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Bridging the Gap: Profiling Environmental Literacy Dimensions among Pre-Service Chemistry Teachers

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Abstract

This study aims to measure the environmental literacy of prospective chemistry teacher students, focusing on three main aspects: knowledge, attitudes, and behavior. This study was conducted on prospective chemistry teacher students from a state university in Makassar. The study population was all students from the class of 2025, consisting of six classes. The sample was selected using purposive sampling based on the criteria of students currently studying chemistry education. The sample size of this study involved 73 prospective chemistry teacher students from three classes of the class of 2025. Data collection was conducted using a questionnaire distributed to prospective chemistry teacher students via Google Form. The data collection instrument met the reliability test with a value of >0.70 using the Cronbach Alpha test and obtained the knowledge aspect with a value of 0.935, attitude with a value of 0.913, and behavior with 0.873. The data obtained were analyzed using descriptive statistical analysis. The results showed that the knowledge aspect had an average score of 64.27% in the medium category. The student attitude aspect obtained an average score of 79.04%, which is in the high category. Meanwhile, for behavior, the average score of 81.48% is in the high category. Although students have positive attitudes toward sustainability and are beginning to adopt pro-environmental behaviors, a gap remains between knowledge and behavior. This research recommends strengthening the chemistry curriculum and conducting research on improving environmental literacy, particularly in the knowledge aspect. Furthermore, a qualitative study is needed to determine why behavior is significantly higher than knowledge.

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INTRODUCTION

Global environmental problems such as climate change, water and air pollution, increasing waste volume, and ecosystem damage are serious challenges facing various countries, including Indonesia (Shivanna, 2022; Abbass et al., 2022). These problems not only impact environmental quality but also affect human health, the economy, and the sustainability of human life. Most of these environmental problems are closely related to human activities involving the use of chemicals, such as industrial waste, motor vehicle emissions, the use of pesticides and chemical fertilizers, and the uncontrolled disposal of plastic waste (Saxena, 2025; Liu, 2024). This condition shows that environmental issues have a strong connection with chemistry because various environmental phenomena essentially involve chemical processes and reactions that occur in nature and as a result of human activities.

The relationship between chemistry and the environment makes education a crucial tool in building environmental awareness and responsibility. Through education, students are expected to not only understand scientific concepts but also be able to apply this knowledge to

address various environmental issues wisely. In this context, environmental literacy is a crucial competency that every individual needs. Environmental literacy encompasses not only an understanding of environmental concepts and issues but also an attitude of environmental concern, critical thinking skills in solving environmental problems, and responsible behavior toward environmental sustainability (Roth, 1992; Hollweg et al., 2011).

Strengthening environmental literacy is becoming increasingly important in the education of prospective teachers, particularly prospective chemistry teachers. As future educators, prospective teachers have a strategic role in instilling sustainable values in students. Meanwhile, prospective chemistry teachers have a more relevant position because chemistry learning is directly related to various environmental issues, such as environmental pollution, waste management, water quality, global warming, acid rain, and the development of environmentally friendly technologies (Abubakar et al., 2024). Therefore, prospective chemistry teachers are not only required to master theoretical chemical concepts but also need to possess the ability to understand, analyze, and address environmental issues from a scientific perspective.

Previous research has shown that although chemistry education students possess basic knowledge of environmental issues, they still lack consistent pro-environmental attitudes and behaviors (Tung et al., 2022). Other studies have also shown that chemistry students and prospective teachers possess knowledge of environmental issues, but their engagement in concrete actions remains low (Mellyzar et al., 2025; Goulgouti et al., 2019). This situation indicates a gap between environmental knowledge and action. Students' environmental knowledge has not been fully followed by the development of environmentally conscious attitudes and responsible behavior. This gap may be influenced by a lack of contextual learning experiences that connect theory with real-life practice. However, education that integrates chemistry concepts with real-life environmental issues can help students not only understand environmental problems but also apply sustainability principles in their lives (Pietarinen et al., 2021; Zhang et al., 2021)

This issue has also become a concern in the context of the education of prospective chemistry teachers at various universities in Makassar City, one of the centers of higher education in Eastern Indonesia. Although students have learned material related to environmental issues through several chemistry and chemistry education courses, the development of environmental literacy in students does not necessarily show optimal achievements in all dimensions. This condition indicates that mastery of environmental knowledge is not always accompanied by the development of cognitive skills in analyzing and solving environmental problems or environmentally responsible behavior. In fact, comprehensive environmental literacy requires an integration of knowledge, attitudes, and behavior so that prospective teachers can effectively integrate sustainability issues into the chemistry learning process.

Environmental literacy generally encompasses several key dimensions, namely attitudes, knowledge, and behavior toward the environment (Hollweg et al., 2011). These dimensions are interrelated and serve as important indicators in assessing the readiness of prospective chemistry teachers to support sustainable education. Therefore, research is needed that can map the profile of each environmental literacy dimension in prospective chemistry teacher students. Based on this description, the study entitled Bridging the Gap: Profiling Environmental Literacy Dimensions among Pre-Service Chemistry Teachers is important to conduct to analyze the profile of environmental literacy dimensions of prospective chemistry teacher students from state universities in Makassar City, so that it can serve as a basis for developing learning and educational programs that are more oriented towards environmental sustainability.

METHODS

This study uses a quantitative descriptive research design to analyze and describe the environmental literacy profile of prospective chemistry education teacher students. The study was conducted on chemistry education students at a state university in Makassar. The study population was all students of the 2025 intake, consisting of six classes with a description of three classes of chemistry education programs, two classes of chemistry science programs, and one class of environmental science programs. The sampling technique used was purposive sampling with the criteria of students currently taking the 2025 prospective chemistry teacher education program. The research sample consisted of 73 students from three classes. The sample was considered representative because it involved all education classes that were prospective chemistry teacher students in that intake. This sample selection aimed to obtain an overview of the environmental literacy profile of students that can be used as a basis for mapping the needs, strategies, and learning media that support the improvement of environmental literacy of prospective chemistry teacher students.

Data collection was conducted using a questionnaire distributed through Google Forms. The research instrument consisted of three main dimensions of environmental literacy: knowledge, attitudes, and behavior towards the environment. The knowledge instrument was adapted from Yeh et al., (2022) Research, the attitude instrument was adapted from Alemari (2016), and the behavior instrument was adapted from Szczytko et al., (2019). The knowledge instrument consisted of fill-in-the-blank questions, while the attitude and behavior instruments used a Likert scale of 1–5. The instrument's reliability was tested using the Cronbach's alpha test. The instrument was declared reliable if it had a Cronbach's alpha value > 0.70, according to the criteria proposed by Ghozali, (2021). The questionnaire data were analyzed using descriptive statistics to describe the environmental literacy level of prospective chemistry teacher students. The analysis was carried out by calculating frequencies, percentages, and average scores for each dimension of environmental literacy: knowledge, attitudes, and behavior. The results of environmental literacy data are processed in percentage form using the following formula:

$$\mathrm{NP} = \frac{\mathrm{R}}{\mathrm{SM}} \times 100\%$$

Information:
NP: Value (%)
R: Scores obtained by students
SM: Maximum test score

(Purwanto, 2013)

Table 1. Environmental Literacy Categories

Interval Score (%)	Interpretation
22.2 - 48.1	Low
48.2-74.1	Medium
74.2-100	High

(Putra et al., 2021)

RESULTS AND DISCUSSION

The questionnaire instrument used in the study was tested for reliability using Cronbach's alpha to measure environmental literacy. The Cronbach's Alpha values for knowledge were 0.935, attitudes 0.913, and behavior 0.873, calculated using SPSS. All three instruments were deemed reliable because they had Cronbach's alpha values > 0.70 (Ghozali, 2021). The instruments were then used to measure students' environmental literacy. The research results presented in Tables 2 and 3 show the data.

Table 2. Score and Categories of Pre-Service Chemistry Teacher Environmental Literacy

Aspect	Score (%)	Interpretation
Cognitive	64.27	Medium
Attitude	79.04	High
Behaviour	81.48	High
Environmental Literacy	74.67	High

Table 3. Frequency and Categories of Pre-Service Chemistry Teacher Environmental Literacy

Environmental literacy aspect	Frequency		
	High	Medium	Low
Cognitive	28	34	11
Attitude	61	9	3
Behaviour	61	10	2

The knowledge aspect of prospective chemistry teacher students regarding environmental issues was in the moderate category, with an average score of 64.27%. This result aligns with research by Al Idrus & Rahmawati, (2021) that found that prospective chemistry teacher students' environmental literacy in the knowledge aspect was in the moderate category. Research by Basheer et al., (2025) Also found that prospective chemistry teachers in Turkey had good environmental attitudes and responsibilities, but were not supported by strong environmental knowledge. Similar findings were conveyed by Özdil & Ayşe, (2022) that environmental attitudes and concerns were better than the knowledge aspects. The low knowledge aspect compared to other aspects is due to environmental knowledge requiring conceptual understanding, analytical skills, and the connection of scientific concepts to real-world problems, while attitudes are more easily formed through experience and the social environment. According to Roth, (1992), Environmental literacy encompasses not only concern but also mastery of ecological knowledge to support appropriate decision-making. Furthermore McBeth & Volk, (2009) explained that environmental knowledge is often a component of lower achievement because it requires integration between scientific concepts, critical thinking skills, and contextual learning experiences. Therefore, it is necessary to strengthen the curriculum through chemistry learning that is integrated with environmental issues, such as renewable energy, green chemistry, and environmental sustainability.

The attitude aspect of prospective chemistry teacher students regarding environmental issues is in the high category, with an average score of 79.04%, indicating that students have a supportive attitude towards sustainability. The majority of students agree that they have a personal responsibility to protect the environment and support environmentally friendly policies, such as pollution reduction, energy conservation, and natural resource conservation. This attitude reflects a high level of awareness of the importance of sustainability in everyday life. Research by Zhang et al., (2021) shows that a positive attitude towards sustainability is associated with a willingness to take pro-environmental measures.

The behavioral aspects of prospective chemistry teacher students regarding environmental issues are in the high category, with the results of the study showing that 81.48% of students have engaged in pro-environmental behavior that supports sustainability in their daily lives. Most students reduce the use of single-use plastics, participate in recycling activities, and conserve energy. The average score indicates that students have begun to implement sustainability principles in their daily lives. This finding is in line with research by Jianyang & Cao (2025) that students have a high tendency for pro-environmental behavior as a form of implementing awareness and concern for the environment. In addition, research by Wang et al. (2024) explains that students' pro-environmental behavior is influenced by sustainability

education, environmental attitudes, self-efficacy, and social norms that encourage students to take concrete actions in supporting environmental conservation.

Overall, the research results indicate that prospective chemistry teacher students have pro-environmental attitudes and behaviors that are in the high category. Students demonstrate concern for environmental issues and have begun to implement behaviors that support sustainability in their daily lives. However, there is still a gap between students' environmental knowledge, attitudes, and behaviors. Although students have positive attitudes toward the environment and demonstrate pro-environmental behavior, their environmental knowledge level is still in the moderate category. This condition indicates that students' knowledge and understanding regarding the application of chemical principles to support environmental sustainability still need to be strengthened, especially in the context of learning and daily life practices.

This finding aligns with research by Akhmetova et al., (2025), which showed that prospective teachers in various countries have positive environmental attitudes and behaviors, but relatively lower levels of environmental knowledge. Research by Esa (2010) Prospective teachers in Malaysia also showed that students exhibited relatively high levels of pro-environmental behavior, but still had low environmental knowledge scores. This situation indicates that mastery of attitudes and behaviors has not been fully accompanied by an adequate conceptual understanding of chemistry-based environmental issues and solutions.

Therefore, it is necessary to strengthen the chemistry education curriculum, orienting it not only toward mastery of concepts and academic skills but also emphasizing the development of environmental knowledge contextually and sustainably. The chemistry education curriculum needs to integrate real-world environmental issues into the learning process so that students not only understand chemical concepts theoretically but also relate them to various environmental issues in society. This integration is crucial for developing prospective teachers with critical thinking skills, ecological awareness, and responsibility in supporting sustainable development.

Based on these conditions, mapping students' environmental literacy profiles is a crucial step in identifying learning needs across each dimension of environmental literacy. The mapping results can be used as a basis for determining appropriate learning strategies, approaches, and media to enhance the knowledge and environmental literacy of prospective chemistry teachers. Furthermore, information on students' environmental literacy can support the development of more contextual, innovative, and Education for Sustainable Development (ESD)-oriented learning, thus better equipping prospective teachers to integrate environmental issues into chemistry instruction at school.

CONCLUSION

Based on the research results, it can be concluded that the environmental literacy of prospective chemistry teacher students is generally in the high category. The results show that students' environmental attitudes and behaviors are in the high category, reflecting concern and a tendency towards pro-environmental behavior in their daily lives. However, environmental knowledge remains in the moderate category. This condition indicates a gap between students' environmental knowledge, attitudes, and behavior. This gap is primarily found between knowledge and behavior. Although students have developed positive attitudes toward sustainability and have begun to implement pro-environmental behavior, their conceptual understanding of chemistry-based environmental issues and solutions still needs to be strengthened. Therefore, it is necessary to strengthen the chemistry education curriculum by integrating environmental issues into the learning process, such as green chemistry, renewable energy, waste management, and environmental sustainability. This integration is expected to

improve students' environmental knowledge and support the formation of a more comprehensive environmental literacy in prospective chemistry teachers.

SUGGESTION

These recommendations focus on strengthening the chemistry education curriculum and researching environmental literacy, particularly in the knowledge aspect. Furthermore, qualitative studies are needed to understand why the behavioral aspect is so much higher than the knowledge aspect.

REFERENCES

Abbass, K., Qasim, M. Z., Song, H., Murshed, M., Mahmood, H., & Younis, I. (2022). A review of the global climate change impacts, adaptation, and sustainable mitigation measures. *Environmental Science and Pollution Research*, *29*(28), 42539–42559. https://doi.org/10.1007/s11356-022-19718-6

Abubakar, M. Y., Haladu, M., Titilayo, O. A., & Adam, A. B. (2024). Effect and Remediation of Environmental Pollution on the Concept of Chemistry - Review. *African Journal of Sciences and Traditional Medicine*, *1*(1), 440–449. https://doi.org/10.58578/ajstm.v1i1.3726

Akhmetova, A. I., Mukazhanova, R. A., Aitpayeva, A. K., Urazova, M. B., Jamoldinova, O. R., & Khodjaev, B. K. (2025). An examination of pre-service teachers' environmental attitudes, behaviors, and knowledge. *Eurasia Journal of Mathematics, Science and Technology Education*, *21*(6), 1–13. https://doi.org/10.29333/ejmste/16415

Al Idrus, S. W., & Rahmawati, R. (2021). Analisis Kemampuan Awal Literasi Lingkungan Mahasiswa dalam Pembelajaran Kimia Lingkungan. *Anwarul*, *1*(1), 242–253. https://doi.org/10.58578/anwarul.v1i1.222

Alemari, K. S. M. (2016). *Determination of Environmental Literacy Levels of University Students Studying on the Northern Cyprus (Master Thesis).* Near East University. http://docs.neu.edu.tr/library/6505646652.pdf

Basheer, A., Gulacar, O., Sindiani, A., & Eilks, I. (2025). The Impact of an Intervention on Plastics and Bioplastics on Pre-Service Science Teachers' Green Chemistry and Sustainability Awareness and Their Attitudes Toward Environmental Education. In *Education Sciences* (Vol. 15, Nomor 3). https://doi.org/10.3390/educsci15030322

Esa, N. (2010). Environmental knowledge, attitude and practices of student teachers. *International Research in Geographical and Environmental Education*, *19*(1), 39–50. https://doi.org/10.1080/10382040903545534

Ghozali. (2021). Aplikasi Analisis Multivariate Dengan Program IBM SPSS 23. In *Badan Penerbit Universitas Diponegoro*.

Goulgouti, A., Plakitsi, A., & Stylos, G. (2019). Environmental Literacy: Evaluating Knowledge, Affect, and Behavior of Pre-service Teachers in Greece. *Interdisciplinary Journal of Environmental and Science Education*, *15*(1). https://doi.org/10.29333/ijese/6287

Hollweg, K. S., Taylor, Bybee, J. R., Marcinkowski, R. W., Mcbeth, T. J., & Zoido, W. C. (2011). Developing a Framework for Assessing Environmental Literacy. In *North American Association for Environmental Education*. https://cdn.naaee.org/sites/default/files/devframewkassessenvlitonlineed

Jianyang, Z., & Cao, A. (2025). The Psychological Mechanisms of Education for Sustainable Development: Environmental Attitudes, Self-Efficacy, and Social Norms as Mediators of Pro-Environmental Behavior Among University Students. *Sustainability*, *17*(3), 933. https://doi.org/10.3390/su17030933

Liu, R. (2024). The pollution and the ecological influence of chemical and industrial waste. In

Science and Technology of Engineering, Chemistry and Environmental Protection (Vol. 1, Nomor 10). https://doi.org/10.61173/31edmx39

McBeth, W., & Volk, T. (2009). The national environmental literacy project: A baseline study of middle grade students in the United States. *Journal of Environmental Education*, *41*(1), 55–67. https://doi.org/10.1080/00958960903210031

Mellyzar, M., Nahadi, N., Rochintaniawati, D., Riandi, R., Hernani, H., Supriatna, A., & Lee, T. T. (2025). Is higher education curriculum prepare to support sustainable environmental chemistry learning? *Journal of Environment and Sustainability Education*, *3*(3), 414–434. https://doi.org/10.62672/joease.v3i3.100.

Özdil, E., & Ayşe, Y. Ç. (2022). Environmental Literacy: Comparison between Chemistry Teacher Candidates, Chemistry Teachers, and Individuals in Environmentally Related Professions. In *International Journal of Educational Research Review* (Vol. 7, Nomor 4, hal. 366–379). https://doi.org/10.24331/ijere.1172688

Pietarinen, J., Juuti, K., & Lavonen, J. (2021). Environmental literacy in Finnish pre-service teachers: Knowledge, attitudes, and behaviors. *Environmental Education Research*, *27*(2), 275–290. https://doi.org/10.1080/13504622.2020.1832829

Purwanto, N. (2013). *Prinsip Prinsip Evaluasi Pelajaran*. PT Remaja Rodaskarya.

Putra, N. S., Sukma, H. N., & Setiawan, H. (2021). Level of Environmental Literacy of Students and School Community in Green Open Space: Is There Any Difference Between Both of Them? *Jurnal Pendidikan IPA Indonesia*, *10*(4), 627–634. https://doi.org/10.15294/jpii.v10i4.31083

Roth, C. E. (1992). *Environmental Literacy: Its Roots, Evolution and Directions in the 1990s*. ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Saxena, V. (2025). Water Quality, Air Pollution, and Climate Change: Investigating the Environmental Impacts of Industrialization and Urbanization. *Water, Air, and Soil Pollution*, *236*(2). https://doi.org/10.1007/s11270-024-07702-4

Shivanna, K. R. (2022). Climate change and its impact on biodiversity and human welfare. *Proceedings of the Indian National Science Academy*, *88*(2), 160–171. https://doi.org/10.1007/s43538-022-00073-6

Szczytko, R., Stevenson, K., Peterson, M. N., Nietfeld, J., & Strnad, R. L. (2019). Development and validation of the environmental literacy instrument for adolescents. *Environmental Education Research*, *25*(2), 193–210. https://doi.org/10.1080/13504622.2018.1487035

Tung, S. P., Wang, Y. H., & Lee, C. H. (2022). Measuring environmental literacy of university students in Taiwan: A comparative study. *Journal of Environmental Education*, *53*(3), 150–160. https://doi.org/10.1080/00958964.2022.1891073

Wang, X., Li, Y., Zhang, H., & Chen, L. (2024). Factors influencing pro-environmental behavior among university students in sustainability education. *Sustainability*, *16*(4), 2156. https://doi.org/10.3390/su16042156

Yeh, F. Y., Tran, N. H., Hung, S. H., & Huang, C. F. (2022). A Study of Environmental Literacy, Scientific Performance, and Environmental Problem-Solving. *International Journal of Science and Mathematics Education*, *20*(8), 1883–1905. https://doi.org/10.1007/s10763-021-10223-9

Zhang, J., Wang, Y., & Liu, L. (2021). Investigating environmental attitudes and behaviors among university students in China: A comparison of pre-service teachers and other students. *Environmental Education Research*, *27*(4), 587–602. https://doi.org/10.1080/13504622.2021.1913060