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THE ANALYSIS OF PRE-SERVICE PHYSICS TEACHERS IN SCIENTIFIC LITERACY: FOCUS ON THE COMPETENCE AND KNOWLEDGE ASPECTS

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ABSTRACT

The role of scientific and technological knowledge is needed to compete in the era of industrial revolution 4.0. One of the roles of scientific knowledge is by analyzing the scientific literacy ability of pre-service physics teachers. This research aims to find out how far the achievement of scientific literacy possesses by current pre-service physics teachers. The measurement of scientific literacy encompasses two aspects, namely, competence and knowledge aspects. The subjects of this research were thirty pre-service physics teachers from Universitas Islam Negeri Raden Intan Lampung (State Islamic University Raden Intan Lampung) selected by using purposive sampling. The research instrument used in this research was a test of scientific literacy ability. The data analysis techniques used consisted of data reduction, data display, and verification. The result of the study indicated that some indicators of scientific literacy skills need to be improved. The results showed that there were differences in the achievement of literacy skills in each indicator. In the aspect of competence, the indicator of Indicating Scientific Issues aspects of competence covers identifying issues scientifically (poor), explaining phenomena scientifically (good), using scientific evidence (poor). The aspects of knowledge: content Knowledge (good), procedural knowledge (poor), epistemic knowledge (moderate). Overall the scientific literacy ability of the pre-service physics teachers has not shown satisfying results. It can be concluded that pre-service physics teachers' literacy ability should be improved. A special strategy is needed that can improve the scientific literacy skills of prospective physics teachers so that the students who will teach in the future also could have good scientific literacy skills.

Keywords: pre-service teachers, physics, scientific literacy

INTRODUCTION

Currently, we are facing we have entered an era of digitalization known as the industrial revolution 4.0 (Aldianto et al., 2018; Anwar et al., 2018; Matsun et al., 2018; Subekti et al., 2018). An era in which humans move the nation's economic development has been slowly displaced by mechanical automation and technology digitalization (Buer et al., 2018; Liao et al., 2017; Suwardana, 2017). In order to remain in the global competition, each person is required to have superior competencies and skills (Yani et al., 2018). The role of scientific and technological knowledge is needed in this global era in order to improve the competitiveness and prosperity of a nation in the international environment (Matsun et al., 2018; Ratnasari et al., 2018) because science is the key to the development of Science and Technology (Choerunnisa et al., 2017).

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The development of science and technology has a major influence on the field of education, especially in Indonesia (Bahriah, 2015; Wulandari & Sholihin, 2016), to balance the rate of development of science and technology, the quality improvement in science learning is one of the challenges that must be faced in the world of education (Subekti et al., 2018). Good education must be able to bring about capable students and pre-service physics teachers, possess the ability to think logically, creatively, able to solve problems, master the technology, adaptive to the times, and to be literate in science (Abdurrahman et al., 2018; Choerunnisa et al., 2017; Isdaryanti et al., 2018; Sulistiyowati et al., 2018) this study obtained t value 4,210 with significance 0,001. The significance value 0,001 < 0,05 showed that there is influence from teachers' performance in arranging learning media integrated with character education to the teachers' performance in science learning. The conclusion of research stated that the performance of science teachers in junior high schools in Semarang City in integrating character education is categorized into a very good category with average score 85,05.

To be literate in science is also known as scientific literacy (Bahriah, 2015). One program that measures scientific literacy in the world is the Program for International Student Assessment (PISA). The PISA defines scientific literacy as an individual's capacity to use scientific knowledge, identify questions scientifically, and draw conclusions based on available evidence (Chi et al., 2018; Diana, 2016; Winata et al., 2016), in order to be able to make decisions about nature and human interaction with nature itself (Nisa' et al., 2015; Nurfaidah, 2017).

Scientific literacy is the main objective of science education (Senturk & Sari, 2018) and is used as an indicator to see the quality of education and human resources in a country (Winata et al., 2016). Scientific literacy is not only the ability to read and understand science (Griffin & Ramachandran, 2010), but also the ability to understand and apply basic principles of science (Holden, 2010; Nahdiah et al., 2017). Therefore, scientific literacy ability is important for citizens at various levels of education.

China and South Korea have made scientific literacy as a state program to boost the strengths and skills of science (Gao et al., 2016; Mun et al., 2015; Wu et al., 2018; Yao & Guo, 2018; Zhu, 2017). When compared with other Asian countries, the literacy ability of Indonesian students is classified as below average (Ariyani et al., 2018; Rosidah & Sunarti, 2017). The average score of scientific literacy of Indonesian students in the PISA study conducted every three years can be seen in the following Table 1.

Table 1. The PISA Score of Indonesian Scientific Literacy in 2000-2015

Year	2000	2003	2006	2009	2012	2015
Score	393	395	393	383	382	403
Ranked	38/41	38/40	50/57	60/65	64/65	62/70

(Ardiansyah et al., 2016; OECD, 2018)

Based on the scientific literacy scores of students in Indonesia in Table 1, the scores obtained are still very low, and there is no significant increase. Many factors certainly influence the low level of scientific literacy ability of these students. Without prejudice to other factors, the teacher is an essential factor in determining the quality of education as well as being a determinant in the success of scientific literacy abilities of students (Hordatt Gentles, 2018; Rohman et al., 2017; Titu et al., 2018).

Teacher's scientific literacy ability and the emergence of scientific literacy in learning in Indonesia are needed to develop students' literacy ability (Afandi et al., 2016; Asyhari, 2017). Much like Japan which strongly emphasizes the quality of teacher competencies to achieve literacy achievements in Trends in the International Mathematics and Science Study (TIMSS) (Diana, 2016).

The quality of science teachers cannot be separated from the process of preparing preservice science teachers (Fernández, 2018)this critical policy analysis examines how teaching, teacher education, and justice were conceptualized in Chile's teacher preparation policies between 2008-2015. It also analyzes the narrative stories implicit in these policy documents. Analysis of the documents shows that national policies emphasize a content knowledge for teaching and teacher education and conceptualize justice as an issue of access to quality teachers. These approaches to teaching, teacher education, and justice are similar to predominant discourses in countries like the US. However, Chilean national policies are promoted using a narrative of development instead of the narrative of decline or crisis usually

used in developed countries. These findings contribute to the understanding of national teacher education policies and their connection to the process of policy borrowing. The paper shows both the particularities of frames and narratives used in teacher education policies in developing countries like Chile and their similarities to those in countries that implement neoliberal policies in teacher education.

Pre-service science teachers are expected to have good scientific literacy in order to be able to produce students with scientific literacy insight (Rachmatullah et al., 2018). Therefore, improving the competence of pre-service science teachers, including pre-service physics teachers in scientific literacy ability is important (Rosidah & Sunarti, 2017; Zainab et al., 2017).

Preparing pre-service physics teachers who are knowledgeable about scientific literacy is a big task for higher education in Indonesia (Putra et al., 2016). This is in line with the goal of nations in the face of the industrial revolution 4.0, which is to prepare qualified science graduates who can compete globally (Subekti et al., 2018). For this reason, higher education plays an important role in preparing pre-service science teachers including pre-service physics teacher. Based on the argument, assessing the extent of the scientific literacy abilities of current pre-service physics teacher is important.

Previously there were many scientific studies that discussed scientific literacy, including scientific literacy studies at the primary education leve (Nurfaidah, 2017), junior high school level (Novili et al., 2017; Wulandari & Sholihin, 2016; Yani et al., 2018), and high school level (Ardiansyah et al., 2016; Rohman et al., 2017). In addition, there are also scientific studies discussed the scientific literacy at the level of higher education, including discussing the initial abilities of students' scientific literacy (Winata et al., 2016), scientific literacy ability for pre-service chemistry teachers (Bahriah, 2015), to the application of learning methods in scientific literacy ability (Gherardini, 2016).

The difference between this research and the previous studies is that this research focuses on scientific literacy ability which covers two aspects of scientific literacy, namely aspects of competency and knowledge for pre-service physics teachers. Both of these aspects are important to determine the scientific literacy skills of pre-service physics teachers. Also, the researchers also analyze the scientific literacy abilities of pre-service physics teachers and present the right steps to obtain appropriate information related to the scientific literacy ability possessed by the pre-service physics teachers. The results of this study can later be used as recommendations for improving the learning process that can improve the scientific literacy skills of pre-service physics teachers especially to face the industrial revolution 4.0 era.

METHODS

This research employed a qualitative descriptive method which aimed at describing the scientific literacy ability of pre-service physics teachers based on the aspects of competence and knowledge.

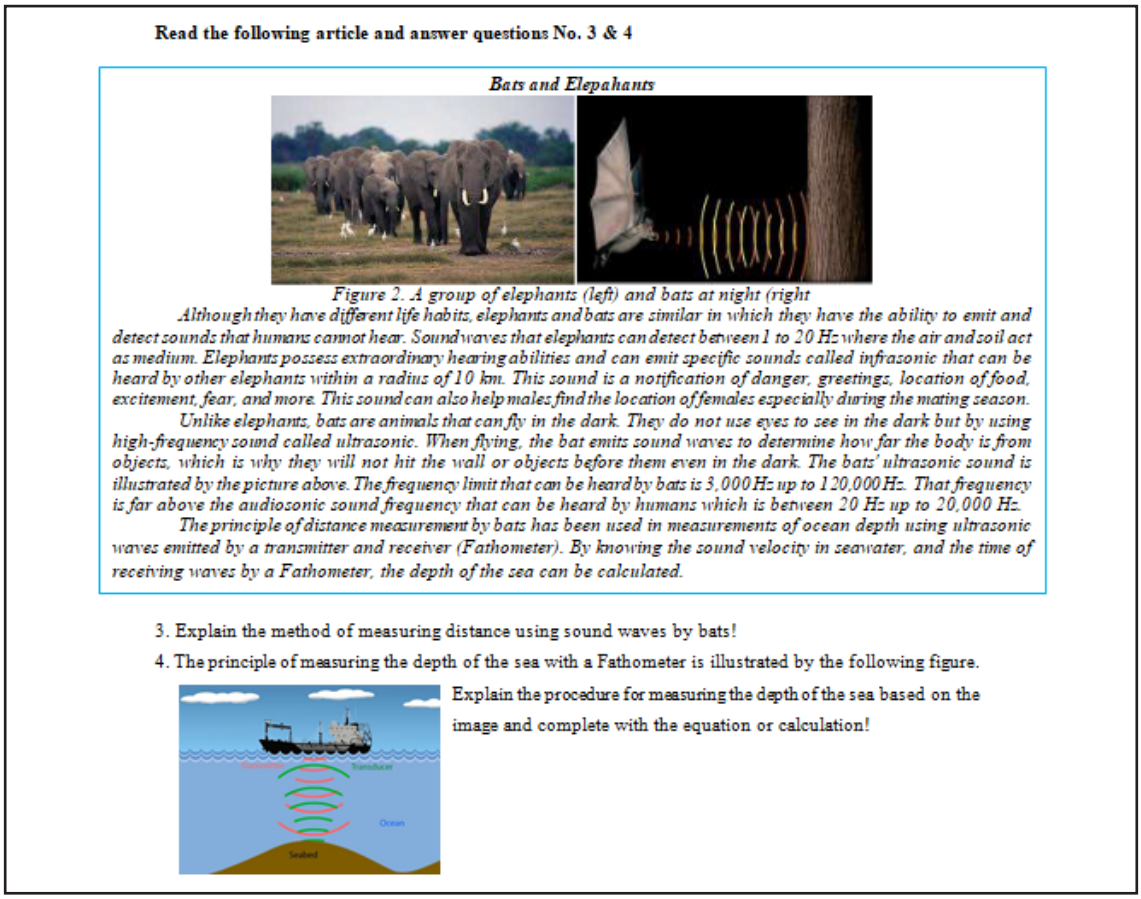
The population in this research were all 4th-semester students of Physics Education Department, Faculty of Education and Teacher Training, Universitas Islam Negeri Raden Intan Lampung in the academic year 2017/2018. Purposive sampling was used to determine the sample that consisted of 30 students. After the data were obtained and analyzed, interviews were then conducted to the students with low, medium, and high abilities. This was done to strengthen the results of previous research.

The instrument used to determine the scientific literacy ability of pre-service physics teacher on the aspects of competence and knowledge was in the form of scientific literacy ability test. The instrument used in this study was in the form of a description and was the result of the adaptation of existing scientific literacy instruments. From the existing instruments, the researchers then re-develop it by constructing 20 items in accordance with the indicators to be achieved. The instrument was then validated in terms of content and language by involving the help of 3 experts (expert judgment). From the results of the second validation, the expert stated that 15 questions were declared valid in terms of content and language so that they were fit to be used for research The item distribution of the test is presented in Table 2.

Table 2. Distribution of Science Literacy Questions

Aspects of Scientific Literacy	Indicator	Number of Questions
Competency	Identifying issues scientifically	1, 2, 8, 10, 11, 13
	Explaining phenomenon scientifically	3, 4, 6, 9, 14
	Using scientific evidence	5, 7, 12, 15
Knowledge	Content Knowledge	1, 2, 9, 13, 14
	Procedural Knowledge	4, 8, 10, 11
	Epistemic Knowledge	3, 5, 6, 7, 12, 15

Table 2 is the distribution of scientific literacy questions based on predetermined scientific literacy indicators. Each question contains indicators on aspects of competence and knowledge. The problems given were in the form of an essay question that covered the sound waves material. The following is an example of the scientific literacy instrument used in this study. The instrument of this research has been translated from the original language, Indonesian.


Read the following article and answer questions No. 3 & 4

Bats and Elepahants

Figure 2. A group of elephants (left) and bats at night (right

Although they have different life habits, elephants and bats are similar in which they have the ability to emit and detect sounds that humans cannot hear. Sound waves that elephants can detect between 1 to 20 Hz where the air and soil act as medium. Elephants possess extraordinary hearing abilities and can emit specific sounds called infrasonic that can be heard by other elephants within a radius of 10 km. This sound is a notification of danger, greetings, location of food, excitement, fear, and more. This sound can also help males find the location of females especially during the mating season.

Unlike elephants, bats are animals that can fly in the dark. They do not use eyes to see in the dark but by using high-frequency sound called ultrasonic. When flying, the bat emits sound waves to determine how far the body is from objects, which is why they will not hit the wall or objects before them even in the dark. The bats' ultrasonic sound is illustrated by the picture above. The frequency limit that can be heard by bats is 3,000 Hz up to 120,000 Hz. That frequency is far above the audiosonic sound frequency that can be heard by humans which is between 20 Hz up to 20,000 Hz.

The principle of distance measurement by bats has been used in measurements of ocean depth using ultrasonic waves emitted by a transmitter and receiver (Fathometer). By knowing the sound velocity in seawater, and the time of receiving waves by a Fathometer, the depth of the sea can be calculated.

3. Explain the method of measuring distance using sound waves by bats!
4. The principle of measuring the depth of the sea with a Fathometer is illustrated by the following figure.

Explain the procedure for measuring the depth of the sea based on the image and complete with the equation or calculation!

Figure 1. Example of a Science Literacy Instrument Used

In addition to the question of the instruments, researchers made interview instruments that contained questions to express students' scientific literacy skills after solving the problem. Interviews were carried out structurally to reveal the extent of students' scientific literacy skills. Before being used, the interview instrument was first validated by the expert.

This research was conducted by giving a test of scientific literacy ability to pre-service physics teachers. Fifteen questions were given and must be finished within 2 x 45 minutes.

The data analysis used in this research was the model provided by Milles and Huberman. The flow of data analysis is shown in Figure 1.

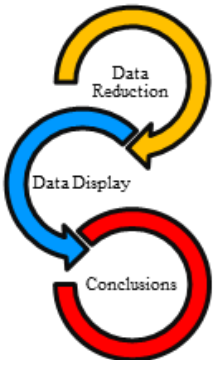


Figure 2. Chart of Qualitative Data Analysis Model by Milles and Huberman

Figure 1 is a qualitative data analysis chart of the Milles and Huberman model used in this research which includes data reduction, data presentation, and conclusion drawing (Rohman et al., 2017; Sugiyono, 2014). The model proposed by Milles and Huberman can help to facilitate the researchers in analyzing research data. In this study, this model reduces the data and the presentation into a quantitative form. In order that quantitative can be more meaningful, it is turned into qualitative in analyzing the data and presenting the data. The data obtained were analyzed by calculating the percentage of achievement of the scientific literacy ability of pre-service physics teachers on the aspects of competence and knowledge.

The percentage of scientific literacy ability achievement was interpreted descriptively based on the criteria of scientific literacy abilities shown in Table 3.

Table 3. Criteria of Scientific Literacy

Persentase (%)	Criterion
80<%≤100	Very Good
66<%≤79	Good
56<%≤65	Moderate
40<%≤55	Poor
0<%≤39	Very Poor

(Novili et al., 2017)

Criteria of scientific literacy ability in Table 3 were used to see the achievement of scientific literacy of the pre-service physics teachers. The percentage of scientific literacy abilities was then interpreted descriptively based on the criteria of scientific literacy abilities. The data obtained was analyzed by every aspect of scientific literacy and discussed in depth so that a conclusion can be obtained.

RESULTS AND DISCUSSION

After the test, the score (x) obtained was then compared to the average score () and standard deviation (S). These values are then grouped into three categories of scientific literacy abilities with the criteria as in Table 4.

Table 4. Categories of Scientific Literacy

Categories	Description
High	$x \geq$ + S
Moderate	- S $\leq x \leq$ + S
Low	$x \leq$ - S

Based on the categorization in Table 4, the scientific literacy ability of the pre-service physics teachers of Universitas Islam Negeri Raden Intan Lampung can be mapped in Table 5.

Table 5. Distribution of Scientific Literacy Ability of the Pre-service Physics Teachers

Categories	N	%
High	6	20.00 %
Moderate	19	63.33 %
Low	5	16.67 %
Total	30	100 %

In this study, the data analysis used was qualitative descriptive. In order to make it easier for the researchers to retrieve data, the strategy by Milles and Huberman's was used (Figure 1). According to Milles and Huberman, data analysis activities in qualitative research were conducted interactively in each stage of the research (Rohman et al., 2017).

The first stage carried out in analyzing the data of scientific literacy skills of pre-service physics teacher was data reduction. The complex and not meaningful data on the results of tests on scientific literacy ability was reduced based on the research objectives to be achieved. In this case, the researcher analyzed the answers of each physics teacher candidate based on the existing assessment rubric so that more meaningful data

could be produced in the form of the score of scientific literacy ability test results. The following is an analysis of two scientific literacy ability questions of the high category student (represented by Subject 1), moderate (represented by Subject 2) and low (represented by Subject 3).

Table 6. Analysis of Pre-service Physics Teacher Answers Based on the Categories of Scientific Literacy Ability

No	Item Description	The Analysis of the Answer of Subject 1 (High Category)	The Analysis of the Answer of Subject 2 (Moderate Category)	The Analysis of the Answer of Subject 3 (Low Category)
3	In this question, the students were expected to be able to explain scientific phenomena related to sound wave propagation (Maximum Score 4).	Based on the answer given, Subject 1 got 2 points. Subject 1 was able to answer the question correctly, but he did not provide a detailed answer and the arguments given were not explained scientifically based on the existing phenomena.	Based on the answer given, Subject 2 only got 1 point. This was because Subject 2 was not able to provide answers in detail and the arguments given were not explained scientifically based on existing phenomena.	Based on the answer given, Subject 3 only got 1 point. Based on the analysis of answers, Subject 3 was unable to provide detailed answers and could not explain the existing phenomena scientifically.
4	In this question, the students were expected to be able to analyze the measurement procedure on a fathometer (Maximum Score 8).	Based on the answer, Subject 1 scored 3 out of 8 because of Subject 1. Couldn't explain the measurement procedure on a fathometer in detail. Subject 1 did not analyze the answer scientifically; Subject 1 was unable to identify the calculation variables in the measurement using the fathometer as instructed.	Based on the answer given, only subject 2 obtained 2 points. This was because Subject 2 was unable to explain the measurement procedure on the fathometer in detail. Subject 2 did not analyze the answers scientifically, and he did not identify the calculation variables in the measurement of the fathometer as expected in the problem.	Based on the answers, Subject 3 obtained 0 points. Subject 3 did not fill in at all the question number 4. So it can be concluded that Subject 3 was not able to identify the calculation variables in the measurement using a fathometer.

After the data on the results of the scientific literacy ability test were reduced, the next data analysis stage was data display. Data reduction was made by adjusting the criteria of the assessment of each item with the results of student literacy ability in solving the problem. The analysis of the result of the interview of the representative data was done to confirm the validity of the data generated. After obtaining valid and consistent data, the research conclusions will be produced.

Data analysis of scientific literacy ability was compared with the results of interviews. This was done to test the validity of the data in this study. The following are the results of data triangulation that has been done on the research subject data.

Table 7. The Data Triangulation of Students' Literacy Ability

Research Subject	Results of the Scientific Literacy Ability Test	Result of Interview
Subject 1 (High Literacy Ability)	Subject 1 has the best scientific literacy ability compared to other subjects. The test results showed that Subject 1 was able to solve the questions given well. In general, subject 1 can solve questions correctly and be able to answer in detail according to his understanding.	Based on the results of the interview, researchers can confirm that Subject 1 did not encounter many difficulties in solving the problem of scientific literacy. Subject 1 argues that the problems he is working on are related to phenomena that often occur in life. So that in answering Subject 1 can associate with the understanding he has. Although it is admitted that there are many difficult questions to answer, Subject 1 still tries to solve them.

Subject 2 (Moderate Literacy Ability)	Subject 2 has moderate scientific literacy. Based on the tests given, Subject 2 was quite able to solve the questions given even though there were still some questions was unable to be resolved. In solving the questions given, Subject 2 was quite capable of answering questions correctly and was able to answer in detail according to his understanding. However, some of the questions found were still not resolved properly.	Based on the results of the interview, Subject 2 provided recognition in solving the problem of scientific literacy. There were several questions that he was not able to complete properly. Subject 2 still found some difficult question. It might be caused by Subject 2 was less able to understand the theories that underlie these problems.
Subject 3 (Low Literacy Ability)	Subject 3 has low scientific literacy ability. From the scientific literacy tests given, subject 3 was not able to solve the questions correctly and in detail. Subject 3 was unable to do until they were finished. In fact, some other questions couldn't be answered at all by Subject 3.	Based on the results of the interview, the researchers found that Subject 3 experienced difficulties in solving the problem of scientific literacy given. It might be caused by subject 3 did not fully understand the concepts underlying the problem. In addition, Subject 3 admitted that he was still unfamiliar with the type of question given, so he encountered many difficulties in answering it.

Based on the score of the scientific literacy ability test, the achievement of scientific literacy ability of the pre-service physics teachers at Universitas Islam Negeri Raden Intan Lampung can be seen in Table 8.

Table 8. The Percentage of Scientific Literacy Ability for each Indicator of Competence and Knowledge Aspects

Aspects of Science Literacy	Indicators of Scientific Literacy Aspects	Percentage (%)	Criteria
Competency aspect	Identifying issues scientifically	51	Poor
	Explaining phenomena scientifically	73	Good
	Using scientific evidence	54	Poor
Knowledge aspect	Content Knowledge	77	Good
	Procedural Knowledge	42	Poor
	Epistemic Knowledge	64	Moderate

After the data on scientific literacy skills are presented and obtained in the form of a percentage, the next stage of data analysis is to conclude from the data presented. Based on the percentage criteria in Table 3, it was found that the scientific literacy abilities of pre-service physics teachers at Universitas Islam Negeri Raden Intan Lampung on the aspect of competence is 59 % and the knowledge aspect is 61 % so that the abilities can be categorized as moderate.

Based on the results obtained in Table 8, it can be shown that the results of literacy abilities obtained are not very encouraging. There are three indicators belong to the poor category, one moderate category, and two indicators are in a good category. None of the indicators belongs to the very good category. The competency aspect of the pre-service physics teachers is in the good category in explaining phenomena scientifically while the scientific literacy ability in identifying issues scientifically and using scientific evidence is in the poor category.

In identifying scientific questions, the pre-service physics teachers are required to be able to recognize questions that might be scientifically investigated in a given situation, find information, identify keywords, and recognize features of scientific inquiry, such as what things should be compared, what variables should be changed and controlled, and what additional information is needed so that relevant data can be collected (Wulandari & Sholihin, 2016). In this indicator, pre-service physics teachers have not been able to investigate the question scientifically, so that they have not been able to provide relevant answers. This is why the scientific literacy ability of pre-service physics teachers on these indicators is still relatively poor. Identifying scientific issues

is a basic thing that pre-service physics teachers must understand before identifying further literacy. This is in line with several studies (Nehru & Syarkowi, 2017; Rahayu, 2015).

The next scientific literacy ability indicator that belongs to the poor category is using scientific evidence. This aspect requires a student to be able to interpret scientific findings as evidence to make a conclusion and communicate the reasons behind the conclusion (Novili et al., 2017). In this indicator, the pre-service physics teachers were not able to provide scientific evidence for resolving problems in scientific literacy issues. This is proven by the analysis of the answers to the questions. Pre-service teachers generally answered with short and less argumentative answers. The answers given were also not accompanied by corroborating concrete evidence. The ability to argue with scientific evidence is an indicator of a teacher's ability to teach in the classroom (Rahayu, 2015). Physics teachers who can explain with scientific evidence will be able to brighten up the atmosphere of the discussion (Deta, 2017). However, this ability still needs to be improved because it is included in poor category.

On the indicator of explaining phenomena scientifically, the pre-service physics teachers were able to solve the problems based on existing scientific phenomena. In solving the problems, the pre-service physics teachers were able to connect scientific concepts and applications quite well. This is in line with the research of Novili et al. (2017) who state that explaining phenomena scientifically will be easy to do because scientific phenomena are often found in everyday life. Therefore, pre-service physics teachers had no difficulty in solving problems on this indicator.

The competency of the pre-service physics teachers' scientific literacy ability has been discussed, so what about their scientific literacy knowledge? In Table 4, it is found that the aspect of scientific literacy knowledge of the pre-service physics teachers belongs to the good category, whereas the epistemic knowledge indicator belongs to the moderate category. The indicators of procedural knowledge obtained the lowest percentage which belongs to the poor category. The three indicators of scientific literacy knowledge are in different categories because the level of knowledge difficulty is different.

The content knowledge emphasizes real life. In this indicator, the pre-service physics teachers already have good content knowledge. This is evidenced by the good process of resolving the questions related to scientific concepts in real life. This is in line with the research of Novili et al. (2017) that claim a person has good content knowledge when he is able to uncover investigations related to cases given in accordance with real life.

The aspect of procedural knowledge is related to the ability to explore knowledge mainly in terms of identifying experimental variables. Scientific literacy ability of the pre-service physics teachers on this indicator belongs to the very poor category. The lack of scientific literacy ability on this indicator is caused by the inability to identify experimental variables and explore their knowledge. This can be seen through the lack of their ability on this indicator. This result is similar to the research by Winata et al. (2016) that the lack of someone's scientific literacy ability is caused by the inability to communicate the results of the experiment in writing.

The aspect of epistemic knowledge is related to the identification of scientific aspects, justifying data, and providing arguments scientifically. Scientific literacy ability of the pre-service physics teachers on this indicator is already good. This is because pre-service physics teachers were able to provide good scientific arguments when solving problems.

Based on the results discussed in this research, several aspects of science must be increased by pre-service physics teachers so that their achievement of scientific literacy abilities could be increased. One of the things that can be done by the pre-service physics teachers is to get used to solving physics problems in the matter of scientific literacy so that they are accustomed to solving physical problems in the matter of scientific literacy. The increase on the teachers' scientific literacy ability could provide opportunities to improve students' scientific literacy.

In addition, the scientific literacy skills improvement of the pre-service physics teachers will certainly support them in facing the 4.0 industrial revolution, because the 4.0 industrial revolution is a development of the integration of science and technology. So, the scientific literacy skills are very important to be improved so that the pre-service physics teachers can be ready to compete when they graduate later.

Increasing scientific literacy skills of pre-service physics teachers will certainly support them in facing the industrial revolution 4.0 because this is a development of the integration of science and technology (Ibda, 2018). Such integration can have positive or negative impacts. To reduce the negative impacts (Crnjac et al., 2017; Liao et al., 2018; Reuters & Standard, 2014; Saregar et al., 2018), each Education Institu-

tion needs to implement three pillars of literacy, reading, writing, and archiving. The three pillars of literacy can be applied through data literacy, technology literacy, and human resource literacy. Data literacy can provide valid information (Subekti et al., 2018), technology literacy can publish information correctly, and literacy of human resources can produce generations who are literate in data literacy and technology. Literacy will be able to answer the challenges of industrial revolution 4.0 (Ahmad, 2018), especially in science learning that always interacts with everyday life (Subekti et al., 2018). So, science literacy skills are very important to be improved so that pre-service physics teachers can be ready to compete when they graduate later.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that, overall, the scientific literacy ability of the pre-service physics teachers at Raden Intan State Islamic University Lampung both on the aspects of competence and the aspects of knowledge. The aspects of competence cover identifying issues scientifically (poor), explaining phenomena scientifically (good), using scientific evidence (poor) and the aspects of knowledge which cover the content Knowledge (good), procedural knowledge (poor), epistemic knowledge (moderate).

The competency aspects of the scientific literacy abilities need to be improved especially on the indicators of problem-solving and using scientific evidence. The indicators of procedural knowledge of the knowledge aspects also need to be improved. The obtained scientific literacy scores indicate that the scientific literacy ability of the pre-service physics teacher is dissatisfactory. Therefore, pre-service physics teachers must increase their scientific literacy ability to be able to become competent science educators and able to compete in the industrial revolution era 4.0.

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