of performance in building the Green Scholl-
oriented school [3,4]. In general, this step of learning development have described student-centered learning. In general, this learning step describes student-centered learning. Implementation of student-centered learning at elementary and secondary education levels can encourage creativity and motivate students to learn independently [11]. High student motivation will encourage curiosity about an object (concept) so that will add understanding to the students. Outdoor learning based on the natural environmental around is expected to provide a good understanding of environmental concepts and be able to relate it to the phenomena that occur in the environmental around.

The application of scientific approach to learning involves process skills, such as observing, classifying, measuring, predicting, explaining, and concluding. Based on its characteristics, the application of learning approach can be varied with model of problem based learning model, discovery, and inquiry. The learning models contain scientific step that encourages student-centered learning. Student-centered learning sees that learning outcomes are not the final estuary, but the learning process is a very important part.

The design of outdoor-based learning model based on the natural environment around the IEI model conceptually encourages environment oriented learning “Teaching Green” where the teachers who have the ability to develop learning that creates good relationships between students and the environment and fosters environmental awareness [10]. Environmental-oriented learning will result in a "Green Teacher", that is teachers who have a positive understanding and attitude towards the environment [4] [3]. The developed learning step illustrates student centered learning. The implementation of student-centered learning encourages creativity and motivates students to learn independently [11]. High motivation will encourage curiosity about an object so that will add understanding to students. Learning based on the surrounding natural environment is expected to provide a good understanding of the concepts of the environment and be able to relate it to the phenomena that occur in the surrounding environment.

3.2. Students Critical Thinking Skills

The results of the limited trial on the learning models in both schools indicated that students' critical thinking skills as follow: very critical (33.3%), critical (33.3%), quite critical (26.7%), and less critical (6.7%).

![Figure 2. Percentage of Students' Critical Thinking Ability on Natural Science Based Environment IEI Learning Step](image)

In general, students who implement science learning using conservation environment as a source of learning has a good critical thinking ability. Students’ achievement showed that students were able to understand the basic concepts of ecology based on facts that they found themselves and were able to link the data they acquired with theoretical concepts. The results of the analysis showed that the ability
of students in providing a simple explanation were better than the ability of giving advanced explanation. The average ability of both these dimensions can be seen in Figure 3.

![Figure 3. Score of Students’ Ability to Provide Simple Explanation and Advanced Explanation on Science Based Learning Environment Through IEI Learning Step](image)

The high values obtained student on this dimension because students at the stage of collecting the facts they got experience from the learning process. This illustrates that science is a body of knowledge that is obtained using methods based on observations. While the dimensions provide advanced explanation, the students achievement is lower, because the dimensions provide advanced explanation, students are required to be able to assimilate or link between the facts they found in the environment with their concept. From the performance analysis showed that the students' ability in concluding had the lowest value because in the process of making the conclusion required to make a decision. The low students’ achievement from the advanced explanatory dimension with the right argument is inseparable from the development of children's thinking ability. Grade VII students in the middle school have an average age of 12-13 years, at this level students are in the ability to observe and collect the facts and information that they get, but they have not been able to relate the variables of each fact with they obtained. This is in line with Piaget's cognitive development theory which states that children aged 7-13 are called concrete steps, where at this stage children begin to think logically about concrete events. Concrete operations stage can be marked by the existence of operating system based on what seems to be real [12].

The developed framework of the IEI learning model involves students to actively learn how to construct knowledge based on observational data. The Production and Exploration Stage of the IEI model encourages students to solve problems and conduct investigations. Learning with problem-solving in a contextual manner, fosters students' appeal to the material and encourages students' interest to be more interested in the subject matter studied [13]. Through problem solving students will construct their own knowledge during the learning process and gain conceptual understanding through the interaction between external and environmental factors [14] [15]. The learned lessons not only emphasize the mastery of the concept, but form the mindset and attitude of students to be more concerned about the environment, and to apply the principles of environmental sustainability. In the learning students are directed to understand the environment by introducing environmental conditions, observing the environmental phenomenon, and addressing the exact environmental issues based on the results of its exploration.

Interpretation stage is a unity of Exploration stage, in both of these stage students are involved, either physically or mentally. In the Interpretation stage there is a step of data presentation and analysis based on observations made at the stage of exportation, through these steps students are invited to actively think to investigate to find answers to problems faced up to the preparation of conclusions. So through the steps of learning that the ability of analysis, reasoning power, and logic of thinking students will develop according to the level of development. The steps of learning in both
stages are part of the syntax of the inquiry learning model. Suggests that the inner-discovery learning model includes three elements: exploration, invention or concept development, and discovery application. Further explained that learning by inquiry can improve intellectual ability, increase intrinsic and extrinsic motivation, and also encourage students to learn more actively. Intrinsic and extrinsic motivation will help improve the spirit and awareness of students to learn [11].

The implementation of IEI based model creates contextual learning. Contextual learning can always connect or apply the subject matter to the practical realities that is found in everyday life around the learner's environment. With such contextual learning, learners will discover the relationship between abstract ideas and practical matters in a real context, and internalize concepts through the process of discovery [16]. The contextual approach assumes that naturally one's mind will seek meaning that is appropriate to the real-world situation and provide benefits to the environment. Integrating subject matter with the student's experience will produce deep foundations of knowledge. Learners will be able to use their knowledge to solve new problems that never faced. Through the expected contextual approach in building the knowledge of learners can be applied in everyday life based on learning experience. Contextual learning is a conception of learning that links the subject studied with real situations, so that learners will be able to apply their knowledge in everyday life.

Referring to the results of the study, the outdoor learning model with IEI steps has motivated students to actively learn by constructing their understanding through ecosystem observation in the area of Sumatran turtle conservation at Bengkulu University campus (UNIB). The acquired understanding can develop students' analytical, reasoning, and logic thinking skills. The broader implementation of learning is expected to cultivate a new perspective on the environment (new environmental paradigm) so that it has a tendency to participate in conserving and preserving the natural environment in general.

3.3. Students' Performance

Students' performance is the ability of student groups in observing, measuring, analyzing data, communicating, and concluding in conducting learning activities. The results of limited trials on student performance in the learning process in general can be seen in Table 1.

| No | Aspect          | Performance score | Criteria |
|----|----------------|-------------------|----------|
| 1  | Observing      | 80                | Very Good|
| 2  | Measuring      | 85                | Very Good|
| 3  | Data processing| 75                | Good     |
| 4  | Communicating  | 75                | Good     |
| 5  | Inferring      | 70                | Good     |

Students' ability to observe the environment and use practical equipment to measure and observe the environmental conditions of the conservation area is quite skilled. Measurement data obtained is very accurate with procedures for using the right equipment. The lowest performance aspect is the ability to conclude, such as the ability of students to make conclusions inductively or deductively. Make conclusions is an activity that brings together the variables that are abstract. So that the students still have difficulty in making a conclusion. Making conclusion occurs when students are able to make abstract concepts or principles that explains their examples. The concluding process involves cognitive processes comparing the entire example, centering on the withdrawal of information patterns served [17]. Thus concluding activities are thought processes that require a comprehensive understanding to generate a new thought or knowledge. The performance of the students shown in the learning process is related to their learning, that is the environmental approach with the IEI learning steps. Learning with an environmental approach can help students to apply their knowledge, so it will bridge between the theory and facts that occur in the environment [5]. Science learning is concerned with how to
systematically find out about nature, so that it is not only the mastery of the science of facts, concepts, or principles, but also the process of discovery.

The key factor of science learning is to provide students with learning experiences to investigate to solve problems. The acquisition of knowledge from experience makes students more enthusiastic and encourages curiosity or has a scientific attitude [7]. The study of Bruner’s inquiry model emphasizes the importance of helping students understand the structure or key ideas of a discipline, the need for students to be actively involved in the learning process, and a belief that actual learning takes place through discovery. Learning science with an inquiry approach is to help students develop the necessary discipline and intellectual skills to bring problems and seek their own answers through curiosity as part of a scientific attitude [18]. Argue that the attitude that always accompanies the process of inquiry is in studying science is a scientific attitude, which includes: curiosity, humility, openness, honest / objective, and a positive approach to failure [19]. Scientific attitudes are defined as attitudes that scientists have in researches that are able to make meaningful discoveries. To be a scientific individual, one must perform a series of mental activities ranging from identifying problems to collecting and interpreting data so as to make conclusions. Or it can be said that science learning experience to be more efficient is through “transfer of scientific concepts and scientific attitude”.

Learning science with inquiry model can lead to students’ satisfaction in problem solving, increasing interest to improve science process skills, and improving students' ability to think rationally and critically [20]. States that scientific attitudes are always associated with critical thinking, someone who has a high scientific attitude always question all the information he received so willing to test the truth of the information [21]. Exploration activities carried out on IEI-based environmental science learning with the IEI model illustrates students’ critical thinking skills cannot be separated from student performance through observation, classifying, communicating, measuring, predicting, differentiating [22]. Student performance activities as a manifestation of the ability of scientific attitudes have a contribution in developing high-order thinking in students.

4. Conclusion
The instructional design was prepared in three phase activities namely Introduction-Exploration-Interpretation (IEI), and then it was compiled in a teaching material Based on Surrounding Natural Environment” (BSNE). The results of limited scale trial at secondary school students in two districts of Bengkulu province showed that, the students who learned using the IEI model at the conservation area have a good performance and critical thinking. The product from the research is a book named BSNE that can be used for teachers and conservation practitioners in doing the learning activities on environmental conservation which involved public participation.

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