

Food Waste Issue for Enriching Biology Topic: A Case Study at Adiwiyata School

Putri Setioningrum^{1*}, Agung Wijaya Subiantoro¹

¹Dept. of Biology Education, Faculty of Mathematics and Natural Science, Universitas Negeri Yogyakarta, DI Yogyakarta, Indonesia.

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Corresponding Author:

Putri Setioningrum

putrisetioningrum.2021@student.uny.ac.id

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Abstract: The purposes of this study were to find out students' learning experiences on environmental change topic and teachers' views about the potential utilization of food waste issue for the topic. This was a descriptive research that carried out using case study method. The data were collected using questionnaire as well as interviews and analysed descriptively. The results showed that although students have had good learning experience on the topic, however, the issue of food waste has not been discussed, and this finding is in align with teachers' view. Despite of the issue had not been applied as the main context for the environmental change topic, nevertheless, the teachers strongly suggested that the food waste issue potentially useful to be implemented for the topic. Considerations of the implementation are further discussed in this paper.

Keywords: Adiwiyata school; Biology topic; Case study; Food waste

Introduction

The Adiwiyata school is an award given to schools by the Ministry of Environment and Forestry for schools that have successfully implemented an environmental care and culture movement at school (KLHK, 2019). There are four aspects of assessment criteria in the Adiwiyata School Award, including school policies, curriculum, school activities, and management of school supporting facilities and infrastructure that are environmentally based and environmentally friendly. Through the Adiwiyata program, it potentially improve the cognitive and affective abilities of environmentally oriented students (Nurwidodo et al., 2020). One form of implementing the program is by associating the concept of adiwiyata with learning materials in class (Waqidah et al., 2020).

As the Adiwiyata program focuses on and for environmental oriented activities, it is more likely that the program is strongly relevant to biology teaching and learning. According to the national curriculum, when learning biology, students are required to analyze their conceptual and procedural knowledge, and apply these

skills to solve contextual problems (Azizah & Alberida, 2021). Specifically, biology is important and needed to understand, manage and resolve the challenges about natural resources problems as well as environmental issues faced by society in the 21st century. Biology is one of subjects that are related to students in their everyday life (Setiawan et al., 2023).

Based on the 2013 curriculum, the topic of environmental problems and change is projected for Grade-10 with the main objectives are mentioned as the Basic Competency 3.11 and 4.11 (Permendikbud, 2018). Meanwhile, in the newest curriculum namely *Kurikulum Merdeka* (Indonesian Ministry of Education, 2022), the topic is stated as the part of Phase E learning objective. the implementation of *Kurikulum Merdeka* have greater significance in the learning context, show relevance to everyday life and higher interactivity (Artika & Rosemary, 2023). Despite of its contextuality which may easy to learn, however, the topic of environmental problems and change has a very broad scope and is generally taught as common perspectives and lack of contextual-related discourse (Wazni & Fatmawati, 2023).

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Learning biology is not only about memorizing the knowledge, but also requires a deep understanding (Syamsurizal et al., 2021). To achieve learning objectives, it is necessary to present a context that is related to science and makes students more able to interpret the topic being discussed in their daily life (Setianingrum et al., 2023). The presenting the context can be carried out by utilizing local and global events or issues as topics in the subject matter to facilitate and make learning more meaningful (Sayan, 2020). Hence, in line with the characteristics of Adiwiyata schools, teachers are required to enable to design environmentally-oriented learning activities in biology classrooms (Maula et al., 2020). However, this looks really challenging for teachers as it is complicated to find and integrate local or global issues into classroom learning (Aprilianti & Suratsih, 2023).

Students, as the nation's future human resources, are expected to be able to recognize and overcome environmental problems that are real in their surroundings. Learning about current issues has been shown to improve students' attitudes and processing skills (Özalemdar, 2021), and using environmental issues as subject matter in the classroom is key to the science learning process (Yani et al., 2021). The use of biology topic with current issues can also assisting students to understand basics knowledge of biology, develop communication skill, and raise awareness to protect the environment (Azhmoldaeva et al., 2022). In addition, the increasing concern for environmental issues is one of the most obvious phenomena of the last two decades (Marpa, 2020). Therefore, it is important to use current issues in classroom learning to provide real-life examples to students.

Food waste is a problem faced by the world today (UNEP, 2021). According to FAO (2011), food waste is food that can be consumed by humans but is no longer consumed and discarded for certain reasons. Indonesia is claimed to be the second largest FLW (food loss and waste) producing country in the world after Saudi Arabia, which is estimated to waste around 300kg of food per capita (EUI, 2017). Food waste occurs as a result of meals that are not consumed (Muliarta et al., 2023). Food waste is proven to be harmful to the environment and is even one of the main causes of global warming (Khusniyah et al., 2022). Food waste deposited in landfills

tends to degrade faster and produce more methane than other organic waste, and it contributes 8% of emissions by releasing methane and greenhouse gases that are 21 times more damaging than CO₂ (Ng & Sia, 2022). Apart from impacting the environment, food waste also impacts social and economic issues (BAPPENAS, 2021).

Food waste in Indonesia reaches 40.16%, the highest percentage compared to other types of waste (SIPSN, 2022). Moreover, food waste has not received special attention, even though it really potential if better management is carried out (Chaerul & Zatadini, 2020; Afla et al., 2023). Thus, the phenomenon of food waste is an example of a problem that is very relevant to be studied in biology class on environmental change topic. However, the utilization of food waste as learning discourse has not known very well.

To understand the functionality of food waste issue in biology teaching and learning, this research was carried out by descriptively investigate Adiwiyata school teachers' and students' experience. The research questions led this research were: how is biology teachers views about the issue of food waste for biology teaching and learning on the topic of environmental change? And how is students' learning experience on environmental change topic in the context of food waste?

Method

This research is descriptive qualitative with case study method that is to collect data, present information, and describe the current situation in the field regarding biology learning in the environmental change topic. Case study method is aimed at a detail description of the existing phenomena (Creswell & Creswell, 2018). On this occasion, this research conducted by questionnaires for student and interview with biology teacher. The questionnaires focused on 5 aspects, namely: learning process, media and teaching material usage, learning output, food waste as a topic, and school facilities. This research was conducted from February to March 2023. The subjects of this research were 3 teachers and 91 students of class XI who were randomly selected and had studied environmental topic at one of Adiwiyata public senior high schools in Yogyakarta district. The research procedure is briefly illustrated by Figure 1.

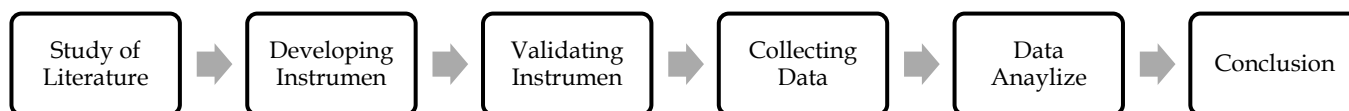


Figure 1. Research procedure

The instruments used to collect data about biology learning in the environmental material. It used Likert scales totally agree, agree, disagree and totally disagree. The instrument validity was validated through expert judgment, then proven through construct validity and reliability. This study is to calculate the validity and reliability of items using SPSS. The data obtained from the questionnaire were analyzed using a percentage formula as can be seen below (Sugiyono, 2018).

$$P = F/N \tag{1}$$

P : Percentage score
 F : Student's frequency
 N: Total students

Result and Discussion

Based on the collection and analysis of data obtained from research that has been carried out by distributing questionnaires to students and conducting interviews with biology teachers, based on the results of the questionnaire, five aspects can be identified: learning process, media and material usage, learning output, food waste as a topic, and school facilities.

The first aspect is the learning process. This aspect is used to get information from students about their enthusiasm, activeness, obstacles, and difficulties in participating in learning environmental change material. The analysis from this aspect result can be seen in Figure 2.

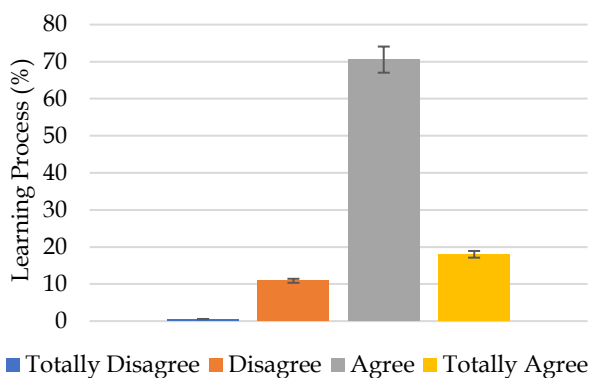


Figure 2. The results of the analysis of aspects of the learning process

The learning process aspect is used to get information from the student about the learning environment for environmental change material. The aspect of the learning process showed that 88% (71% agreed and 17% totally agreed) of the students were happy, enthusiastic, played an active role, and had no obstacles or difficulties in the learning process of

changing the environment in the classroom. However, there were still 12% (11% disagree and 1% totally disagree) of students who were not enthusiastic, did not play an active role, and experienced difficulties and obstacles when participating in learning environmental change material. This was reinforced by the results of interviews conducted with biology teachers, who stated that the enthusiasm and activeness of students in the learning process in the classroom depended on the learning model used to teach material about environmental change.

The teacher said, "The enthusiasm and activeness of students depends on the learning model applied, students are more enthusiastic when working on worksheets that contain problems related to environmental change." Besides that, the teacher also said "There are no significant obstacles when teaching environmental change material, but when discussing, there are still some students who are passive ". This is in line with Pradana et al. (2023), who say that during the learning process, the teacher must know the condition of the class; therefore, knowledge is needed to select suitable and appropriate learning methods to increase students' interest in learning.

The second aspect is media and teaching usage to find out learning resources and the utilization of teaching materials used during the process of learning environmental change material. The analysis from this aspect result can be seen in Figure 3.

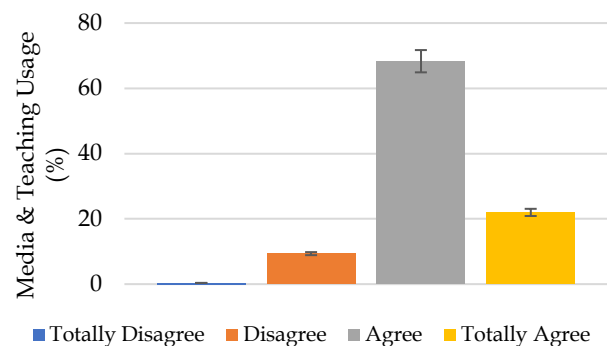


Figure 3. The results of the analysis of aspects of media and teaching usage

The aspect of media and material usage showed that 90% (68% agreed and 22% totally agreed) of students used learning resources other than textbooks and collected information via the internet, including through videos related to environmental change, posters, magazines, and research articles. From these results, it is also shown that the teacher has facilitated students learning by providing a variety of media and teaching materials used in learning environmental change material. This was revealed in the results of the

interview: "Besides using the textbooks provided by the school, I also make my own teaching materials by incorporating current events related to environmental change. Apart from that, I also use sources such as events in daily life, videos about environmental change, and research articles that are relevant to environmental change material".

The teacher also admits that in the process of learning environmental change material, students learn not to share information obtained from social media or the internet on the issue of environmental change. This effort was made by the teacher as a manifestation of the function of biology as a scientific discipline that studies living things and their lives, so in studying biology, an understanding of the problems obtained from contextual problems in the daily lives of students is needed (Hidayanti et al., 2023). The teacher admits that the teaching materials used so far have made students enthusiastic about participating in lessons on environmental change, "I provide material from research articles in the form of PowerPoint texts in which there are videos from YouTube and news from the mass media". The third aspect is learning output. This aspect describes learning outcomes after students learn environmental change material. The analysis from this aspect result can be seen in Figure 4.

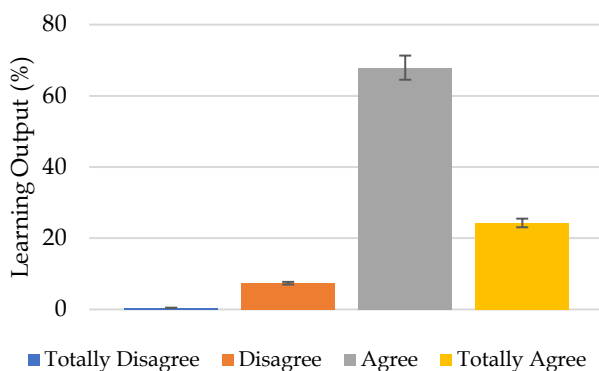


Figure 4. The results of the analysis of aspects of learning output

In the learning output, 95% (68% agree and 24% totally agree) of students admit that they have good learning outcomes, but there are still 5% (4% disagree and 1% totally disagree) who have not been able to solve existing environmental change problems around the school and where they live, have not been able to provide ideas to prevent changes in the environment, and have not understood the causes of environmental changes. This is in accordance with Zamzami et al. (2020) finding that the learning process of each student is certainly different and that individual characteristics are one of the factors that result in differences in student learning outcomes. In achieving learning outcomes, of

course, some of them are successful, but there are also those who experience obstacles or difficulties. The teacher also revealed that "one of the teacher's obstacles in studying environmental change material is that during the evaluation, there are still students who cannot work on analytical questions". The use of analytical questions is in accordance with the demands of the 2013 curriculum.

The curriculum used by the school is the 2013 curriculum, which has been adjusted by inserting reinforcement of environmental management efforts in accordance with the characteristics of the Adiwiyata program. This is in accordance with the results of interviews conducted with teachers, who indicated that one form of effort to implement the Adiwiyata program is to rancangan pelaksanaan pembelajaran (RPP) by utilizing the environment as a form of protection and management of the environment into learning materials. According to the results of the interview, the teacher's efforts are to build students' awareness during the learning process by providing information on how to manage waste, selecting waste, and reducing plastic waste by bringing their own food containers or drinking bottles.

Biology teachers also admit that biology lessons are closely related to the adiwiyata program: "With the adiwiyata predicate, one of my efforts is to instill awareness in students to reduce waste and provide knowledge to separate waste by the type. Although until now There are still students who don't do these", biology teachers do not experience too much difficulty in connecting adiwiyata into the learning process in the classroom. Biology teachers also revealed that "awareness of environmental sustainability owned by students may only be 75%; teachers can only see the behavior of students at school and are limited to the demands of the subject matter". In contrast to other subjects, teachers have difficulty linking lessons with the environment because it is not related to the lessons taught (Aprilianti & Suratsih, 2023). The Adiwiyata program is one of the concrete forms of implementing environmental education in formal education (Larashati et al., 2022). Providing information in order to build awareness among students is a form of effort to preserve the environment by making schools an example (Safrizal et al., 2022).

The next aspect is food waste as a topic. This aspect aims to explore students' knowledge of the issue of food waste and the teacher's opinion on the use of the issue of food waste as a topic in biology learning materials for environmental change. The analysis from this aspect result can be seen in Figure 5.

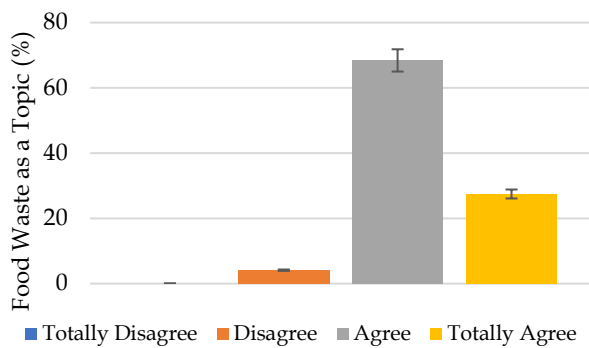


Figure 5. The results of the analysis of aspects of food waste as a topic

The results of the analysis of this aspect show that 96% (68% agree and 28% totally agree) of learners also agree that the use of food waste issues can be studied and is more interesting if studied because it is an environmental problem that comes from everyday life and is also an environmental problem related to social aspects. Food waste is a problem facing the world today. Food waste that burdens the waste management system is a major contributor to the crises that are happening on earth. These crises are climate change, biodiversity loss, pollution, and waste (UNEP, 2021). Based on the results of interviews with the biology teacher, the teacher admits that they know about the issue of food waste and believes that the issue of food waste can be used in material on environmental change. 2 of the 3 teachers admitted that they had never taught the issue of food waste in environmental change material. "I agree with the idea of using the issue of food waste as a topic in learning environmental change material. In my opinion, the issue of food waste is interesting because it is close to the students' daily activities and can be studied scientifically and socially. The hope is to increase students' knowledge and critical thinking skills".

Teachers who have conducted learning on the issue of food waste admit that they have just introduced food waste as an example of a problem that exists in the environment around students, "I use the issue of food waste as a real example of pollution because food waste is a form of pollution, so that it can be discussed in learning environmental change material. Therefore, it is possible if food waste is used as a topic in learning biology material on environmental change". The use of food waste as a context for learning is in accordance with the goals of sustainable development, which requires problem solving on a local and global scale (Bilianska & Yaroshenko, 2020). Food waste as a context is also in accordance with the learning outcomes in phase E, namely that students have the ability to solve problems and provide solutions to problems originating from local, national, and global issues related to

environmental change (Indonesian Ministry of Education, 2022).

Food waste is one of the global problems that leads to environmental disruption. Food waste stems from people buying too much food, not storing food properly, and a lack of knowledge about waste management (Ilyuk, 2018). Wasting food also means wasting water, energy, land, and money, which will ultimately impact the environment (Seberini, 2020). The accumulation of food waste causes decomposition, which produces methane gas that is harmful to the atmosphere. Methane gas is a toxic greenhouse gas that is 21 times more damaging than CO₂ (EUI, 2017). In addition, food waste tends to degrade faster and produce more methane gas than other organic waste, which globally accounts for 8% of total greenhouse gas emissions (Ng & Sia, 2022). Food waste is proven to be very harmful to the environment and even one of the main causes of global warming (Susilo et al., 2021).

Through learning biology, it is expected that students can overcome and provide solutions related to food waste problems that currently occur locally, nationally, and even globally. In addition to being an example of a contextual problem, food waste has a science study that is very relevant to environmental change material, so it is possible to use food waste as a context in learning biology on environmental change material. Based on the questionnaire results, 64% of teachers have never used food waste as a context for learning in the classroom. The results of interviews also show that teachers who have claimed to have used food waste are only limited to examples and have not been used as a whole learning context. Education about food waste in schools is expected to be one of the efforts to reduce food waste and make students aware of their role as social beings to pay more attention to the environment and other impacts, such as economic and social, that might occur. The last aspect is school facilities. This aspect aims to find out whether school facilities support the learning of environmental change materials. The analysis from this aspect result can be seen in Figure 6.

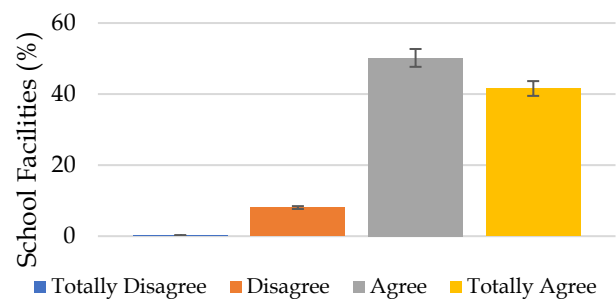


Figure 6. The results of the analysis of aspects of school facilities

The results of the analysis show that the facilities at the school are sufficiently supportive for the learning process using the internet, but there are still classes that are not reached by the wifi network provided by the school. Therefore, there are still 9% of students who cannot use the wifi network at school. The teacher also said that "wifi signals do not reach certain classes, so inevitably students must use personal quotas to access the internet". While the majority of learners have mobile devices (smartphones), teachers have also directed students to look for additional information via the internet in learning activities on environmental change material. The development of teaching materials in digital form is important (Ichsan et al., 2021). Topics that can be developed are topics related to environmental change, such as the phenomenon of food waste, because they are close to the lives of students.

Conclusion

The findings of this research study revealed that both biology teachers and students of an Adiwiyata school strongly agree that the issue of food waste is likely interesting as well as potentially useful for biology teaching and learning on the topic of environmental issue. However, there was a lack of experiences perceived by students on learning about environmental issue with supported by the issue of food waste.

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Author Contributions

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Conflict of Interest

There is no conflict of interest in this research.

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