JPPIPA 9(12) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Zero Waste Knowledge and Behavior of Early Childhood Pre-Service Teacher in Science Education

Rohimi Zamzam[1*], Ati Kusmawati[2], Ilmi Zajuli Ichsan[3], Putri Ratih Puspitasari[4]

[1] Department of Early Childhood Education, Universitas Muhammadiyah Jakarta, Indonesia.
[2] Department of Social Welfare Science, Universitas Muhammadiyah Jakarta, Indonesia.
[3] Department of Elementary Teacher Education, Universitas Mohammad Husni Thamrin, Indonesia.
[4] Department of Early Childhood Education, Universitas Mohammad Husni Thamrin, Indonesia.

Received: September 25, 2023
Revised: November 3, 2023
Accepted: December 25, 2023
Published: December 31, 2023

Corresponding Author:
Rohimi Zamzam
rohimi.zamzam@umj.ac.id

DOI: 10.29303/jppipa.v9i12.5464

Abstract: The importance of environmental education needs to be integrated with science learning related to zero waste topics. Environmental topics related to zero waste need to be understood by early childhood pre-service teachers because teachers are an important subject in providing understanding to young children regarding the environment. This research aims to describe environmental knowledge and zero waste behavior in early childhood pre-service teachers. The method used in this research is a descriptive method through data collection techniques using surveys. The instruments used in this research were 2 types, namely test questions used to measure environmental knowledge and questionnaires used to measure zero waste behavior. The results of this research show that the average zero waste knowledge score of early childhood pre-service teachers is still in the very low category (32.87). The average zero waste behavior score for early childhood pre-service teachers is in the moderate category (65.83). The results of this research show how important environmental education related to zero waste is integrated with science education. The recommendation from this research is to be able to develop media that can be integrated into zero-waste learning.

Keywords: Behavior; Environmental knowledge; Zero waste

Introduction

Early childhood pre-service teachers have an interest in being able to contribute to improving the quality of the living environment. One of them is related to efforts to prevent environmental pollution through the education process for early childhood. Early childhood pre-service teachers who are students in the Early Childhood Education study program need to be given more in-depth education related to current environmental issues. Zero waste is a concept of environmental problems that must be considered and understood in order to prevent environmental problems from occurring in the future (Haider et al., 2019; Stanescu, 2021).

Zero waste is a concept for minimizing waste by reducing the use of products that produce waste. This zero-waste concept has been developed in various places ranging from transportation, health, and education (ElShishtawy et al., 2022; Saeidi & Wimberley, 2018). Several waste processing locations are also the focus of this zero-waste movement. Early childhood education is the right tool to teach young children the initial concept of zero waste. Early childhood children must begin to be given an understanding of saving on the use of everyday items. Good early childhood education in this case will enable the concept of zero waste to be better conveyed to young children.

Learning related to zero waste can be integrated into environmental education which is included in science education. Universities must facilitate various learning related to science education because every student who is a per-service teacher must be able to understand the importance of the environment, especially related to zero waste. This is because zero waste is an urgent topic that must be addressed

How to Cite:
Zamzam, R., Kusmawati, A., Ichsan, I. Z., & Puspitasari, P. R. (2023). Zero Waste Knowledge and Behavior of Early Childhood Pre-Service Teacher in Science Education. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10590–10595. https://doi.org/10.29303/jppipa.v9i12.5464

immediately. Early childhood pre-service teachers must be given a more comprehensive environmental education formulation that can be viewed in terms of knowledge and behavior related to zero waste.

Several studies related to zero waste state that many results show that the implementation of the zero waste concept is very beneficial for implementing environmentally friendly cities (Aye & Widjaya, 2006; Carducci et al., 2021). The zero waste concept is an application of a complex concept that must be owned by all life support institutions in urban areas. Research related to the role of teachers in providing environmental education shows that the role of teachers is very important in providing education over a long time (Goldman et al., 2014; McCullough et al., 2018). Other research results show that knowledge related to zero waste is an important thing to learn, it needs to be implemented in the form of environmental behavior (Wright et al., 2022; Zhang et al., 2021). Based on this, this research aims to describe the knowledge and behavior of zero waste in early childhood pre-service teachers.

Method

The method used in this research is a descriptive method with data collection techniques using surveys. This research was carried out at Mohammad Husni Thamrin University, Jakarta. This research was carried out in July 2023 involving 38 randomly selected samples. The sample used was early childhood pre-service teachers who were undergraduate students in the PAUD study program. The instruments used in this research are in the form of tests and questionnaires consisting of 12 knowledge test questions related to zero waste and 12 questionnaires related to zero waste behavior. The grid of the knowledge test question instruments was developed based on the levels of thinking in Anderson's taxonomy which can be seen in the table below.

Table 1. Indicators of Early Childhood Pre-Service Teachers' Environmental Knowledge Regarding Zero Waste

Indicators	Item
Remember (C1)	1 and 2
Understand (C2)	3 and 4
Apply (C3)	5 and 6
Analyze (C4)	7 and 8
Evaluate (C5)	9 and 10
Create (C6)	11 and 12

In addition to early childhood pre-service teacher knowledge which was measured in this study, early childhood pre-service teacher behavior was measured using a questionnaire. The answer options for the zero waste behavior questionnaire consist of Always, often, sometimes, rarely, and never. Indicators of the zero waste behavior instrument can be seen in the following table.

Table 2. Early Childhood Pre-Service Teacher Environmental Behavior Indicators Related to Zero Waste

Indicators	Item
Use of energy	1 and 2
Transportation	3 and 4
Waste avoidance	5 and 6
Green consumption	7 and 8
Recycling	9 and 10
Social Behavior	11 and 12

The average score of all instruments is interpreted in the form of categories, consisting of very high, high, moderate, low, and very low. This category is a grouping of early childhood pre-service teachers' level of knowledge and behavior related to zero waste. These categories can be seen more clearly in the table below.

Table 3. Categories of Environmental Knowledge and Behavior Based on Score Intervals

Category	Interval Score
Very high	$X > 81.28$
High	$70.64 < X \leq 81.28$
Moderate	$49.36 < X \leq 70.64$
Low	$38.72 < X \leq 49.36$
Very low	$X \leq 38.72$

Result and Discussion

The results of this study indicate that early childhood pre-service teachers' knowledge is at a very low level (32.87). This indicates that there is a need for innovation in science education, especially those related to the environment. The results of this research also describe the environmental knowledge of early childhood pre-service teachers from a cognitive perspective based on 6 levels of thinking (see Table 4).

Table 4. Zero Waste Knowledge Score Results for Early Childhood Pre-Service Teachers for Each Item

Item	Score (scale 1-10)
Mentions zero waste behavior	3.95
Mentions bad habits related to zero waste	3.32
Explain the meaning of zero waste	3.26
Explain the principle of "reuse"	3.50
Example of implementing zero waste on campus	3.37
implementing zero waste in the environment around where you live	3.32
Impact analysis of the city is not yet zero waste	3.24
Analysis of unrecycled waste around the house	3.16

Item	Score (scale 1-10)
Criticism of the paid plastic bag policy	3.16
Criticize students who do not separate organic and inorganic waste	3.08
Write down interesting ideas to promote zero waste behavior on campus	3.18
Write creative problem solving to prevent zero waste students	2.92
Overall average	32.87
Category	Very low

The average score of early childhood pre-service teachers when viewed in terms of indicators shows varying results. The score with the indicator that has largest score is the first indicator, namely remember (C1), which is included in the lower-order thinking skills (LOTS) type of ability. The score with the lowest average is the create indicator (C6) which is the highest level of thinking ability that is included in the higher-order thinking skills (HOTS) type. The results of a clearer description of the scores can be seen in Table 5.

Table 5. Zero Waste Knowledge Score Results for Early Childhood Pre-Service Teachers for Each Indicator

Indicators	Average Score
Remember (C1)	3.63
Understand (C2)	3.38
Apply (C3)	3.34
Analyze (C4)	3.20
Evaluate (C5)	3.12
Create (C6)	3.05

Table 6. Zero Waste Behavior Score Results for Early Childhood Pre-Service Teachers for Each Item

Item	Score (scale 1-5)
Uses efficient energy for cooking	3.95
Reusing used wood as cooking fuel	3.32
Using public transportation based on electric/gas energy	3.26
When riding public transportation/private vehicles, I throw away trash in the appropriate place	3.50
Reuse waste paper that is no longer used	3.37
Reduce waste by following the zero waste program	3.32
Use shopping bags when shopping	3.24
Invite peers to continue using shopping bags and avoid plastic bags	3.16
Recycle plastic waste on campus	3.16
Participate in the waste recycling program	3.08
Get involved in zero waste-based student organizations	3.18
Participate in educating the public regarding zero waste	2.92
Overall average	65.83
Category	Moderate

This research also measures the environmental behavior of pre service teachers with detailed scores which can be seen in Table 5. The average score results for the environmental behavior of early childhood pre-service teachers are in the moderate category. The results of this research are confirmed by several items that already have quite good scores with a moderate level/category.

The results of this research show a zero waste behavior score for each indicator, the largest result is in the fourth indicator, namely consumption. The lowest score is in the sixth indicator, namely social behavior. The results of this research indicate that the social contribution of early childhood pre-service teachers still needs to be improved. More clearly, the results of research on zero waste behavior can be seen in Table 7.

Table 7. Zero Waste Behavior Score Results for Early Childhood Pre-Service Teachers for Each Indicator

Indicators	Average Score
Energy Efficient	2.87
Transportation	3.67
Waste avoidance	3.84
Consumption	4.30
Recycling	2.64
Social Behavior	2.42

The results of this research indicate that the need for science learning is related to zero waste in early childhood pre-service teachers. Socialization related to zero waste needs to be increased to early childhood pre-service teachers, this is because a teacher needs to understand the importance of protecting the environment, in this case, related to zero waste. Based on the results of research that has been carried out, it can be categorized that the knowledge of early childhood pre-service teachers is still very low so it needs to be improved. As for the environmental behavior of early childhood pre-service teachers, they already have a moderate category, which means that early childhood pre-service teachers are sufficiently able to apply environmental knowledge in the form of zero waste behavior.

Early childhood pre-service teacher is a subject that provides education to young children who need to understand the concept of zero waste. Some zero-waste topics related to education in schools include waste processing, waste recycling, and reducing the use of plastic bags (Hoffmann & Muttarak, 2020; Kim et al., 2021; Listyarini et al., 2019; Meloni et al., 2019; Nkaizirwa et al., 2022). Early childhood pre-service teachers must have good attitudes and behavior related to protecting the environment on the topic of zero waste. Early childhood pre-service teachers must learn about

learning strategies and learning media to support efforts to prevent zero waste.

Learning strategies that can be used to support increasing students' knowledge and behavior include problem-based learning, project-based learning, and contextual teaching learning (Bustami et al., 2018; Fitriati et al., 2021; Jantakun & Jantakoon, 2017; Pablo & Saborido, 2015). These three learning strategies need to be integrated into various lessons that have been implemented in the classroom in environmental learning or science education. The problem-based learning strategy in science education will improve the analytical abilities of early childhood pre-service teachers to identify problems that occur. In this case, the project-based learning strategy can be used to create learning with outcomes in the form of projects that can be shown to classmates. Contextual teaching learning will help to understand contextual material in a zero-waste context.

Learning media is an important component in providing understanding related to environmental knowledge. Learning media that can be an alternative for use in improving science learning related to zero waste are websites, videos, and applications on smartphones. Websites have been widely used to replace print media which is considered more difficult to transport to various places. The advantage of websites is that they can store a lot of information more easily and without the burden of physical media (Fauziyah & Jailani, 2014; Fitriani et al., 2018; Kruikemeier et al., 2018; Suryanda et al., 2016). Apart from using websites, there are video media and smartphone applications that can also be used to provide understanding and implementation of behavior related to zero waste to early childhood pre-service teachers. (Astuti et al., 2017; Reyna et al., 2018; Stanescu, 2021; Wilson et al., 2023).

Conclusion

Based on the results of this research, it can be concluded that zero waste knowledge among early childhood pre-service teachers is still very low (32.87). The zero waste behavior of early childhood pre-service teachers is in the moderate category (65.83). The important role of PAUD teachers in providing education regarding zero waste to young children is something that must be anticipated. Early childhood pre-service teachers must be given education related to environmental education that is integrated into science education to be able to provide additional insight related to zero waste. It is hoped that the insightful knowledge that early childhood pre-service teachers already have can be applied to everyday life. Suggestions for future research include the need to test several media that are integrated into environmental learning, apart from that it is necessary to develop contextual media and teaching materials to support environmental education.

Acknowledgments
Thank you for Universitas Muhammadiyah Jakarta to support this research in 2023.

Author Contributions
R.Z., Designing the research and method; A.K., Making instruments; I.Z.I., collect data and write article; P.R.P., write article.

Funding
No external funding.

Conflicts of Interest
No conflict interest.

References

Astuti, I. A. D., Sumarni, R. A., & Saraswati, D. L. (2017). Pengembangan Media Pembelajaran Fisika Mobile Learning berbasis Android. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *3*(1), 57. https://doi.org/10.21009/1.03108

Aye, L., & Widjaya, E. R. (2006). Environmental and economic analyses of waste disposal options for traditional markets in Indonesia. *Waste Management*, *26*(10), 1180–1191. https://doi.org/10.1016/j.wasman.2005.09.010

Bustami, Y., Syafruddin, D., & Afriani, R. (2018). The implementation of contextual learning to enhance biology students' critical thinking skills. *Jurnal Pendidikan IPA Indonesia*, *7*(4), 451–457. https://doi.org/10.15294/jpii.v7i4.11721

Carducci, A., Fiore, M., Azara, A., Bonaccorsi, G., Bortoletto, M., Caggiano, G., Calamusa, A., De Donno, A., De Giglio, O., Dettori, M., Di Giovanni, P., Di Pietro, A., Facciolà, A., Federigi, I., Grappasonni, I., Izzotti, A., Libralato, G., Lorini, C., Montagna, M. T., … Ferrante, M. (2021). Pro-environmental behaviors: Determinants and obstacles among italian university students. *International Journal of Environmental Research and Public Health*, *18*(6). https://doi.org/10.3390/ijerph18063306

ElShishtawy, N., Sinha, P., & Bennell, J. A. (2022). A comparative review of zero-waste fashion design thinking and operational research on cutting and packing optimisation. *International Journal of Fashion Design, Technology and Education*, *15*(2), 187–199. https://doi.org/10.1080/17543266.2021.1990416

Fauziyah, L., & Jailani, J. (2014). Pengembangan perangkat pembelajaran matematika yang

menunjang pendidikan karakter siswa kelas IV sekolah dasar. *Jurnal Prima Edukasia*, *2*(2), 149–163. https://doi.org/10.21831/jpe.v2i2.2715

Fitriani, U., Adisyahputra, A., & Komala, R. (2018). Eco-friendly website development in biology learning based on project activities on environmental pollution. *Biosfer: Jurnal Pendidikan Biologi*, *11*(1), 32–46. https://doi.org/10.21009/biosferjpb.11-1.4

Fitriati, F., Marlaini, M., & Elizar, E. (2021). Integrating rich task into the mathematics classroom to develop students' higher order thinking skills: A collaborative action research study in a secondary school. *Elementary Education Online*, *20*(1), 479–494. https://doi.org/10.17051/ilkonline.2021.01.042

Goldman, D., Yavetz, B., & Pe'er, S. (2014). Student teachers' attainment of environmental literacy in relation to their disciplinary major during undergraduate studies. *International Journal of Environmental and Science Education*, *9*(4), 369–383. https://doi.org/10.12973/ijese.2014.222a

Haider, T. P., Völker, C., Kramm, J., Landfester, K., & Wurm, F. R. (2019). Plastics of the Future? The Impact of Biodegradable Polymers on the Environment and on Society. *Angewandte Chemie - International Edition*, *58*(1), 50–62. https://doi.org/10.1002/anie.201805766

Hoffmann, R., & Muttarak, R. (2020). Greening through schooling: Understanding the link between education and pro-environmental behavior in the Philippines. *Environmental Research Letters*, *15*(1). https://doi.org/10.1088/1748-9326/ab5ea0

Jantakun, T., & Jantakoon, T. (2017). Model of project-based learning on cloud computing technology in collaboration to enhance ict literacy. *Turkish Online Journal of Educational Technology*, *2017*(November Special Issue INTE), 523–529. Retrieved from https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057643532&partnerID=40&md5=db2270cf798f9892d31695c60758d895

Kim, A., Kim, K. P., & Nguyen, T. H. D. (2021). The green accommodation management practices: The role of environmentally responsible tourist markets in understanding tourists' pro-environmental behaviour. *Sustainability (Switzerland)*, *13*(4), 1–23. https://doi.org/10.3390/su13042326

Kruikemeier, S., Lecheler, S., & Boyer, M. M. (2018). Learning From News on Different Media Platforms: An Eye-Tracking Experiment. *Political Communication*, *35*(1), 75–96. https://doi.org/10.1080/10584609.2017.1388310

Listyarini, R. V, Pamenang, F. D. N., Harta, J., Wijayanti, L. W., Asy'ari, M., & Lee, W. (2019). The integration of green chemistry principles into small scale chemistry practicum for senior high school students. *Jurnal Pendidikan IPA Indonesia*, *8*(3), 371–378. https://doi.org/10.15294/jpii.v8i3.19250

McCullough, M. B., Martin, M. D., & Sajady, M. A. (2018). Implementing green walls in schools. *Frontiers in Psychology*, *9*(JUN). https://doi.org/10.3389/fpsyg.2018.00619

Meloni, A., Fornara, F., & Carrus, G. (2019). Predicting pro-environmental behaviors in the urban context: The direct or moderated effect of urban stress, city identity, and worldviews. *Cities*, *88*, 83–90. https://doi.org/10.1016/j.cities.2019.01.001

Nkaizirwa, J. P., Nsanganwimana, F., & Aurah, C. M. (2022). On the predictors of pro-environmental behaviors: integrating personal values and the 2-MEV among secondary school students in Tanzania. *Heliyon*, *8*(3). https://doi.org/10.1016/j.heliyon.2022.e09064

Pablo, M. N., & Saborido, E. J. G. (2015). Teaching to Training Teachers through Cooperative Learning. *Procedia-Social and Behavioral Sciences*, *180*, 401–406. https://doi.org/10.1016/j.sbspro.2015.02.136

Reyna, J., Hanham, J., & Meier, P. (2018). The Internet explosion, digital media principles and implications to communicate effectively in the digital space. *E-Learning and Digital Media*, *15*(1), 36–52. https://doi.org/10.1177/2042753018754361

Saeidi, E., & Wimberley, V. S. (2018). Precious cut: exploring creative pattern cutting and draping for zero-waste design. *International Journal of Fashion Design, Technology and Education*, *11*(2), 243–253. https://doi.org/10.1080/17543266.2017.1389997

Stanescu, M. D. (2021). State of the art of post-consumer textile waste upcycling to reach the zero waste milestone. *Environmental Science and Pollution Research*, *28*(12), 14253–14270. https://doi.org/10.1007/s11356-021-12416-9

Suryanda, A., Azrai, E. P., & Wari, N. (2016). Pengaruh Penerapan Model Pembelajaran Group Investigation (GI) Terhadap Kemampuan Berpikir Analisis Siswa Pada Materi Pencemaran Lingkungan. *Biosfer: Jurnal Pendidikan Biologi*, *9*(2), 37–44. https://doi.org/10.21009/biosferjpb.9-2.6

Wilson, J., Sanchez Rodrigues, V., Bhaird, C. M. an, Lotfi, M., Kumar, M., Horgan, D., Dodd, S., & Danson, M. (2023). On the beer wagon: the past, present and future of Celtic craft brewing and its policies. *Regional Studies, Regional Science*, *10*(1), 329–346. https://doi.org/10.1080/21681376.2022.2158751

Wright, J. D., Schmitt, M. T., & Mackay, C. M. L. (2022). Access to Environmental Cognitive Alternatives Predicts Pro-Environmental Activist Behavior. *Environment and Behavior*, *54*(3), 712–742. https://doi.org/10.1177/00139165211065008

Zhang, Y., Jiang, J., Sun, Y., Gu, D., & Jiang, W. (2021). Engagement in Cause-Related Marketing Reduces Pro-Environmental Behaviors. *Environment and Behavior*, *53*(10), 1047–1069. https://doi.org/10.1177/0013916520942602