



# How is Student's Awareness to Support Zero Food Waste for Sustainable Food System?

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**Abstract.** Food waste is a primary concern worldwide, accounting for almost a third of the total food produced is wasted [1]. Discarded food fills landfills and creates a massive waste of energy and a threatening source of methane gas. This study aims to see students' awareness of supporting zero food waste for high school students in biology subject matter of environmental change. The research method used was descriptive qualitative, with a total sample of 72 students. Furthermore, using instrument questioners, the total of statements is 45 with five answer choices: strongly agree, agree, neutral, disagree, and strongly disagree. This instrument is included three indicators, namely conceptual knowledge, attitudes, and willingness to participate, each with 15 statement items for each indicator. Consisting of 2 classes, class A has studied environmental change material, and class B has yet to study environmental change material. Based on the results of the analysis, their level of awareness regarding the issue of food waste is the same. And it was found that students' awareness of food waste still needed to be improved. Most teenagers have no clue about this issue. They do not know how their eating behaviour can significantly impact the environment. Therefore, they need to increase their awareness of their eating behaviours because teenage students tend to be the biggest contributor to produce food waste since they have more choices in their food than other ages.

**Keywords:** Awareness, Biology Education, Students, Sustainable Development Goals, Zero Food Waste

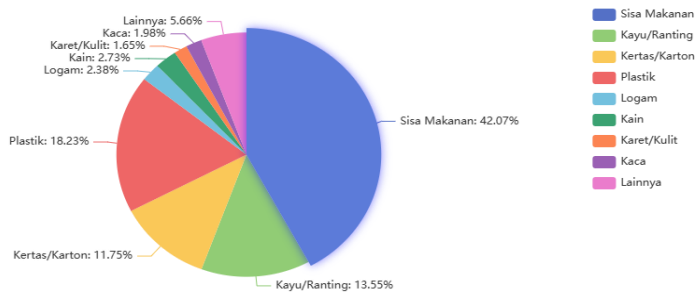
## Introduction

The Food and Agriculture Organization of the United Nations [1], released data estimating the number of losses resulting from food waste on a global scale. It is estimated that the resulting losses are 1.3 billion tons per year, paid out to around \$ 1 Trillion. Food waste has become a global and complex problem. This problem affects the environment, the economy, and society [2]. Wasting food means wasting the valuable resource used to produce it [3]. The results of a study from the team formed by BAPPENAS [4] stated that Indonesia's food loss and food waste reached 184 kg per person per year, or a total of 48 million ton per a year. Based on data from Ministry [5], the highest waste composition comes from food waste. The following is a graph along with the percentage of each type of waste composition for 2022 data.

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Indonesian Ministry of Environment [5], stated that food waste was the most common type of waste, namely 39.8 per cent of all types of waste generated by the people of Indonesia. Food consumption patterns are among those that are heavily influenced by one's lifestyle and perspective, so massive socialization is needed to carry out the transformation to achieve responsible food consumption. Food that has become leftovers should be reused before it ends up in the trash. Realizing this goal requires complex, even, and continuous efforts through involvement from various parties. In essence, the two main keys are integrative supply and demand management [6]. Although the agricultural stage has the greatest environmental impact among all stages of the food supply chain, food consumption greatly impacts the environment through energy used, packaging, transportation, and cooking [7]. The estimated carbon footprint of wasted food production per year is 3.3 tons [8].



**Fig. 1.** SIPSN Waste Composition in 2022

The problems caused by these foods are very close of our daily life and familiar to students too. However, it is not usually explicitly studied at school. Most teenagers are unaware of their eating behavior impact on the environment [9]. In addition, compared to younger children, teenage students become larger food waste contributors because they are able to make more choices for their food [10]. And, more information about food systems in this adolescent age group needs to be improved. Children are not the only target of food education in schools, but school leaders and parents must also be involved in food system education [11]. Researchers in Brazil conducted research by looking at how students' habits in implementing sustainable diets, food waste prevention, and implementing a more holistic food system approach. As a result, students had an increase in sustainable awareness because they realized food waste could impact their environmental, economic, and health [12].

Awareness can be interpreted to mean knowledge because if a person has consciousness, then they already have the concept of that knowledge. Nevertheless, knowledge can be unconscious or conscious, so the definition of consciousness can be called experience itself, and consciousness can be made up of everything we can observe [13]. Sustainable awareness refers to awareness of sustainability phenomena, including experience and perception. This sustainable awareness is closely related to environmental awareness in human relationships and behavior [14]. Environmental awareness is a belief system that refers to psychological factors related to the individual's tendency to

engage in pro-environmental behavior. For example, environmental issues, the willingness to make lifestyle changes, such as the importance of environmental awareness for buying and eating organic food [15].

Nowadays, the various problems associated with the global food system are complex and interrelated. Therefore, based on this problem, this study aimed to analyze how high school students' awareness of food waste and eating behaviours can impact the environment.

## 2 Methodology

This research is a type of qualitative descriptive research, which is a method that utilizes qualitative data and is studied descriptively to explore or photograph social situations that will be studied comprehensively. The population of this study were all students of class X SMA N 7 Bandung with an average age of 15 years old. , and the sample consisted of 2 classes with 72 students. Class A has studied environmental change material, and class B has yet to study environmental change material. This sample was determined using a convenience sampling technique, which was used by selecting samples from a part of the closest population. [16]. This technique was chosen to facilitate the implementation of research because it can adapt to the researcher's needs. Based on the results of the analysis, their level of awareness regarding the issue of food waste is the same. Data was taken using a questionnaire developed as an instrument from several study results [17-23].

The awareness instrument consists of 45 questions derived from 3 indicators, and each indicator consists of 3 sub-indicators, so each indicator consists of 15 statements or about five statements per sub-indicator. The first indicator is Knowledge, which consists of sub-indicators: Knowledge of sustainable lifestyles from students about the causes of environmental changes arising from food waste, Knowledge of sustainable lifestyles from students about their impacts and the need for countermeasures and prevention of food waste, and Student responses regarding issues of environmental change caused by food waste generation. The second indicator is Attitudes, consisting of sub-indicators: Students' caring attitude towards environmental change issues around them, especially towards food waste, Students' caring attitude towards managing and processing food waste to reduce environmental change, and Students' caring attitude towards sustainable consumption and production responsibility. Furthermore, the third indicator is for the category of desire to participate consisting of sub-indicators: Frequency of involvement of students hearing various issues or problems of environmental change, especially regarding food waste, Awareness of students to be involved in opinionating on various issues or problems of environmental change, especially regarding the prevention of food waste, and Student awareness related to the desire to participate in environmental change issues, especially regarding food waste management.

This instrument has been tested with validity and reliability values. It has that  $r_{count} > r_{table}$  (0.2423), then the instrument is declared Valid. For reliability, it has Croanbach's Alpha value of  $0.957 > 0.60$ , so the instrument is reliable.

### 3 Result and Discussion

This sustainable awareness data is obtained from the analysis of questionnaires in class A, who have studied environmental change material, and class B, who have not studied environmental change material. The questionnaire contains statements with five answer options: strongly agree, agree, neutral, disagree, and strongly disagree. While in-scale responses provide information about students' level of agreement, disagreement, or neutrality regarding the sentences in each section, the off-scale responses are also important as they indicate that the student did not know how to respond or did not understand the sentence. For any given scale response, it is possible that the student is not entirely sure how to respond and/or did not fully understand the sentence being considered, because we have no way of measuring the level of nuance of such responses and so use a 5 Likert scale.

The scores obtained were tested statistically to be interpreted. The data was converted into scores first to get an average scale 100. From the data obtained, the average must first be calculated. The normality test determines whether the data distribution is normal for both classes. Then, the homogeneity test is used to see if the data is uniform or homogeneous. After that, if it is known that the data is normally distributed and homogeneous, a t-test is carried out to see if there is a significant difference in the data results of the two classes tested at different times [16]. The following are the analysis results of the awareness questionnaire.

**Table 1.** Data from Statistical Analysis of Sustainable Awareness of Sustainable Food Systems

	N	Min	Max	Mean	Std. Dev	Normality	Homo- genity	t
Score Sustainable Awareness Class A	36	58.0	84.0	71.861	6.7450	0.361		
Score Sustainable Awareness Class B	36	54.2	86.9	73.322	6.1250	0.102	0.272	0.339
Valid N (listwise)	72			72,591	6.435		No significant difference	

\*Normality and Homogeneity: (sig) > 0.05

Independent t-test: (sig) < 0.05

This analysis provides information on the percentage of alignment between knowledge, attitudes, emotions, and behaviours needed to increase students of the food waste issue. Based on the results of data analysis in Table 1, it is seen that there is no significant difference between students who have studied environmental change material and those who have yet to study it. And has a homogeneity value (0.272) > sig (0.05) and normality, which is also higher than sig value, which means that the data from this class is normally distributed and homogeneous. This means that classes A and B have equal levels of awareness of FW issues. Although in class A, students have learned about environmental change and are expected to know the impact of their daily behaviour. External factors can also affect the results of the data, such as the situation of students when filling out the questionnaire, the duration required when filling out the

questionnaire, the length of the questionnaire, and other environmental factors [24]. Thus, even though class A has studied environmental change material, the results obtained can be lower than class B because these internal and external factors influence it. However, the reality is that learning about environmental changes in general is not enough to raise their awareness of food waste issues. Only some students were able to realise that the dangers of food waste can have an impact on the environment.

Sustainable Awareness is the concern that students have for their surrounding environment and in respecting nature, which in this study focuses more on their Awareness of the causes, impacts, management of FW, and eating behaviours that can affect the environment. Awareness is an aspect that relies on characteristics and elements unique, to each person. It encompasses factors like ones understanding of their surroundings, personal values, attitudes and emotional engagement [18]. This Awareness Questionnaire consists of 3 main Indicators: knowledge, attitude, and willingness to participate. Following is an explanation of data analysis for each indicator.

### 3.1 Sustainable Awareness in Knowledge of Zero Food Waste

The definition of conceptual knowledge in this context is students' awareness related to their knowledge about the causes, impacts, and responses related to food waste and eating behaviour to environmental changes around them to achieve sustainable development. This indicator consists of 15 statements that have general criteria, such as "knowing the difference between organic and inorganic waste", to specific ones, such as "knowing the impact of food waste that is not managed properly, and knowing the difference between expired date, best before, and use by date on packaging". These 15 statements are further divided into three sub-indicators, as seen in the Table 2.

**Table 2.** Knowledge Categories of Sustainable Food System

Knowledge Category	Item
Knowledge of sustainable lifestyles from students about the causes of environmental changes arising from food waste	1,2,3,7,15
Knowledge of sustainable lifestyles from students about their impacts and the need for countermeasures and prevention of food waste	4,5,9,10,11
Student responses regarding issues of environmental change caused by food waste generation	6,8,12,13,14

From these statements, learners must honestly fill in according to their knowledge by ticking the questionnaire from strongly agree-neutral-strongly disagree. Conceptual knowledge possessed by both classes has no significant difference. The main factor is that students have studied environmental pollution material at the junior high school level. So, the results between the two classes are almost equivalent. The analysis results align with previous research, stating that continuous material within a certain period can provide better results [25]. In this case, they were familiar with environmental change but not with sustainable food systems and food waste issues. Therefore, the

results obtained for several question points that can be seen in the table were very low, and it could have been higher, especially for class A.

**Table 3.** Descriptive Statistics of Knowledge Indicator

Item Statement	Class A		Class B	
	Mean	St. Dev	Mean	Std. Dev
1. All our daily activities have an impact on the environment	3.94	.984	4.11	0.785
2. I know the difference between organic and inorganic waste.	3.89	.785	3.89	0.854
3. Inorganic and organic waste that is not separated will have a severe impact in the future.	3.97	.910	4.14	0.762
4. Not being wasteful in using natural resources is a way to achieve the goal of sustainable development, which is to fulfil the needs of the present without compromising the right to fulfil the needs of future generations.	4.17	.910	3.89	0.887
5. Food waste management measures are a way to maintain food security nationally and globally.	4.03	1.055	3.67	0.756
6. I do not know the difference between food loss and food waste.	3.06	1.170	2.53	1.028
7. Food waste is not dangerous because it decomposes easily	2.61	1.202	2.97	0.845
8. I know what types of food are perishable and what foods are perishable.	3.78	.832	3.72	0.914
9. Food waste can be dangerous because it will become rubbish that produces methane gas.	3.42	1.025	3.50	0.697
10. Food waste that is not managed and just piled up can cause a strong odour and become a source of disease.	4.58	.770	4.56	0.504
11. Food waste is unrelated to the depletion of the ozone layer and environmental change on Earth.	2.42	1.131	3.00	0.756
12. I know the difference between expiry date, best before, and use-by date on food and beverage packaging.	3.89	1.116	3.86	0.762
13. I know the dangers of eating ready-to-eat or junk food	4.19	.786	3.78	0.929
14. I know the importance of eating healthy and nutritious food.	4.56	.695	4.58	0.500
15. Food waste is not only detrimental to the environment but can also lead to economic and social losses	3.53	1.028	4.06	0.754
Overall (level of sustainable awareness for knowledge indicator)	3.74	0.96	3.75	0.78

\*level indicator: Means 1.00-2.33 low; 2.34-3.66 medium; 3.67-5.00 high

Class A (has studied environmental change issue before)

Class B (has yet to study environmental change issue)

**Table 4.** Scale Category [26]

Scale	Category	
1.00	1.80	Very Bad
1.81	2.60	Bad
2.61	3.40	Neither Good Nor Bad

Scale	Category
3.41	4.20
4.21	5.00
	Good
	Very Good

The mean score is obtained from the overall answer of each student, for a maximum score of 5. The score scale consists of five categories, namely very good, good, not good, bad, and very bad (Table 4). Standard deviation is the best measure of dispersion in statistics. It is used to determine the data distribution in a sample and to see how close the data is to the mean value. The standard deviation has smaller values, indicating more homogeneous data. The smaller the resulting standard deviation value, the more homogeneous or uniform the calculated data. This means the data values are within a smaller range and not too far from the average. Conversely, if the resulting standard deviation value is large, this indicates more varied and non-uniform data. Standard deviation values can also be used to compare data between one group and another. If two data groups have the same standard deviation value, both groups have the same level of variability. Conversely, if the standard deviation value of one group is greater than the other, the group with a larger standard deviation value tends to be more varied [27].

Based on Table 3, it can be concluded that statements no. 6, 7, and 11 have low mean scores. Students generally have contrary opinions to these statements, so the results obtained are low. No. 6 is a statement that comes from sub-indicator 3. regarding Student responses regarding issues of change environment caused by the generation of food waste, which gets a mean score of 2.53 in class B with the "Bad" category, while in class A, it gets a better average score of 3.06 with "Neither good nor bad" category, this category scale is adapted from [26]. This means that many students do not know the difference between food loss and food waste. This is the most waste humans often produce. In line with research [28], which states that the food system in the world is starting to worry because of the large amount of food loss and waste. This statement is very ironic because there is a lot of food and they become garbage only while many out there are starving and need food.

No. 7 is a statement from sub-indicator 1, namely knowledge of sustainable lifestyles from students about the causes of environmental changes arising from food waste. Both classes got the "Bad" category because they considered that food waste was not dangerous just because it could be composted easily. Class A obtained a mean value of 2.61, lower than class B, with a mean value 2.97. The class that has studied environmental change (A) considers that food waste is not dangerous and cannot damage the environment compared to other forms of pollution. In line with statement No. 11, sub-indicator 2, regarding "Food waste is unrelated to the depletion of the ozone layer and environmental change on Earth", many class A students agreed with this statement. This is not entirely wrong, but it should be known that food waste piled up without processing can produce methane gas, which is more dangerous than CO<sub>2</sub> and CO, which cause global warming [28].

### 3.2 Sustainable Awareness in Attitude of Food Waste

The definition of attitude in this research is students' attitude in dealing with the problems caused by food waste and their eating behaviour towards environmental changes around them in the context of sustainable consumption and responsible production. This indicator consists of 15 statements that have general criteria, such as "caring about their portion of food", "caring about healthy food", and "caring about food waste produced." These 15 statements are further divided into three sub-indicators, as seen in Table 5.

**Table 5.** Attitude Categories of Sustainable Food System

Attitude Category	Item
Students' caring attitude towards environmental change issues around them, especially towards food waste	16,17,18,20,29
Students' caring attitude towards managing and processing food waste to reduce environmental change	22,23,24,27,28
Students' caring attitude towards sustainable consumption and production responsibility	19,21,25,26,30

**Table 6.** Descriptive Statistics of Attitude Indicator

ItemStatement	Class A		Class B	
	Mean	Std. Dev	Mean	Std. Dev
16. I feel uncomfortable seeing leftover food because it can accumulate into rubbish.	4.06	1.068	4.14	0.723
17. I empathise with children out there who are food insecure and malnourished.	4.19	.980	4.19	0.577
18. I am not bothered by Indonesia's environment, which produces a lot of food waste.	1.56	.735	4.17	0.878
19. I cannot eat all my food in public, let alone in front of my friend.	1.83	1.159	3.83	1.028
20. I am aware of the ongoing consequences of my daily eating behaviour.	3.89	.919	3.47	0.654
21. I am happy to share food with my relatives, neighbours and friends.	4.25	.874	4.17	0.697
22. I think food should end up in my stomach rather than in the bin	4.58	.806	4.19	0.577
23. I do not care about the rubbish in my house, especially kitchen waste and leftover food	1.61	.803	3.89	1.008
24. It's normal to waste food because it is only a tiny amount.	2.00	1.121	3.50	0.845
25. I think throwing food away is wasteful and not good.	4.33	1.195	4.17	1.000
26. I always appreciate and finish the food that has been served to me.	4.36	.833	4.25	0.649
27. I am susceptible to smells and flavours, so when food tastes change, I throw it away.	3.25	1.105	2.81	1.064



ItemStatement	Class A		Class B	
	Mean	Std. Dev	Mean	Std. Dev
28. I am not used to eating vegetables and fruit because I think they taste bad, so if there are vegetables in the food, I will throw them away.	1.78	.989	3.78	0.929
29. I realise that the plate of food on my table has many people contributing to it and has large carbon emissions	3.56	1.157	3.39	0.803
30. I still eat food that looks ugly but has a good flavour because it is still worth eating.	3.69	1.142	3.69	0.920
<b>Overall (level of sustainable awareness for knowledge indicator)</b>	<b>3.26</b>	<b>0.99</b>	<b>3.84</b>	<b>0.82</b>

\*level indicator: Means 1.00-2.33 low; 2.34-3.66 medium; 3.67-5.00 high

The results of the statistical data analysis of the questionnaire for the attitude indicator can be seen in Table 6. Surprisingly, class B got better results compared to class A. In contrast, class B has not studied environmental change, and class A has studied environmental change material. Nevertheless, because the data is distributed normally and homogeneous, it indicates no difference in ability between these two classes. They do have an equal level of awareness. Six statements had low mean scores of three of them in the "Very Bad" category and others for the "Bad" category, with one statement having a "Bad" result in class B and a "Not Good and Not Bad" result for class A in the same number. Four statements (No 23, 24, 27, 28) come from sub-indicator two: Students' caring attitude towards managing and processing food waste to reduce environmental change. This analysis indicates that students still need an attitude to manage and process their food waste. This data analysis shows that many high school students are still picky about food; they tend not to like vegetables or fruit, so they end up just throwing them away. The students also only like it if the food looks attractive. The results of this study are also supported by the results of previous researchers, who stated that changes in consumption patterns in adolescents who tend to consume "popular" foods compared to healthy foods, which have extreme tastes such as too spicy, sweet, and salty, thus shifting the majority of healthy foods to bland tastes [29].

The other statement with a low mean value of 1.56 is in No 18, a sub-indicator of point 1, namely Students' caring attitude towards environmental change issues around them, especially food waste. Students still have a low sense of empathy for the surrounding environment, and they do not really care about the fact that Indonesia is one of the countries that contributes the most food waste. Furthermore, No. 19, with an average score of 1.83, came from sub-indicator 3, namely 3—students' caring attitude towards sustainable consumption and production responsibility. Many factors make students waste their food, especially their lifestyle. As seen in Table 6, many students still agree that they cannot eat all their food in public, especially in front of their friends. Many students are unaware that habits like this can negatively affect the environment, society, and economy. Other researchers also mentioned that raising awareness of sustainable consumption and production responsibility is important because many aspects can be improved with this awareness. Besides the environment, the economic and social will also be better because there is less food waste [30].

### 3.3 Sustainable Awareness in Willingness to Participate of Zero Food Waste

The willingness to participate in this study is related to the desire to behave in food waste management to deal with the problem of environmental change around them in supporting Zero Food Waste, which is expected to continue to become a new habit. This indicator consists of 15 statements that have general criteria, such as "willing to participate as food volunteers, share information about food waste, and change the bad habits of consuming and producing to be more sustainable" These 15 statements are further divided into three sub-indicators, as seen in Table 7.

**Table 7.** Willingness to Participate Categories of Sustainable Food System

Willingness to Participate Category	Item
Frequency of involvement of students hearing various issues or problems of environmental change, especially regarding food waste	35,36,41,45
Awareness of students to be involved in opinionating on various issues or problems of environmental change, especially regarding the prevention of food waste	31,32,34,37,39,40
Student awareness related to the desire to participate in environmental change issues, especially regarding food waste management	33,38,42,43,44

**Table 8.** Descriptive Statistics of Attitude Indicator

Item	Statement	Class A		Class B	
		Mean	Std. Dev	Mean	Std. Dev
31.	I often talk about the dangers of food waste with my friends and family, because I think it needs to be discussed.	3.17	0.910	3.25	0.906
32.	I can utilise social media to spread positive things related to protecting the environment, so that my social media can be more useful.	4.00	0.828	3.81	0.822
33.	I make it a habit to buy or take food in the amount that suits my portion because I do not want to leave any food behind.	4.14	0.723	4.00	0.793
34.	I will reprimand my friends or family if they do not finish their food because it is wasteful and can have an impact on the environment.	3.58	0.967	3.69	0.786
35.	I know about the zero food waste programme and try to apply it as much as I can	2.78	1.174	3.06	0.955
36.	I know that Indonesia is one of the top food waste producers in the world because I have read/heard about it on TV news and other digital media.	3.97	0.810	3.72	0.779
37.	I want to learn, explain, and discuss the idea of food waste management more deeply because I can apply it later at home	3.69	0.920	3.42	0.770
38.	After eating, I try to clean up my own plate, starting from washing the plate and throwing away the remaining food waste because I am responsible for my plate.	4.06	0.791	4.06	0.924

Item	Statement	Class A		Class B	
		Mean	Std. Dev	Mean	Std. Dev
39.	If I see someone littering, I will reprimand them because littering is harmful, especially to the environment.	3.86	0.762	3.92	0.732
40.	I discuss with my family how to manage waste at home, including leftover food management, because it is necessary so that there are no more parasitic animals in my house, such as rats, cockroaches, flies, and others.	3.58	1.052	3.47	0.910
41.	I enjoy following social media content on food management tips because it can increase my knowledge and skills.	3.69	0.889	3.33	0.862
42.	Suppose a bin consists of 3 types (organic waste, non-organic waste, and hazardous waste). In that case, I will dispose of the waste according to its category because this small action can make it easier for the janitor to manage.	3.94	1.040	3.83	0.941
43.	I am ready to succeed in preventing the production of excess food waste in my school because I think it is important and necessary to do so.	3.67	0.756	3.78	0.760
44.	I realise that my concern for the environment needs to be improved	1.67	0.926	1.72	0.615
45	I need more knowledge about sustainable food systems to increase my understanding and awareness.	1.81	0.889	2.03	0.736
<b>Overall (level of sustainable awareness for knowledge indicator)</b>		<b>3.44</b>	<b>0.89</b>	<b>3.41</b>	<b>0.82</b>

\*level indicator: Means 1.00-2.33 low; 2.34-3.66 medium; 3.67-5.00 high

Based on Table 8, there are three statements with a low mean value in the "Bad" category and one in the "Neither Good Nor Bad" category. As in the attitude indicator, class A has lower mean scores for some of its statements in this indicator. However, the overall average results of class A are better than class B, which has yet to study environmental change material at all. In the first sub-indicator (Table 7), two statements have low average scores: No. 35 and 45. For No. 35 in class A, the mean score is 2.78, so the category is "Bad"; for class B has a mean score 3.25 with the category "Neither Good Nor Bad". And no 45 with a mean average value for class A of 1.81 and class B of 2.03.

The first sub-indicator is about their frequency of hearing or reading about food waste issues on any digital platform. Based on the results of questionnaire data analysis, many students do not know the zero-food waste program and how to apply it. The term zero food waste is still very unfamiliar to students, and they also do not know what a sustainable food system is; students admit that they need knowledge about sustainable food systems to increase their awareness. In line with this, another statement with a low mean average value is No 44, which comes from sub-indicator 3. Students know their awareness has been lacking and needs to be increased.

## 4 Conclusion

Based on the results and discussions presented, this analysis's conclusion contains information about the percentage of alignment between knowledge, attitudes, emotions, and behaviours needed to change and increase awareness about zero food waste for the better. The results seem fine, but there are still low categories in specific questions for food waste, and both classes are unfamiliar with sustainable food systems, and what Zero Food Waste is. Although class A has learnt about environmental change, the results are equivalent to class B, who have yet to learn about environmental change. It can be interpreted that they both need to learn about sustainable food systems to increase their awareness of food waste issues.

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