ICSAT INTERNATIONAL PROCEEDING
ISBN: 978-623-7496-62-5
Vol, 11 Issue 5

Profile of Science Literacy Skills amongst Pre-service Science Teachers

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Abstract
Science literacy-based learning is central to 21st-century education, and Science Teachers are key facilitators in developing students' scientific literacy. This study provides an overview of the perception of scientific literacy abilities of prospective science teachers measured based on 7 aspects, namely metacognitive (M), nature and function of science (NFS), science as human endeavor (SHE), habits of mind (HM), interest in science (IS), teaching scientific literacy (TSL), a sense of moral and social responsibility (MSR), and ethics in science (ES). The research data were obtained from 200 respondents on several campuses in Makassar City. The data were analyzed using SPSS to process and determine the value and then interpreted in criteria ranging from very low to very high. The analysis results show that the ES aspect is in the high criteria with a percentage of 75%, the other 7 aspects are in the very high criteria with a percentage above 80%, and the highest percentage is in the SHE aspect with a figure of 92%.

Keywords: *Science Teacher, Science Literacy*

INTRODUCTION

Scientific literacy-based learning is the main in education in the 21st century for the development of the nation. In facing the challenges of science education in the era of globalization, scientific literacy is one of the key competencies for the 21st century, namely considering the need for society to see scientific and technological literacy as the ability to access, read and understand the global world with science or technology dimensions, then make judgments, and used evaluation to inform and make decisions (Okada, 2013).

Scientific literacy is the main goal of science education in the 21st century. Regarding scientific literacy, the international science education community is concerned about what competencies must be possessed by 21st-century citizens, including Indonesia (Faisal & Martin, 2019). Scientific literacy focuses on the competence of citizens to make decisions about everyday life and social problems, given the proliferation of science, information, and technological advances (Suwono et al., 2021).

Science teachers are key facilitators in developing students' scientific literacy. Teachers with good scientific literacy skills will find it easier to develop students' scientific literacy. A science teacher with scientific literacy and knowledge skills has an intrinsic motivation to teach science, appreciates the nature of science, and is sensitive to quality science education (Cavas et al., 2013). The process of self-development affects the quality of science teachers. Al Sultan et al. (2018) suggest that prospective science teachers need to develop more enjoyment in teaching science and improve their

ISBN: 978-623-7496-62-5
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scientific literacy skills to succeed in teaching science to students.

The urgency of this research includes 1) For prospective science teachers, as information about the level of perception of scientific literacy so that they can learn independently to build their knowledge. 2) For higher education institutions, especially LPTK, research results can contribute to prospective science teachers' perception of scientific literacy. 3) For researchers, the results of this study are expected to provide information on the perception of prospective science teachers regarding scientific literacy in learning so that it can be used as reference material or consideration for further research.

Scientific literacy comes from a combination of two Latin words, namely literatus, meaning marked by letters, literate or educated, and scientia, which means having knowledge. DeBoer (2000) revealed that the first person to use the term scientific literacy was Paul de Hart Hurt from Stanford University. Hurt science literacy means the act of understanding science and applying it to the needs of society. The assessment of scientific literacy in PISA is not only in the form of measuring the level of understanding of scientific knowledge but also understanding various aspects of the scientific process, as well as the ability to apply knowledge and scientific processes in real situations faced by students, both as individuals, community members, and citizens.

Scientific literacy, according to the National Science Education Standards, is "scientific literacy is knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. Scientific literacy is a science and understanding of scientific concepts and processes that will enable a person to make a decision with his knowledge and to be involved in matters of state, culture, and economic growth. Scientific literacy can be defined as an understanding of science and its application to the needs of society. Based on this, it can be concluded that scientific literacy is the use of knowledge in responding to issues or phenomena in the surrounding environment related to science.

Chabalengula et al. (2008) suggested that scientific literacy consists of four aspects, namely: (a) knowledge of science, (b) the nature of the scientific investigation, (c) science as a way to know, and (d) the interaction of science, technology and society. According to Shen, scientific literacy is classified into seven components, namely: (a) the basic concepts of science, (b) the nature of science, (c) the work ethic of scientists, (d) the relationship between science and society, (e) the relationship between science and the humanities, and (f) understand the relationship and differences between science and technology. (Toharudin et al., 2011)

The Scientific Literacy Perception Questionnaire Instrument for Prospective Science Teachers uses the Item of Scientific Literacy Questionnaire for Prospective Science Teachers instrument (Suwono et al., 2021):

Metacognitive (M)
(1) When I complete research procedures, I verify whether the procedures are correct or not
(2) After completing my research projects, I ask myself whether I have reached the goals or not
(3) When doing one procedure, I ask myself whether I have understood all the procedures before continuing to the next procedure
(4) Before doing research, I ask myself whether I have understood the research problems
(5) I search for information and scientific evidence to make a decision
(6) Before doing research, I think of the procedures that will be undertaken
(7) When doing research, I think of the problems for every procedure I complete

The nature and function of science (NFS)
(1) Science has a significant relationship with human life
(2) Science is affected by civilization and local cultures

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(3) Not only technological advancement but also ethics and advantages can be discerned from science
(4) Scientific research should improve human life
(5) How a person uses science and technology will always involve social problem solving
(6) If the scientific problem is very complex and does not have a clear solution, it needs to be reviewed, and the causes of complexity examined
(7) Learning science develops a person's spirituality

Science as human endeavor (SHE)
(1) Scientists must be honest in conducting and reporting research
(2) Scientists must be open-minded when conducting research
(3) Science, technology, and society are closely interrelated
(4) Public support for scientific research is needed for the development of science
(5) Creativity plays an essential role in the development of scientific knowledge

Habits of mind (HM)
(1) When doing research, I try to find patterns or sequences in the data
(2) I analyze the data carefully to formulate correct conclusions
(3) When doing research, I look for related information from various sources
(4) I develop or use existing scientific procedures to explain the research
(5) When conducting research, I compare and evaluate information to determine which is most appropriate

Interest in science (IS)
(1) I consider science as an essential subject to teach
(2) I have a strong motivation to study science
(3) I have a positive attitude toward science as it involves teaching fascinating material
(4) Science helps everyone to have a better life
(5) Science helps me to understand phenomena that occur around me
The teaching of scientific literacy (TSL)
(1) I always discuss with peers and lecturers when learning science
(2) I do a practicum/experiment/research project in learning science in the class
(3) I use technology to support my learning process
(4) The science learning process that I receive can help me in making decisions
A sense of moral and social responsibility (MSR)
(1) I want to participate in solving problems that affect the lives of people in other parts of the world
(2) I want to play a role in making decisions about scientific issues affecting the world
(3) I try to understand and appreciate people in other parts of the world

Ethics in science (ES)
(1) Research does not need to be carried out systematically
(2) Scientific research does not need to be linked to global impacts
(3) Research we carry out does not need to be linked to other research findings
(4) When doing research, sometimes I skip or commit the research procedures

Science teachers are the main agents in developing students' scientific literacy. Therefore, it is important to identify teachers' perceptions of scientific literacy to improve students' scientific literacy. Research findings of Erwin et al. (2019), Fuadi et al. (2020), and Sumanik et al. (2021) show that the science literacy level of science teachers is still low; thus, it impacts the low scientific literacy of students, which has an impact on the low scientific literacy of students. Accordingly, it is imperative o study the perception of prospective science teachers on scientific literacy since it has implications for policy-making by education providers to quickly identify whether the implemented program effectively increases the perception of prospective science teachers on scientific literacy.

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The scientific literacy of students in the future must be high to keep up with the development of knowledge and technology in this competitive era, which needs to be supported by science teachers who also have a high level of scientific literacy. To find out how the science teacher's description of science literacy in the future can be carried out, mapping related to the profile of prospective science teachers' current science literacy ability. The current scientific literacy profile of prospective science teachers can be used as a reference to improve aspects of scientific literacy that are considered necessary so that scientific literacy skills when becoming a science teacher are in accordance with the need to educate and teach students.

METHOD

Type of the Study

This research is a quantitative descriptive study that aims to describe the scientific literacy ability profile of prospective science teachers. This study provides an overview of the ability of prospective science teachers to understand the existing aspects of scientific literacy. The data from this study can provide an overview of the level of each aspect of scientific literacy possessed by prospective science teachers so that it can be used as a reference for improving certain aspects of scientific literacy in the future and giving influence on increasing the scientific literacy of students who are taught when they have become science teachers.

Sample

The research sample includes prospective biology and science teacher students at the Universitas Negeri Makassar (UNM). The sample used was 375 UNM students in the fields of biology and science, consisting of several batches. Sampling was carried out by purposive sampling to obtain certain criteria from the study sample, namely the sample with the criteria for prospective biology and science teachers.

Instrument of Study

The instrument used in this study is a scientific literacy instrument adapted from the Instrument "Items of Scientific Literacy Questionnaire for Prospective Science Teachers" developed by Suwono et al. (2021). This instrument is distributed to respondents using a google form. The questionnaire was filled out based on a Likert scale (1 to 5) by selecting the statements strongly agree, agree, disagree, or strongly disagree with the statements.

Data Analysis Technique

The data obtained were analyzed using the SPSS application. The data is inputted in SPSS by converting the Likert scale statement data into numbers.

Table 1. Criteria for evaluating response questionnaire items

No	Criteria	Positive Statement	Negative Statement
1	Strongly agree	5	1
2	Agree	4	2
3	Neither agree nor disagree	3	3
4	Disagree	2	4
5	Strongly disagree	1	5

Source: adapted from Sugiyono (2009)

After the data is inputted, respondent mapping is carried out to describe how the respondents give the answers. The mapping results were then carried out with the Pearson correlation test to determine

ISBN: 978-623-7496-62-5
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the relationship between the existing variables. After the Pearson correlation test, Cronbach's Alpha reliability test was carried out to measure the level of consistency or stability of the questionnaire data. The Cronbach's Alpha test results are then matched with the table of alpha values.

Table 2. Alpha Cronbach's Values

Alpha Value Classification	Conclusion
$\alpha > 0.9$	Excellent
$\alpha > 0.8$	Good
$\alpha > 0.7$	Acceptable
$\alpha > 0.6$	Questionable
$\alpha > 0.5$	Poor
$\alpha < 0.5$	Unacceptable

Source: Geoge and Mallery (2003)

Then a regression test was performed to get the data mapping of each aspect. The value obtained **is** then interpreted into criteria by looking at (Table 3.2). The scores obtained will be described for each aspect of the Items of Scientific Literacy Questionnaire for Prospective Science Teachers based on available data.

Table 3. Criteria for Interpretation of Science Literacy Scores

Interval	Criteria
0 – 20%	Very low
21 – 40%	Low
41 – 60%	Enough
61 – 80 %	Tall
81 – 100%	Very high

Source: modified from (Riduwan, 2012)

RESULT AND DISCUSSION

Result

The study results indicate that the percentage of literacy skills of prospective biology and science teachers, in general, is very high. Of the eight aspects assessed, seven are in the 81-100% interval, and one is in the 61-80% interval. The data mapped from the questionnaire was first tested for the reliability of Cronbach's Alpha, and the following results were obtained:

Table 4. Reliability Statistic

Cronbach's Alpha	**N of Items**
.938	41

The data is then matched with the range of Cronbach's alpha values. The smaller the alpha value, it indicates that the more items are unreliable. The alpha value > 0.90 obtained indicates perfect reliability based on Cronbach's alpha table.

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The data is then performed a regression test to get the mapping of each aspect, the following graph of the mapping results obtained:

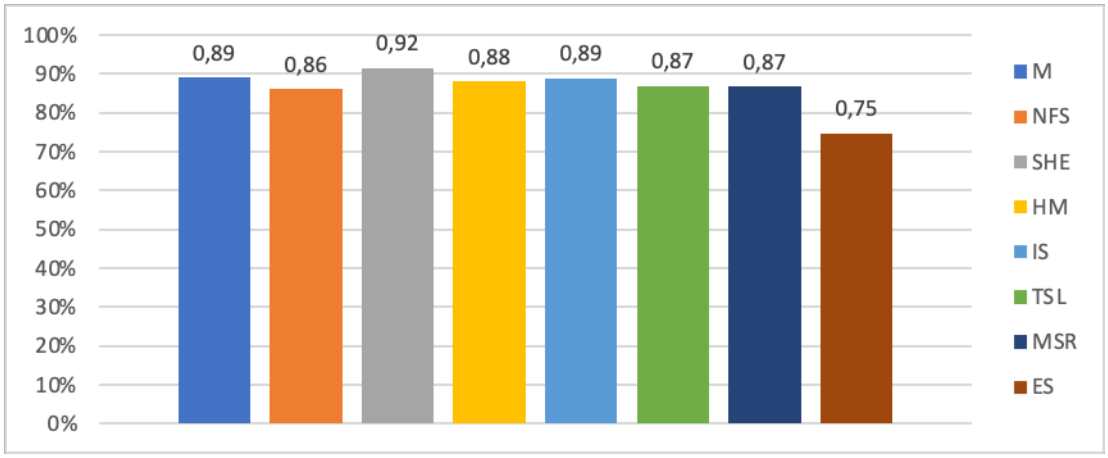

Figure 1. Percentage of Science Literacy Ability

Discussion

The average percentage of science literacy skills for science and biology teacher candidates obtained is in the "very high" range. Of the eight aspects, only one aspect is in the high range, while the other seven are in the "very high" range. The ability of scientific literacy is one of the most important abilities needed by everyone to improve the quality of human life itself. With good scientific literacy, the development of science and technology will be more environmentally friendly so that natural damage can be avoided.

The first aspect is Metacognitive (M). The new high school curriculum in Indonesia has placed the accomplishment of metacognitive knowledge. High school students are targeted to achieve metacognitive knowledge. If most of the teacher candidates have low metacognitive attitudes and knowledge, it is feared that the future curriculum in Indonesia will not be achieved properly. The teacher candidate-producing universities should consider metacognitive strategies in their lecturing classes. Metacognitive strategy is the most effective one in enhancing academic achievement and being integrated into the classroom to help students learn the material more efficiently, retain information longer and generalize skills. Implementing metacognitive strategies contributed to the increase in learning and curricula (Herlanti et al., 2019). Based on the data, the science literacy metacognitive ability of prospective science teachers is 89%; this provides a greater opportunity for future science teachers to improve students' progress in retaining information and using that information as a skill.

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The second aspect is the Nature and Function of Science (NFS). Teachers need to comprehensively comprehend the Nature of Science content and communicate this understanding effectively to students through various strategies or learning approaches. Specific learning tool or Subject Specific Pedagogic (SSP) not only contains material content but also contains knowledge about science (Nature of Science) as it invites students to inquiry (Uzpen et al., 2017). The NFS ability of the science teacher candidates obtained in this study was 86%. The ability of the NFS is included in the high category so that future science teacher candidates are expected to be able to assist students in increasing significant relationships with human life, local culture, spirituality, social problem solving, etc.

Aspects of Science as human endeavor (SHE), Science as a Human Endeavor should not be seen as the pinnacle. It is one of many approaches to deepen students' engagement with science. The science education of tomorrow will hopefully be different from today's science education. The center of gravity for science teaching has shifted. The goal now might be to develop individuals who think for themselves and can move towards making more informed decisions and actions (Sammel, 2014). SHE has the highest percentage of all aspects of scientific literacy measured, which is 92%. Aspects of SHE included how science is treated as a life experience, skill development, and everyday information. Science teachers who understand the SHE aspect of scientific literacy will help students to achieve this.

The interplay of the Habits of Mind (HM) results in the scientific attitude, in which no idea, conclusion, decision, or solution is accepted just because a particular person makes a claim but is treated skeptically and critically until its soundness can be judged according to the weight of evidence which is relevant to it. A key feature of evidence claims is that scientists have very high internal critical standards (Coll et al., 2006). The ability level of prospective science teacher HM is 88%; the ability with this level is expected to help the formation of scientific attitudes and internal critical standards of students being taught.

Science literacy is very important for students because students will use the scientific process in problem-solving, decision-making, and further understanding society and the environment. To help solve problems entirely and precisely. Besides, with the scientific method, they can use higher thinking skills, not just talking. Some problems are solved only with opinions but with scientific evidence to strengthen those opinions (Fadila et al., 2020). The high Interest in Science (IS) aspect will help students in this regard. The ability of prospective science teachers in the IS aspect reaches 89%; this ability will help science teachers to develop students' IS aspects.

Teachers identify problems they perceive as challenges in their teaching of scientific literacy; however, in most cases, they cannot articulate how these issues affect their teaching to promote scientific literacy. Also, in many cases, they express their limited ability to face challenges. Teacher problems considered challenging can be grouped into issues related to curriculum, schooling, and assessment (Sarkar & Corrigan, 2012). To overcome this, prospective science teachers must own the Teaching of Scientific Literacy (TSL). Based on the data, the TL ability of prospective science teachers is 87%,

It is not enough to contextualize science and reflect on its various risks and impacts; science education should not be content with teaching practices that focus on reading and writing scientific texts but should promote more disruptive learning. Science education should encourage a more equitable distribution of the benefits of science to build more global resilience and project new anti-oppression and more supportive and sustainable social relations, not only among people but also between the environment and the world (Valladares, 2021). A sense of Moral and Social Responsibility (MSR) is needed to achieve scientific goals. The percentage of 87% on the MSR ability aspect of science teacher candidates illustrates an excellent opportunity for achieving these science goals in the future.

Scientific knowledge has long been free from values and ethics. Even in STSE education, concerned with ethical issues of science and technology, the gap between knowledge and action has not been discussed significantly because it has adopted a linear model of knowledge and action. An important difficulty for teaching the ethics of scientific knowledge stems from the epistemology inherent in science and teaching science: Separating the mind from the body, humans from nature, and the knowing subject from the objects of their understanding of knowledge, scientific knowledge is free from subjectivity and human values in the everyday world. -day (Kim & Roth, 2008). Ethics in Science (ES) is a very important aspect of forming scientists who are knowledgeable and have humanity and manners. The ability of prospective science teachers in the ES aspect is the lowest of all existing aspects, namely 75%. Treatment needs to be done to increase further knowledge related to ES aspects.

CONCLUSIONS AND SUGGESTIONS

The scientific literacy skills amongst pre-service science teachers in the eight aspects that have been measured show that the scientific literacy ability of the prospective science teacher is generally very high. Especially in the aspect of ES (Ethics in Science), there needs to be an increase because the ability in this aspect is the lowest from the other aspects with a considerable difference.

Scientific literacy skills amongst pre-service science teachers are expected to be maintained and improved to be good science teachers. In addition, their scientific literacy skills must always be upgraded to become science teachers later and applied in teaching so that students can also improve their scientific literacy skills.

ACKNOWLEDGEMENT

This project was supported and funded by Research and Community Service Institute, Universitas Negeri Makassar. We want to thank Husain Syam, who has contributed to completing this paper.

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