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Profile of Undergraduate Students as Prospective Science Teachers in terms of Science Literacy

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***Abstract*— This study aims to describe the profile of the scientific literacy skills of undergraduate students at Tanjungpura University, Pontianak. The research method used is a descriptive method to describe the initial ability of scientific literacy of undergraduate students as prospective science teachers, especially in chemistry. The research subjects were undergraduate students in the chemistry education study program. The research sample uses a purposive sampling technique. The sample is undergraduate students in the first semester of the 2018/2019 school year. The data collection tool in this study is a written test in the form of a description to measure students' scientific literacy, interviews, observations, and learning questionnaires to find out the learning process during teaching lecturers in class. The results showed that the profile of the scientific literacy ability of undergraduate students at Tanjungpura University in Pontianak is still low, so it needs to be improved by developing learning models. This result can be seen from the percentage of student scores in the very low category of 84%. The low ability of scientific literacy is in aspects of scientific literacy as content, process, and context.**

Keywords: science literacy, educational science, undergraduate students

I. INTRODUCTION

The development of science and technology in the 21st century is developing fast and dynamically so that it impacts on various sectors of life, one of which is the education sector. The education process is expected to be able to shape people who are fully literate in science and technology. Education is also expected to act as a bridge that connects individuals with the environment so that individuals can act as quality human resources. This condition requires the ability of undergraduate students to be able to think intelligently and selectively in choosing valid and relevant information [1]. Education is an important factor in human life and is a major factor in determining the quality of a nation. Very fundamental things that must be owned by students in facing the global era to be able to meet the needs of life in various situations, namely the ability of scientific literacy.

Nowadays, science literacy is a discussion in the world of education. Many developed and developing countries have made science literacy the goal of science learning. Science literacy is the ability to understand science, communicate science, and apply the ability of science to solve problems. Science literacy is a very important thing that students need to develop their minds while at university. This is important for someone who is educated to be able to make the right decision, explain the reason, and can find a way out on a problem [2].

The ability of science literacy for prospective teachers, especially natural science/science teachers, really needs to be improved. To increase science literacy, students' motivation and learning strategies are needed by the conditions and potential of students. It is very important to develop science literacy skills for students as prospective science teachers because of the problems that occur in everyday life are very related to science [3]. Science literacy (science literacy) is now a demand to be mastered by every individual both in everyday life and in the world of work. Individuals who are literate in science can use the science information they have to overcome problems in their daily lives [4]. The importance of science literacy to deal with everyday life in society, participate in various issues related to science-complex, part of cultural heritage and greatly affect our view of the world and the place of humans in it and the science workforce needs that are science literacy [5]

The ability of science literacy of Indonesian students is still below average when compared with the average international score; this based on PISA (Program for International Student Assessment) data quoted from The Organization for Economic Co-operation and Development (OECD) ranking of Indonesia at PISA in the year 2009 was 57th out of 65 with a score of 383. In 2012 Indonesia was

ranked 64th out of 65 countries with a score of 382. In 2015 Indonesia was ranked 64th out of 72 countries with a score of 403. Based on the results three times, the survey scores Indonesian students on science literacy skills far below the international standard score set by the OECD institution [6-8]. One of the factors that influence low science literacy is because science learning still emphasizes memorization [9].

The education world needs a big revolution both at the level of paradigm shift from mastering content to mastering skills, from surface learning to deep learning, from teacher center to the student center. Science/Science Education as part of education plays an important role in preparing students who have science literacy, namely those who can think critically, creatively, logically, and take initiatives in responding to issues in society [10]. Science education has an important and strategic role in preparing quality human resources to enter the world of their lives. Science is essentially a product and process. Science products include facts, concepts, principles, theories, and law. The science process includes ways to acquire, develop, and apply the knowledge that includes how to work, how to think, how to solve problems, and how to behave.

One of the essential factors in improving the quality of learning outcomes is the teacher factor. Educators/lecturers are the determining factors for the creation of quality education services. The teacher is the deciding agent for the creation of quality educational services quality, and this means that what students know is influenced by what the teacher provides during learning [11]. The quality of prospective teachers of science cannot separate from the process of preparing prospective teachers. Prospective teachers must be taught step by step the process of observation, formulating conclusions, identifying assumptions, formulating, and testing hypotheses [12]. The teacher must be creative and innovative in carrying out the learning process. The teacher plays a strategic role. Therefore, it is not enough armed with knowledge related to the material taught, but it is necessary to pay attention to other aspects that support the realization of the potential development of students. Prospective teachers must understand and be aware of the important role of the teacher so they must be able to science and creative literacy.

To produce teachers and education personnel who have the competencies as stated in the national education quality standards, it requires a Teacher Training Institute (LPTK) that can compete and can offer quality outcomes. The progress of a nation is largely determined by the quality of human resources which rests on the quality of education. In line with the era of globalization, the problem of the quality of education has become very important to be realized.

II. METHOD

This type of research is a descriptive study to describe the initial ability of the science literacy of undergraduate students at the Tanjungpura University of Pontianak. This type of research is used to describe the initial ability of the science literacy of undergraduate students as prospective science teachers, especially in the field of chemistry. The research subjects were students of chemistry education study programs. The research sample uses a purposive sampling technique. Purposive sampling is a data source sampling technique with certain considerations [13]. Samples were 50 students in semester one of the 2018/2019 academic years as 50 candidates for teacher placement in universities. A tool to collect data needed in this research is a written test in the form of a description to measure the science literacy of undergraduate students. Interviews in this study were used to complete the main data obtained from student test results. Observation and learning questionnaire to determine the learning process during the lecturer teaching in class. Criteria for assessment of science literacy undergraduate students use the following categories [14],[15]:

TABLE I. CRITERIA FOR ASSESSMENT OF SCIENCE LITERACY

Category	Interval
Very High	86 – 100
High	76 – 85
Moderate	60 – 75
Low	55- 59
Very Low	≤ 54

III. RESULTS AND DISCUSSION

A. Description of Science Literacy Abilities

Based on the results of the science literacy test, it was obtained the results of the science literacy abilities of prospective science teacher students, especially in chemistry. The percentage of undergraduate students science literacy show in Table 2.

TABLE II. PROFILE OF LITERACY ABILITIES OF UNDERGRADUATE STUDENTS PROSPECTIVE SCIENCE TEACHERS IN GENERAL

Category	The number of students	Student scores	Percentage (%)
Very High	0	86-100	0
High	0	76-85	0
Moderate	8	60-75	16
Low	0	55-59	0
Very Low	42	≤ 54	84

Based on Table 2, the percentage of science literacy ability is included in the low category by 84%. This shows that the ability of the science literacy of students as natural science teacher candidates is still low. Science literacy can be interpreted as scientific knowledge and skills to be able to identify questions, obtain new knowledge, explain scientific phenomena, and draw conclusions based on facts, understand the characteristics of science, awareness of how science and technology shape the natural, intellectual, and cultural environments, and the willingness to engage and care about issues related to science [20],[25].

In science learning, lecturers can utilize the environment to apply scientific literacy. In the use of the environment, lecturers bring learning activities that are usually carried out in the classroom by lecturers and undergraduate students to a more tangible reality namely the environment [25]. This means that through learning by utilizing the environment as a source of learning, students are invited to understand concepts, apply concepts, solve problems to conclude a problem by involving the surrounding environment close to undergraduate students.

The ability of science literacy observed in this study consisted of three aspects namely, aspects of science content, aspects of the scientific process, and aspects of the science

context. The results of the science literacy aspects can be seen in the following Table 3:

TABLE III. PERCENTAGE OF ASPECTS OF SCIENCE LITERACY

Question Number	The Literacy Aspect	Percentage (%)
1	Science content: Determine the cause of acid rain	76
	Science process: Explain the phenomenon of acid rain	42
	Science context: Air pollution causes acid rain	100
2	Science content: acid corrosive properties	84
	Science process: Conclude with science evidence	66
	Science context: Using the concept of acid and base to solve problems in the area of life	100
3	Science content: Determine the difference between acid and water	72
	Science process: Identify science statements	76
	Science context: Using the concept of acid-base to solve problems in the environmental field	88
4	Science content: Determine the concept of dilution	16
	Science process: Identity how much vinegar is safe for consumption	10
	Science context: Using the concept of dilution to solve problems in the health field	10

The ability of undergraduate students science literacy is based on aspects of science literacy in each of the indicator questions as follows.

1) Apply the concept of acid-base to solve the problem of the effects of acid rain

The aspect of science content measured was being able to write down the cause of acid rain, averaging percentage of 76% was obtained. This result is because the answers already mentioned the origin of sulfur oxides and nitrogen oxides in acid rain. Only a few answers write down substances in acid rain. Aspects of the measured scientific process are able to explain the phenomenon of acid rain.

This aspect of the scientific process aims to determine the ability of undergraduate students to identify problems, understand the facts of nature and the environment [19]. As well as using his knowledge, to understand various natural phenomena and changes that occur in the environment. The aspect of scientific literacy in the science process is 42% because the average student does not explain which content is higher between acid rain and normal rain. The aspect of the science context that is measured is that air pollution by humans can cause acid rain. The aspect of scientific literacy in the scientific context of 100% of students understands acid rain can cause pollution to the environment.

2) Apply the concept of acid-base to solve the problem of the effects of acid rain.

The aspect of science content measured is the corrosive nature of acid. The aspect of science literacy in science content by 84% of students has been able to explain the effect of acid rain on rocks in nature. Measured aspects of the science process that is concluding with science evidence show the results of 66% of students have been able to explain the process of rock erosion based on data.

Aspects of the measured scientific process are able to explain the phenomenon of acid rain. This aspect of the scientific process aims to determine the ability of undergraduate students to identify problems, understand the facts of nature and the environment [19]. As well as using his knowledge, to understand various natural phenomena and changes that occur in the environment. The aspect of science context measured is able to use the concept of acid and base to solve problems in the field of life. This aspect results in as much as 100% of students have been able to use the concept of acid-base to solve problems on rocks.

3) Apply the concept of acid-base to solve the problem of the effects of acid rain.

The aspect of science content measured is to determine the difference between acidic and water properties. The aspect of science literacy in science content by 72% of students has been able to explain the difference between stones that are soaked with acid and those that are soaked in plain water. Other undergraduate students did not give a complete explanation and even only mentioned the effect of the stone soaked in water.

The aspect of the science process measured in identifying science statements. Aspects of the science process by 76% of students have been able to identify science statements in the questions given. Other undergraduate students do not understand the purpose of the problem. These results are in line with research that shows that the cause of students' difficulty in solving story problems, one of which is students cannot interpret the intent of the problems [15].

Aspects of the measured scientific process are able to explain the phenomenon of acid rain. This aspect of the scientific process aims to determine the ability of undergraduate students to identify problems, understand the facts of nature and the environment [19]. As well as using his knowledge, to understand various natural phenomena and changes that occur in the environment. The aspect of the science context that is measured is to use the concept of acid-base to solve problems in the environmental field. The aspect of science literacy in the science process by 88% of students has been able to use the concept of acid-base to solve problems in the erosion of marble.

4) Apply the concept of dilution to the vinegar acid solution.

The aspect of science content measured in determining the concept of dilution. The aspect of science literacy in science content is 16% of undergraduate students who can determine the concept of dilution. This is because undergraduate students do not use the dilution formula correctly. Students do not understand the concept and have low memory in applying the concept of dilution to the vinegar acid solution. The aspect of the science process measured is identifying the amount of vinegar that is safe for consumption. The aspect of science literacy in the science process by 10% of undergraduate students does not write the things that are known, does not write the dilution formula, and does not do the calculations correctly. Many undergraduate students do not write a dilution formula and only write calculations.

Students do not write what is known, what is asked and do not write the formula correctly. Many factors affect undergraduate students in making mistakes in working on problems. One of these influences is the undergraduate students are not careful in working on the problems. Students are less careful in calculating or doing it in a hurry because they feel pressed for time. Aspects of the measured scientific process are able to explain the phenomenon of acid rain. This aspect of the scientific process aims to determine the ability of undergraduate students to identify problems, understand the facts of nature and the environment [19] as well as using his knowledge, to understand various natural phenomena and changes that occur in the environment. The aspect of science context measured is being able to use the concept of dilution to solve problems in the health field. The aspect of science literacy in the science context is 10% because undergraduate students have not used the concept of dilution to solve problems. Students are not careful in doing calculations.

B. Learning Process Description

Science literacy learning is learning based on the development of scientific knowledge in various aspects of life, finding solutions to problems, making decisions, and improving quality of life [21],[22]. Many factors affect efforts to improve the quality of learning outcomes in both cognitive, affective, and psychomotor aspects. One of the essential factors in improvement is the teacher factor. Lecturers are the determining factors for the creation of quality education services. To find out the learning process in the classroom, observation, and dissemination of the questionnaire about the learning process in class are carried out. Observation results indicate that the implementation of learning carried out by lecturers so far has been dominated by the use of lecture methods. Based on the questionnaire given gives the results as in Table 4.

TABLE IV. LEARNING PROCESS OF SCIENCE TEACHER PROSPECTIVE STUDENTS

Aspect	Type	Number of respondents	Percentage (%)
Model	Lecture	43	86
	Others	7	14
Lecturer task	Homework and paper making	50	100
Attitude to the task	Burdened	32	64
	Not burdened	13	26
	Happy	5	10
Need a new model	Improve science literacy	50	100

Based on the results of Table 4, it is known that the use of lecture methods has dominated the implementation of learning carried out so far. As many as 86% of students stated that lecturers more often use the lecture method in conducting learning in class. As many as 14% of students gave questionnaire answers that the lecturer had used other methods, namely practicum and group discussion. The lecture method is a method of giving a description or explanation to several students at a certain time and place. This lecture method only relies on the sense of hearing as the most dominant learning tool. In other words, this method is a teaching method by conveying information and knowledge verbally to many students who generally follow passively.

Based on interviews, it is known that the use of lecture methods has dominated the implementation of learning carried out so far. Learning this lecture model should not be used if the learning objective is to change students' attitudes [15]. Weaknesses of the lecture method are passive students because attention is only focused on the teacher, students seem to be required to follow everything that is conveyed by the teacher, although there are students who are critical because the teacher is always considered right, students will be more bored and feel sleepy [16].

The reality of the learning process is currently dominated by lecturers (teacher-centered), which should have been dominated by students (student-centered). Lecturers are more likely to be oriented towards textbooks and powerpoints. Lecturers are instrumental in determining the success of the educational process because the transfer of knowledge is carried out to students. Learning outcomes obtained sometimes become less meaningful and less supportive of the development of students' science literacy skills. A habit of science literacy needs to be done because it can increase good knowledge and skills to achieve success in school and later in social life.

Lecturers have given assignments in learning and are recognized by 100% of students. The task is in the form of homework (PR) and making papers. As many as 64% of students feel burdened with lecturer assignments, 26% feel ordinary/unencumbered and 10% feel happy with the assignment. This data shows that student literacy is very lacking in the sense of willingness, and the ability to read is very lacking. The initial concept of literacy is understood as the ability to read and write [20]. Reading and writing are important activities in life. Most education processes depend on literacy skills and awareness.

The task of making papers by lecturers means students are required to look for information as literature reading material. In the current digital era, of course, sources of information are not only obtained through textbooks but more than that, the existence of internet facilities has resulted in the explosion of information sources. Students need to be trained to find appropriate and relevant sources of information according to their needs. The number of students who feel burdened by the lecturers' assignments shows that literacy culture is very low. Students need to familiarize themselves with learning to process and understand information when doing the reading and writing process.

Through the distribution of questionnaires and interviews with students, data were obtained that students were eager to become competent and professional educators in the fields of chemistry and science. According to them, prospective teachers need to have an understanding of science or have the ability of science literacy. As many as 100% of students stated the need for learning models that increase science literacy. They strongly agree with the changing implementation of educational patterns that provide 21st-century skills. Science literacy is considered an important skill for students in facing future life challenges. Having the ability of science literacy is the right of every individual and is the basis for lifelong learning.

Many factors can affect the low scientific literacy of students. One of the factors that cause the low ability of

scientific literacy is the selection of learning resources. This is in line with the results of research conducted by Irawan [23] which is one of the factors causing the low scientific literacy of students who are directly and closely related to students in the selection of learning resources. In Indonesia, scientific literacy in natural science learning is still largely limited to textbooks or text material rather than direct learning. One learning strategy that can improve students' scientific literacy skills is to utilize the environment as a learning resource. This is a strategy for delivering learning material that is contextual in nature. Contextual learning, according to Hosnan [24] is a learning concept that brings the real world to the classroom. The role of the lecturer in guiding undergraduate students to make connections between knowledge and its application in everyday life.

IV. CONCLUSION

The results of the research and discussion show that the profile of the scientific literacy ability of undergraduate students at Tanjungpura University in Pontianak is still low. This result can be seen from the percentage of student scores in the very low category of 84%. The low ability of scientific literacy is in aspects of scientific literacy as content, process, and context. The ability of scientific literacy must continue to be developed. It is very important for prospective science teachers, especially in chemistry, to master the ability of scientific literacy. The ability of scientific literacy is the basic competence of students as prospective science teachers in understanding their environment. Efforts to develop scientific literacy so that they can adjust to future technological advancements. Prospective science teachers must have an understanding of science or scientific literacy skills. This ability must be possessed so that one day after becoming a teacher, they can deliver scientific material to their students in-depth and can shape their students to have scientific literacy abilities.

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