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How is the Inquiry Skills of Biology Preservice Teachers in Biotechnology Lecture?

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Abstract. This study was to investigate the inquiry skills of biology pre-service teachers in one teachers college in Central Java in biotechnology lecture. The method used is a case study of 29 biology preservice teacher. Data were collected using observation sheets, questionnaires, and interview guidelines. Research findings collected through questionnaires show that most students are accustomed to asking questions and formulating biotechnology issues; Skilled in conducting experiments; Skilled in obtaining relevant information from various sources; As well as skilled at processing, analyzing and interpreting data. Based on observation: lectures are not dominated by lecturers, students are able to solve problems encountered and conduct investigations. Based on the interview towards lecturers: students are always actively involved in questioning, investigation, inquiry, problem solving and experimenting in lectures. Why do most students show good inquiry skills? Because students are accustomed to invited inquiry in biology lectures. The impact, the students become more ready to be invited to do more advanced inquiry, such as real-world application inquiry, because the skill of inquiry is essentially trained.

1. Introduction

Biology is part of a science that continues to develop, especially entering the second decade in the 21st. Biological science content is very promising to develop, because it is influenced by the rapid advances in technology. The integration of biological and technological advancements breeds innovations that can be useful for increasing the welfare and quality of life of the people, for example the discovery of sophisticated tools for detecting health, telemedicine, artificial intelligence, bioengineer, and synthetic biology [1]. To face the development of science, especially in biology, reliable resources needs to be prepared. Education has a central role in preparing resources according to need, which has competency in facing 21st century challenges. There are ten skills that must be owned by 21st century society and categorized into four groups, namely: ways of thinking (creative and innovation; critical thinking, problem solving and decision making; learning to learn, metacognition); ways of working (communication; collaboration); tolls for working (information literacy, ICT literacy); and living in the world (citizenship-local and global, life and career, personal and social responsibility-including cultural awareness and competence [2].

In the midst of high demand for reliable Human Resource (HR) and literate on the progress and challenges of the 21st century, there seems to be a lack of awareness among Indonesia. These
indicators include many graduates of universities who are not directly absorbed by the workforce because of lack of competition, lack of special skills or creativity owned by the community in empowering and utilizing local potentials into economically valuable products, on the other hand many untapped natural potentials become waste and pollute the environment. Science lessons that emphasize mastery of concepts without learner lifelong learning also exacerbate the conditions that are not promising despite having a certificate on various levels (primary, secondary, high education), thus challenging educators prospective teachers and education practitioners to find a solution [3].

To meet these challenges, learners should be more invited to solve problems with the context that is often faced in everyday life. Real-world application inquiry can be one of the strategies offered to address the challenges faced by Indonesian society today. Real-world application inquiry guides students to be able to solve problems that occur in the real world. Real-world application inquiry can build students to solve problems that occur in everyday life [4]. Students apply experiences they have learned into new situations, so they find authentic answers related to problems solved by individual or cooperative and collaborative ways. The learning experience that students do can be problem-driven & project-based approaches like those done by scientists and engineers [5], for example energy, global warming, healthy food, and others.

Before the implementation of real-world application inquiry strategy, it is necessary to first analyze the readiness of biology pre-service teacher in the course. Are the students already accustomed to inquiry? What type of inquiry are introduced?. The things that must be prepared in advance to the students, so they are skilled in doing questioning, solving problems, experimenting and hands-on activity. Inquiry is a strategy to teach students about the process of researching and explaining foreign phenomena on the conceptions of scientific methods [6]. Inquiry as a process of defining and investigating problems, formulating hypotheses, designing experiments, finding data, and illustrating the conclusions of those problems [7]. The National Science Education Standards [8] emphasizes that inquiry is an activity that involves observation; asking question; Check books and information from other sources to see what is known; Investigative planning; Review what is already known from the experimental evidence; using tools to collect, analyze, and interpret data; Proposing answers, explaining, predicting; and communicate results.

The success of students in achieving these indicators is certainly supported by various factors, such as the teaching strategies applied by the lecturers, the significance of the challenges faced by the students, as well as the supporting facilities in the continuity of the lectures. The teachers college has full responsibility in preparing prospective teachers to become professional teachers and meet the standards of 21st century competence. Therefore, based on the above background, the problem formulation in this study is "How is the inquiry skills of biology preservice teachers in one teachers college in Central Java on biotechnology lecture? ".

2. Method
This article is the result of qualitative descriptive analysis of a case study. The research was conducted in Biology Education Department in one teachers college in Central Java with the subjects involved were students as many as 29 people selected by purposive method from six semesters in academic year 2016-2017 and four lecturers. The sample selection of students from the sixth semester is based on the experience of taking enough courses, so their responses are enough to represent the readiness of the biology students as a whole in the course of real-world application inquiry.

The focus of the research is on the readiness of biology pre-service teacher to follow lectures oriented towards real-world application inquiry. The matters revealed in this study were adapted from NRC [8] and Wenning [4] on inquiry aspects, there are: 1) students' habits in asking questions and formulating problems; 2) the skill of experimenting; and 3); The skills of finding relevant information and analyzing and interpreting data. The data were collected using the main instrument of questionnaire, consisting of 11 statements. In addition, supported by data collected through observation, which is done in lecturing process in four subjects that serve as the subject of research;
3. Result and Discussion

How ready the students to follow the real-world application inquiry based on the lectures collected using various instruments is described in two major sections. The things that can be revealed from the results of this study include the general description of how ready the students in following the lectures based on real-world application inquiry, and the specific analysis of how ready the students based on the aspect of inquiry.

3.1. General description readiness of students in following lectures based on inquiry

In general, how ready the students in dealing with lectures designed with Inquiry is represented from three data retrieval techniques, namely student questionnaire, lecture observation, and interview with lecturer.

3.1.1. Student questionnaire data. Based on the questionnaire which contains 11 statements about how ready the students in dealing with biology lectures based on Inquiry, the overall data analysis results are represented as in Figure 1. Figure 1 showed that 31.42% strongly agreed to the statement on the questionnaire; 46.93% agreed; 18.39% stated disagree; and 3.26% stated strongly disagree. This data indicates that overall the average student states are ready to follow lectures designed based on Real-world Application Inquiry. That is, so far most of the students have been accustomed to do inquiry process in the lectures and actually feeling the impact.

![Figure 1. Total presentation of student questionnaires](image)

3.1.2. Data results of lectures observations. This section represents some of the findings of field observations in one of the courses, which are.

a. Lecturing process are not dominated by lectures done by the lecturers, but are done by varied methods. This means that lectures are based on student centered learning with various methods or strategies applied by lecturers;

b. Students are guided to solve problems by first identifying the problems to be solved in a structured way;

c. Students are directed to investigate problems by searching for various sources / literatures, then the data obtained are categorized by group.
3.1.3. Data of interview with the lecturers. Interviews were conducted on lecturers who were a subject of the research, the aim was to cross-check and compare the data that have been collected from the questionnaire and observation. From several questions asked, represented by some important questions that represent the purpose of the study. Interview data are shown in Table 1.

**Table 1.** Data results of interview with the lecturers

| No | Questions                                                                 | Lecturers’ Answers                                                                                                                                 |
|----|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | What methods / approaches / learning models have been used in lectures?   | Each course and even each material use different learning strategies modified to fit the characteristics of the material. Ordinary students are invited to discuss, question, answer, argue, inquiry, practicum, problem-solving, even on a certain subject we invite to experiment produce a product. |
| 2  | Are students already used to being actively involved in asking and answering questions? If yes, What percentage of students who are active in a class? | Students are accustomed to be active in the lecturing process, especially doing questions and answers. Their involvement between 40-70% actively ask. |
| 3  | Are students accustomed to being invited to formulate and solve problems? | In the lecturing process, students are usually invited to formulate and solve problems.                                                            |

3.2. Specific analysis of how ready the student based on inquiry aspect

The student questionnaire consisting of 11 statements is based on five aspects of inquiry. Determination of the five aspects of the objective is to represent the readiness of students in following the lecture real-world application inquiry, as well as see the habits built in lectures that have been done. The data of the research on the readiness of students specifically based on inquiry aspect is illustrated in Table 2-4.

Table 2 represents Aspect I data, which is the student's habit of asking questions and formulating problems. On average 0.86% of students strongly disagree with the four statements; 13.79% disagree; 58.62% agreed; and 26.72% strongly agree. This data shows that most students are used to asking questions and formulating problems in lectures. Even if analyzed more specifically from Table 3, there is a very interesting fact to be discussed: 1) statement-2, shows the most strongly agreeing percentage of the other options, which is 44.83%. This means that in the lecture, students are very involved to develop scientifically oriented questions; 2) the percentage agree on statement-3 approaching at absolute percentage, that is 82.76%. This fact indicates that the lecturer is really training students to ask questions and answer questions, by giving further questions until students understand the concepts/materials learned.

**Table 2.** Aspect data I: the students' habits in asking questions and formulating problems

| Aspect 1   | SD  | D    | A    | SA   |
|------------|-----|------|------|------|
| Statement 1| 0   | 17,24| 55,17| 27,59|
| Statement 2| 3,45| 10,34| 41,38| 44,83|
| Statement 3| 0   | 3,45 | 82,76| 13,79|
| Statement 4| 0   | 24,14| 55,17| 20,69|
| Average    | 0,86| 13,79| 58,62| 26,72|
Aspect data II, that is experimental skill is shown in Table 3. On average 4.60% of students stated strongly disagree with the statement; 24.14% disagree; 39.08% agreed; And 32.18% strongly agree. The data represent the majority of students used to solve problems by experimenting. However, the percentage of disapproval is also quite large on this aspect. Moreover, if you look more specific on the statement, the percentage does not agree greater than the agreed percentage, which is 34.48%> 27.59%. This means that the students are not yet fully used in following up the problems into scientific investigation, observation, practicum and experiment.

| Statement | SD  | D   | A   | SA  |
|-----------|-----|-----|-----|-----|
| Statement 5 | 3.45 | 34.48 | 27.59 | 34.48 |
| Statement 6 | 3.45 | 13.79 | 48.28 | 34.48 |
| Statement 7 | 6.90 | 24.14 | 41.38 | 27.59 |
| Average   | 4.60 | 24.14 | 39.08 | 32.18 |

Aspect III, on the skills of finding relevant information and analyzing and interpreting data, is illustrated in Table 4 that an average of 3.45% of students responded strongly disagreeing with the statement; 18.97% disagree; 43.97% agreed; And 33.62% strongly agree. Specific data on each statement also represent the same with the average data. This fact indicates that most of the students are accustomed and skilled at obtaining relevant information from various sources and able to analyze and interpret the data.

| Statement | SD  | D   | A   | SA  |
|-----------|-----|-----|-----|-----|
| Statement 8 | 10.34 | 20.69 | 44.83 | 24.14 |
| Statement 9 | 0   | 13.79 | 44.83 | 41.38 |
| Statement 10 | 0   | 20.69 | 41.38 | 37.93 |
| Statement 11 | 3.45 | 20.69 | 44.83 | 31.03 |
| Average   | 3.45 | 18.97 | 43.97 | 33.62 |

The data that has been shown previously generally has represented the readiness of students in facing lectures based on real-world application inquiry. One indicator that can be used as a reference is the student's habits in doing inquiry. The findings are in line with the results of the research by Sen & Vekli, that in inquiry learning students are invited to undergo a research process such as a scientist, determining research questions, hypotheses, obtaining results by designing experiments and developing science process skills [9]. Different studies confirm that, students who are more often invited to do inquiry by their teachers are more active in doing scientific practice and more interactive in the learning process [10]. In addition, the habit of doing inquiry trains students to develop problem-solving skills, especially those that are often faced by people in everyday life. Fulfillment of these indicators can be used as a recommendation that students have demonstrated readiness to follow lectures designed with the development of real-world application inquiry.

4. Conclusion
Based on the data collected, students have shown how ready they are in following the lectures based on inquiry. The facts shown by most of the percentage of students responding agree and strongly agree on each statement on the questionnaire. In addition, based on the results of field observations and interviews with lecturers, students have been actively engaged in question and answer, investigation, inquiry, solving problems and experimenting in lectures.
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