Analysis of Environmental Literacy Readiness of Pre-service and Science Teachers in Facing Ecological and Sustainability Challenges

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Abstract: This study aims to determine the level of environmental literacy readiness of pre-service and science teachers in East Lombok in facing ecological and sustainability challenges. This descriptive quantitative research involved 39 pre-service and science teachers in East Lombok Regency at the end of 2022. Data were collected using a questionnaire that includes 3 components of environmental literacy by adapting the criteria from NEEF. The results found that the overall score of environmental literacy of pre-service and science teachers was 143.70 and included in the high category. Detailed achievements of environmental literacy of pre-service and science teachers are: aspects of attitudes towards the environment with scores of 45.40 (high) and 45.90 (high) respectively, aspects of attention to the environment score at a moderate level with scores of 37 and 37.10. and the score of aspects of perception of the environment and its protection efforts reached 61.10 (high) and 60.90 (high). Referring to the research findings, it can be concluded that the level of readiness of pre-service and science teachers in East Lombok Regency to face ecological and sustainability challenges is at a high level.

Keywords: Environmental literacy; Pre-service and Science teachers; Sustainability

Introduction

Environmental damage is currently at an alarming level (Ma'rifah et al., 2020), and has become one of the biggest problems facing Indonesia (Wulandari & Sulistiyowati, 2017). Globally, environmental sustainability is threatened by global warming and climate change (Djalante, 2019), as a result of increasing Earth's surface temperature. Surface air temperature (SUP) on Java Island increased by 0.11-1,240 C in 30 years (Prasetyo et al., 2021). This condition causes unpredictable rainfall and seasons, decreased productivity, etc. (Wahyudi, 2016), environmental disasters, and extreme weather (Phillips et al., 2015; Herman, 2015). The main actor causing this to happen is humans (Goulgouti et al., 2019), so improving and maintaining environmental sustainability is a shared responsibility of humanity (Yusup, 2021).

Sustainability principles and values must be a guide in carrying out activities (Salas-Zapata & Ortiz-Muñoz, 2019). The key factor in making this happen is developing community environmental literacy (Tascı, 2015; Farida et al., 2017; Evers, 2018). Environmental literacy determines individual behavior and actions towards environment (Kuruppuarachchi et al., 2021). Environmental literacy aims to form individual awareness and concern for protecting the environment (Mardiani et al., 2020; Ashari et al., 2023), as well as fostering pro-environmental behavior (Bissinger & Bogner, 2018), which is an important part of sustainability.

Environmental literacy consists of several components, that is knowledge, cognitive skills,

compassion, and behavior (Szczytko et al., 2019; Maurer & Bogner, 2020; Veisi et al., 2018). National Environmental Education Foundation (NEEF, 2015) reduces and divides the components that form environmental literacy into three groups, namely environmentally friendly behavior, attitudes towards the environment, and environmental information.

　　　　Education is the best way and forum to internalize the value of sustainability (Sumirat et al., 2023; Putri et al., 2023), global climate crisis (Kumar et al., 2023), and environmental literacy in society (Zulfa et al., 2016; Goldman et al., 2017; Anggraini et al., 2018; Nafsih & Usmeldi, 2022) especially science education which is part of citizenship and sustainability education (Vesterinen et al., 2016). The main key to optimizing education in developing sustainability is the quality of environmental literacy of teachers and prospective teachers (Wamsler, 2020; Istiningsih et al., 2022), because teachers are facilitators for building students' environmental literacy (Perkasa & Aznam, 2016).

　　　　Research on environmental literacy in Lombok has so far focused on students' environmental literacy and learning, such as PBL (Suhirman, 2020; Sukri, 2023) while Dewi et al., (2021) researched environmental education to increase students' environmental literacy at the Al-Istiqomah Islamic Boarding School West Lombok. On the other hand, research on the environmental literacy of teachers and prospective science teachers has never been conducted. Based on the above background, ensuring the quality of environmental literacy of science teachers and prospective teachers, especially regarding global warming and climate change and sustainability, is important. This research aims to determine the level of environmental literacy readiness of teachers and prospective science teachers in East Lombok to face ecological challenges and environmental sustainability.

Methods

　　　　This research is a descriptive study with a quantitative approach involving 39 people, with details of 16 prospective science teachers from the Physics Education study program at Hamzanwadi University, and 13 science teachers in 5 middle schools (SMP/SMA) in East Lombok Regency in 2022 (Table 1). The procedure of this research is shown in Figure 1.

　　　　The readiness indicator measured is the quality of environmental literacy of teachers and prospective science teachers using an environmental literacy questionnaire that adapts the National Environmental Education Foundation (NEEF, 2015) criteria with more general and flexible components, the substance of each aspect is presented in table 2. The questionnaire consists of 39 items and includes three aspects, namely attitudes towards the environment, attention to environmental

conditions, and perceptions of the environment and efforts to protect it.
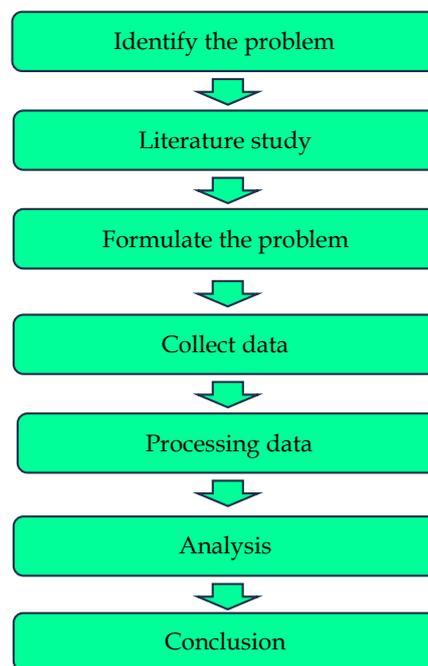

Figure 1. Research procedures

Table 1. Description of Research Subjects

Demographics	Science Teachers	Prospective Science Tearchers
Age (Years)	28-56	20-21
Male	2	4
Female	11	12
Service Period (Year)/Semester	1-10 (5 people) 11-20 (7 people) 35 (1 people)	V & VII

Table 2. Environmental literacy (LL) instrument grid

Aspect LL	Indicator
Attitude	– Environmental management and ecological crisis
	– Garbage, waste, and environmental balance
	– Utilization of natural resources and sustainability
Attention	– Pollution and exhaust emissions
	– Global warming and climate change
	– Environmental disasters
Perception	– The role of living things in ecological systems
	– Environmental law and management
	– Science and ecological impacts
	– Lifestyle and environmental sustainability

　　　　Research data was analyzed descriptively and converted into environmental literacy quality levels. The formula and criteria for environmental literacy conversion are presented in Table 3 (Azwar, 2015).

Table 3. Formula and Criteria for Environmental Literacy Level

Conversion Formula	Environmental Literacy	Environmental Literacy Aspect			Category
		Attitude	Attention	Perception	
$X > \bar{X}_i + 1{,}80SB_i$	163.90-195	46.20 – 55	54.80 – 65	64 – 75	Very High
$\bar{X}_i + 0{,}60\ SB_i < X \leq \bar{X}_i + 1{,}80\ SB_i$	132.70-163.80	37.50–46.10	44.30–54.70	52 – 63	High
$\bar{X}_i - 0{,}60\ SB_i < X \leq \bar{X}_i + 0{,}60SB_i$	101.50-132.60	28.70–37.40	33.90–44.20	40 – 51	Middle
$\bar{X}_i - 1{,}80\ SB_i < X \leq \bar{X}_i - 0{,}60SB_i$	70.30-101.40	18.90–28.60	23.40–33.80	28 – 39	Low
$X \leq \bar{X}_i - 1{,}80SB_i$	39 – 70.20	11 – 18.80	13 – 23.20	15 – 27	Very Low

Result and Discussion

In general, this research found that the quality of environmental literacy of teachers and prospective science teachers in East Lombok in 2022 was in the high category, with a score of 143.70. However, this high achievement is not evenly distributed in all aspects.

Aspects of Attitudes towards the Environment

Partially, in the aspect of attitude towards the environment, the results of the research show that the average scores of science teachers and prospective science teachers reached 45.40 and 45.90 respectively (high category). These results indicate that the attitude or treatment of science teachers and prospective teachers towards the environment has improved during the pandemic. This finding is in line with the research results of Farwati et al., (2017) which found that the attitude of prospective Chemistry teachers at Sriwijaya University was in the high category. Achievement of environmental literacy in the aspect of attitudes towards the environment is shown in Figure 2.
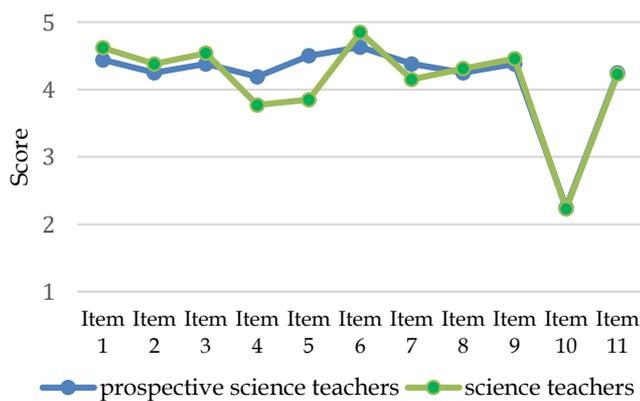

Figure 2. Attitudes of teachers and prospective science teachers towards the environment

The findings in Figure 2 show that there were negative responses from teachers and prospective science teachers on item 10 regarding the threat of environmental disasters due to climate change with a mean score of only 2.23 and 2.25. These results show that there is distrust among them regarding the ecological crisis that is hitting and threatening the survival of life on Earth.

Their lack of information or reading regarding this matter is the reason that science teachers and prospective teachers are less or even unfamiliar with the latest ecological issues that are currently affecting the earth (Napitupulu, 2015). Even though environmental problems are a serious topic discussed globally (Fetiana et al., 2022), especially regarding the threat of climate change and global warming (Hess & Collins, 2018).

Aspects of Attention to Environmental Conditions

The next component of environmental literacy measured in this research is attention to environmental conditions. In this aspect, researchers explore how much science teachers and prospective teachers pay attention to either reading, listening, discussing, or teaching substances related to current environmental problems, especially global warming and climate change. The scores achieved by teachers and prospective science teachers in this aspect are 37 and 37.10. Referring to the criteria in Table 3, this result is in the medium category. Detailed achievements of science teachers and prospective teachers in this aspect are depicted in Figure 3.
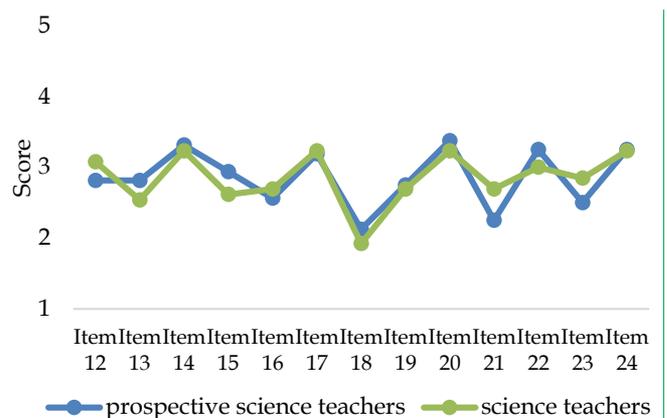

Figure 3. Attention of teachers and prospective science teachers to the environment

The data in Figure 3 shows that the response of teachers and prospective science teachers is still low in several respects. In item 13 regarding waste recycling, it can be seen that the level of attention that science teachers have regarding waste is very low with a score

of 2.50 lower than the attention of prospective science teachers about the same thing where the score is 2.80. This is certainly not good for maintaining environmental sustainability. Khairunnisa et al., (2023) stated that waste is a crucial environmental problem facing Indonesia. The attention of the public, including teachers and prospective science teachers, to waste processing efforts is very much needed because of the high volume of waste produced by human activities, both on a household and industrial scale (Hasibuan, 2016). In a larger context, namely pollution or industrial waste (item 23), science teachers and prospective teachers also consider this to be normal.

On substances related to greenhouse gas emissions, global warming, and climate change (items 15 and 16), it was found that the attention of teachers and prospective science teachers was also low. Greenhouse gases are the main cause of environmental damage today, especially global warming and climate change (Djalante, 2019; Rompegading & Handayani, 2023) which originate from the burning of fossil fuels for energy supply, industrial use and transportation (Hsu & Lin, 2015). Global data shows a decrease of around 0.3% in total CO2 emissions during the Covid-19 pandemic which was triggered by a decrease in emissions in transportation sector activities, especially aviation (Tahir & Batool, 2020).

On the substance regarding transgenic food ingredients and health (item 18), neither science teachers nor prospective science teachers apparently paid sufficient attention to this matter. This condition can be seen in their scores, which are respectively at 1.90 and 2.10. Responses like this emerged most likely because the respondents in this study had rarely had contact with either planting, seeing, or buying GMO food products. Concerning the cause and effect between the use of air conditioners (AC)/refrigerators and the formation of ozone holes in the atmosphere (item 21), it can be seen that the attention of teachers and prospective science teachers is very low with average scores of only 2.70 and 2.20 respectively. In other words, teachers and prospective science teachers think that the use of AC/refrigerator does not affect the state of the ozone layer in the atmosphere. This is very unfortunate because teachers and prospective science teachers are the figures who will prepare future generations. Exhaust gas emissions in the form of F-gas resulting from the use of air conditioning and refrigerators contribute around 30% of greenhouse gases (Wahyudi, 2016).

Aspects of Perception of the Environment and Its Protection

The last component of environmental literacy is perception of the environment and efforts to protect it. Measuring this aspect is to find out the personal views of science teachers and prospective science teachers

regarding environmental conditions, ecosystem balance, and efforts to maintain it. From the research results, it was found that the achievement scores of science teachers and prospective teachers in this aspect were 61.10 and 60.90 respectively. Referring to Table 3, this result is in the high category. The environmental literacy achievements of teachers and prospective science teachers in this aspect are shown in detail in Figure 4.
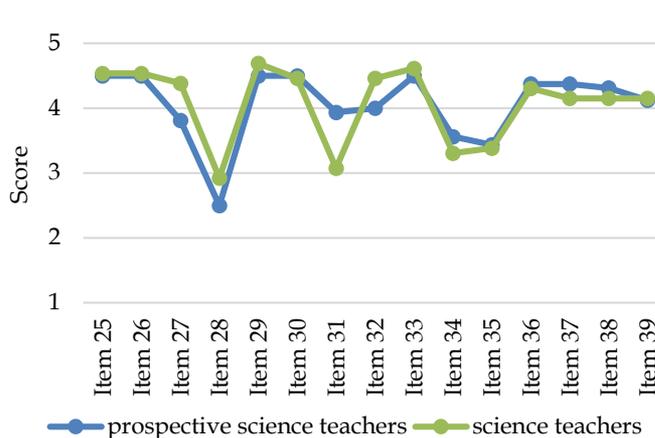

Figure 4. Perception of science teachers and prospective teachers towards the environment

More specifically, the data in Figure 4 shows that there are slightly contrasting results in some statement items compared to the results in other items. One of them is related to the existence of venomous animals and plants (item 28), the majority, namely 26 out of 29 people (90%) of teachers and prospective science teachers, stated that venomous and poisonous animals or plants are a threat to the lives of other living creatures so their existence must be avoided. minimized. This finding is inversely proportional to their perception that every plant and animal has an important role in the environment (item 33). This shows that there is a wrong understanding of the concept of balance of living things in the context of sustainability regarding the role and function of each living creature in large ecological systems. Researchers suspect that there are external factors that cause such perceptions to emerge among teachers and prospective science teachers. Culturally, the view of most Indonesian people towards venomous animals such as snakes, etc. is still bad and is often compared to various myths in life. This bad view of society means that venomous plants or animals will be treated negatively, and vice versa (Suryanda et al., 2020).

On the substance regarding the use of technology and its relationship with the environment (item 34), both science teachers and prospective teachers admit that technology hurts the environment. This is reflected in the scores of science teachers and prospective teachers of 3.30 and 3.40 respectively. The use of technology will increase the amount of fossil fuel consumption and CO_2

emissions into the atmosphere. The amount of CO_2 gas emissions is a crucial factor that determines environmental quality (Hdom, 2019), in the current context, namely global warming and climate change which are the main challenges for the current global environment and threats to the survival of life in the future (Amin et al., 2020).

About efforts to control air pollution through formal legal means (item 35); 6 people (46%) science teachers and 10 people (63%) prospective science teachers think that current legal regulations are not strong and strict enough to control and reduce air pollution. At the regulatory level, legal tools that can be used to take action against perpetrators of environmental damage are quite available (Hakim, 2020), but at the practical level, these enforcement efforts are often not implemented well.

The Influence of Gender Factors and Years of Service on Environmental Literacy

To strengthen the picture of the readiness of science teachers and prospective teachers to face the latest ecological challenges, researchers conducted a deeper analysis of the research subjects' environmental literacy achievements in terms of their demographics, that is gender and length of service.
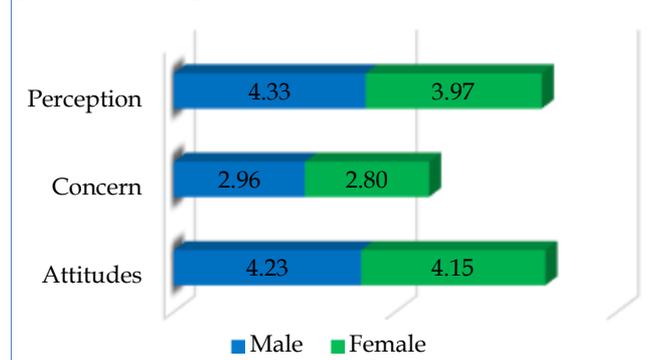
Figure 5. Environmental literacy of prospective science teachers based on gender

The results of the analysis show that from a gender perspective (figures 5 and 6) it appears that male science teacher candidates have a better level of literacy than female science teacher candidates in all environmental literacy components. This result is inversely proportional to the achievements of science teachers, where female science teachers have better achievements in all environmental literacy components measured. Biological and psychological differences make women more concerned about the environment (Drake et al., 2023; Ivan et al., 2023).

Figure 6. Environmental literacy of science teachers based on gender
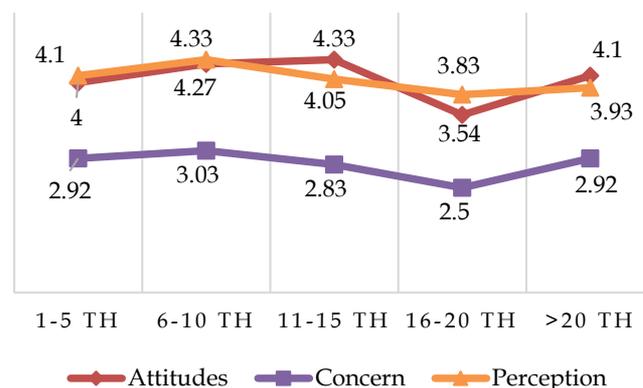
Figure 7. Environmental literacy of science teachers according to the service period

Regarding teaching experience (figure 7), this research found unique findings where the environmental literacy achievements of science teachers with a low service period (1-10 years) were high and tended to increase, but for teachers with a medium service period (11-20 years), This achievement continues to decline, and increases again for teachers who enter high service (>20 years). For beginning science teachers (1-10 years), the main factor that drives their environmental literacy achievements is teaching motivation, because high motivation will determine the teacher's professionalism in teaching (Yulianto, 2019). Meanwhile, for senior science teachers (>20 years), a lot of experience is the biggest supporter of their environmental literacy achievements, because experience makes them more emotionally mature, wise, and professional (Alamsyah et al., 2020; Yulianto, 2019). Considering their very important role, developing the abilities of science teachers and prospective teachers regarding sustainability and the environment must be carried out sustainably (Eliyawati et al., 2023).

Apart from that, other factors influence the positive environmental literacy achievements of teachers and prospective science teachers, namely the COVID-19 pandemic (Severo et al., 2021). The Covid-19 pandemic forces the education process to be carried out online

(Khaerunnisa et al., 2022), to avoid the spread of Covid-19 (Alatas & Solehat, 2022). Under these conditions, teachers and prospective science teachers and the community have a lot of time to interact, understand environmental conditions, and care for them, this contributes positively to the quality of environmental literacy in society, including the younger generation (Burlea-Schiopoiu et al., 2021).

In other words, a lot of time and intensity interacting with and caring for nature and the environment makes people know about the real conditions of the environment, see and feel the damage that occurs, and behave and act more positively towards the environment.

Restricting activities outside the home means that people have lots of time to interact and care for the environment with various activities, such as cleaning the yard or garden, renewing plants, and planting vegetables or gardening. The COVID-19 pandemic can and must be a fulcrum for humans to deepen their understanding that our behavior determines the degree of "health" of the earth we live on and ourselves, not only for our survival but more than that, namely for the survival of life in this world (Marazziti et al., 2021).

Conclusion

Based on the findings and analysis of research results, it can be concluded that the level of environmental literacy readiness of teachers and prospective science teachers at middle/high schools in East Lombok to face ecological and sustainability challenges is high. Gender factors and teaching experience also determine the level of readiness of science teachers and prospective teachers to face ecological and sustainability challenges. Many other factors have the potential to influence the readiness of science teachers and prospective teachers that were not measured in this research, such as geographic, economic, and socio-cultural. Researchers suggest that future research will reveal the influence of these factors on the readiness of science teachers and prospective science teachers to face ecological and sustainability challenges.

Author Contributions
Donna Boedi Maritasari: preparing research plans, processing and analyzing research data; M. Syahruddin Amin: compiled research instruments, collected data, and wrote articles.

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