CHAPTER III
RESEARCH METHODOLOGY

3.1. Research Method and Research Design

3.1.1. Research Method

This research used a weak experimental to test whether the small intervention have an effect on the sustainability understanding and action of students. The researcher used this method due to limited participants in the selected schools. Moreover, there was no control class in this study because it only observes the influence of the independent variable towards the dependent one. Researcher acted as a teacher throughout the learning and teaching process.

3.1.2. Research Design

The research design in this research is a single group pretest-posttest design. There will be intervention, present by teaching and learning process related to the food waste topic, between the pre-test and post-test. The design shows in the Table 3.1.

Table 3.1 Research Design One Group Pretest-Posttest Design

Group 1	Pre-test	Intervention	Post-test
	O	X	O

O : Pre-test of students' sustainability understanding and action

X : Teaching and learning process through the Action-Oriented ESD approach of the food waste topic

O : Post-test of students' sustainability understanding and action

3.2. Population and Sample

This research conducted in one of the junior high schools in Bandung, which implemented *Merdeka* Curriculum (Indonesia's Independent Curriculum) as their basic fundamental. The sample is 7 grade students in one class chosen by the school that had not been exposed to the topic of food waste, the total was 36 students with 18 boys and 18 girls. The sampling method was a convenience sampling technique

which samples are selected based on the availability. Therefore, the learning practice implemented precisely based on the students' needs. The permission letter for conducting research is shown in Appendix 2.

3.3. Assumptions

i. Action-Oriented ESD approach in learning Food Waste topic enhance the students' sustainability understanding.
ii. Action-Oriented ESD approach in learning Food Waste topic enhance the students' sustainability action.

3.4. Hypothesis

1. H_{01}: There is no significant difference in students' sustainability understanding before and after the implementation of Action-Oriented ESD learning approach in food waste topic.
2. H_{02}: There is no significant difference in students' sustainability action before and after the implementation of Action-Oriented ESD learning approach in food waste topic.
3. H_{03}: There is no significant correlation between students' sustainability action before and after the implementation of Action-Oriented ESD learning approach in food waste topic.

3.5. Research Instrument

This research used two instruments in measuring the dependent variables. The research instrument shown in Table 3.2 below.

Table 3.2 Research Instrument

No	Variable(s)	Instrument
1	Students' sustainability understanding	Open-ended essay questions
2	Students' sustainability action	Questionnaire
Additional instrument will be added to support the research		

Research data were collected with various instruments as follows:

3.5.1. Students' Sustainability Understanding

Sustainability understanding of students are measured based on UNESCO's learning objective SDGs 12 "Sustainable Production and Consumption". The

process of developing the instrument began with deriving the learning objectives into more specific topic along with the action verb from Bloom's Taxonomy Cognitive Levels. The questions consist of 12 open-ended essay questions which includes the environmental, society, and economic aspects. It purposedly to assess the understanding of students in food waste topic, especially in the topic of sustainable lifestyles, food consumption pattern, food waste management, also strategies and practices of sustainable food consumption. Students' understanding of this topic will form the foundation for solving related problems and taking further action. The test items had been validated before implementing to students widely. Researcher distributed the questions before (pretest) and after (post-test) implementation of Action-Oriented ESD approach teaching and learning processes. The instrument is shown in Table 3.3.

Table 3.3 The Instrument's Mapping of Students' Sustainability Understanding

Learning Objective	Indicators	Description	Total Number
Cognitive	The student is able to explain the sustainable lifestyle based on economic, social, and environment aspects.	Student explain the sustainable lifestyles that help to reduce the food waste based on economic, social, and environment aspects in their surroundings through discussion.	3
		Student explain the sustainable lifestyles that help to manage the food waste based on economic, social, and environment aspects in their surroundings through discussion.	
	The student is able to identify the food consumption patterns related to its toxicity affect the environment, social, and economy.	Student identify the food consumption patterns related to toxic effect on the environment, social, and economy through observation in school area.	3
	The student is able to describe the food waste related to its management towards environment, society, and economy.	Student classify the food waste management based on its type concerning the environment, society, and economy through discussion.	

Learning Objective	Indicators	Description	Total Number
	The student is able to report the strategies and practices of sustainable food consumption.	Student report the strategies and practices of the sustainable food consumption that help to reduce the food waste in their surroundings through discussion.	3
		Student report the strategies and practices of the sustainable food consumptions that help to manage the food waste in their surroundings through discussion.	
Total			12

(Source: UNESCO, 2017)

Once the essay questions have been distributed to students, teacher will assess their answer using rubrics. The rubric consists of keywords related to the answer that students must accomplish. The keywords vary across scores 1 to 4, with a minimum score is 1 and maximum is 4, each reflecting a different level of response quality. Therefore, the teacher can collect the students' score quantitatively. Student' pretest and posttest score are analyzed using statistical methods to assess the impact of Action-Oriented ESD learning. The pretest identifies students' initial comprehension before the learning intervention, while the posttest measures their understanding after the intervention is implemented.

3.5.1.1.Sustainability Understanding Instrument Analysis

Before distributed to students, the instrument was validated through experts' judgement along with the readability test. The Table 3.4 shows the feedback given through experts' judgment. The complete feedback from experts' judgement can be seen in Appendix 3.

Table 3.4 Experts given feedback for sustainable understanding instrument

Experts' feedback		
Expert A	Expert B	Expert C
The key answers should be concise, preferably presented in bullet points or brief statements, with minimal description but clear distinctions between points. The economic	In general, the questions are structurally sound but lack variety, as they mainly focus on normative responses that are relatively easy to answer. To improve their quality, the questions	Twelve cognitive questions related to understanding sustainability in the context of food waste have been aligned with the indicators; however, some are not well constructed and may

Experts' feedback		
Expert A	Expert B	Expert C
aspect is currently underrepresented and should be more proportionally integrated into the questions to ensure balance across all aspects. Additionally, some questions need to explicitly require detailed answers that align closely with the assessment rubric.	should provide a variety of challenging questions, encouraging higher-order thinking. Moreover, there is a fundamental concern regarding the visibility of Action-Oriented ESD Learning in the questions. The questions can be answered without any specific learning intervention, relying only on basic text comprehension rather than reflecting the impact of the learning process.	confuse students. These questions should be rephrased for clarity, with suggested revisions provided above. In addition, certain sample answers that include multiple points should be formatted as lists to facilitate easier evaluation. For the rubric, ensure that each score level consistently uses action verbs to describe student responses. Some levels currently lack clear distinctions and should be revised according to the suggestions given for each question.

Feedback collected from experts were then reviewed and revised based on the need of instrument. Once the instrument was revised, it was further tested for validation using IBM SPSS. All scores from 12 open-ended essay questions were collected from 31 students. The first test was a validity test, which aimed to ensure the accuracy of result, usefulness, and significance of the results. The interpretation of validity score is used the rTable based on the number of students, which shown in the Table 3.5 followed by the result of validation test in Table 3.6.

Table 3.5 Validity Interpretation

rValue	Interpretation
$r \geq 0.35$	Valid
$r \leq 0.35$	Invalid

Table 3.6 Validation result of sustainable understanding

Item number	Validity	Valid	Conclusion
1	0.681	Valid	Accepted
2	0.807	Valid	Accepted
3	0.826	Valid	Accepted
4	0.626	Valid	Accepted
5	0.693	Valid	Accepted
6	0.448	Valid	Accepted
7	0.680	Valid	Accepted
8	0.579	Valid	Accepted
9	0.705	Valid	Accepted
10	0.813	Valid	Accepted
11	0.659	Valid	Accepted
12	0.721	Valid	Accepted

The instrument of sustainability understanding was fully accepted and validated. It was then tested for consistency through a reliability test, as shown in Table 3.7.

Table 3.7 Reliability test result of Sustainable Understanding Instrument

Result	Conclusion
0.899 Reliable	Accepted

The instrument for assessing sustainability understanding was approved for student use and for measuring the impact of intervention. Through the trials, it aimed to test the instrument's validity and reliability to ensure that the questions were acceptable and understandable to the respondents. Therefore, 12 essay questions were used as the instrument of sustainability understanding. The completed instrument is shown in Appendix 4.

3.5.2. Students' Sustainability Action

The students' sustainability action will be measured using the indicator of Environmental Citizenship Questionnaire (ECQ) that was developed by (Hadjichambis et al., 2020), and modified by the researcher. The indicator of ECQ

was developed from Education for Environmental Citizenship (EEC) which includes the essential knowledge, values, attitudes, skills, competences and behaviors that student should be equipped with. These essentials components also supported students in achieving sustainability and sustainable development goals (SDGs), especially in action-taking. The purpose of this instrument is to assess students' actions in solving problems related to food waste. Through the sustainable action instrument, students were asked about their daily practices in reducing and managing food waste. The questionnaire consists of 36 items statement which includes past, present, and future actions, which also includes positive and negative statements. The score used is a 1 to 4 Likert scale, with a minimum score is 1 and maximum score is 4. Past and present action had four choices which are never, seldom, often, and always. Future actions have refuse to do, hesitant to do, trying to do, and willing to do. Meanwhile, competencies had four choices with very incapable (1), incapable (2), capable (3), very capable (4). It will be distributed to the students in the beginning (pre-test) and ending (post-test) of learning. The pretest and posttest were analyzed through various tests to see the differences before and after the implementation. The description of the questionnaire is shown in Table 3.8 below.

Table 3.8 The blueprint instrument of sustainability action questionnaire before validation

No	Indicator	Number of questions				Total number
		The impact of food waste	Sustainable strategies in food waste management	Food consumption's behavior	Sustainable Lifestyle	
1	Past, present. and future actions	1,2,3,4	5,6,7,8,9,10	11,12,13,14	15,16,17,18,19,20	20
2	Competences	1,2,3,4	5,6,7,8	9,10,11,12	13,14,15,16	16
Total						36

(Adapted from: Hadjichambis et al., 2020)

3.5.2.1.Sustainability Action Instrument Analysis

The instrument was validated through experts' judgment and readability test before distributed to the students. The feedback from experts were reported in the Table 3.9. The complete feedback from experts' judgement is shown in Appendix 3.

Table 3.9 Experts given feedback for sustainable action instrument

Indicator	Experts' feedback		
	Expert A	Expert B	Expert C
Past, present, and future actions	The statements provided are not clearly aligned with the Sustainable Development Goals (SDGs), and in some cases, it's unclear what the intended message or implication is. Additionally, some of the action words used resemble behavioral statements rather than socio-emotional. It is recommended to revise these action words and reword the statements to enhance clarity and ensure they are easier to understand.	Use more specific and appropriate words. Revise for correct grammar and clearer statements.	Some of the goals in the statements overlap, especially in the socio-emotional areas. Maybe you can add the emotion to the statements to make them stand out more clearly.
Competences	The statements don't clearly show the sustainability focus. Use clearer action words.	There is an overlap between behavioral and socio-emotional aspects. Please establish clear boundaries between the two to avoid confusion.	The statements mostly focus on behavior and don't clearly show the emotional part. To make them better, try adding emotional aspects so it's easier to see the difference between behavior and socio-emotional goals.

The instrument of sustainability action was revised and adjusted followed the guidance from experts. Then the data was tested to the students in order to

collect the validity and reliability scores. The total of 53 students were collected were analyzed through IBM SPSS to undergo the validity and reliability tests. Validity test purposedly measure the accuracy of the data within the score presented in the rTable that shown in Table 3.10.

Table 3.10 The interpretation of validity score

rValue	Interpretation
$r \geq 0.35$	Valid
$r \leq 0.35$	Invalid

The validity scores were reported using SPSS and compared to the rValue represented in the Table 3.10. The results of the validity tests from first and second trials are shown in Table 3.11.

Table 3.11 Recapitulation of sustainable action questionnaire past, present, and future indicator

Item number	First trial validity			Valid	Second trial validity			Valid	Conclusion
	Past action	Present action	Future action		Past action	Present action	Future action		
1	0.301	0.410	0.379	Valid					Accepted
2	0.481	0.602	0.499	Valid					Accepted
3	0.142	0.220	0.219	Invalid	0.612	0.732	0.644	Valid	Accepted
4	0.433	0.137	0.386	Invalid	0.654	0.702	0.687	Valid	Accepted
5	0.554	0.400	0.424	Valid					Accepted
6	0.557	0.419	0.321	Valid					Accepted
7	0.411	0.444	0.346	Valid					Accepted
8	0.431	0.456	0.602	Valid					Accepted
9	0.519	0.515	0.621	Valid					Accepted
10	0.255	0.382	0.310	Invalid	0.536	0.657	0.518	Valid	Accepted
11	0.470	0.194	0.207	Invalid	0.555	0.648	0.614	Valid	Accepted
12	0.416	0.370	0.390	Valid					Accepted
13	0.615	0.737	0.584	Valid					Accepted
14	0.381	0.238	0.368	Invalid	0.772	0.672	0.768	Valid	Accepted
15	0.536	0.437	0.483	Valid					Accepted
16	0.591	0.458	0.476	Valid					Accepted
17	0.321	0.370	0.255	Invalid	0.691	0.700	0.679	Valid	Accepted
18	0.501	0.334	0.329	Valid					Accepted
19	0.408	0.408	0.231	Invalid					Rejected

Item number	First trial validity			Valid	Second trial validity			Valid	Conclusion
	Past action	Present action	Future action		Past action	Present action	Future action		
20	-0.266	-0.295	0.124	Invalid					Rejected

The table indicated that in the first and second trials, 2 out of 20 statements were rejected. After the validity test, the valid statements from both in first and second trials underwent reliability test, which presented in the Table 3.12. The reliability test assisted the researcher in measuring the consistency of the instrument.

Table 3.12 The result of reliability test of sustainable action questionnaire past, present, and future actions

Reliability test score				Conclusion
	Past action	Present action	Future action	
First trial	0.762	0.740	0.705	Accepted
Second trial	0.707	0.774	0.730	Accepted

From the Table 3.12, the reliability test for both first and second trial was accepted showing the consistency of the statements. These valid statements represented all sub-indicators, leading to the conclusion that 18 questions were used for the research to measure students' sustainability action regarding the food waste topic for the past, present, and future actions. On the other hand, the competences questionnaire presented in the Table 3.13 and its reliability test results for both first and second trials.

Table 3.13 Recapitulation of sustainable action questionnaire competences indicator

Item number	First trial validity	Valid	Second trial validity	Valid	Conclusion
1	0.198	Invalid	0.689	Valid	Accepted
2	0.209	Invalid	0.557	Valid	Accepted
3	0.532	Valid			Accepted
4	0.387	Valid			Accepted
5	0.533	Valid			Accepted
6	0.681	Valid			Accepted
7	0.382	Valid			Accepted
8	0.714	Valid			Accepted
9	0.474	Valid			Accepted
10	-0.04	Invalid	0.787	Valid	Accepted
11	0.284	Valid			Accepted
12	0.657	Valid			Accepted
13	0.639	Valid			Accepted

Item number	First trial validity	Valid	Second trial validity	Valid	Conclusion
14	0.411	Valid			Accepted
15	0.417	Valid			Accepted
16	0.539	Valid			Accepted

Table 3.13 shows three invalid statements at the first trial shift to valid after revision. It reported that the questionnaire of action competence is all valid. Validity and reliability are crucial for measuring the accuracy and consistency of the instrument before it is administered to students. This instrument underwent modifications and adjustments based on previous model developed by (Hadjichambis et al., 2020). The reliability test result of both first and second trial shows in Table 3.14.

Table 3.14 The result of reliability test of sustainable action competences

Reliability test		Conclusion
First trial	Second trial	
0.769	0.415	Accepted

From Tables 3.14, the reliability test of action competences questionnaire in second trial is below the standard. It was concluded that only 13 statements of competences indicator were declared valid and accepted for use in the research instrument. Therefore, the instrument of sustainability action consists of 31 statements, which will be used to measure students' sustainable action regarding the food waste topic. The blueprint of the sustainable action questionnaire after validation was reported in Table 3.15.

Table 3.15 The blueprint instrument of sustainability action questionnaire after validation

No.	Indicator	Number of questions				Total number
		The impact of food waste	Sustainable strategies in food waste management	Food consumption 's behavior	Sustainable Lifestyle	
1	Past, present. and future actions	1,2,3,4	5,6,7,8,9,10	11,12,13,14	15,16,17,18	18
2	Competences	1,2	3,4,5,6	7,8,9	10,11,12,13	16
Total		6	10	7	8	31

The instrument uses simple language and easily understood by junior high school students. The examples of statements used were shown in Table 3.16. The completed instrument to assess students' sustainability action is shown in Appendix 5.

Table 3.16 Sample statement of students' sustainability action instrument

Indicator	Statement
Past, present, and future action	*Saya mengingatkan teman saya untuk menyimpan makanan sisa agar bisa dimakan kembali*
Competences	*Saya mengajak teman saya untuk memperbaiki kebiasaan pengolahan sampah makanan yang buruk*

3.5.3. Additional instrument

Other than sustainability understanding and action, there are additional variables included as the supporting sources for the research. There is observational assessment, worksheet, lesson plan, learning module, and action journal. The worksheet, shown in Appendix 6, includes the observation of problem around school area, identification of the problems, and analyze the big causes of the problems. The students must find the solution of the food waste issue through action and collaborative learning based on the Action-Oriented ESD learning approach proposed by (Sinakou et al., 2019). Once the worksheet done, the students will continue to fill their action journal (Appendix 6) to collect their progress throughout the action. The action journal was adopted from (Eliyawati et al., 2024) that consists of description of action program, students' action plan for 20 days, the result of implementation, reflections, limitations, and recommendations for further action. These additional instruments were analyzed qualitatively using descriptive analysis to summarize the collected data.

3.6. Research Procedure

3.6.1 Preparation Stage

Researcher did several pre-research activities. These included a literature review by reading news and articles to identify suitable research problems, gathering information related to environmental issues and Education for Sustainable Development (ESD) learning, and exploring the Action-Oriented ESD approaches. Moreover, research problem was formulated, then focusing on the variables of sustainability understanding and action. Following the identification of the research focus, a research proposal was developed in required structure. Instruments were then created to measure students' understanding and action. Researcher also prepared the learning module which consists of lesson plan, media, students' worksheet, students' action journal, and assessment for the teaching and learning process. During this preparation stage, lecturers and experts also provided input by reviewing and evaluating the instruments and module. Administrative preparations were also completed, including discussions with the school's science teacher and obtaining official permissions.

3.6.2. Implementation Stage

There are several steps comprise in the implementation stage, which are:

3.6.2.1.Pre-test

Before starting the lesson, researcher distributed the pre-test of sustainable understanding and action, which include the essay questions and action questionnaire for students in one class. The pre-test helped researcher to identified students' initial abilities regarding the topic of food waste. The distribution of pretest was used Google Form and filled out through their mobile phones. Both of the instruments will be distributed and collected on the same day.

3.6.2.2.Teaching and learning through Action-Oriented ESD approach

The intervention began with the teaching and learning process used the learning modules that has been prepared. Students started learning about the food waste topic with the general activities presented in Table 3.17.

Table 3.17 Learning activities in three meetings

Meeting	General Activities
1	Students learn about food waste through an Action-Oriented ESD learning approach, which includes group activities and observations. They fill out a worksheet that helps them explore areas affected by food waste. Student identify the problems related to the topic.
2	Students continue to fulfil their worksheet in group, they choose a food waste problem and promote a management strategy to solve it. The activity includes planning and processing the investigation. The investigation takes place in school area that must finish in one meeting.
3	Students analyze the data they have collected and draw conclusions about the effectiveness of their actions in reducing food waste. They plan to expand their solution to a larger area, such as their neighbourhood, for one month. Each step of their action-taking process is documented in an action journal. The teacher reviews the journal weekly, providing feedback and suggestions.

Those three meetings had been observed by several observers in order to assessed students' outcome from the learning process. Observers were equipped with the observation sheet. The learning period consists of 3 meetings and 20-day students' individual action-taking. Students had to fulfilled the worksheet and individual action journal during this period. Therefore, students' action-taking were observed through their individual reports only. After the intervention in the learning, researcher distributed the posttest and collected all students' answers. The completed lesson plan is shown in Appendix 7.

3.6.3. Completion Stage

Researcher analyzed the data collected using rubrics and proceed with IBM SPSS. This step required statistical methodologies in analyzing the collected information. The data analysis will be completed with the evaluation from the lecturer, and the research paper is finalized.

3.7. Research Flow

The following is a flowchart that summarizes the entire research flow:

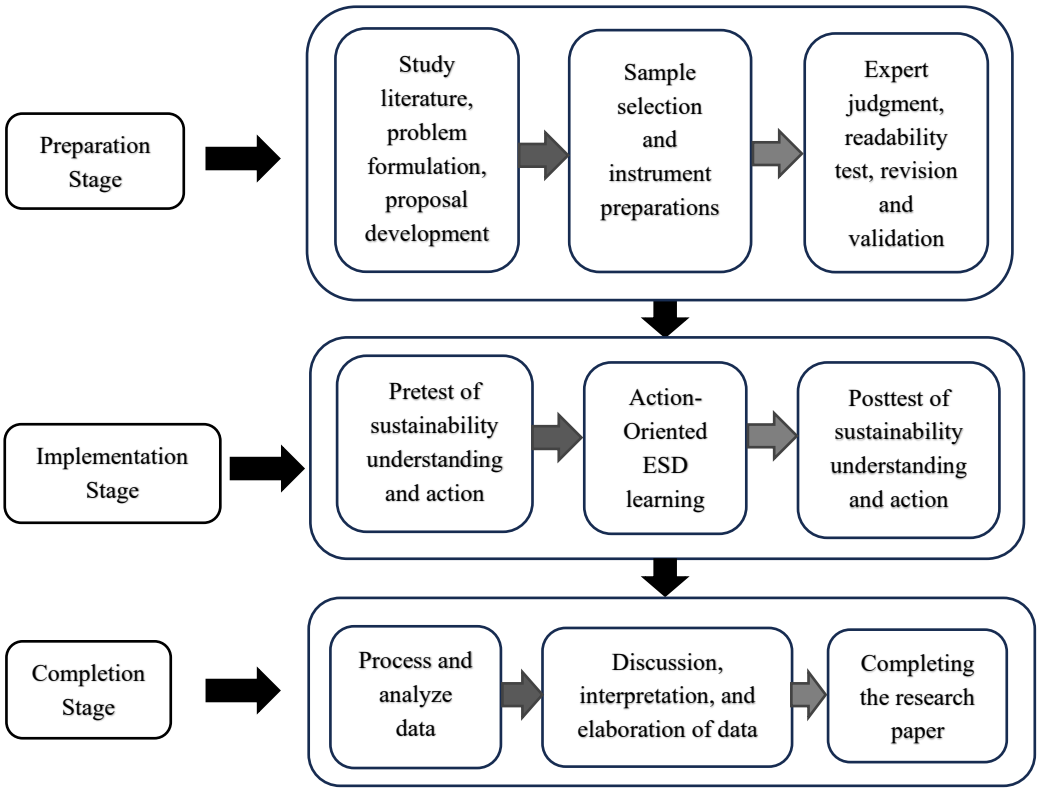

Figure 3.1: Flowchart of the research

3.8. Data Analysis

The instrument includes both quantitative and qualitative data to assess sustainable understanding and action. The collected data were analyzed using appropriate methods to ensure accurate and meaningful interpretation. The quantitative data were analyzed through descriptive statistics to identify the difference between before and after intervention. Meanwhile, qualitative data includes a deeper exploration of the data to captured more meaningful insights of the research.

3.8.1. Sustainability understanding

Quantitative data were collected from students' responses on open-ended essay questions. The answers were analyzed using developed rubrics with the score ranging from 1 to 4, based on the questions' possible answers. Once the data were

converted into numerical values, a normality test was conducted. The research's participants were around 30 students, therefore Shapiro-Wilk test was used. Full results of sustainable understanding statistical data are presented in Appendix 8. Based on the test, the data with normal distribution has p value > $\alpha = 0.05$. The result of normality test for pretest and posttest to measure students' sustainability understanding was 0.181 and 0.278, respectively, which both tests represented as normal due to higher value then the $\alpha = 0.05$.

The data processing also included calculating mean, standard deviation, and frequency distribution. After the data reported as normal, homogeneity test conducted to check whether pretest and posttest have equal variance. Sig. = 0.479 > 0.05, showed that the pretest and posttest data have equal variances. Then, paired sample t-test was conducted to see the significant difference statistically between pretest and posttest. The result will be interpreted as two category, p value > 0.05 shows no significant difference, while p value < 0.05 shows significant difference. This hypothesis test was accepted since the sig. value (0.00) < 0.05, indicated that was significant. Additionally, an n-gain test was performed to assessed the effectiveness of the intervention using an Action-Oriented ESD approach. This test quantified the improvement or change in pretest and posttest result. The N gain scores were interpreted as low for sig. < 0.3, moderate for 0.3 < Sig. < 0.7, or high for Sig. > 0.7, indicating the effectiveness of the intervention (Hake, 1998). The score resulted was 0.464 which considered moderate. It concluded that the learning using Action-Oriented ESD approach had moderate impact to students' sustainability action.

On the other hand, qualitative data were obtained during the implementation of Action-Oriented ESD learning which obtained from worksheet, action journal, and observation sheet. These data aimed to determine whether students' inputs and outputs met the learning objectives throughout the learning process. In the observation sheet. each learning stage involved at least one learning objective to enhance students' understanding of the topic. Moreover, researcher also conducted individual interviews with several students to gather supporting information about their comprehension of the learning process using the Action-Oriented ESD

approach, as well as their subsequent actions in relation to their learning goals. The qualitative data were interpreted through descriptive analytics, focusing on students' understanding of food waste topic, particularly regarding lifestyles, food consumption patterns, food waste management, also strategies and practices.

3.8.2. Sustainability action

The sustainability action instrument involved both quantitative and qualitative data. Quantitative data were obtained through an action questionnaire administered as pretest and posttest. Students' responses to the statements were converted into numerical numbers to facilitate data processing and interpretation. Using a Likert scale, where the lowest score is 1 and the highest is 4, a normality test was conducted. The research's participants were around 30 students, therefore Shapiro-Wilk test was used with the complete statistical data are presented in Appendix 9. Based on the test, the data with normal distribution has p value > α = 0.05. The significant value for pretest and posttest of sustainable action questionnaires shown 0.497 and 0.978 respectively, which both tests represented as normal due to higher value then the $\alpha = 0.05$.

Negative and positive statements were assigned reversed values to reflect the differences in responses. The homogeneity test using Levene test resulted Sig. = 0.000 < 0.05, indicated pretest and posttest data did not have equal variance. The hypothesis test using paired sample t-test also reported that sig. value (0.04) < 0.05 shows significant difference in correspond to p value > 0.05 shows no significant difference, while p value < 0.05 shows significant difference. Descriptive statistics were performed, followed by the N-gain test, which determine whether students' achievement was classified as low for sig. < 0.3, moderate for 0.3 < Sig. < 0.7, or high for Sig. > 0.7, indicating the effectiveness of the intervention (Hake, 1998). Once the effectiveness of the intervention was measured, the data were reported in a data table. The N gain score resulted was 0.0438 which considered low. It concluded that the learning using Action-Oriented ESD approach had low impact to students' sustainability action.

Qualitative data from sustainability action instrument included group worksheets and individual action journals. Both in worksheets and action journals were analyzed using descriptive analytics to examine students' action-taking processes and their approaches to problem-solving while considering environmental, social, and economic aspects. Additionally, the Action-Oriented ESD components related to action-taking and community involvement were measured through an observation sheet, which aimed to assess students' accomplishments throughout the learning process.

3.8.3. Correlation Analysis

A correlation analysis was conducted to investigate the interconnectedness between students' sustainable understanding and action. the purpose of this test is to examine whether students who demonstrate higher levels of sustainable understanding also tend to have higher levels of sustainable action after the implementation of Action-Oriented ESD learning. The normality test using Shapiro-Wilk was conducted to determine the type of correlation used in the research. The result showed that both the posttest of sustainability understanding and action were normally distributed (p value (0.270) > α = 0.05) and (p value (0.998) > α = 0.05), respectfully. Therefore, Pearson's correlation was used to analyze the relationship between the two variables. The correlation strength interpretation of the Pearson correlation is shown in Table 3.18.

Table 3.18 Correlation Coefficient Interpretation

Correlation Coefficient	Interpretation
0.00 – 0.19	Very weak
0.20 – 0.39	Weak
0.40 – 0.59	Moderate
0.60 – 0.79	Strong
0.80 – 1.0	Very strong

(Adapted from Hauke and Kossowski (2011) by Nakawala et al. (2025)