Teaching Sustainability outside the Classroom: Preliminary Findings of Food Waste from Indonesian University Students

Inaya Sari Melati
Universitas Negeri Malang, Indonesia, https://orcid.org/0000-0002-4492-9167

Wahjoedi
Universitas Negeri Malang, Indonesia, https://orcid.org/0000-0002-5057-1405

Imam Mukhlis
Universitas Negeri Malang, Indonesia, https://orcid.org/0000-0001-9321-9703

Hari Wahyono
Universitas Negeri Malang, Indonesia, https://orcid.org/0000-0002-2988-1601

Abstract: The fact that Indonesia becomes the first country contributing to food loss and food waste among the G20 countries in 2021 is an opportunity to evaluate the effectiveness of sustainability education taught in universities. This study aims to map students' initial knowledge and skills in processing the food waste and to create an integrated food waste management design in a higher education institution. An explanatory sequential mixed method was used in this study involving 641 student respondents for the quantitative phase and three institutions for the qualitative phase. The quantitative phase found that 67.71% of students did not have experience processing organic waste, and their perception about waste segregation benefit is still in the moderate category. However, the index number of students' self-identity is high (80.94) regarding their perception that they had behaved in an environmentally friendly manner. This finding is then communicated with several related institutions during the qualitative phase to develop an integrated sustainability education model outside the formal curriculum to improve students' knowledge and skills in processing food waste.

Keywords: Sustainability, Education, Food Waste, Higher Education Institutions

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Introduction

Globally, Romero-Luis et al. (2021) found that campaign regarding the circular economy and bioenergy through education is still in their early stages and have a low level of maturity. Although many studies states that teaching about sustainability and circular economy in the classroom has shown a positive trend (Bugallo-Rodríguez & Vega-Marcote, 2020; Williams et al., 2018), there are also research results that criticize it. Several studies suggest that so far, the insights about the circular economy taught in class have been more conceptual (Hens et al., 2018; Kirchherr & Piscicelli, 2019) and inconsistent with the content of knowledge being taught (Fonseca et al., 2018). In addition, the material taught is not simple, concrete, inclusive and transparent (Corvellec et al., 2021). This causes the concept of sustainability and circular economy that are taught in classes are failed to develop critical, imaginative and innovative thinking about sustainable development (Kopnina, 2018). Another problem related to classroom learning regarding the circular economy, sustainability, and other relevant matters are difficulty to observe changes in student behavior permanently due to the limited number of meetings and evaluation duration (Bugallo-Rodríguez & Vega-Marcote, 2020), the need for more lecturers, the teaching load for lecturers will become heavier, faculty financial management problems related to the increasing complex activities to be carried out, construction of new facilities, and difficulty of determining the right evaluation design (Wandl et al., 2019).

The UN has a global performance ranking that assesses university performance in supporting SDGs called the Times Higher Education (THE) Impact Rankings. The 2022 Impact Rankings is the fourth edition and the overall ranking includes 1,406 universities from 106 countries/regions. THE Impact Ranking uses carefully calibrated indicators to provide comprehensive and balanced comparisons across four broad areas: research, stewardship, outreach, and teaching. In 2022, the university with the best TPB practice is Western Sydney University (Australia) with a score of 99.1; Arizona State University (United States) with a score of 98.5 and Western University (Canada) with a score of 97.8. Only 28 Indonesian universities are listed in this rank board. It implies that most universities in Indonesia have not paid much attention to their role in supporting sustainable development. The top 10 national rankings of listed Indonesian universities can be seen in Table 1.

Table 1. Listed Universities with the Highest Sustainable Development Score in Indonesia

No.	World Rank	University	Total Score
1.	18	Universitas Indonesia	95,1
2.	87	Universitas Gadjah Mada	89,2
3.	101-200	Institut Teknologi Bandung	82,1 – 88,5
4.	101 – 200	Universitas Padjajaran	82,1 – 88,5
5.	201-300	Universitas Airlangga	76,9 – 82,0
6.	201-300	Institut Teknologi Bandung	76,9 – 82,0
7.	201-300	Universitas Diponegoro	76,9 – 82,0

8.	301-400	Universitas Sebelas Maret	72,0 – 76,7
9.	301-400	Institut Teknologi Sepuluh November	72.0 – 76,7
10.	401-600	Universitas Brawijaya	65,0 – 71,9

Source: THE Impact Rankings (2022)

Table 1. shows that almost every university has a high partnership score (Partnership for the Goals -TPB number 17). Ironically, only two universities were able to achieve a high Education Quality score (TPB number 4), namely IPB and UNS. Apart from these two higher education institutions, there is no ranking regarding the quality of education that contributes to achieving the total score of the top 10 universities in Indonesia.

Although only a few universities in Indonesia are listed in THE impact rankings, several universities and study programs in Indonesia have introduced the concept of sustainable development. However, based on the results of searching various information using internet searching techniques, it was found that most of these courses were presented for the Master Program and the discussion in them was focused on the approach of each scientific discipline. For example, the Insititut Teknologi Sepuluh Nopember Surabaya (ITS) has a course on "Sustainable Development" which is taught to students of the Master Program in Development Studies, the Postgraduate School of Universitas Brawijaya (UB) offers courses on Sustainable Development and Environmental Insight in the Master Program in Environmental Resource Management and Development (https://ppsub.ub.ac.id/akademik/program-studi-interdisciplinary/), Tadulako University equips Master of Economics students with Green Economy courses (https://siaga.kemdikbud.go.id). Several universities also teach it to students in undergraduate study programs, but with a tendency to only teach it to certain study programs such as study programs related to engineering and economics. For example, Mulawarman University requires undergraduate students in the Development Economics Study Program to take Natural Resource and Environmental Economics courses, ITS with the same study program features courses on Sustainable Development Education (semester 5) and Sustainable Society: Theory and Practice (semester 6). Interestingly the courses in semester 6 are opened for other study programs. On the other hand, Universitas Negeri Semarang (UNNES) introduced the Environmental Education course as a general subject which is a mandatory for all undergraduate students in any study program.

The problems and obstacles to teaching sustainability inside the classroom require a more concrete solution than simply improving the existing curriculum design. De la Torre et al. (2021) argues that there are other ways to help transition of circular economy by promoting the concept of sustainability outside the formal curriculum. The results of these thoughts inspire novelty in this research: how universities should not only focus on integrating the concept of sustainability into the formal curriculum, but also be able to become pioneers of this transformation through a more concrete movement that is supported by all components of the HEIs.

Food Waste Problem in Indonesian HEIs

In 2021, Indonesia became the largest food waste producer in Southeast Asia according to Food Waste Index

2021 developed by United Nations report Environment Program (UNEP). The total food waste in Indonesia reaches 20.93 million tons annually. This number has a significant impact on greenhouse gas emissions. The related data could be seen in Figure 1.

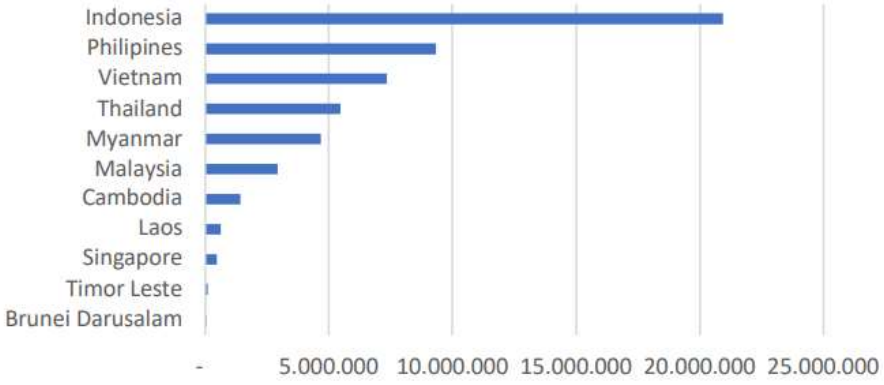

Figure 1. Household Foodwaste Estimate (tons/year) in South East Asia
Source: Food Waste Index, UNEP (2021)

Furthermore, according to the Sustainable Development Report (2022), Indonesia is listed as one of the countries that has not made enough progress in meeting the 2015 Paris Agreement targets. In general, the composition of organic waste in the form of food scraps in households is proven to have a larger amount than inorganic waste, which ranges from 60% to 73% of the total household waste generation (Arief, 2019; Brigita & Rahardyan, 2013; Khasanah et al., 2019; Widiarti, 2012). However, compared to inorganic waste management, the progress of food waste management in Indonesia seems quite slow. Several research results try to unravel the causes of the slow progress in food waste management activities, including: the lack of awareness of the government in providing special food waste processing facilities (Brigita & Rahardyan, 2013); lack of public awareness and knowledge in sorting waste (Brigita & Rahardyan, 2013; Kurniawan & Santoso, 2020; Yudistirani et al., 2016); there are no resources specifically employed to sort waste and a lack of creative communities in waste management (Kurniawan & Santoso, 2020).

Non-profit organizations whose activities focus on reducing FLW actually exist and are developing in Indonesia, such as "Food Cycle Indonesia" (Jabodetabek), "Garda Pangan" (Surabaya), "Hunger Bank" (Bandung), "Zero Waste Indonesia" (online community). Foodbank of Indonesia (FoI) and other similar non-profit organizations. Most of these organizations operate as food banks that are committed to distributing food assistance to underprivileged people in need. In addition, several organizations also carry out recycling activities and sell their products online. Several movements that focus on reducing food waste have also come from corporate initiatives in the form of Corporate Social Responsibility (CSR) such as McDonalds with the "Food Rescue" program, DBS Bank with the "Towards Zero Food Waste" program, or Aswata Insurance Company with the "Fighting the Food Waste" program. Food Waste Action".

In a smaller scope such as the university environment, most stakeholders still do not have awareness in waste management. The problem of waste in tertiary institutions still does not reflect the success of teaching in the classroom. The generation of waste in tertiary institutions is recorded in several studies as still high and the management is not optimal. The findings of Nurjannah et al. (2020) in their case study in a university canteen estimated the weight of leftover food produced by each respondent studied was 147 grams/day with a percentage of leftover food weight per individual of 38% of the portion served. The estimated value of food waste from this amount is IDR 4,244 per individual/day with the percentage value of food waste per individual being 38% of the total cost incurred for consuming food per day. Meanwhile, the results of other studies regarding waste generation in the campus environment found varying amounts, namely every day the campus produces waste weighing 123.43 kg (Masrida, 2017), 770 kg (Yuliandari et al., 2019), up to 12 tons (Retnoningsih et al., 2022). Based on the results of these studies, the percentage of types of organic waste is greater than other types of waste.

The number of students in Indonesia is 9.32 million people in 2022 (Indonesian Department of Education, 2023). They are all potential to be the agent of change regarding to environmental transformation. The irony that occurs in this case is that students who are expected to become the agents of change, especially in terms of promoting circular economy transformation and becoming pioneers of the concept of sustainability in all aspects of life, are in fact still far from expectations. A study by Sima et al. (2022) revealed that the lack of knowledge and lack of student interest in activities related to environmental issues is the biggest obstacle to the success of tertiary institutions in Romania. The majority of respondents to a study in the United Arab Emirates agreed that young people generate more food waste than their parents, most of which comes from excessive food purchases and poor food management (Yagoub et al., 2022).

Studies on the behavior of disposing of food waste by Indonesian students are still limited to describing the behavior of disposing of food waste and the factors that influence it (Amalia, 2019); identification of types of waste in the university area (Dewilda & Julianto, 2019); and an inorganic waste processing model (Sunandar et al., 2020). Studies on organic waste management models in HEIs involving the students are still very difficult to find in Indonesia. Therefore, the research questions of the current study are:

1. How is the students' perception about food waste management?
2. How university could build an integrated food waste management with students' active participation?

Method

An explanatory sequential mixed method was used in this study. The quantitative phase used a cross-sectional online survey conducted in Universitas Negeri Semarang, Indonesia which is the state university that declared their vision to be international reputable conservation university in Indonesia. As many as 641 students across disciplines and semesters filled in the survey anonymously to know about their knowledge about waste management, their perception about it, and their perception about their environmentally friendly self-identity.

The survey was adopted from Nguyen et al. (2022) with minor adjustment and had been re-tested in terms of its reliability and construct validity. The descriptive qualitative methods using index number was applied to explain the findings regarding research question number 1 up to 3.

The qualitative phase was done by doing interviews to 4 key persons, they are: the manager of the central landfills Jatibarang Semarang City, the head for integrated organic waste processing site of UNNES named *Tempat Pembuangan Sampah Terpadu* (TPST) UNNES, the staff of Conservation Development Unit (UPT Bangvasi) UNNES and the head for household sub-division of UNNES. The interview transcripts were analyzed using N-Vivo program to do the interactive method as Miles et al. (2018) explained which are data condensation, data display, drawing and verifying conclusion about how to build an integrated food waste management with students' active participation.

Results

Respondents Demographic Data

A total of 641 anonymous respondents who are active students in Universitas Negeri Semarang, Indonesia completed the online survey. The Demographic data and respondents' characteristics are shown in Table 2.

Table 2. The Demographic Data

Indicators	Answer Options	Total	Percentage
Sex	Female	485	73,4%
	Male	176	26,6%
Semester	1	414	64,59%
	3	122	19,03%
	5	74	11,54%
	7	15	2,34%
	More than 7	16	2,50%
Residence	Boarding house	485	73,4%
	Parents' house	128	19,4%
	Rent House	40	56,1%
	Private House	8	1,2%
Have experience in managing organic waste	No	450	68,1%
	Yes	211	31,9%
Have pet(s) or livestock	No	403	62,87%
	Yes	238	37,13%

Indicators	Answer Options	Total	Percentage
How to deal with the organic waste currently	Put it in garbage bin without sorting process	350	54,60%
	Put it in garbage bin after sorting process	100	15,60%
	Feed it to pet(s)/livestock	26	4,06%
	Put it in composter	11	1,72%
	Others	154	24,02%

As cited in the Table 2, more than a half of students do not have any experience in managing organic waste However, the 31,9% students with the experience of managing organic waste shared interesting experience they did to their organic waste, such as: processing the organic waste into compost, utilizing food waste as animal feed (since 37,13% of respondents stated they have pets and livestock), restoring the leaves waste into artistic souvenirs, or just simply burying the organic waste at their backyard. As many as 54,60% students revealed that they just simply put the waste without sorting it. This fact requires deeper attention because waste separation is an important thing to achieve high rates of waste reuse and recycling (Stoeva & Alriksson, 2017). Despite this fact, the number of students who have taken care their waste separation reached 100 students, even only 11 students that put their organic waste into the composter by themselves.

Students' Perception about Food Waste Management

Table 3 describes the students' perception about food waste management based on 3 indicators: perceived personal benefits of sorting food waste, inconvenience in sorting food waste, and environmental self-identity by measuring index number for each indicator.

Table 3. Students' Perception about Food Waste (FW) Management

No	Statement	Answer Frequency (%)					Index	Category
Personal benefits of sorting food waste (Cronbach's α =0.89)								
1	Putting FW into the green bin is the right thing to do	9,7	15,9	46,3	20,3	7,8	60,12	Moderate
2	I feel good when I sort and dispose of FW correctly into the green bin	7,3	10,3	33,1	28,9	20,4	68,96	Moderate
3	By using the green bin for FW, my rubbish bin stays cleaner and does not need to be taken out as frequently	19,8	28,5	30,3	12,5	8,9	52,44	Low

Inconvenience and lack of control in using the green bin (Cronbach's α =0.79)								
4	I do not have sufficient information regarding FW going into the green bin	7,6	14,9	35,7	26,8	15	65,34	Moderate
5	It is expensive to buy supplies (e.g. compostable bags, kitchen caddy, etc.) to sort into the green bin	10,8	24	39,6	16,9	8,7	57,74	Moderate
6	I do not want to deal with the smell and the mess of food when sorting	10,5	18,4	33,8	24,8	12,5	62,08	Moderate
7	FW It takes too much time and effort to sort FW into the green bin	8,9	21,4	38,8	22,8	8,1	59,96	Moderate
8	I have no control over FW as other people in the house are the ones disposing FW	10,5	17,6	33,7	24	14,2	62,76	Moderate
Environmental self-identity (Cronbach's α =0.89)								
9	Acting environmentally friendly is an important part of who I am	3,4	1,6	3,4	10,5	81,1	92,86	Very High
10	I am the type of person who acts in an environmentally friendly way	0,8	3,1	32,4	40,6	23,1	76,42	High
11	I see myself as an environmentally friendly person	1,4	4,1	39,4	35,6	19,5	73,54	High

Note: All items were assessed on 5-point Likert scales; higher values correspond to stronger agreement with the statement or higher frequency of recycling habit. FW=Food waste (Adopted from Nguyen et al., 2022)

University's Perception about Food Waste Management

According to the interviews with the key persons, the outcomes of qualitative phase in the current research were classified, sorted and arranged using NVivo to identify themes and patterns of interviews transcript. The NVivo tools used in this analysis are including: word frequency (word cloud and cluster analysis), text search, and hierarchy chart. Figure 2 displays the word cloud of 25 most frequent words mentioned during interviews with minimum length of word as many as 3 characters. The word "waste" dominated conversation by mentioned 82 times (4.92% of total words during interviews), followed by "UNNES" which mentioned 56 times (3.36%), "TPST" (34 or 2.04%), garbage (33 or 1.98%) and Bangvasi (23 or 1.38%). It implies that by putting aside the words "waste" and "UNNES" which are the main topics of conversation, TPST UNNES and Bangvasi are considered as the main actors related to waste management at UNNES, especially to set "programs" (22 times or 1.32%) for managing garbage.

Figure 2. Word Cloud of Waste Management Interviews

Source: NVivo Output (2023)

Figure 3 shows the cluster analysis of word mentioned during interviews.

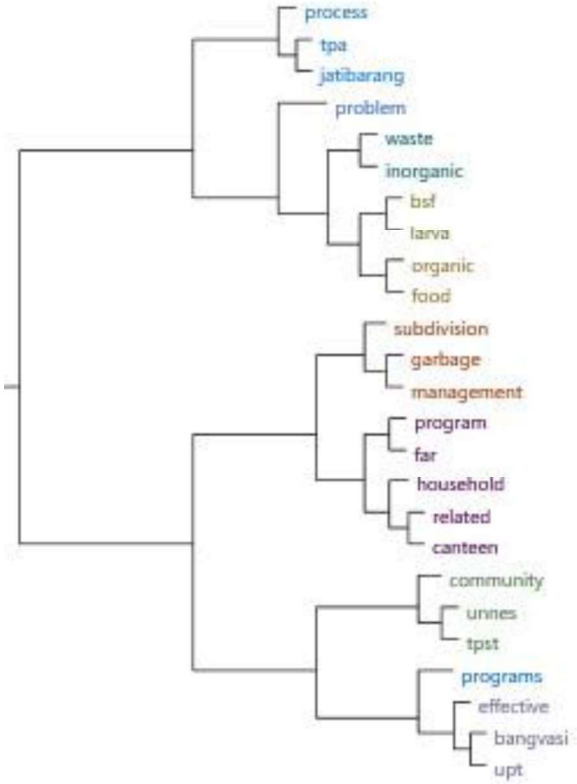

Figure 3. Word Cloud of Waste Management Interviews

Source: NVivo Output (2023)

The two main clusters talk about the wrong process of waste management (organic and inorganic waste) has become the main problem in the city final landfill (TPA Jatibarang) and the other cluster focuses more in UNNES waste management program. Furthermore, in the first cluster about TPA Jatibarang, the interview results revealed that they tried to develop an education program for citizens about organic waste management by cultivation Black Soldier Fly (BSF) larvae which has economic value to be traded as animal feed. Meanwhile, the waste management in UNNES is handled by TPST UNNES collaborating with UPT Bangvasi and Household Sub-division. BSF larvae cultivation is also implemented in TPST UNNES as a strategy to recover food waste energy into new energy, while other organic waste such as leaves and grass are processed into organic fertilizer. The food waste is collected from campus canteens and sorted by janitors before distributed to TPST UNNES. UPT Bangvasi claimed that the waste management program has been effective enough to handle campus' waste so far. However, when it comes to student community, they also admitted that there is a problem with sustainability and durability of typical student community concerning in conservation.

The discussion about youth community for supporting waste management campaign in university was led to some important points mentioned by the key persons during the interviews. The theme "community" itself was analyzed using text search query and produced some structured concepts shown in Figure 4.

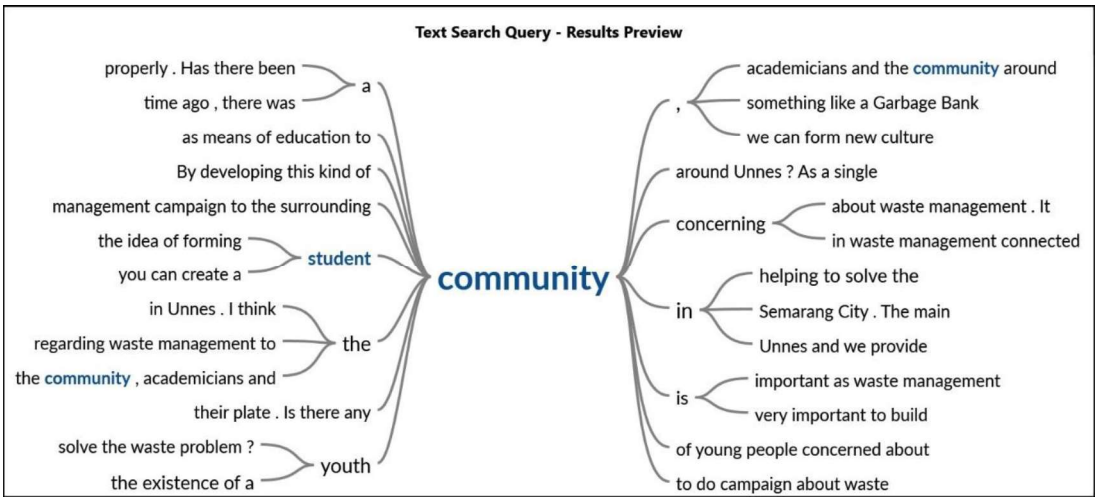

Figure 4. Text Search Query for Community Theme

Basically, all the key persons interviewed reacted positively about an idea to form a youth community concerning in waste management campaign. According to them, the following are some things that need to be considered if students want to create a waste-aware youth community: (1) representation; (2) program durability; and (3) sustainability. Representation was proposed by TPST considering there are many faculties in the university so each of it need its representative to make sure the waste management education can reach all students, lecturers, and canteen sellers in all faculties on campus. Program durability was suggested by Household Sub-Division as they experienced typical communities set short-term programs which do not have a solid management to achieve long-term goals. The implementation of this long-term program is important

because it takes a long time to change the culture, for example a culture for sorting waste, mindful eating, zero plate waste, etc. Meanwhile, sustainability was emphasized by UPT Bangvasi regarding the fact that some community just vanished simply when the founder graduated from university. The youth community in the university needs to make sure that the system they have can be run by all members of the community so that if there is a change in members this will not affect significantly to community activities.

Discussion

The interviews revealed that basically the university waste management units have implemented zero waste policy consistently by arranging university waste independently without sending them to the city landfills. However, this program run at institutional level by hiring people who professionally and specifically manage the waste. University should not forget its function to provide the waste management education for their students. The fact that students in conservatory university which has a particular and mandatory common course related to conservation knowledge named “Pendidikan Lingkungan Hidup” or “Environmental Education” in the first semester still have low awareness in managing their waste becomes evidence that incorporating environmental issues into the curriculum in the form of courses does not necessarily increase environmental awareness around students. Meanwhile, Kurniawan & Santoso (2020) found that more participation from the creative community is needed to overcome this waste processing problem, especially food waste.

Based on the interviews with university parties, student community might be needed to support the environmental education inside the class by providing more real action outside the class. Creating a community concerning in waste awareness and waste management among university students is not easy. Holdsworth & Quinn (2012) stated that there is always a possibility that students from different backgrounds may not have the sense of belonging or inclusiveness towards the community. This study in line with the finding of environmental self-identity variable that students are tend to create a positive image of themselves, in this case is to tell others that they care enough about environmental issues, even though in the reality they have not participated actively in protecting the environment.

Student community heavily depends on volunteers. Therefore, to build a strong student community it is important to treat the volunteers based on their motivation joining community. Clary et al. (1998) formulated a set of six essential motives of volunteers and developed the Volunteer Function Inventory (VFI) which consists of six motivational functions that volunteering may serve: (a) values, communicating values that are personally important; (b) understanding, learning about the world, developing skills; (c) social, strengthening one’s social relationships, being concerned about social rewards; (d) enhancement, growing psychologically; (e) career, gaining career-relevant experience; and (f) protective, addressing personal problems, reducing negative feelings.in order to get deal with sustainability issue, it is recommended that in recruiting volunteers, the committee should first identify their motivation in registering for the community program and assign them tasks that will enable them to achieve their goals.

In terms of community programs, there are studies suggested many programs to manage the waste designed specifically for students. For instance, in order to reduce canteen's plate waste, several studies have proposed various alternative interventions that can be carried out, such as: provision of food tasting spoons in the canteen (Cardwell et al., 2019; Malefors et al., 2022); doing campaign about plate waste (Visschers et al., 2020); plate tracker installation, forecasting canteen visitors (Malefors et al., 2022); changes in food serving infrastructure (Berkowitz et al., 2016; Lorenz et al., 2017; Thiagarajah & Getty, 2013; Vermote et al., 2018); and even providing incentives to consumers (Priefer et al., 2016). All those activities could be handled by student community by spreading volunteers in the campus canteen. In addition, volunteers could also be educated to transform food waste into products such as fertilizer (Kurniawan & Santoso, 2020; Loan et al., 2019) and BSF larvae (Fowles & Nansen, 2020; Ojha et al., 2020).

Other than the discussed aspects (representation; program durability; and sustainability), the future student community should also consider the role of social media in carrying out waste awareness campaigns. (Scholtz et al., 2016) found that the social media campaign had numerous positive benefits for promoting environmental awareness in South African HEIs. Social media can be utilized in online advocacy such as the Greenpeace Mediterranean food campaign which has had significant success in its short time in Turkey (Özdemir, 2012). The study of Haenlein et al. (2020) revealed that Instagram and TikTok are the most prominent social media recently because they have the youngest user bases. The implication is that these two social media users are very vulnerable to all forms of online communications, including online campaign about environmental awareness. The student community could manage their social media as one of the tools for campaigning, recruiting members, and informing their future agendas to public.

Conclusion

The fact that there is a gap between university programs and students' knowledge and skills in terms of waste management raises awareness to bridge this gap by grounding knowledge about the environment to be more than just in the form of formal courses. A student community is needed to increase the environmental awareness, knowledge and skills of students. However, building a community needs extra time and efforts. Therefore, university should plan some strategies to make sure the student community could be representative, durable, and sustainable. The strategies are including food waste campaigns in faculty canteens, several workshops, voluntary activities, and online campaigns using social media. By building the student community, the university gets the better chance to promote sustainability and environmental awareness outside the classroom in the more relatable and interesting way for students. The future study is planned to identify the students' motivation joining this community and how social media engagement support community agendas.

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