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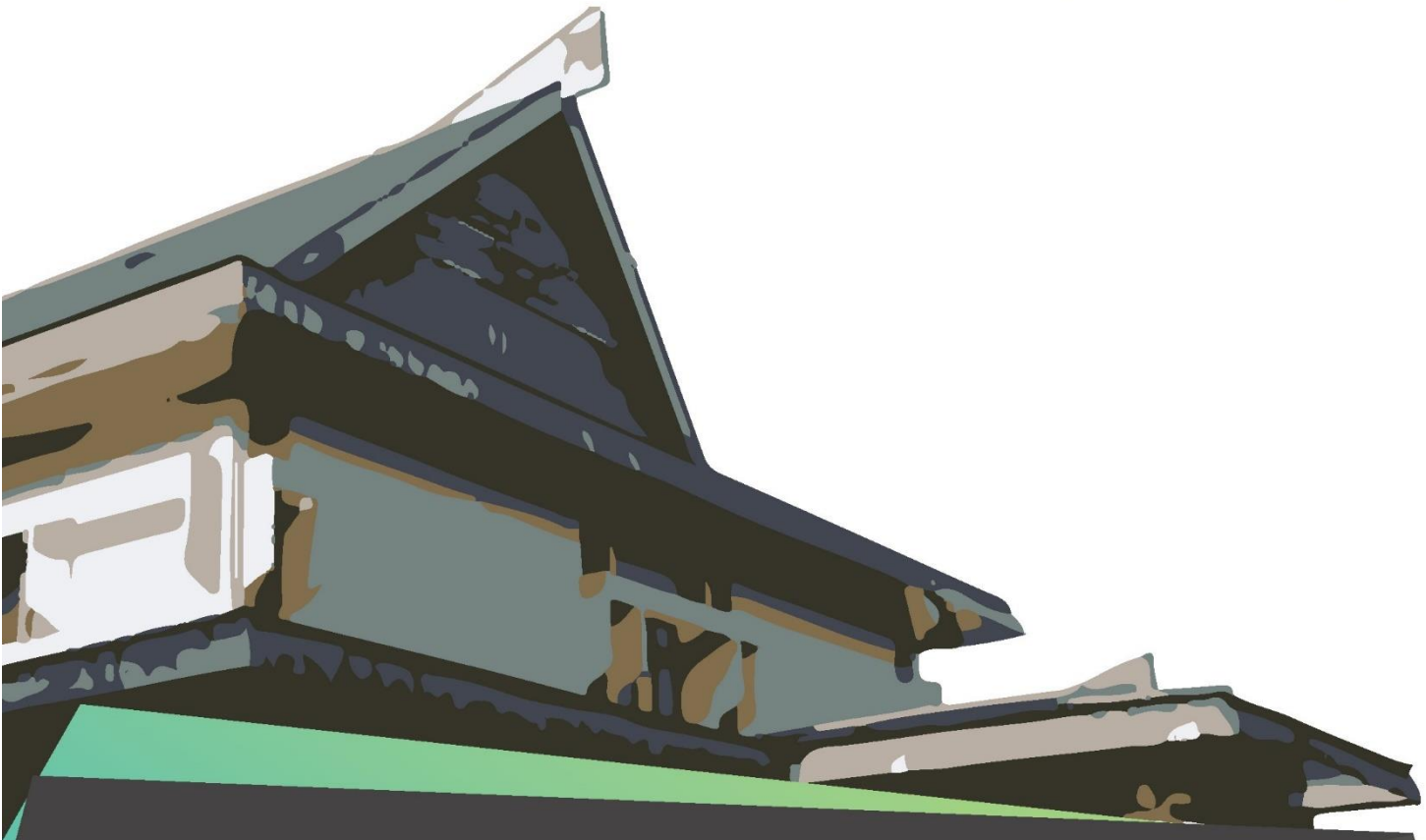
ABSTRACT **BOOK**



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Students' scientific literacy skills through inquiry-based learning in bryophyta and pteridophyta topic

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Abstract. Educational reforms have encouraged educators in different educational institutions to switch to student-centered programs, one of them is by applying an inquiry-based learning. This study aimed to determine the influence of inquirybased learning in the ability of scientific literacy skills. The data were obtained by comparing the class with the learning process using classical model with the class using inquiry based on the topic of bryophyta and pteridophyta. The data were analyzed using Anova. The results showed that inquiry-based learning in the learning process tended to have a higher potential in improving the ability of scientific literacy skills of students. Statistical analysis also shows that, inquiry significantly influence the scientific literacy skills of students. It is believed that inquiry-based learning has the proper learning stages required by students to improve their skills and achievements, one of them is the science literacy skill

1. Introduction

The role of biology learning in 21st century skills mastery is very strategic, especially in preparing future learners who are critical, creative, competitive, able to solve problems and dare to make decisions quickly and precisely [1]. It is considered important to combine 21st century skills in science education. Scientific literacy is one of the necessary skills in the 21st century [2]. Scientific literacy is very important in our modern society because of many issues related to science and technology [1]. The role of science, especially biology for the future of life is very strategic, especially in preparing students who are able to survive productively amid the swift wave of competition of the global digital era with full of opportunities and challenges [3].

The low scientific literacy of students in Indonesia is caused by the teaching-learning process that is still oriented to the mastery of science concepts, less in involving the process of science [4]. High school student studies have found that many students have difficulty evaluating the truth and objectivity of information [5]. Students also point out the shortcomings in citing sources appropriately [6]. Lack of information-seeking skills, critical thinking, especially among students, is also evident in the literature [7,8]. Overall, research literature on scientific literacy skills among students is generally lacking. Likewise the practice of science learning in various countries ignores the social dimension of science education and the drive to develop the students' skills necessary to participate actively in society [9].

In order to achieve learning outcomes learning activities are designed to provide a learning experience that involves mental and physical processes through various interactions, including teachers, students, the environment and other learning resources so that goals can be achieved. In science, inquiry-based learning has been widely promoted to increase literacy and skill development [10]. Inquiry-based learning involves greater activity in science literacy and student skills. The researchers assessed the exposure of science that is practiced more authentic though more challenging, and can explain the widespread student resistance. [11] states that using science-based inquiry in science education has some positive effects on cognitive achievement, process skills and attitudes toward science.

Inquiry-based teaching methods are one way that can purseued to achieve scientific literacy skills as they provide students with the opportunity to discuss and debate scientific ideas [12]. [13] demonstrated this as the main way of practicing scientists evaluating scientific ideas and conclusions. [14] define the type of scientific literacy as a basis for transferring conceptual understanding and accurately interpreting and evaluating texts related to scientific concepts. As well as the skills required by a student when reading newspaper articles, interpreting published tables and figures, and making personal and public decisions [15].

Scientific literacy skills focus on identifying skills related to two main categories, including skills related to identifying and analyzing the use of inquiry methods that lead to scientific knowledge and skills related to organizing, analyzing, and interpreting quantitative scientific data and information [16]. Scientific literacy skills are a combination of the skills, attitudes, understandings and knowledge about science needed for individuals to develop their investigative, problem-solving and decision-making skills, to familiarize lifelong learning individuals. Some of the opinions and research results that have been presented show how important scientific literacy skills are owned by the students. Therefore, scientific literacy skills need to be developed, so that responses to indicate concerns related to content needs and lack of time or skills for skills development can be overcome [17]. Large-scale longitudinal studies have shown that literacy skills are a strong predictor of achieving academic success [18]. The scientific literacy skills component should be used as a frame of mind in realizing a science-oriented learning development of literacy learners. [16] distinguishes it into nine scientific literacy skills indicators. They are all indispensable indicators for students to learn and obtain during the study period. This inquiry-based learning is done on the topic of bryophyta and pterydophytha. This topic can accommodate various knowledge about low level plants. These materials, if examined more deeply by using the right learning model, are very potential to develop and improve scientific literacy skills. [19] states that the success of learning depends on the number of student activities and a good learning environment.

No specific research had yet specifically linked the indicators of scientific literacy skills in inquiry-based learning on the topics of bryophyta and pterydophytha. This is what lies behind this research, with the hope can be revealed how strong influence of inquiry-based learning to the scientific literacy skills of students. Other expectations as an effort in improving the quality of education, improve skills mastery and enrich the experience and spur new spirit in student learning in accordance with the goals of science. The question asked in this study is how inquiry-based learning can affect the scientific literacy skills of students? The main objective of this study was to describe the scientific ability of students' literacy skills through inquiry-based learning on the topic of bryophyta and pterydophyta.

2. Experimental Method

This research is a quantitative research to see the effectiveness of inquirybased learning to scientific literacy skills. Meanwhile, to reveal the influence of each indicator of each predictor, a qualitative descriptive analysis is used. Scientific literacy skills include: 1) identification of scientific arguments; 2) evaluation of source truths; 3) evaluation of scientific information; 4) understanding of research design and impact on scientific discoveries; 5) graphs; 6) interpretation of graphical representation; 7) problem solving; 8) basic statistical interpretation; and 9) inference, prediction and conclusion.

There are five material topics studied by the students during this study, namely the basic classification of bryophyta and pterydophyta plants, the characteristics of bryophyta and pterydophyta plants, the classification of lowgrade plants, the metagenesis of bryophyta and pterydophyta and the role of bryophyta and pterydophyta. The experimental class and the classroom all learn five topics. Inquiry-based learning activities are independent variables, while scientific literacy skills as a dependent variable.

Implementation of inquiry learning in the experimental class was done gradually in accordance with the steps of inquiry study which referred to Borich, (2006) includeded stage (1) asks; (2) investigation; (3) create; (4) discussion; and (5) reflection. As for the conventional class apply teacher center model with the lecture method. In the process students only listen to the delivery of material from the teacher. Respondents in this study are high school students of class X academic year 2017/2018 in SMAN 7

Tasikmalaya Indonesia consisting of 178 students. A sample of 35 students taken with cluster random sampling technique. The design used was quasi-experimental, posttest only design group control [20]. The research instrument is a scientific literacy skills test, consisting of 34 items that have been validated by science experts and tested against students who are not research samples. The test is given in the form of multiple choice test according to indicator put forward by [16] as mentioned above. The questions provided consist of 5 items for the first indicator; 5 items for the second indicator; 3 items for the third indicator; 5 items for the fourth indicator; 2 items for the fifth indicator; 2 items for the sixth indicator; 5 items for the seventh indicator; 2 items for the eighth indicator and 5 items for the ninth indicator. One example of the indicator is that students are able to analyse the meaning of plants appropriately. An example of the test is the following statement which is appropriate to be called a scientific argument about the meaning of plants. Validity and reliability tests were determined based on the results of trials in 35 students who were not samples of the study. Reliability test results with Crocbach's Alpha show results of 0.860. The scientific literacy skills have been tested for validity using the Pearson Correlation test which shows all the valid items.

The research data were tested statistically by using ANOVA which aimed to explain the difference between more than two groups or more categories with significance level of 5% ($p < 0.5$) [21]. The data obtained were first tested on the prerequisite of the analysis including the KolmogorovSmirnov normality test and homogeneity of variance using Levene's-Test. The hypothesis tested is that there is no influence of inquiry-based learning on the scientific literacy skills. All data testing is done by using Program SPSS version 23.0 for windows.

3. Result and Discussion

The result of data analysis which has been done to explain the effect of inquiry-based learning in bryophyta and pterydophyta topics to the scientific literacy skills of students is presented in Table 1.

Table 1. The summary of the Analysis of Inquiry-Based Learning in Students' Scientific Literacy Skills.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	126,229	1	126.229	8.859	.004
Within Groups	968,857	68	14.248		
Total	1095,086	69			
Between Groups	321,429	1	321.429	38.915	.000
Within Groups	561,657	68	8.260		
Total	883,086	69			

The result of ANOVA test shows that inquiry-based learning has significant effect on the scientific literacy skills of students which is shown by the significance of the calculation result of 0.000 which is smaller than the significance that is used (0.05) with the price of F equal to 38.915. The results of this study are in line with some previous studies that examine the relationship of inquiry learning both as a model and learning strategy to the scientific literacy skills of students. The application of this lesson is reinforced by [22] opinion that learning using inquiry approach makes learners more active in learning. In this case the inquiry does not stand alone, but involves the interests and challenges of learners to link their world with the curriculum [23]. Some important things in inquiry study are interesting and challenging, but not frustrating; open-ended; focus on how to find out something rather than know what it is; the teacher acts as a guide by the side, not as a sage on the stage; the inquiry process is a nonlinear spiral. These findings are becoming increasingly important for students who are learning to use inquiry-based learning, this learning strategy as an alternative to putting them as learners in a better position [24].

In general, inquiry learning in its implementation according to [25] has advantages in helping students learn by exploring questions and developing hypotheses, making a problem solver good enough, developing students' self-confidence about what is found in the inquiry process, a good critical

thinker. Inquiry learning is a learning that aligns with the theory of learning kontruktivisme and cognitive that emphasizes students as an active student (student center).

The study of [26] concluded that the application of inquiry learning with issue-oriented science can produce significant benefits for students. Similarly, the same study conducted by [27] explains that inquiry significantly produces more capabilities in terms of applying science concepts. [27] mentioned that to develop the skills needed to face the challenges in everyday life required some skills. Of course, scientific lieteracy skills are no exception, which can contribute to social and economic life, and to improve public and private decision making [28]. The results of this study confirms that scientific literacy skills can be trained and developed through process-based learning or integrated inquiry and incorporation of inquiry learning with other learning strategies. Further explanation of the position of the indicators on scientific literacy skills from the first indicator up to nine as described previously is shown in Figure 1.

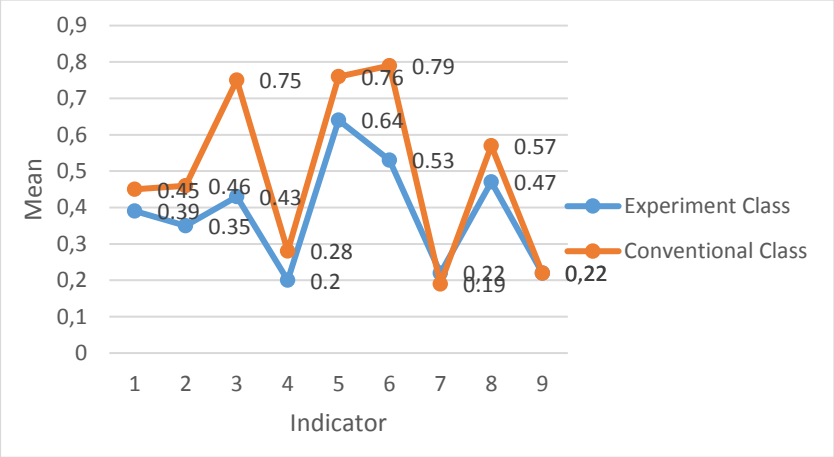

Figure 1: Pre-test mean score of scientific literacy skills in experimental and conventional classrooms

Figure 1 shows for the highest pretest scores experiment class scientific skill found in indicator 5 that is making the graph with the average score of 0.64 and the lowest pretest score of scientific literacy skill found in indicator 4 is the understanding of research design and the impact on scientific findings with the average score 0.22. While for conventional class, the highest pretest score of scientific literacy skill is found in indicator 6 which is interpretation of graph.

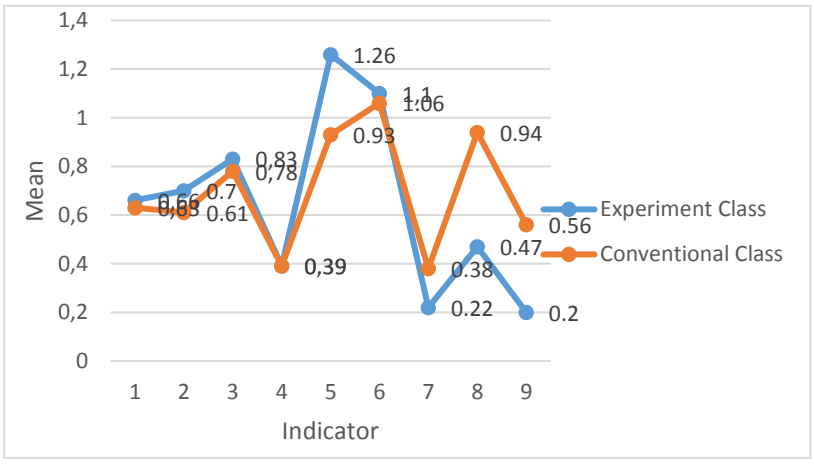

Figure 2: Mean score of post-test scientific literacy skills in experimental and conventional classrooms

Figure 2 shows for the highest experimental post-test score score of scientific literacy skill found in indicator 5 which is graph with average score 1.26 and the lowest post-test score of scientific literacy skill is in indicator 7 and indicator 9 that is problem solving and inference, prediction and conclusions with an average score of 0.22 each. While for the conventional class the highest posttest score of scientific literacy skill is found in indicator 6 that is interpretation of graph representation with mean score of 1.06 and the lowest post-test score of scientific literacy skill is in indicator 7 that is problem solving with average score 0.38.

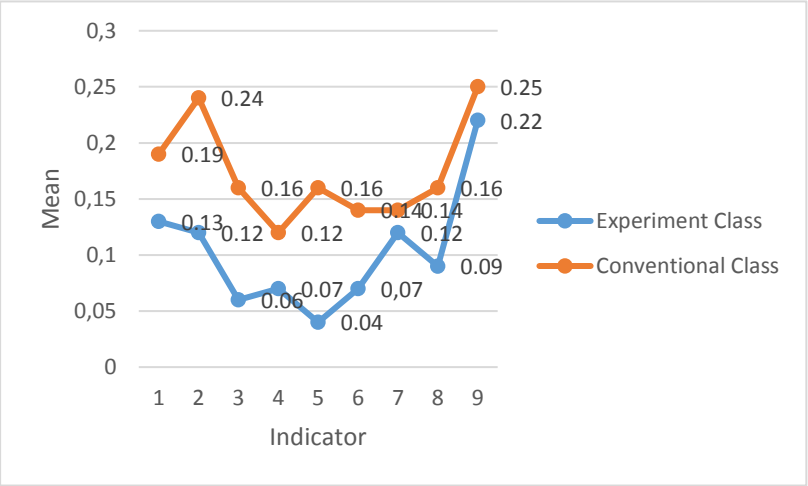

Figure 3: Mean score of N-gain scientific literacy skills
in experimental and conventional classrooms

Figure 3 shows that for experimental grade, the highest N-gain value of scientific literacy skill is found in indicator 9 with the average score of 0.22 and the lowest N-gain value of scientific literacy skill is in indicator 5 with average score of 0.04 each. While for the conventional class the highest N-gain value of scientific literacy skill is found in indicator 9 with the average score of 0.22 and the lowest N-gain value of scientific literacy skill is in indicator 5 ie problem solving with average score of 0.04.

When it is examined from the point of view of behavioral theory [29] learning behavior can affect the learning process. Some of the things suggested in behavioral learning theory have not been attached to several indicators in the experimental class. The ability of students in exploring themselves is still said to be lacking so meaningful learning concepts as in Ausubel theory need to get a deep emphasis as a challenge and a positive chance to be better. In [30] that inquiry is a diverse activity for it requires the identification of assumptions, using critical and logical thinking skills and the consideration of alternative explanations. So students can more complex understanding of integrated science skills. Students need to develop a wide range of skills to approach quantitative scientific phenomena as well as apply basic quantitative concepts in everyday life [31].

4. Coclusion

Based on the above discussion of inquiry-based learning in the learning process tend to have a higher potential in improving the ability of scientific literacy skills of students. Statistical analysis showed that, inquiry significantly influence the scientific literacy skills of students. It is believed that inquiry-based learning has the proper learning stages required by students to improve their skills and achievements. This study contributes to biology teachers to apply inquiry-based learning that involves various skills in training and developing scientific literacy skills of students. The implications of this research include that high school curricula should have a direct impact on improving student learning and achievement in science learning. Limitations of this research include the number of samples less representative in representing research. Another thing is the limited concept of discussion in research on bryophyta and pterydophyta materials. For further research it is suggested to add number of samples to represent the respondent representation and to expand the study material study.

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