Profile of inquiry skills pre-service physics teacher in Aceh

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Abstract. This study purposed to explore the inquiry literacy of pre-service physics teacher’s skill in Aceh. The subject was 85 pre-service physics teacher from two universities in Aceh. The study used descriptive-quantitative approach, and ScInqLiT instrument to measure the skill of inquiry literacy which is developed by Wenning. Data analyse result showed the average score of formulating the hypothesis is 45,5% (enough), making prediction is 29,0% (low), designing experiment procedure is 57,0% (enough), scientific investigating is 26,9% (low), analyse and interpreting data is 33,0% (low), applying the numeric and statistic method is 46,6%, explaining unpredictable result is 34,2%, and using technology is 28,5%(low). Over all, the conclusion of inquiry skill of pre-service physics teachers are low and need to be improved for all aspect. The low inquiry skill because they are never be introduced by learning activity, verify experiment design and intellectual skill.

1. Introduction
Science education in schools or colleges should apply two important components: science products and science process. The science product is an accumulation between the results of empirical activity and the analysis of scientists. It is through a process of scientific inquiry involving scientific attitudes and science process. While the science as a process includes the skills and attitudes possessed by scientists when investigating the natural phenomena to produce science products [1]. Science education greatly affects in progress of Science and Technology which requires a person to master the information and knowledge.

The National Research Council explained that science should prioritize in building of principles, concepts, and interrelation of science in daily life [2]. The NRC also argued that scientific inquiry is the most basic principle of scientific learning and it serves as an essence of science education and becomes a very effective learning applied in science learning. Developed countries around the world now regard inquiry and inquiry learning as a goal and methodology in science education. The results of the current international conference show how the best way to learn science is through inquiry-based learning [3-5].

Levels of Inquiry (LoI) is an inquiry-based learning model consisting of six levels, namely discovery learning, interactive demonstration, inquiry lesson, laboratory inquiry, real-world applications, and hypothetical inquiry [6]. At each level is equipped with students' science process skills ranging from the most basic skills of discovery learning to advanced skills at the hypothetical inquiry level and has different pedagogical goals [7]. The six levels of inquiry learning are sequenced on the basis of
intellectual skills (Rudimentary, basic, intermediate, integrated, Culminating) of students and controllers. The sequence of inquiry learning moves from left to right, starting from discovery learning to hypothetical inquiry. Through the learning model of Levels of Inquiry can be seen in detail how the process of change and development of students' science process skills. Therefore, the learning of the Levels of Inquiry model will help to develop inquiry skills.

Wenning describes the inquiry stage into four activities: first Observation, manipulation, generalization, verification, and application [8]. Observation activities are activities aimed at observing the phenomenon to bring up ideas or scientific ideas. These stage students explain in detail related to what is observed through the activities of analogies or simulations. Student manipulation activities propose hypotheses and challenge ideas and develop the approaches to scientific investigation. In generalizing activities students build principles or laws based on observed phenomena. Students provide a scientific explanation related to the phenomenon. Furthermore, on verification activities, students make predictions and tests based on data in the previous stage. The last stage is the application, at this stage, students draw conclusions together with friends of the group, and able to provide examples of cases in everyday life.

Based on the above description, it is necessary to conduct a research to find out the skills profile pre-service physics teacher inquiry skills. Benefits obtained by this research are expected to make consideration for teachers and lecturers in developing theoretical learning program and laboratory practice.

2. Method
This research uses descriptive-quantitative approach. The subjects were 85 pre-service physics teacher in grade two and six came from two State Universities in Aceh Province. The first college was selected one of the new study programs with accreditation status C, and the second college as a comparison selected study program with accreditation rank A. Quantitative data collection was conducted using Scientific Inquiry literacy Test (ScInqLiT) developed by Wennin [9]. The ScInqLiT question formed in multiple choices with four alternative answerable pops and has only one correct answer. The purpose of this test is to know the literacy skill of pre-service physics teacher in conducting a scientific investigation. The picture below is one example of the problem ScInqLiT related aspects of data interpretation is as follows.

The graph next to this shows the movement of a toy car that shows the position and time changes as shown in the picture below.

![Figure 1. Position relation chart (m) and time (s).](image)

Which of the following questions describes the movement of the car accordingly?

a. First, the car does not move, then moves backward at a constant speed and finally stops.
b. The car moved along a flat track, then drove down the hill, and finally stopped.
c. The car moves at a constant speed, then slows down and finally stops.
d. The car moves along a flat track, then down the hill and keeps moving without interruption.
Aspects of literacy skill inquiry that is measured inquiry skills developed by Wenni include aspects (a) identify problems to be investigated; (b) using induction to formulate hypotheses or models; (c) using deduction to make predictions; (d) design of experimental procedures; (e) conducting an investigation; (f) analysis and interpretation of data; (g) using numerical and statistical methods; (h) describes unexpected results; and (i) utilizing available ICT to report investigation data [9].

3. Result and discussion
The inquiry skills profile was analyzed based on the result of Scinqlit test that given to pre-service physics teacher from two state universities in Aceh Province. The difference between the two lies in experience, human resources, curriculum and accreditation scores. Here are a recapitulation result of the inquiry test skills of pre-service physics teacher as shown in the table 1.

| Aspects of Inquiry Skills                        | University X Score | Inf. | University Y Score | Inf. | Average Score |
|--------------------------------------------------|--------------------|------|--------------------|------|---------------|
| Identifying the problem                          | 42,7               | E    | 48,4               | E    | 45,5          |
| Formulate hypothesis                             | 51,0               | E    | 56,7               | E    | 53,9          |
| Make Predictions                                 | 23,8               | L    | 34,2               | L    | 29,0          |
| Designing Experimental Procedure                 | 54,6               | E    | 59,4               | E    | 57,0          |
| Conducting Scientific Experiments               | 25,0               | L    | 28,5               | L    | 26,7          |
| Perform analysis and interpretation of data     | 31,5               | L    | 34,5               | L    | 33,0          |
| Applying Numerical Methods and Statistics        | 45,6               | E    | 47,7               | E    | 46,6          |
| Explaining the Unexpected Results                | 37,6               | L    | 30,7               | L    | 34,2          |
| Utilizing available technology                   | 12,9               | VL   | 44,0               | E    | 28,5          |
| **Average Score**                                | **36,1**           | L    | **42,7**           | E    | **39,4**      |

Table 1. Recapitulation of inquiry skills pre-service physics teacher in Aceh.

Description: Very High (VH) = 81%-100%; Height (H) = 61%-80%; Enough (E) = 41%-60%; Low (L) = 21%-40%; Very Low (VL) = 0%-20%

Based on the table above, the score of skill in identifying the problem of pre-service physics teacher from universities X and Y is 42.7% (enough) and 48.4% (enough). The skill in identifying student problems from university Y is higher than that of university X. This is due to the process of practicum implementation at university X starting by explaining the purpose of the practicum being studied. Unlike the Y University, the practicum implementation begins by linking the concept investigated with the problems of everyday life on a waveguide with a preliminary question. This activity space the students to link and formulate issues to be learned.

The next skill is formulating the hypothesis. Comparison of the average score of pre-service physics teacher from university X and Y in formulating hypothesis is 51,0% (enough) and 56,7% (enough). Observation result of experiment implementation showed that the activity of formulating hypothesis at university Y is done through the preliminary question as in the previous stage. However, the hypothesis formulation activity is not so generated and directed in implementation. The same case also occurs in the skill of making predictions, not at all done during the experiment process. As a result, the average score of this term is 23.8% (low) and 34.2% (low) from both universities.

An important step in conducting an experiment is the activity of designing an experimental procedure. The skills of designing experimental procedures for university pre-service physics teacher X and Y students are 54.6% (enough) and 59.4% (enough). Observations indicate that during the student practicum implementation process are not directed to design experimental procedures since the design of experimental procedures is already available in the experimental module used. At least they already have experience how to design the experimental procedures ranging from tool design instructions,
experimenting steps. The next aspect is the skill of experimenting. The average score of pre-service physics teacher from both universities is 25.0% (low) and 28.5% (low). These results indicate that the experience of students in conducting experiments is still limited. The result of observation on the implementation of the lab showed that the experimental activity was more dominantly performed by laboratory assistant, the role of the students observing and recording the observed data. The same is true of analytical skills and data interpretation, the average score is 31.5% (low) and 34.5% (low). Analysis of experimental data is done according to the relationship of variables that have been formulated in the data table of observations. Interpretation of experimental results data is directed by laboratory assistants to find the relationship between data variables.

The skills of applying numerical and statistical methods of university X and Y students are 45.6% (enough) and 47.7% (enough). The observations show the mathematical concepts used in proving the relationship between experimental variables using simple mathematical concepts so that students do not experience constraints. With regard to skills explaining unexpected results, the acquisition of university X and Y student’s scores is 37.6% low category and 30.7% also with the low category. A pre-service physics teacher from universities X and Y are generally unfamiliar with identifying and evaluating experimental procedures because experimental procedures are already provided in the experimental module.

The skills of utilize available technology in the report and describe experimental data to strengthen the results of experimental findings. The results of data processing show the skills utilizing the available technology of university pre-service physics teacher X and Y is 12.9% (very low) and 44.0% (enough). It appears that the skills from university Y are better than university X. The observations show that University Y has laboratory facilities supported by adequate technology to conduct experiments, while in university X the availability of tools and lab materials is very limited.

Based on data analysis result, it can be concluded that one of the factors of low inquiry skills of a pre-service physics teacher in Aceh province is because the skills have never been trained and introduced through laboratory investigation activities. A teacher in order to have understanding and inquiry skills, then they must be trained and taught how the inquiry design is applied [10]. The observation results show that the design of physics practicum observed at universities X and Y are directed to support the improvement of conceptual understanding. This can be seen from the purpose and procedure practicum used. For example, experimental objectives observed from practicum module at university Y about ohms legal experiments. The objectives of the experiment are: (a) to study the effect of potential difference to electric current; (b) studying the effect of introductory resistance to electric current strength; (c) study the influence of temperature on barrier values; (d) to prove the ohm law; and (e) studying the effect of obstacles on the decrease of potential difference. From the objectives that have been described very clearly, all experimental objectives are directed to improving conceptual understanding. While aspects of inquiry skills and intellectual (scientific reasoning, critical and problem-solving skills) are not raised in the design and execution of experiments.

In relation to the observation of observed physics experiments, the steps of practicum activities undertaken are (a) beginning by introducing the topic and objectives of the experiment; (b) introducing experimental tools and materials; (c) Laboratory assistants together with students assembling tools and experiment materials based on instructions in the module; (d) Laboratory assistants and students both conduct experiments based on orders or experimental steps; (e) Laboratory Assistant directs the assembly to conduct further experiments by varying the variables according to the experimental guidance (f) The laboratory assistant guides the practitioner to find the relationship between experimental variables and prove the physics equation; (g) Practice answering the question of variables that have been prepared in the module; (h) student summarizes the results of the experiment based on the observations and answers of the statement, and (i) make a report on the results of the lab. From the stages of practicum done can be ascertained that the experiment used is a verification model. The verification practice is a laboratory activity in which students are directed to follow experiments in accordance with predetermined procedures, student’s questions answered by the teacher, and when finding the results of the experiment they will confirm to the teacher [11]. Activities of verification
laboratory activities include observation, measurement, processing and conclusion activities aimed at proving the concept [12]. In practice, the verification of the role of supervisor or laboratory assistant is most dominant than the role of students so that the process of scientific investigation such as identifying problems, formulating problems, making hypotheses, planning and conducting experiments should be done by students just ignored.

In addition to verification practicum factor, inquiry skill literacy is also influenced by intellectual ability such as scientific reasoning skills, scientific-solving skills, and critical thinking skills [9, 13]. Scientific reasoning is a process whereby principles of logic are applied to conduct investigations such as making explanations, formulating hypotheses, making predictions, providing solutions of problems, designing experimental procedures, conducting scientific investigations, analyzing and interpreting data, controlling variables, and developing law or theory based on scientific evidence [14]. Thus, it can be concluded that students' scientific reasoning skill is also one of the causes of the low literacy skill test results inquiry.

4. Conclusion
Based on the result of data analysis, it can be concluded that the skill of pre-service physics teacher in Aceh is still low on all aspects in the test. There are several factors that cause low literacy skills inquiry such as (a) inquiry learning has never been trained or introduced to students both laboratory activities and learning in the classroom; (b) the design of a verification experiment applied which aims to improve conceptual understanding and limit the student's space for conducting investigations; and (c) students' intellectual skills such as scientific reasoning, problem solving and critical thinking skills. These findings can be used as a starting point for lecturers and researchers to develop a practical model that can train the literacy skills of pre-service physics teacher inquiry.

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