Available online at: http://journal.uny.ac.id/index.php/jpms

Jurnal Pendidikan Matematika dan Sains, XI (2), 2023, 20-27

Waste-Wise Education: Impact on Zero Waste Awareness and Practices

Dina Dina [1] *, Annisa Fillaeli [1], Asti Aulia Jayanti [1]

[1]Chemistry Education Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta,
Yogyakarta 55281, Indonesia
* Corresponding author: dina@uny.ac.id

Abstract

This study aimed to determine how waste-aware education affected the zero-waste consciousness and behaviors of chemical education students. A one-group, pretest-posttest design was implemented using a sample of 70 first-year students enrolled at Yogyakarta State University. The students were provided with workshop materials about waste management at temporary storage sites (TPS) and final processing sites (TPA) in Yogyakarta, as well as waste issues that have arisen with the advancement of science and technology. After completing two meetings of the workshop, they were assigned a series of consultations and a final project. In order to gather information, questionnaires, and portfolios were utilized. The findings of the study indicated that waste-aware education can enhance students' zero-waste awareness and practices. The sig value of 0.000 for the Wilcoxon test on zero waste awareness indicated a substantial increase. Similarly, the t-test conducted on zero waste practices yielded a significance value of 0.000, indicating that the provision of waste-aware education had a noteworthy impact. Students were, on the whole, enthusiastic about spreading the zero-waste philosophy throughout society.

Keywords: waste-wise education, zero waste awareness, zero waste practices

How to Cite: Dina, D., Fillaeli, A. Jayanti, A. A., (2023). Waste-wise education: impact on zero waste awareness and practices. *Jurnal Pendidikan Matematika dan Sains, IV*(1), 20-27. doi:http://dx.doi.org/10.21831/jpms.v4i1.10111

Permalink/DOI: ***DOI:*** *http://dx.doi.org/10.21831/jpms.v11i2.67346*

INTRODUCTION

The increasing volume of waste in Indonesia is one of the signs of low public awareness of waste management (Syiddatul Akliyah et al., 2019). According to the Information on National Waste Management (SIPSN) from the Ministry of Environment and Forestry, the national waste volume in Indonesia reached 21.1 million tons in 2022 (Kemenko PMK, 2023). Of the total national waste production, 65.71% (13.9 million tons) can be managed, while the remaining 34.29% (7.2 million tons) needs to be appropriately managed (Kemenko PMK, 2023). In 2021, the volume of waste in Indonesia was 68.5 million tons, and in 2022 it increased to 70 million tons (dpr.go.id, 2022). The majority of the waste is food waste (Annur, 2023). In 2021, Indonesia produced 21.88 million tons of waste, a decrease of 33.33% compared to the previous year (Mahdi, 2022). However, the amount of plastic waste in 2021 increased to 11.6 million tons, which is 17% of the total national waste (CNN Indonesia, 2022).

The lack of proper waste management is due to the limited capacity of waste disposal sites, both final processing sites (TPA) and temporary storage sites (TPS), as well as the need for standards in waste management (Kemenko PMK, 2023). The community's essential role is expected, especially in household waste management, as it generates waste.

Good health and well-being, clean water and sanitation, and sustainable cities and communities are all components of sustainable development (Syiddatul Akliyah et al., 2019). Sustainable cities need a healthy population and access to clean water and sanitation services to accomplish these objectives and foster community development. The community can appreciate this state when the environment is clean and free of waste, which has the potential to cause pollution and disease outbreaks in

numerous regions across the world (Licy et al., 2013).

Environmental pollution can occur due to economic and technological developments that exceed the threshold of ecosystem tolerance, increasing the amount of pollutants in the environment (Liao et al., 2015). Environmental pollution is divided into three types: air pollution, soil pollution, and water pollution (CNN Indonesia, 2022). Air pollution occurs due to the presence of pollutants that contaminate the air. These pollutants can be generated using tools like air conditioners, motor vehicles, and hair dryers. In addition, pollutants can also be generated from human activities, such as burning waste, using pesticides to kill pests in agricultural land, and factory activities that produce smoke. Therefore, it is vital to address environmental pollution to create a good and healthy environment for the community.

Within the Indonesian context, the government continues to bear the responsibility for waste management (Syiddatul Akliyah et al., 2019). Universities are among the institutions that contribute to adolescents' education and awareness of waste management. Nevertheless, many adolescents in Indonesia continue to lack an appreciation for the critical nature of waste management. Consequently, streamlining and sensitizing young brains to environmental issues and concerns is urgently necessary. Education is how individuals acquire knowledge regarding the environment and its associated issues. Students must understand environmental issues to fulfill their responsibility for appropriate waste management effectively (Licy et al., 2013).

The use of technology has brought significant changes to the way people live, including in the food industry. Online food delivery services have become a trend in society, especially during the pandemic when people must stay at home (VOA Indonesia, 2020). The use of technology in the food industry has also brought benefits, such as saving time and providing convenience for consumers. However, the misuse of technology also has negative impacts, such as the increase in plastic waste and the threat to the confidentiality of test tools (Tapilatu & Kolibongso, 2021).

In conclusion, waste management studies have shown that there still needs to be more discussion about the importance of waste management awareness education for adolescents in universities. To address these issues, waste-wise education is needed to increase awareness and practices of waste management among students. This education should cover topics such as waste knowledge, organic waste processing, and plastic waste processing. By integrating waste management education into the curriculum, students can learn about the importance of waste management and how to properly manage waste to reduce its negative impact on the environment.

METHOD

Waste-wise education in this research used a weak experiment research method with one group pretest-posttest design (Fraenkel, 2008). This design can be depicted as shown in Figure 1.

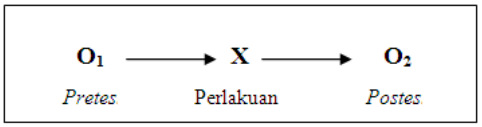

Figure 1. One Group Pretest-Posttest Design

Information:
O_1 : pretest
O_2 : postest
X : waste wise education

The research subjects were 70 chemistry education students at Yogyakarta State University. The instruments used in this research consisted of a zero waste awareness and practices questionnaire and a product assessment sheet.

This zero waste education was conducted as a workshop that was carried out using several implementation methods, namely lectures, assignments and mentoring, final project exhibitions, and questionnaires.

Lectures were held at meetings 1 and 2. This method was used to convey material about waste as a problem in increasingly modern advances in science and technology. Lectures are held in two face-to-face meetings and are carried out within one week between activities. The workshop materials provided are as follows.

At the first meeting, material was presented: The waste problem in Yogyakarta with the tagline Yogya is a waste emergency. The material included knowledge about landfill points in Yogya and the average daily amount of waste that goes to the landfill; Waste flow from upstream to downstream; Danger of heavy metal pollution in landfills; and Waste management in Yogya.

At the second meeting, material was presented: Plastic waste and its problems; Organic waste; Waste sorting; and Composting.

Assignments and Mentoring are carried out at meetings 3, 4, and 5. This method was used as a follow-up to face-to-face activities that had been carried out.

The third meeting presented an introduction to the project where students were asked to develop products as a waste solution for both organic waste and plastic waste. As an intellectual generation, it is natural for students to be responsible for the waste they produce, for example, by implementing 3R, 4R, or 5R, and processing organic waste so that no more organic waste ends up in landfills.

The fourth meeting was used as a forum for the final project consultation. The lecturer presented examples of products that might be produced using waste raw materials. Students will then, in groups, submit a draft solution to the waste problem with assistance from the lecturer. Mentoring was provided through online consultations that are not limited in time via email, WhatsApp, telephone contact, or face-to-face. Once approved, students proceed to the execution stage at the fifth meeting with a 1-2 weeks deadline.

The final project exhibition and presentation were held at the sixth meeting. Each group will explain the process of completing the final project and be given feedback by other groups. Student products were assessed using a product evaluation sheet.

Lastly, questionnaire sheet. This instrument is used to reveal the level of zero waste awareness and practices of students. Questionnaires were given before and after the activity ended.

Table 2. Zero Waste Questionnaires

Statement	Zero waste		Type of Statement
	A	P	
I've heard the term zero waste	√		positive
I try to reduce the amount of waste I produce every day		√	positive
If yes, what I will do is...			
I consistently sort waste		√	positive
I deposit the waste I produce in a waste bank		√	positive
I choose to buy bottled water when traveling to avoid the hassle		√	negative
I bring my own bag when shopping		√	positive
I've heard the term ecobricks	√		positive
I have done composting		√	positive
I'm trying to reduce my use of single-use straws		√	positive
I use liquid soap rather than bar		√	negative
Waste is closely related to disasters	√		positive
I know about the triangle symbol on plastic containers	√		positive
I tend to use cloth handkerchiefs rather than tissue for daily needs		√	positive
I've heard the term biopori	√		positive
Waste is related to climate change	√		positive
I follow the latest fashion developments		√	negative
Every time a new clothing model appears, I try to buy it		√	negative
I throw away unused clothes		√	negative
If not, what I do is....			
I have made works from used items		√	positive
When my jacket or shoes break, I tend to repair them rather than buy new ones		√	positive
I'm interested in buying discounted items even though I don't need them		√	negative
I bought a new cellphone even though the old cellphone still works		√	negative
When attending certain events for which I don't have a dress code, I prepare myself by buying clothes rather than borrowing or renting		√	negative
I will participate if the government implements minimal waste movements		√	positive
I am called to spread this spirit of minimal waste to others	√		positive

Evaluation of waste-wise education activities was carried out in two stages, namely process evaluation and results evaluation. Process evaluation used observation sheet instruments to analyze student activities during activities and questionnaires to analyze the influence of activities on student zero waste awareness and practices. Results were evaluated

using a product assessment sheet to assess students' skills in compiling assignment products.

Increasing zero waste awareness and practices was carried out by comparing the results of questionnaires before and after treatment. The results obtained were tested for normality, then analyzed using Wilcoxon signed-rank for non-parametric and paired sample t-test for parametric.

RESULTS AND DISCUSSION

Females are the majority of participants in this agenda, 84.29% of the total. People believe that women are vital in shaping the community's character. Women are not only the first educators for children, but even in society, they can be environmental stewards (Maria & Huus-Hansen, 2018). This potential composition of women is also supported by their ages, which are around 17-19 years old, as they are the students in the second semester, called the young generation. Students most adequately equipped to confront future challenges are agents of change. Individuals can exert a beneficial influence on their environment, shape the course of events to come, comprehend the motives, behaviors, and emotions of others, and foresee the immediate and lasting outcomes of their actions (Andreas, 2018). The complete features of the participants' demographic data are presented in Table 2.

Table 2. Participant Demographic

Survey	Quantity
Number of participants	70
Gender	
Male	15.71%
Female	84.29%
Place of residence	
countryside	72.30%
city	27.70%

As presented, 72.3% of participants live in the countryside, while the rest live in a city environment. Related to the awareness of the environment, the place of living will influence the people's perception of the rising problems related to the environment they face (Singh, 2016).

A. Zero Waste Awareness

Zero waste awareness is the understanding and recognition of the impact of waste on the environment and the importance of reducing waste. It involves educating individuals and communities about the benefits of reducing waste, recycling, composting, and other sustainable knowledge. The questionnaire used to reveal zero waste awareness includes seven statements in the questionnaire.

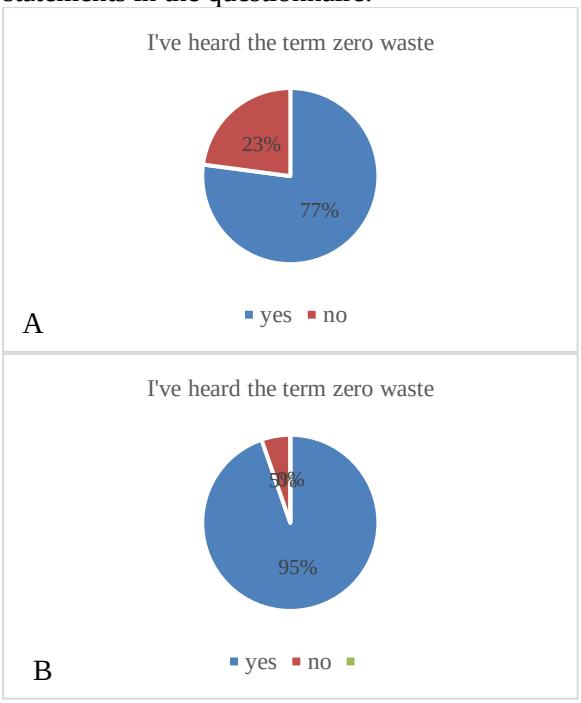

Figure 2. Zero Waste Awareness A. Before Treatment; B. After Treatment

Based on Figure 2, before treatment, only 77% of students had heard of the term zero waste, increasing to almost all students knowing the term.

Some other statements include: "Waste is closely related to disasters" and "Waste is related to climate change". Before wise-waste education, 64.5% of students stated that disasters were related to waste management, increasing to 70% after the treatment.

The proportion of students who understood the connection between waste and climate change increased from 74.3% prior to 82.9% after the treatment. The most significant increase was in the statement I have heard the word eco-bricks," which was mentioned by fewer than half of the students prior to treatment, jumped to 85.5% as the most significant rise. Almost all (97.4%) students felt called to share the spirit of minimal waste with society. Students considered that it constituted a manifestation of their accountability. They believe that their actions contribute to the phenomenon of climate change. Students acknowledged that sectors that rely on fossil fuels, operate motorized vehicles, burn or log forests, and utilize plastic contribute to climate change.

The results of statistical tests to test zero waste awareness can be seen in Table 3 and Table 4.

Table 3. Tests of Normality

	Shapiro-Wilk		
	Statistic	df	Sig.
Pretest Awareness	.901	70	.000
Postest Awareness	.773	70	.000

If Sig.> α 0.05, it is normally distributed. Based on the prerequisite tests, it was found that the zero waste awareness data was not normally distributed. Therefore, statistical tests were continued with Wilcoxon signed rank.

Table 4. Test Statistics[a]

	Postest Awareness - Pretest Awareness
Z	-4.290[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Criteria for rejecting H_0 if Sig. ≤ α 0.05. Based on the output table of Wilcoxon test results, the value obtained is Sig = 0.000, which means it was smaller than 0.05. Thus, H_0 was rejected, and H_a was accepted.

Table 5. Descriptives Statistics

		Mean	N
Pair 1	Pretest Awareness	78.5286	70
	Postest Awareness	90.0286	70

Based on the results of descriptive analysis, the mean value for pretest = 78.53 and posttest = 90.03. This means there was an increase in zero waste awareness after receiving waste-wise education.

Thus, providing waste-wise education significantly increased students' zero waste awareness.

B. Zero Waste Practices

Zero waste practices are actions taken to reduce waste and minimize the impact of waste on the environment. These practices include reducing the use of single-use plastics, composting organic waste, recycling, and using sustainable products. The promotion of zero waste practices can be achieved through education and awareness campaigns, as well as through the implementation of policies and regulations that encourage sustainable practices.

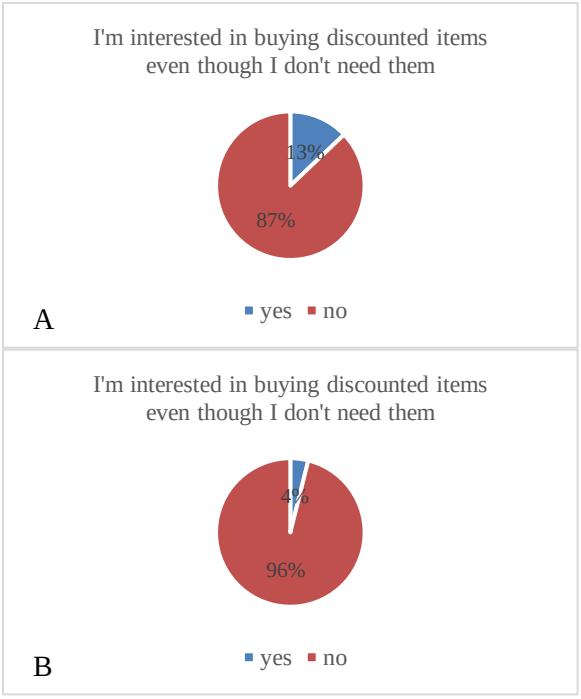

Figure 3. Zero Waste Practices A. Before Treatment; B. After Treatment

Based on Figure 3, as many as 12.9% of students felt interested in buying goods at discounts even though they did not need them, decreased significantly to 3.9% after treatment.

Apart from that, 95.2% of students felt responsible due to climate change, and 98.7% were interested in solving related problems through minimal waste movement. Providing links between daily life problems in the curriculum is more important when there is a change in students' attitudes towards the environment, such as plastic diet behavior and choosing environmentally friendly goods.

The zero waste practices normality test results can be seen in Table 6.

Tabel 6. Tests of Normality

	Shapiro-Wilk		
	Statistic	df	Sig.
Pretest Practices	.968	70	.068
Postest Practices	.966	70	.052

a. Lilliefors Significance Correction

Sig.> α 0.05 data is normally distributed. Because the data was normally distributed, parametric statistics using paired sample t-test was employed.

Table 7. Paired Samples Test

	95% Confidence Interval of the Difference			Sig. (2-tailed)
	Lower	Upper	df	
Pretest Practices - Postest Practices	-11.81697	-3.98303	69	.000

Based on the output table of t-test results, the value obtained is sig = 0.000, which means it was smaller than α. Reject H_0 if Sig. ≤ α 0.05. Thus, H_0 wass rejected, and H_a was accepted.

Furthermore, descriptive statistics for zero waste practices can be seen in Table 8.

Table 8. Descriptives Statistics

		Mean	N
Pair 1	Pretest Practices	68.9571	70
	Postest Practices	76.8571	70

Based on the results of descriptive analysis, the mean value for pretest = 68.95 and posttest = 76.85. This means there is an increase in zero waste practices after receiving waste-wise education.

Thus, providing waste-wise education had a significant effect on increasing student zero waste practices.

C. Group Final Projects

Group portfolios are collected via BeSmart LMS and monitored periodically. The portfolio includes final project consultation drafts, fixed final project consultations, video storyboards, products, and YouTube videos.

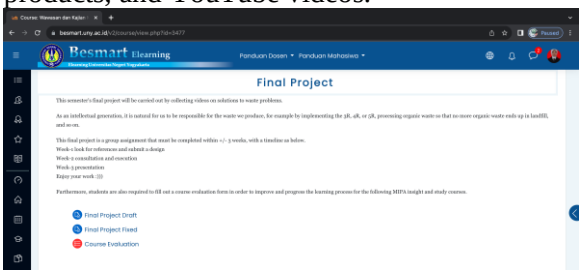

Figure 4. LMS BeSmart

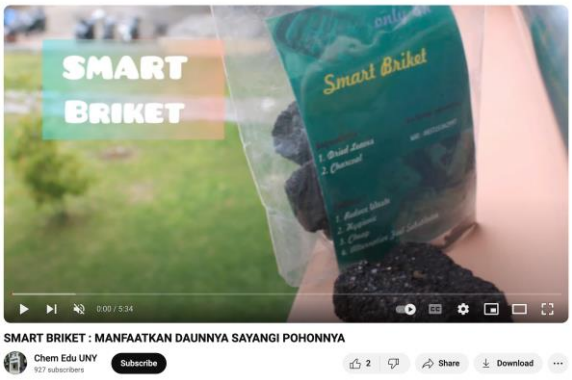

Figure 5. Youtube Video: Organic Waste Processing

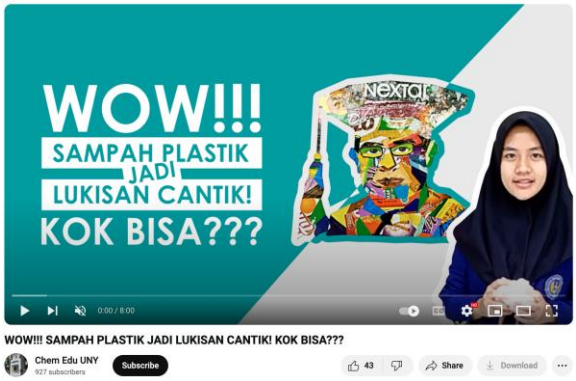

Figure 6. Youtube Video: Plastik Waste Processing

Using plastic as packaging but lacking processing has caused disaster for life on earth. The increase in the amount of plastic waste on earth can threaten the stability of the environmental ecosystem, considering that the plastic that is widely used is plastic that cannot be biodegraded (Sa'diyah & Juliastuti, 2015). Natural decomposition of plastic takes approximately 80 years for it to be thoroughly degraded (Kurniawan & Nasrun, 2017). The long process of decomposing plastic can result in an uncontrolled accumulation of plastic waste if the use of plastic is not limited. Controversial issues regarding plastic are mandatory to be integrated into the education curriculum because plastic waste processing is one of the developments in science that can provide positive benefits in overcoming environmental problems and improving the standard of living of many people (Kurniawan & Nasrun, 2017).

CONCLUSION

Waste-wise education is an effective way to increase student zero waste awareness and practices. This is proven by the results obtained, namely increasing student awareness regarding the relevance of waste to disasters and climate change. Based on the Wilcoxon test, it was found that wise-waste education had a significant effect on increasing zero waste awareness. Likewise, students' zero waste practices related to reducing the use of single-use plastic, choosing environmentally friendly goods, and carrying out 3R, 4R, and 5R practices experienced a significant increase after waste-wise education activities. The t-test results indicated a significant change in students' zero waste practices before and during treatment, further supporting this notion.

REFERENCES

Andreas. S. (2018). "The Future of Education and Skills: Education 2030." *OECD Education Working Papers* 23.

Annur, C. M. (2023). *Sampah indonesia bertambah pada 2022, terbanyak dalam empat tahun.* Diakses tanggal 8 November 2023 dari https://databoks.katadata.co.id/.

CNN Indonesia. (2022). *Sampah plastik 2021 naik ke 11,6 juta ton, klhk sindir belanja online.* Diakses tanggal 7 November 2023 dari https://www.cnnindonesia.com/nasional/

dpr.go.id. (2022). *Ditjen pslb3 klhk didesak miliki langkah terukur tangani volume sampah.* Diakses tanggal 7 November 2023 dari https://www.dpr.go.id/berita/detail/id/

Fraenkel, J. P. & Wallen N. E. (2008). "How to Design and Evaluate Research in Education". New York: McGraw-Hill Companies, Inc.

Kemenko PMK. (2023). *7,2 juta ton sampah di indonesia belum terkelola dengan baik.* Diakses tanggal 7 November 2023 dari https://www.kemenkopmk.go.id/

Kurniawan, E., & Nasrun. (2017). Karakterisasi bahan bakar dari sampah plastik jenis high density polyethelene (HDPE) dan low density polyethelene (LDPE). *Jurnal Teknologi Kimia Unimal*, *3*(2), 41–52.

Liao, X., Tu, H., Maddock, J. E., Fan, S., Lan, G., Wu, Y., Yuan, Z. K., & Lu, Y. (2015). Residents' perception of air quality, pollution sources, and air pollution control in Nanchang, China. *Atmospheric Pollution Research*, *6*(5), 835–841. https://doi.org/10.5094/APR.2015.092

Licy, C. D., Vivek, R., Saritha, K., Anies, T. K., & Josphina, C. T. (2013). Awareness, Attitude and Practice of School Students towards Household Waste Management. *Journal of Environment*, *02*, 147–150. www.scientific-journals.co.uk

Mahdi, M. I. (2022). *Indonesia hasilkan 21,88 juta ton sampah pada 2021.*

Maria, C. A., & Huus-Hansen, I. (2018). "Women as environmental stewards: the experience of the small grants programme." *Sustainable Development Cluster Bureau for Policy and Programme Support United Nations Development Programme*. Retrieved November 7, 2023 (https://medcraveonline.com/OAJS/OAJS-02-00091).

Sa'diyah, K., & Juliastuti, S. R. (2015). Pengaruh jumlah katalis zeolit alam pada produk proses pirolisis limbah plastik polipropilen (PP). *Jurnal Bahan Alam Terbarukan*, *4*(2), 40–45. https://doi.org/10.15294/jbat.v4i2.4171

Singh, R., 2016. Environmental awareness among undergraduate students in relation to their stream of study and area of residence Rajvir Singh, Ph. D. Assistant Professor Department of Education Kurukshetra University, Kurukshetra 2830–2845.

Syiddatul A., L., Odah, O., Burhanudin, H., & Kurniasari, N. (2019). Waste management awareness education for senior high school students. *1st Social and Humaniora Research Symposium. 307*. 512-514.

Tapilatu, J. R., & Kolibongso, D. (2021). Strategi pengelolaan lingkungan laut pada masa pandemi covid 19 oleh divers clean action. *Musamus Devotion Journal*, *3*(2).

VOA Indonesia. (2020). *Aktivis lingkungan anjurkan batasi konsumsi plastik selama pandemi.* Diakses tanggal 5 November 2023 dari https://www.voaindonesia.com/

PROFILE

A. Dina

Dina, born in Pekalongan on 28 April 1988, earned a Bachelor's degree in Chemistry Education at Semarang State University, graduating in 2009, then continued her Master's degree in Science Education, SL Chemistry Education Concentration at the Indonesian University of Education, graduating in 2012. Since 2014, she has been a Lecturer in the Chemistry Education Study Program at Yogyakarta State University with expertise in ICT and sustainability in chemistry learning.

B. Annisa Fillaeli

Annisa Fillaeli, born in Cilacap on 22 May 1979, earned a bachelor's degree in chemistry at Yogyakarta State University, graduating in 2003, a master's degree in chemistry at Gadjah Mada University, Yogyakarta in 2007, and is currently studying environmental engineering at Chung Yuan Christian University, Taiwan. Since 2008,

he has been a lecturer at the Chemistry Study Program at Yogyakarta State University with expertise in Analytical and Environmental Chemistry.

C. Asti Aulia Jayanti

Asti was born in Yogyakarta on 12 March 2000. She has completed his undergraduate studies at Chemistry Education, Yogyakarta State University. During her final thesis assignment, Asti presented research with the title "Development of learning videos based on socio-scientific issues in order to support education for sustainable development in hydrocarbon and petroleum materials for class XI SMA/MA students". Currently, Asti is continuing her professional education (PPG) as a science teacher.