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Empowering Students with Environmental Education on Plastic Waste Management: A Crucial Step Towards Achieving Green Campus Sustainability

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ABSTRACT

The high number of students and the various activities that involve them can contribute to the increase in plastic waste on campus. Student environmental education in plastic waste management plays an important role in the sustainability of a green campus. The objective of this study was: 1) to evaluate the implementation of environmental education in plastic waste management on the green campus in Malang City; and 2) to determine the students' achievements in environmental education about plastic waste management, focusing on the knowledge, awareness, behavior, skills, and participation. This study utilized a survey method with a quantitative descriptive approach, involving a total of 1,038 respondents. Data was acquired using a closed questionnaire that had been modified and distributed using a QR code. The Weighted Mean approach was utilized in data analysis. The study revealed the following findings: 1) The green campus in Malang City has implemented a curriculum that is integrated with environmental education but has different implementation specifications; 2) Students' environmental education in plastic waste management at the three green campuses fits in the high category; 3) The results indicated that student achievement was very high in awareness, high in knowledge and behavior, but low in skills and participation. Integrating environmental education into the learning process, along with stimulating activities, is crucial to encourage student participation in plastic waste management.

1. INTRODUCTION

The extent of environmental issues is escalating due to the growing global challenges, such as climate change and environmental pollution [1]. The behavior of individuals who demonstrate less responsibility in protecting the environment contributes to environmental issues [2]. Environmental issues arise from the lack of public awareness and environmental education, leading to environmental degradation, flooding, pollution, water contamination, and increased solid waste production.

Universities generate significant amounts of solid waste, especially plastic waste [3]. The high number of students and the various activities that involve them can contribute to the increase in plastic waste on campus [4, 5]. The significant volume of plastic waste generated makes it a critical environmental issue [6, 7]. Plastic is a product that is commonly used and has economic value due to its affordability, durability, flexibility, and waterproof properties [8]. On the other hand, if it is disposed of improperly, plastic can become a hazardous waste that pollutes the environment and human health [9-12].

Universities carry ethical and moral responsibilities and play a crucial role in regulating the accumulation of plastic waste in the environment [13]. Universities need to incorporate the concept of environmental sustainability into their operational systems to facilitate practical learning and research activities [14]. Additionally, universities should establish sustainable plastic waste management systems to preserve the environment [15-17]. Implementing effective and comprehensive plastic waste management practices can play a crucial role in achieving a sustainable campus environment [18, 19]. Thus, it is crucial to promote and enhance the participation of the campus community in managing plastic waste and the implementation of effective sustainable practices [20].

Students are among the campus communities with the most significant population that can impact environmental sustainability [21]. However, the irresponsible behavior of students, such as the act of littering and leaving waste in public areas, may actually lead to the rise of pollution levels [22]. A study found that university students continue to show a lack of awareness about plastic waste management [23]. Accordingly, it is essential to have a curriculum that incorporates environmental education in all courses [24]. The level of

student awareness can be influenced by environmental education [25]. The issue of plastic waste is commonly caused by daily activities or habits [26].

Environmental education can be defined as a learning process that may impact actions and behaviors, enhance knowledge, develop skills, and encourage motivation and commitment to environmental protection [27]. Environmental education is necessary to develop environmentally friendly habits [28]. A study conducted in Mexico demonstrated the importance of environmental education, as it enables students to not only acquire knowledge about environmental issues but also comprehend the causes and effects, and develop potential solutions [29]. Environmental education can also enhance the environment and sustainability aspects of the campus [30].

Research in China shows that environmental education is vital for understanding the environment and promoting good attitudes towards solid waste sorting [31]. A study at a Romanian university investigated the attitudes and behaviors of individuals who have a positive relationship but do not wish to engage in reuse activities [27]. A Spanish study found that effective environmental education is crucial for students to address community environmental challenges [32].

Based on the research background, the objectives of this study are as follows: 1) to evaluate the implementation of environmental education in plastic waste management at the green campus in Malang City; 2) to determine the students' achievements in environmental education about plastic waste management, focusing on the knowledge, awareness, behavior, skills, and participation. The findings of this study are anticipated to serve as the reference for achieving a sustainable green campus that prioritizes conservation of the environment.

2. LITERATURE REVIEW

Environmental education is a pedagogical subject that requires adopting policies at both the school [33-35] and university levels [36, 37]. Environmental education aims to raise awareness of environmental sustainability and promote eco-friendly alternatives [38, 39]. Environmental education strives to increase community knowledge, skills, and motivation to save the environment [40].

Implementing environmental education in the campus environment is essential [41]. Environmental education offers students the chance to develop their abilities and take responsibility for the plastic waste they produce [42]. This is because environmental education has the potential to enhance students' behavior and their understanding of environmental sustainability. Critical and contextual thinking can be fostered in students through environmental education [43]. Environmental education has the potential to develop the next generation that is both environmentally friendly and responsible [44].

According to the literature study, environmental education has the potential to enhance knowledge and affect attitudes and behaviors related to proper waste management [31, 45]. Previous research suggests assessing student awareness regarding plastic waste management and making comparisons between universities [27, 31]. The suggested improvements focus around assessing the development of campus sustainability [21]. The literature review findings indicate a lack of studies that examine the assessment of environmental education with a focus on knowledge, awareness, behavior, skills, and student participation in managing plastic waste, particularly in the context of green campuses.

Green Campus refers to a campus that demonstrates a strong commitment to environmental sustainability by incorporating environmental science into its research activities, management practices, and campus policies [46]. The University of Indonesia developed the green campus assessment in 2010 as part of the UI GreenMetric World University Rankings program, with aims to provide an overview and compare the sustainability commitments of different campuses, one of the indicators measured in this assessment is waste management, accounted for 18% of the overall evaluation [19]. The University Leaders for a Sustainable Future (ULSF) Sustainability Evaluation Questionnaire outlines the procedures needed to create a sustainable green campus, including curriculum development for environmental education, student involvement, research findings, social services, environmental advocacy, operations and management, training for campus staff, and responsibility [47, 48]. Therefore, the significance of environmental education in promoting the sustainability of the green campus is important.

3. METHOD

3.1 Research design

This study utilizes survey research with a quantitative descriptive research method that systematically and carefully describes student environmental education in plastic waste management on campus. The research subjects are focused on students, as they represent a larger proportion of the campus community population in comparison to the number of lecturers and administrative staff. The large student population also impacts the volume of plastic waste produced. However, it is crucial for universities to evaluate students' environmental education in order to make necessary adjustments and improvements to their sustainable campus efforts, as students play a significant role in promoting campus sustainability.

The evaluation indicators are designed based on the objectives of environmental education, which consist of five indicators: knowledge, awareness, behavior, skills, and participation [49]. Data were collected by distributing a closed questionnaire to students, which had been modified from previous studies [50-54]. Data analysis was carried out by analyzing the quantitative data obtained using the weighted mean technique.

3.2 Research location

According to the data, Indonesia contributes the second-largest amount of plastic waste in the world, so it can be called a plastic waste emergency. Malang, an educational city in Indonesia, accommodates more than 150,000 students every year and contributes as much as 764.79 tons of waste every day, with a plastic waste composition of 13.66% or 104.47 tons/day [55]. The Green campus was selected as the research location due to its significant impact on sustainability [56, 57]. Universitas Brawijaya, Universitas Negeri Malang, and Universitas Muhammadiyah Malang were chosen as the research locations because the three campuses are the largest green campuses in Malang City, with a total of more than 37,000 students. The high number of students affects the burden of plastic waste produced. With the background above, Malang City is used as a study area., as shown in Figure 1.

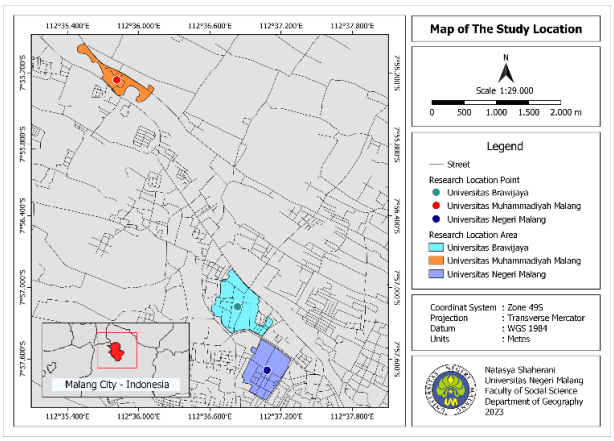

Figure 1. Map of research location

3.3 Research sample

The research covered all currently enrolled students (D3/D4/S1/S2/S3) at Universitas Negeri Malang, Universitas Brawijaya, and Universitas Muhammadiyah Malang, totaling 160,533 individuals. The sample selection used a proportional stratified random sampling approach, calculated using a formula developed by Michael [58]. The calculation results are shown in Table 1.

The formula by Isaac and Michael:

$$S = \frac{x^2 .N.P.Q}{d^2 (N-1)+x^2 .P.Q} \quad (1)$$

where, s=number of samples; N=population size; d=0,05; P=Q =0,5; x^2=Chi Square; dk=1, error level 1%, 5%, 10%.

The sample size was determined based on the population of each faculty member on each campus, so a sample of 1,038 was obtained, which included 347 students from Universitas Brawijaya, 346 students from Universitas Negeri Malang, and 345 students from Universitas Muhammadiyah Malang. Through a proportional stratified random sampling approach, the proportion entered at each campus was as much as 33%. The sampling error in this study is 0.0155, and the confidence level is 95%.

Table 1. Population and research sample in the campuses

	UB			UM			UMM	
F	**P**	**S**	**F**	**P**	**S**	**F**	**P**	**S**
FH	3082	14	FEB	5490	40	FH	2648	24
FEB	6731	31	FT	5244	39	FEB	5175	47
FIA	6785	31	Fmipa	5084	37	FT	7127	65
FP	6660	31	FV	2082	15	Fisip	5710	52
Fpet	3685	17	PG	12712	93	Fkes	3402	31
FT	6165	28	FIP	4248	31	PG	1466	13
Fpik	5243	24	FS	5203	38	FPsi	2431	22
Fmipa	4388	20	FIK	3081	23	Fkip	5940	54
FTP	4589	21	FIS	3916	29	FPP	2749	25
Fisip	6172	28	-	-	-	FAI	1313	12
FIB	4272	20	-	-	-	-	-	-
Filkom	4076	19	-	-	-	-	-	-
FV	4593	21	-	-	-	-	-	-
PG	9071	42	-	-	-	-	-	-
T	**75512**	**347**		**47060**	**346**		**37961**	**345**
TP	**160533**							
TS	**1038**							
Note	1. UB (Universitas Brawijaya), 2. UM (Universitas Negeri Malang), 3. UMM (Universitas Muhammadiyah Malang), 4. F (Faculty), 5. P (Population), 6. S (Sample), 7. FH (Fakultas Hukum/Faculty of Law), 8. FEB (Fakultas Ekonomi dan Bisnis/Faculty of Economics and Business), 9. FIA (Fakultas Ilmu Administrasi (Faculty of Administrative Science), 10. FP (Fakultas Pertanian/Faculty of Agriculture), 11. Fapet (Fakultas Peternakan/Faculty Animal Science), 12. FT (Fakultas Teknik/Faculty of Engineering), 13. Fpik (Fakultas Perikanan dan Ilmu Kelautan (Faculty of Fisheris and Marine Science), 14. Fmipa (Fakultas Matematika dan Ilmu Pengetahuan Alam/Faculty of Mathematics and Natural Sciences), 15. FTP (Fakultas Teknologi Pertanian/Faculty of Agricultural Technology), 16. Fisip (Fakultas Ilmu Sosial dan Ilmu Politik (Faculty of Social and Political Sciences), 17. FIB (Fakultas Ilmu Budaya/Faculty of Cultural Sciences), 18. Filkom (Fakultas Ilmu Komunikasi/Faculty of Communication Sciences), 19. FV (Fakultas Vokasi/Faculty of Vocational Studies), 20. PG (Postgraduate), 21. FIP (Fakultas Ilmu Pendidikan/Faculty of Science Education), 22. FS (Fakultas Sastra/Faculty of Literature), 23. FIK (Fakultas Ilmu Pendidikan/Faculty of Sport Science), 24. FIS (Fakultas Ilmu Sosial/Faculty of Social Science), 25. Fikes (Fakultas Ilmu Kesehatan/Faculty of Health Sciences), 26. FPsi (Fakultas Psikologi/Faculty of Psychology), 27. Fkip (Fakultas Keguruan dan Ilmu Pendidikan (Faculty of Teacher Training and Education), 28. FPP (Fakultas Pertanian-Peternakan/Faculty of Agriculture-Animal Science), 29. FAI (Fakultas Agama Islam/Faculty of Islamic Studies), 30. T (Total), 31. TP (Total Population), 32. TS (Total Sample)							

3.4 Research procedure

This study utilizes primary data collected through direct *observation*, field surveys, and the distribution of closed questionnaires to students via Google form using the QR Code (Figure 2) along with digital distribution using messaging app WhatsApp. The closed questionnaire was chosen because this study's sample size was 1038. The format's selection can facilitate systematic and efficient data collection and analysis in accordance with the research objectives.

Secondary data is obtained by a comprehensive review of literature sources including journals, books, previous academic articles, websites, and documents available at the research location. The duration of this investigation is two months, specifically from February to March 2024.

Figure 2. QR code of environmental education instrument

To avoid potential self-report bias and social desirability bias in survey responses, this research directly involves the researcher's role in collecting data when respondents fill out the questionnaire. The researcher gave a brief verbal description to the respondents regarding how to fill in the questionnaire and the indicators for the questions contained in it. Researchers allowed respondents to ask questions about the clarity of each indicator's questionnaire contents. Researchers also carried out direct checks on respondents filling out questionnaires (Figure 3).

Figure 3. The process when respondents fill out the questionnaire

3.5 Data collecting instrument

The research instrument contains a comprehensive assessment of environmental education, focusing in knowledge, awareness, behavior, skills, and student participation in managing plastic waste. The five indicators were chosen because they can encourage students to take sustainable collective action in managing plastic waste effectively. They are designed based on the environmental education objectives that have been agreed upon at the Intergovernmental Conference on Environmental Education in Tbilisi since 1977 [49, 59].

The basis for calculating the results of the indicators in this study was adopted and modified from previous studies [50-54], which were then adjusted to the conditions of universities in Indonesia, resulting in 22 questions. There are seven questions to measure knowledge indicators, five to measure awareness indicators, four to measure behavioral indicators, three to measure skill indicators, and three to measure participation indicators, as shown in Table 2.

Table 2. Indicators selected for assessment of students' environmental education [50-54]

Indicators of Environmental Education	No.	Question Indicators
Knowledge	1	Do you aware that plastic waste is in the category of non-biodegradable waste?
	2	How much do you know about the potential for pollution of the environment resulting from improper handling of plastic waste?
	3	How much do you know about the health risks caused by burning plastic waste, such as bronchitis and asthma?
	4	How much do you agree that the Final Disposal Site (TPA) may have to handle more waste if it isn't sorted?
	5	How much do you agree that selling and recycling plastic waste can help to minimize environmental pollution?
	6	How much do you think that reducing the load of daily waste production requires proper knowledge about managing plastic waste?
	7	How familiar are you with the contents of Government Regulation No. 22 of 2021 on Environmental Protection and Management?
Awareness	8	How much do you understand about the importance of managing plastic waste in preserving the environment?
	9	How much do you understand the importance of reading the label of waste type before throwing it away?
	10	How much do you know that plastic waste takes hundreds of years to decompose completely?
	11	How much do you know about the potential effects to the environment of reducing the consumption of single-use plastic waste?
	12	How much do you understand the importance of sorting and recycling plastic waste in daily life?
	13	How much do you agree that plastic waste is perceived as having no value?
Behavior	14	How often do you sort the waste by category before throwing it away?
	15	How much do you agree that the Green Campus effort has influenced your behavior and awareness about the problem of plastic waste?
	16	How often do you consider selling your plastic waste for recycling?
Skills	17	How often do you make or learn crafts with plastic waste (bags, decorative flowers, vases, pencil cases, ecobricks, etc.) as a creative solution in waste management?
	18	How often do you think about learning or developing abilities to make fashion show clothing from of plastic waste?
	19	Have you ever used plastic waste as a planting medium to support environmental sustainability?
	20	How often do you actively participate in applying the three R's (reuse, reduce, and recycle) in your daily life?
Participation	21	How frequently do you sell plastic waste to collectors/waste banks, throw it out, or pick it up to reduce its negative impact on the environment?
	22	How often do you take part in initiatives or activities aimed at reducing plastic waste?

The measurement of each question indicator is based on a Likert scale ranging from 1 to 4, with specific assessment criteria provided in Table 3.

Table 3. Assessment criteria

Scale	Assessment Criteria
1	Very unfamiliar/Very unaware/Strongly disagree/never
2	Unfamiliar/Unaware/Disagree/Rarely
3	Familiar/Aware/Agree/Often
4	Very familiar/Very aware/Strongly agree/Very often

The validation process of the instruments in the study has been carried out qualitatively and quantitatively. Qualitative validation is carried out by requesting an assessment by an expert validator regarding the suitability of the content with the purpose of the research, the construct of each item, and the language used. Quantitative validation was carried out with a

limited trial of 30 students, including 10 from Universitas Brawijaya, 10 from Universitas Negeri Malang, and 10 from Universitas Muhammadiyah Malang. The data that has been obtained is then tested for validity and reliability using SPPS version 26 because it is more accurate, efficient, and avoids human error. The results are valid and reliable because the sig. (2-tailed) value < 0.05 and the Cronbach's Alpha value on reliability statistics > 0.60, as seen in Table 4.

Table 4. Results of instrument validity and reliability

Aspect	Item	Sig.(2-tailed)	Result	*Nilai Cronbach's Alpha*	Result
Knowledge	1	0.017		0.898	
	2	0.002		0.894	
	3	0.000		0.892	
	4	0.002		0.894	
	5	0.000		0.892	
	6	0.000		0.890	
	7	0.003		0.895	
Awareness	8	0.017		0.898	
	9	0.000		0.890	
	10	0.001		0.894	
	11	0.034	VALID	0.899	RELIABLE
	12	0.006		0.895	
Behavior	13	0.001		0.894	
	14	0.000		0.889	
	15	0.000		0.892	
	16	0.001		0.894	
Skills	17	0.006		0.895	
	18	0.000		0.891	
	19	0.006		0.895	
Participation	20	0.000		0.892	
	21	0.000		0.892	
	22	0.000		0.892	

3.6 Data analysis

This study's data analysis uses the Weighted Mean technique to assess students' environmental education achievements in plastic waste management, especially in indicators of knowledge, awareness, behavior, skills, and participation. Data analysis using weighted mean strongly considers the weight of each data. The calculation process using weighted mean in this study starts by identifying the questionnaire scores obtained and then grouped according to criteria using the countif formula. The results obtained are then calculated as a weighted average using Microsoft Excel with the formula below:

$$X = \frac{\sum fx}{f} \quad (2)$$

where, X=weighted mean; f=frequency; ∑fx =total of weighted mean.

The weighted mean results that have been analyzed are then classified using the predetermined score category, as shown in Table 5. The interpretation is to classify students' environmental education into very high, high, low, or very low categories. The higher the score category obtained, the more positive the result.

Table 5. Score for environmental education criteria [60]

Score	*Interpretation*
3.25-4.00	Very High
2.50-3.24	High
1.75-2.49	Low
1.00-1.74	Very Low

4. RESULTS AND DISCUSSION

4.1 The evaluation of the implementation of environmental education in managing plastic waste on the green campus

Environmental education plays a crucial role to address the increasing environmental issues, such as the problem of plastic waste. Universitas Brawijaya, Universitas Negeri Malang, and Universitas Muhammadiyah Malang are considered Green Campuses due to their implementation of a curriculum that integrates environmental education and focuses on environmental sustainability. However, each university has various criteria in implementing this curriculum. Integrating environmental education in the green campus program is a way to implement campus activities, contributions, and commitments to sustainability [21].

Universitas Brawijaya and Universitas Negeri Malang have incorporated environmental education into several courses by actively engaging students in the learning process. For example, this could involve carrying out observation activities at the Final Disposal Site (TPA) or engaging students in a program on campus that focuses on reusing and sorting plastic waste (Figure 3). Similar to previous research, it has been demonstrated that incorporating environmental courses focused on plastic waste management is crucial for promoting sustainability in higher education [61]. Further study also indicates that students who enroll in sustainability courses and actively participate in activities have a deeper comprehension of green campus strategies (Figure 4) [62]. In accordance with the concept of planned behavior, engagement plays a significant role in developing habits related to environmental management [63, 64].

(a) Universitas Brawijaya

(b) Universitas Negeri Malang

Figure 4. Integration of environmental education in academic courses

At Universitas Muhammadiyah Malang, the integration of environmental education is demonstrated by engaging in participatory organizational work programs, such as the *Kenduri Kali* program and the production of paving blocks using plastic waste. Students can participate in environmental preservation through campus projects (Figure 5) [26]. Therefore, it is crucial for campus organizations to establish work programs that might stimulate students' voluntary interest to engage in managing plastic waste [65]. The

objective is to enhance students' ability in transforming plastic waste into valuable products and develop an environmentally friendly habit. Implementing environmental education programs that incorporate practical actions or initiatives can serve as a strategic approach to mitigating the issue of plastic waste [66].

Figure 5. Integration of environmental education into organizational work programs at Universitas Muhammadiyah Malang

Various initiatives and strategies have been carried out to overcome these problems of plastic waste by providing infrastructure in the campus environment, both at Universitas Brawijaya, Universitas Negeri Malang, and Universitas Muhammadiyah Malang. The installation of sufficient infrastructure is an essential factor in addressing the waste issue (Figure 5) [67, 68]. This is demonstrated by the presence of a complete waste management facility that incorporates a plastic waste categorization procedure, the supply of trash cans according to the various types, and the implementation of various educational programs in public spaces. Universitas Negeri Malang features a self-designed storage facility specifically for plastic bottles. The purpose of these programs is to inform students on the importance of sorting plastic waste right from its source, so that they can increase responsibility for the waste produced (Figure 6) [69].

(a) Universitas Brawijaya

(b) Universitas Negeri Malang

(c) Universitas Muhammadiyah Malang

Figure 6. Proving plastic waste management facilities in the campus environment

4.2 Achievements of students' environmental education in managing plastic waste on green campus

The aim of establishing a green campus is to develop students who have a productive lifestyle by actively promoting sustainable development [70]. UNESCO highlights the significance of education in upholding environmental sustainability, which serves as the basis for a green campus [71]. The study's findings indicate that students have a significantly increased level of environmental education in managing plastic waste on a green campus (Table 6). Universities may contribute to the development of an environmentally friendly society through the provision of environmental education [72, 73].

Table 6. Environmental education achievements of students in managing plastic waste

University	Weighted Mean
Universitas Brawijaya	2.93
Universitas Negeri Malang	2.92
Universitas Muhammadiyah Malang	2.90

The study that has been conducted previously in 2022 in Indonesia found that environmental education programs had significant effects on students' behavior, participation, and knowledge of sustainable development, specifically in relation to waste management issues [26]. Significantly, the findings in 2024 revealed an important change in the results related to the aspect of participation, thereby highlighting the importance of this study. From a comprehensive perspective, students demonstrate a high level of knowledge and behavior in managing plastic waste. In fact, the level of student awareness has reached a significantly high level, although their skills and participation tend to be low (Figure 7).

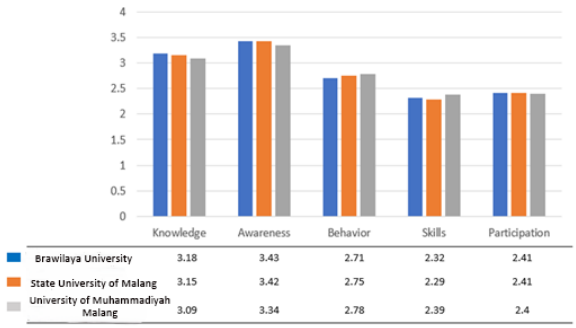

Figure 7. Differences in the level of knowledge, awareness, behavior, skills, and participation of students in managing plastic waste

Universitas Brawijaya demonstrated the highest average score (3.18) in terms of knowledge, as compared to Universitas Negeri Malang (3.15) and Universitas Muhammadiyah Malang (3.09) (Figure 7). Having an excellent knowledge of the environment is crucial for equipping students with the ability to make responsible choices that can significantly influence the environment [74]. This fits with the many environmental-based study programs offered by Universitas Brawijaya. The importance of incorporating sustainability elements into educational instruction and learning activities [75]. Universitas Negeri Malang and Universitas Muhammadiyah Malang demonstrate their involvement through activities such as socialization, seminars, workshops, integration in various courses, and sharing info on social media. These three campuses can enhance students' comprehension of the environmental consequences resulting from plastic waste through several teaching programs [76].

Based on several research, students have a positive understanding of addressing environmental problems through the implementation of the 3R concept, which includes reusing, reducing, and recycling [77, 78]. According to the research findings, students at Universitas Brawijaya have the highest level of awareness, with a score of 3.43. This is followed by Universitas Negeri Malang with a score of 3.42, and Universitas Muhammadiyah Malang with a score of 3.34 (Figure 7). This is demonstrated through a variety of work activities organized by the campus, Student Executive Board (BEM), and Student Activity Units (UKM), which aim to educate and raise awareness about effective plastic waste management. Therefore, participation may provide a sense of ownership and responsibility for environmental sustainability, making awareness a crucial component of plastic waste management [79].

In term of behavior, Universitas Muhammadiyah Malang had the best score of 2.78, exceeding both Universitas Negeri Malang (2.75) and Universitas Brawijaya (2.71) (Figure 7). Intra-campus organizations and Student Activity Units (UKM) of the Universitas Muhammadiyah Malang have implemented educational programs aimed at reducing plastic waste, with the goal of promoting an increase in behavior towards the use of non-disposable products [76]. Previous research has indicated that the level of environmental behavior plays a significant role in the success of waste management [80, 81].

Having a high level of knowledge, awareness, and behavior does not always guarantee that students have proficient skills in managing plastic waste. The study's findings indicated that the Universitas Muhammadiyah Malang achieved a score of 2.39, while Universitas Brawijaya obtained a score of 2.32 and Universitas Negeri Malang received a score of 2.29 (Figure 7). The Universitas Muhammadiyah Malang has successfully implemented a recycling process that transforms plastic waste into valuable products, specifically pavement blocks (Figure 5). In the meantime, Universitas Brawijaya and Universitas Negeri Malang continue to engage in partnerships with external organizations such as collectors and waste banks. The low proficiency of students is sometimes attributed to courses that prioritize theoretical concepts over practical skills, resulting in a lack of practical knowledge in properly managing plastic garbage. The research conducted in Turkey and Macedonia also identified a gap in the focus on developing environmental skills [82].

Participation is the act of engaging in an environmental action [27]. Figure 7 presented the findings indicating that there was a relatively low level of student engagement across all three sites. This is because even though students may possess a high level of knowledge, awareness, and behavior about plastic waste management, it does not necessarily ensure their active engagement [83, 84]. Studies conducted in India have found that the majority of students possess a strong understanding of and commitment to plastic waste management practices, but it was observed that only one-third of students actively engage in such practices [85, 86]. Students frequently display difficulty in actively participating in environmental projects on an individual level, unless there is a specific campus event that requires their participation. Students perceive managing plastic waste as laborious and time-consuming, hence preferring to dispose of it quickly rather than engaging in sorting. Therefore, it is essential to implement various programs that can engage students in actively contributing in managing plastic waste [87, 88].

The findings of this study have significant implications for green campuses in decision-making processes to enhance students' environmental education, particularly in terms of skills and participation. Empowering students through environmental education has a significant role in managing plastic waste for the sustainability of green campuses if every aspect is performed properly. Students with a comprehensive understanding of environmental education will possess the ability to identify and implement several alternative approaches to address the issue of plastic waste. The reason for this is that environmental education enables students to develop a more selective approach while addressing a wide range of environmental issues.

In order to obtain more representative results, it is essential to examine several green campuses in various places, as the study has been limited to Malang City, Indonesia. Further research in different locations is recommended to adjust and test the consistency of these findings in various contexts. Further research is also needed to examine students' environmental education about plastic waste management practices to support environmental sustainability. Although there are limits, the findings of this study can assist universities and policymakers in identifying various programs that incorporate environmental education, particularly those that engage students in managing plastic waste.

The limitation of this study is that the content of the questionnaire is quite long, which can influence respondents to fill in answers accurately so that it can trigger a slight potential for self-report bias. Using a questionnaire as a survey instrument in this research also has limitations because we focused on measuring only five indicators. Therefore, these limitations have implications for using a mixed methods approach to obtain more comprehensive results, such as adding in-depth interviews when conducting surveys.

5. CONCLUSION

The green campus program incorporates environmental education to foster a learning environment that acknowledges the importance of plastic waste management. Environmental education enables students to actively engage in and take an active role in managing plastic waste. Environmental education in plastic waste management at Universitas Brawijaya, Universitas Negeri Malang, and Universitas Muhammadiyah Malang is generally considered to be of a high standard. However, each university has a different approach to implementing this learning. The study findings indicate that students possess a "very high" level of awareness and a "high" level of knowledge and behavior about plastic waste management. However, their level of abilities and engagement in this area is assessed as "low".

The limitation of this study is that the content of the questionnaire is quite long, which can influence respondents' accuracy in filling in answers. The research location is still limited to Malang City, so exploring several green campuses in other areas is necessary to get more representative results. Further research is needed to examine students' environmental education regarding practices in managing plastic waste to support environmental sustainability.

Therefore, in order to achieve the sustainability of a green campus, universities play a crucial role in developing student knowledge, awareness, and behavior by including environmental education into their curriculum. Student

participation and skill in plastic waste management can be enhanced through diverse programs that offer opportunities for active participation and foster lasting memories. Environmental education through simulation and practice-based activities packaged in the form of teaching materials, models, and learning media is highly suggested to promote student involvement. The objective is to establish an environmentally friendly community that actively contributes to the sustainability of the environment.

Based on these findings, especially regarding the low level of student skills and participation in plastic waste management, this research recommends several things to achieve green campus sustainability: 1) combining various programs that can invite students to get involved in environmental activities to provide long-term experience; 2) applying environmental education through simulation game-based activities and practice in the learning process packaged in the form of teaching materials, media, and learning models to improve student skills and participation. This aims to build a green society that can contribute to sustainable development.

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