

Solid Waste: Preliminary Study on Benefits of Engaging Students in Research Project using Citizen Science

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Abstract— Solid waste, one of the main environmental concerns contributes to various health and other environmental problems. The awareness of solid waste issues is the prerequisite in attitude changes toward the reduction and management of waste. By using the citizen science approach, with some modification, students who involved in designated project had been expected to develop a sense of responsibility towards their waste. Students are required to do interviews, then calculated the amount of waste generated on the campus and identified recyclable and non-recyclable items. The data collected had shown that the main contributor to solid waste on the campus was food waste and followed by paper, plastics, aluminium cans and glass whereas the number of recyclable items was 62.5%. The interview data showed the lack of awareness and knowledge among the campus community in regard to the waste issues. However, the students have gained benefits by doing the project because they were the one who collected the wastes and interviewed the respondents. It also revealed that students got many potential and interesting ideas regarding the waste issue if they were given the opportunities.

Index Terms: Solid waste, awareness, citizen science, university student, campus

I. INTRODUCTION

The environmental problem is one of the crucial concerns which happened globally in the post-modern world. As long as humans inhabit the earth, there will always be environmental concerns. Among the main environmental issues that keep on happening are global warming, solid waste, water pollution, and biodiversity loss as well as air pollution. Solid waste is a serious environmental issue because there are numerous environmental problems that will arise from the ineffective solid waste management. One of the

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examples is the water pollution due to the remnants of solid waste if it was not being contained properly. Solid waste can be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economic, engineering, conservation aesthetic and other environmental considerations, that also responsive to public attitudes. There is no doubt that solid waste is related to the cleanliness and hygiene issue because the scenery of overloaded bins and uncollected trash in waste bins resulted in not just foul aroma, but insightful too (Desa, Kadir & Yusoooff, 2011).

One of the ways to tackle environmental problems and issues is through education. Environmental education can have a significant influence on the environmental awareness, everyday lifestyles and consumer behaviour of students. One of the ways to make the student gain all the benefits while still enjoying the learning process is by incorporating citizen science. The term 'citizen science' has many interpretations. It can be defined as the practice of engaging the public in a scientific project that can be used by many stakeholders (McKinley, Miller-Rushing, Ballard, Bonney, Brown, Cook-Patton & Soukup (2017). Citizen science is symbiosis interaction between volunteers and researcher which can provide public education and engagement. Interactive research-based models of education can prominently improve the student's performance while achieving the objectives of the research.

Students in higher education play important roles in shaping the future nation. Since they are the backbone of the country and the hope for the future, they need to be trained with the adequate environmental knowledge, so that they will be able to foster the awareness towards the environment. Estrada-Vidal and Tójar-Hurtado (2017) stated that sustainable education is related to environmental health concern because, without sustainability, the world will face various risks such as transmission of diseases and pollution. Human actions might cause impacts on the environment that will affect the human back directly or indirectly. The fundamental elements of the environment are the resources such as water, air, minerals and soils. The main concern of environment arises caused by human and it can affect another part of the environment because the reality is as long as there are humans, there will be wastes.

All of the planning for systematic waste management is not going to be effective if the generation of waste keeps on increasing from year to year. The possibility to control the generation of waste is still considered as a noteworthy topic in

research because of the increase in the population. That is why the need to instill awareness among the university students is very crucial and one way to do this is through implementing the citizen science approach. Citizen science has been applied to a number of areas in environmental management such as water (Jollymore, Haines, Satterfield & Johnson, 2017), conservation (Gray, Jordan, Crall, Newman, Hmelo-Silver, Huang & Singer (2017) and coral reef restoration (Hesley, Burdeno, Drury, Schopmeyer & Lirman, 2017). One of the most beneficial aspects of citizen science is its ability to provide the public involved in the project with practical and real-life opportunities to learn and implement the methods to solve problems that they faced in their communities. In applying this approach to the university students, they can also practice what they have learned in class to the real-life situation.

II. METHODOLOGY

The location of the study is one of the universities located off the coast of the state of Sabah in East Malaysia. Students involved are the first-year students who are currently taking one of university course related to the environment. The name of the project is ‘*Waste Not, Want Not*’ and it started by introducing the students to the basic of waste management. The current situation regarding the amount of waste generated from each state of Malaysia was discussed in class. From this activity, students can foster the knowledge and awareness by themselves. Then, the students had been divided into 20 groups with five or six members per group. Instructions, guidelines and expectation are being explained so that the students will be able to achieve the objective intended for their project.

There are two main activities that they need to complete in this particular project where they need to find out the amount of waste generated and its composition in percentage. Besides, they need to segregate the waste and identify the recyclable and non-recyclable items. For this activity, students are advised to be careful with sharp objects and any dangerous items. The name of the first activity is “*Feed the Bin!*”.

In the second activities which known as, “*Do You Care?*” where the students need to interview other students, staff and cleaning workers on the campus. The interview questions had been discussed and agreed by all the groups involved in the project. All the 20 groups had six same questions and another two additional questions which vary from each group for the interview. Throughout this activity, the groups have been encouraged to come out with any additional questions to determine the knowledge and the awareness of their respondents.

III. MATH

Students presented their project findings by writing the outcomes in their group blog and had explained it to the researcher. The outcome of their study based on the activities will also result in the benefits that they have gained

throughout the activities which can be explicated as follows:

a. Activity 1: Composition of Solid Waste – Feed The Bin!

In this activity, students had been distributed to several places on the campus to identify the amount of waste that had been produced from different sources. They needed to find the composition of each type of waste and its percentage. Their findings of this activity are as shown in Table 1.

Table 1: Waste Composition

Waste Component	Composition (Percentage)
Food Waste	41%
Paper	27%
Plastics	19%
Aluminum Can	8%
Glass	5%

The findings are in accordance with several studies that had been done on different campus. Plastic, papers and metals, for instance, are the type of waste found in a study in one of the universities in Mexico. (Armijo de Vega, Ojeda Benítez & Ramírez Barreto, 2008). Another study from one of the universities in Nigeria by Adeniran, Nubi, & Adelopo (2017) also indicated that plastic, paper, organic matters and metal are among of the composition of solid waste in the university. According to Tchobanoglous, Theisen & Vigil (1993), types of waste that commonly existed in institutional (including schools, university and government centre) are paper, cardboard, plastics, wood, food waste, glass, metals and hazardous waste.

Then, the students separated the waste into recyclable and non-recyclable items. The most recyclable items that they found are papers and aluminium cans. All items had been brought to the recycle bin facilities. The percentage of recyclable items is 62.5%, while the remainder of the waste which is non-recyclable items or a portion of the waste can be composted. Since there is no specific compost bin, students brought the remainder to the mix trash bin.

When queried by the researcher, the students have realised that they also threw away the rubbish according to their convenience and did not know that there are many recyclable items that can be discovered from a pile of rubbish. Many of them also stated that in the future they will appreciate food and will only buy what they need and finish the food since food waste constitutes the highest amount of waste percentage. There are also several suggestions to create a place to make compost from the food waste and gain money from the recyclable items.

b. Activity 2: Knowledge and Awareness – ‘Do You Care?’



Students involved in this project have contributed interview data with 60 students, 20 staffs and five cleaning workers. The students had shown little knowledge about the locations of the recycle bins. Some of them only know one location of the recycle bins and surprisingly, there are students that did not realise the existence of recycling bins on the campus. Majority of the staffs and cleaning workers knew at least one location of the recycling bins. However, when being queried regarding the frequency of the recycling bins usage, most of them stated that they rarely use them. They indicated that it is more convenient to throw all the rubbish in one trash bin rather than separating them accordingly to the type of waste. There is no doubt that solid waste is one of the significant environmental issues that need to be concerned by everyone in the community.

When queried about whether the waste is a problem on the campus, most students agreed that waste is not a problem on the campus. Among the reason is, they rarely saw rubbish lying around the campus even after the big event being held on campus. It was contradicting with staff and cleaning worker's views. All of the cleaners stated that waste is a big issue on the campus because there is a high amount of waste generated by the user every day. According to them, sometimes, the students did not care about the rubbish that was lying in front of them because they had the perception that the cleaners will manage all the rubbish because they are paid to do so. Half of the staffs also thought that waste is not part of the environmental problem in the administration area. However, it was a different story in another part of the campus such as in the cafeteria, lecture hall and residence of the student.

Most of the respondents did not know the location of the landfill and did not understand the meaning of e-waste. This is quite disappointing and shocking because most of them are often dealing with e-waste. The improper managing of e-waste can lead to various bad consequences to the human health and at the same time, it will affect the environment negatively. The society needs to be educated on the information regarding E-waste because it contains a lot of toxic and can be considered as hazardous waste. Therefore, further research needs to be done in e-waste awareness among the campus community.

The students mentioned that once they had completed the activity, they realised the existence of several recycling facilities that have been provided on the campus; even so, without the awareness to do recycling, the recycle bins are impractical. In the process of completing their task for the activity, the students who had been interviewing the respondents also feel a little bit embarrassed because many of them did not know the location of recycling bins, the location of the landfill and the type of waste that can be categorised as e-waste. Hence, they are willing to do another research regarding e-waste in the future. While interviewing the cleaning workers, they started to feel sympathise because many of them did not consider waste as a problem, despite the fact that they are the one who generates the wastes every day. It can be proven that citizen science able to stimulate the students in developing the awareness towards environmental issue specifically in the case of waste issue.

c. Advantages of using citizen science

Waste Awareness

Most of the students agreed that this project has increased their awareness towards waste. The practice of a good waste management needs to start from the awareness and knowledge of people. Student's engagement in citizen science can foster youth, in this case, the students in current conservation actions, and build their capacity for future conservation actions (Ballard, Dixon & Harris, 2017). Most of the students also learned that managing the waste is not a one-man's task which they realized when they had interviewed the cleaner. They also discover that it is easy to separate and recycle the waste since there are recycle bins located in the main administration building as well as at the residence of the students.

Soft Skills Development

Since it is the first time those students had been given the duty to take data on their own, most of the students mentioned that they were excited and at the same time also scared because they had been told that every data will be very important to the future campus sustainability effort. The trust that had been nurtured inside students can be reflected on how they manage to complete the project. The preliminary discussion had been done to make sure the projects can be successfully completed in a designated duration of time. One of the skills that they need to utilise in this project is to properly approach the respondent for the interviews. From the projects, they able to improve or increase their communication skills and their project management skills.

Students' Suggestion

Based on the activity, students agreed that knowledge is needed to make people care about the environment. One of the suggestions is to have a formal or an informal course on waste. The existing course is only a 2 credit hour course that covers very broad aspects of environmental issues. One of the examples of waste education is a course of recycling at the College of Engineering at Wichita State University, which was taught in spring 2008 and 2010. The course focused on the basic characterisation and separation techniques of recyclable materials, recycled products, environmental concerns, and potential commercial applications. From the course, students became more aware that without recycling, waste materials would be corroded or degraded and be completely destroyed by nature, which would be a waste of resources and caused environmental damage (Asmatulu & Asmatulu, 2011).

Another suggestion is to create an environmental club on the campus in order to attract students who want to volunteer in any environmental project. In researcher's point of view, this is a good suggestion since the volunteers can help in nurturing awareness to the community on the campus and organizing the environmental campaigns for the local people. The list of suggested environmental activities that can

be done shows that the student's awareness of the environmental issue has increased. This project has instigated student's mindset to be a responsible citizen towards the environment, especially regarding the waste issue.

IV. CONCLUSION

University students play an important role in ensuring the well-being of the environment in the future because they are the leaders of tomorrow. An environmentally conscious student can make a good decision to ensure that every element of the environment is being taken care of. Thus, it is crucial and essential to nurture the right attitudes on how to manage the environment in them. One of the environmental concern that always becomes the main topic is waste management. Although there are many campaigns that had been organised by the government to increase people's awareness, the efforts seemed to be not effective enough to increase the involvement of the society in resolving the waste problem. One of the causes that had been identified is they did not realize that waste is a concerning issue due to the fact that there are certain organisations that will specifically manage the waste in every state. The generation of waste keep on increasing from year to year and this is a worrying situation for the future generation. That is why university as an establish education centre need to train students to be responsible towards waste. The campus sustainability is not a new concept since universities can reflect a small city that can become an ideal setting for exploring and practising the sustainability (Lauder, Sari, Suwartha & Tjahjono, 2015). University environment, as well as the student's engagement by means of citizen science, can create awareness among the students. Students will be empowered by giving them the opportunity to be involved in research related to waste. The benefits of the citizen science are beyond the expected outcomes which refer to the attainment of the waste composition data and awareness. The students realised that the waste can become a larger problem due to students' negative attitude. All this while, have the management part of the waste may have been tackled but it still cannot foster and develop the environmental responsibility among the society. The project has proven that by involving the students in citizen science, the pro-environmental behaviours can be cultivated among the leaders of tomorrow.

REFERENCES

- [1] Adeniran, A.E., Nubi, A. T., & Adelopo, A. O. (2017). Solid waste generation and characterization in the University of Lagos for a sustainable waste management. *Waste Management*, 67, 3–10. <https://doi.org/10.1016/j.wasman.2017.05.002>.
- [2] Armijo de Vega, C., Ojeda Benítez, S., & Ramírez Barreto, M.E. (2008). Solid waste characterization and recycling potential for a university campus. *Waste Management (New York, N.Y.)*, 28 Suppl 1, S21-6. <https://doi.org/10.1016/j.wasman.2008.03.022>.
- [3] Asmatulu, R., & Asmatulu, E. (2011). Importance of recycling education: A curriculum development at WSU. *Journal of Material Cycles and Waste Management*, 13(2), 131–138. <https://doi.org/10.1007/s10163-011-0002-4>.
- [4] B. Smith, "An approach to graphs of linear forms (Unpublished work style)," unpublished.
- [5] Ballard, H.L., Dixon, C.G H., & Harris, E.M. (2017). Youth-focused citizen science: Examining the role of environmental science learning and agency for conservation. *Biological Conservation*, 208, 65–75. <https://doi.org/10.1016/j.biocon.2016.05.024>.
- [6] Desa, A., Kadir, N.B.A., & Yusoff, F. (2011). A Study on the Knowledge, Attitudes, Awareness Status and Behaviour Concerning Solid Waste Management. *Procedia - Social and Behavioral Sciences*, 18, 643–648.
- [7] Estrada-Vidal, L.I., & Tójar-Hurtado, J.C. (2017). College Student Knowledge and Attitudes Related to Sustainability Education and Environmental Health. *Procedia - Social and Behavioral Sciences*, 237(June 2016), 386–392.
- [8] Gray, S., Jordan, R., Crall, A. , Newman, G., Hmelo-Silver, C., Huang, J., & Singer, A. (2017). Combining participatory modelling and citizen science to support volunteer conservation action. *Biological Conservation*, 208, 76–86. <https://doi.org/10.1016/j.biocon.2016.07.037>
- [9] Hesley, D., Burdeno, D., Drury, C., Schopmeyer, S., & Lirman, D. (2017). Citizen science benefits coral reef restoration activities. *Journal for Nature Conservation*, 40(September), 94–99. <https://doi.org/10.1016/j.jnc.2017.09.001>.
- [10] Jollymore, A., Haines, M. J., Satterfield, T., & Johnson, M. S. (2017). Citizen science for water quality monitoring: Data implications of citizen perspectives. *Journal of Environmental Management*, 200, 456–467.
- [11] Lauder, A., Sari, R.F., Suwartha, N., & Tjahjono, G. (2015). Critical review of a global campus sustainability ranking: GreenMetric. *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2015.02.080>
- [12] McKinley, D.C., Miller-Rushing, A.J., Ballard, H.L., Bonney, R., Brown, H., Cook-Patton, S.C., & Soukup, M.A. (2017). Citizen science can improve conservation science, natural resource management, and environmental protection. *Biological Conservation*, 208, 15–28. <https://doi.org/10.1016/j.biocon.2016.05.015>
- [13] Tchobanoglous, G., Theisen, H., & Vigil, S. (1993). *Integrated Solid Waste Management: Engineering Principles and Management issues*, McGraw-Hill, New York.

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