

BUKTI KORESPONDENSI
ARTIKEL JURNAL TERINDEKS SINTA 2

Judul Artikel : *Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education*

Nama Jurnal : Jurnal Pendidikan Sains Indonesia (Sinta 2)

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No.	Perihal	Tanggal
1.	Bukti Konfirmasi Submit Artikel dan Artikel Yang disubmit	21 Januari 2026
2.	Bukti Konfirmasi Review dan Hasil Review Tahap 1	21 Januari 2026
3.	Bukti Resubmit Hasil Review dan Artikel Yang diresubmit	24 Januari 2026
4.	Bukti Konfirmasi Review dan Hasil Review Tahap 2	4 Februari 2026
5.	Bukti Resubmit Hasil Review dan Artikel Yang diresubmit	5 Februari 2026
6.	Bukti Konfirmasi Review Artikel dan Artikel Accepted	5 Februari 2026
7.	Bukti Konfirmasi Artikel Complete dan LoA Terbit	6 Februari 2026
8.	Bukti Artikel Terpublikasi Secara Online dan Artikel Yang Dipublikasi	10 April 2026

**BUKTI KONFIRMASI SUBMIT ARTIKEL
DAN
ARTIKEL YANG DISUBMIT
21 Januari 2026**

[JPSI] Submission Acknowledgement ▶️ Inbox x



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Wed, Jan 21, 10:32 AM ☆ 😊 ↶ ⋮

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Improving the Character of Caring for the Environment in Students Through the “A Plate of Food” Learning Media Application

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Abstract: *In this technological era, learning media plays an important role in supporting the teaching and learning process, including in the development of environmental awareness character. This research aims to improve the character of environmental care in Don Bosco 1 Jakarta high school students through the application of learning media “A Plate of Food”. In the research activities conducted in October 2024, the method used was focus group discussion. The results showed that students understand the importance of reducing food waste and are committed to being involved in food waste reduction. The majority of students are aware of the negative environmental and social impacts of food waste, such as food scarcity and climate change. They hope to play an active role in reducing food waste, by managing food wisely and appreciating food more. The application of food plate learning media has the potential to be an effective step in shaping the character of environmental care in students, which can be applied more widely in other schools to support environmental sustainability.*

Keywords: *character education, learning media, food plate*

Abstrak: Pada era teknologi ini, media pembelajaran memainkan peran penting dalam mendukung proses belajar mengajar, termasuk dalam pengembangan karakter peduli lingkungan. Penelitian ini bertujuan untuk meningkatkan karakter peduli lingkungan pada siswa SMA Don Bosco 1 Jakarta melalui aplikasi media pembelajaran "Sepiring Makanan". Dalam kegiatan penelitian yang dilakukan pada bulan Oktober 2024, metode yang digunakan adalah focus group discussion. Hasil penelitian menunjukkan bahwa siswa memahami pentingnya mengurangi sampah makanan dan berkomitmen untuk terlibat dalam pengurangan sampah makanan. Mayoritas siswa menyadari dampak negatif dari membuang makanan, baik terhadap lingkungan maupun sosial, seperti kelangkaan bahan makanan dan perubahan iklim. Mereka berharap dapat berperan aktif dalam mengurangi sampah makanan, dengan cara mengelola makanan secara bijak dan lebih menghargai makanan. Penerapan media pembelajaran sepiring makanan berpotensi menjadi langkah efektif dalam membentuk karakter peduli lingkungan pada siswa, yang dapat diterapkan lebih luas di sekolah-sekolah lainnya untuk mendukung keberlanjutan lingkungan.

Kata kunci: pendidikan karakter, media pembelajaran, sepiring makanan

INTRODUCTION

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and

learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process.

Learning media can be used as a tool in teaching and learning activities in the school environment (Nurfadhillah, 2021). The school environment is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner so as to achieve maximum results for both educators and students (Anggraini, 2017). The environment provides all human needs, such as food, drink, oxygen, and other life needs. So that humans always take advantage of the environment to meet basic needs and improve the quality of their lives. The school environment has a significant influence on the learning process and learning success both directly and indirectly (Khoiron, 2016). A supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020).

On February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Isnaeni, 2013). In accordance with the Environmental Regulation (Permen) Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, which aims to create environmentally sound schools and foster an environmental culture. This

implementation is based on three principles: educative, participatory, and sustainable (Latief et al., 2019). The Adiwiyata program is a step towards creating a school dedicated to educating students who value and foster an environmental culture (Fadlillah et al., 2018). A person's character needs to be developed in three stages: knowledge, practice, and habit (Aini, Rachmadiarti & Prastiwi, 2014).

The character of environmental care is one of the aspects that must be implemented at all levels of education in schools. All school members must realize the importance of environmental protection and take steps to prevent environmental damage (Purwanti, 2017). The character of environmental care is an attitude that a person must have in order to develop and manage the environment so that it can be enjoyed indefinitely without causing environmental damage and is long-term (Hasanah, 2021). The character of environmental care must be instilled regularly through learning, habituation, and exemplary behavior (Khotimah, 2019).

The character of environmental care cannot grow just like that, but it must be pursued continuously from an early age through real activities that are close to everyday life (Masturoh & Ridlo, 2020). To foster the character of environmental care,

the most strategic step is through education. Realizing this, the school as an educational forum needs to instill and develop students' concern for the environment from an early age so that human resources are formed who can wisely utilize their potential in acting to create a conducive, ecological, sustainable environmental quality in a real and sustainable manner, of course in ways that are sympathetic, creative, and innovative by adhering to local cultural values and wisdom (Arisona, 2018).

Improving the quality of education is highly dependent on the quality of human resources, especially teachers as a key component in the school environment (Sudjana, 2018). A good teacher is a teacher who teaches professionally and must not only be able to teach well but must also be able to teach and be a role model for students. All teacher actions (both words and actions) are usually imitated by students. Teachers are not only in charge of conveying knowledge to students but can also help develop student character (Jannah, 2022). The character of caring for the environment that is taught, such as teaching and reminding children not to litter and reminding children not to leave food.

Food waste has a considerable impact on the environment, both directly and indirectly (Amelia, 2019). Therefore, the wise management of food waste is

closely related to the character of environmental care (Ramadhan, 2022). Food waste has a direct impact on the environment, both through the waste of natural resources and as a contribution to pollution and climate change. The character of caring for the environment is closely related to the awareness to reduce food waste and manage food waste in a more sustainable way, such as by recycling it into compost or sharing it with others (Sirfiandi, 2022).

This shows how environmental responsibility can be realized through simple actions related to food consumption and management. Some learning models that teachers can use to shape the character of environmental care in students are Problem-Based Learning (PBL), Project-Based Learning (PjBL), Contextual Teaching and Learning (CTL), and outdoor learning methods. Teaching materials and learning media also play an important role in shaping the character of environmental care in students (Santika, 2022). If students can practice the character of environmental care, then these students will always be aware of the environment both at school and in their homes and will preserve the environment wholeheartedly (Fatimah & Adawiyah, 2017).

A plate of food can be a learning medium or symbol that explains food

consumption patterns in everyday life. A plate of food as part of human daily life can act as an educational medium that has a positive effect on pro-environmental habits or behavior. The application of the role of a plate of food can foster the character of environmental care; for example, the interpretation of a plate of food helps humans determine the nutritional content and the best portion to support their health and quality of life. In addition, a plate of food can involve the wearer in making decisions that save the earth. A plate of food acts as a data bank and can be chemistry learning material (Simanjuntak, 2020a) to encourage active community participation in converting food waste into renewable energy (Jude et al., 2021; Sharma et al., 2022). Chemistry is the study of matter and its changes. Chemistry is studied and developed based on experiments. There are three things that cannot be separated when studying chemistry. namely chemistry as a process (scientific results), attitude, and knowledge (concepts, facts, laws, principles, and theories). Chemistry is often considered a difficult subject by students because it is abstract and full of complex concepts compared to other subjects (Rahmawati, 2019). Chemical concepts basically utilize or cover three inseparable aspects of study: macroscopic (observable properties),

submicroscopic (particles that make up a substance), and symbolic (chemical formulas and other chemical symbols).

The chemistry education study program is one of the study programs that utilizes food plate learning media as one of the learning media in education. The application of this food plate learning media must, of course, be spread to various educational circles, including schools. And this requires teachers who are able to apply it so as to stimulate interest in learning, increase the character of environmental care, and change the students' perspective that science, especially chemistry, is easy to learn and absorb with the help of learning media. Therefore, the Chemistry Education Study Program is here to conduct research and introduce the Food Plate learning media, which is expected to stimulate interest and increase the environmental care character of students at Don Bosco 1 Jakarta High School.

METHOD

This research was conducted in October 2024. The population of this study was all students of SMA Don Bosco 1 Jakarta. The sample used in this study was students in grade XI of SMA Don Bosco 1 Jakarta. The research involved expert lecturers who have conducted studies or research related to food plates. The method

used in this research is focus group discussion (FGD). Before implementing the focus group discussion, the expert lecturers compiled the instruments and materials to be used. The focus group discussion method was carried out in several stages. The first stage is presentation. At this stage, the expert lecturer will explain the material that will be discussed in this study. Then, after the description of the material, expert lecturers and research subjects will conduct discussions and eating simulations using the food plate media. After these stages are carried out, the next step is the evaluation of research conducted with the help of Google Forms. The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements. As for the details of the instrument used, among others:

1. Food menu criteria that students want.

This category consists of 4 statements, namely:

- What was the last meal you had today?
- Did you finish your last meal? Why?
- In general, people choose food based on its taste. How do you choose your food?

- Based on your experience, what kind of food makes you (happy) to finish your meal?

2. Student responses on food waste

This category consists of 4 statements, namely:

- In your opinion, should we waste food? Why? Please explain briefly!
- What do you think we should do with our leftover food?
- When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why?
- Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts!

3. Students' expectations and involvement in reducing food waste.

This category consists of 2 statements, namely:

- What do you expect from yourself regarding the condition of food waste in Indonesia?
- Are you willing to be involved in reducing food waste? Why?

RESULTS AND DISCUSSION

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this.

The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher. The first criterion is the food menu that students want. This category consists of 4 statements, namely:

- What was the last meal you had today?
Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general

overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability.

- Did you finish your last meal? Why?
The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience.
- In general, people choose food based on its taste. How do you choose your food?

In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste,

flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by habits, personal preferences, and various social and emotional factors.

- Based on your experience, what kind of food makes you (happy) to finish your meal?

Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious,

suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience.

In the second criterion, students' responses about the action of disposing of food waste. This category consists of 4 statements, namely:

- In your opinion, should we throw away food? Why? Please explain briefly! In this question, there are 54 students as respondents. There were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful

because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly.

- What do you think we should do with our leftover food?
According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This

not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability.

- When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why?

Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own

behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action.

- Based on your knowledge and information gained from social media, what are the impacts of food waste? Please name three impacts! Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations.

The third criterion is students' expectations and involvement in reducing food waste. This category consists of 2 statements, namely:

- What do you expect from yourself regarding the condition of food waste that occurs in Indonesia?

The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste. Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security.

- Are you willing to be involved in food waste reduction? Why?

Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future.

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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

Article History:

Received date:
Received in revised from:
Accepted date:
Available online:

Citation:

Manyak, A.K., Budiman, T., Meutuwah, A., & Rayeuk, M. (20xx). The Importance of Knowledge about Disaster Management from an Early Age for Students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, xx(x), xx-xx

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Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "a plate of food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "a plate of food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "a plate of food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: chemistry education, environmental care character, learning media, a plate of food, qualitative research

Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Therefore, learning media can be used as an important tool in teaching and learning activities within the school environment (Nurfadhillah et al., 2021).

The school environment itself is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner in order to achieve maximum results for both educators and students (Anggraini, 2017). In a broader context, the environment provides all human needs, such as food, drink, oxygen, and other necessities of life. Consequently, humans continuously utilize the environment to meet basic needs and improve their quality of life. In this regard, the school environment has a significant influence on the learning process

and learning outcomes, both directly and indirectly. Thus, a supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020).

As a response to the importance of environmental awareness within educational settings, on February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Wardani, 2020). In accordance with Environmental Regulation Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, this program aims to create environmentally sound schools and foster an environmental culture. The implementation of the Adiwiyata program is based on three main principles, namely educative, participatory, and sustainable principles (Latief et al., 2019). Through these principles, the Adiwiyata program serves as a concrete step toward creating schools that are dedicated to educating students who value and actively cultivate an environmental culture (Fadlillah et al., 2018).

In line with the objectives of environmentally oriented education, a person's character needs to be developed through three stages: knowledge, practice, and habit (Aini et al., 2014). For students who are still in the developmental stage, this process requires a more intensive approach, such as individual mentoring, the provision of role models by teachers and peers, and the implementation of experiential learning methods to enhance the understanding and application of values (Andayani, 2025). One important character value that needs to be developed is environmental care, which should be implemented at all levels of education in schools. Accordingly, all school members need to be aware of the importance of environmental protection and take concrete steps to prevent environmental damage (Purwanti, 2017). An environmentally conscious character reflects an attitude that enables individuals to manage and preserve the environment sustainably without causing long-term damage (Hasanah & Afianah, 2021). Therefore, the character of environmental care must be consistently instilled through learning activities, habituation, and exemplary behavior (Pane, 2016).

However, the character of environmental care does not develop automatically; rather, it must be cultivated continuously from an early age through real activities that are closely related to everyday life (Masturoh et al., 2020). Education plays a strategic role in fostering this character. Recognizing this role, schools as educational institutions need to instill and develop students' concern for the environment from an early stage. Through this effort, human resources can be formed who are able to utilize their potential wisely in creating a conducive, ecological, and sustainable environmental quality in real and lasting ways, while still adhering to local cultural values and wisdom (Arisona, 2022).

The effectiveness of education is greatly influenced by the quality of human resources, particularly teachers, who are a key component of the school environment (Sudjana & Wijayanti, 2018). Teachers are not only required to professionally master teaching skills but also to serve as role models for their students. According to Simanjuntak et al. (2023), chemistry teachers need to provide more space for students to express the difficulties and doubts they experience during the learning process. This is important because teachers' words and behavior are often imitated by students, making teachers central figures not only in the transfer of knowledge but also in shaping students' character. Various perspectives emphasize the importance of character education, which receives strong cultural and professional attention (Chowdhury, 2018). One concrete form of character education is cultivating environmental awareness, which can be instilled through consistent guidance from teachers, such as reminding students not to litter and to reduce food waste (Astari, 2018).

In this context, food waste emerges as a relevant environmental issue, as it has a considerable impact on the environment both directly and indirectly (Amelia et al., 2019). Consequently, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste contributes to environmental degradation through the waste of natural resources and its role in pollution and climate change. Therefore, the development of environmental care character is closely linked to awareness of reducing food waste and managing it in more sustainable ways, such as recycling it into compost or sharing it with others (Oktarina, 2021).

One contextual approach that connects daily behavior with environmental awareness is the use of a plate of food as a learning medium or symbol that explains food consumption patterns in everyday life. As part of human daily activities, a plate of food can function as an educational medium that positively influences pro-environmental habits and behaviors. The interpretation of a plate of food can foster environmental care character by helping individuals determine appropriate nutritional content and portion sizes that support health and quality of life, while also encouraging decisions that contribute to environmental preservation. Furthermore, a plate of food can serve as a data bank and a source of chemistry learning material (Simanjuntak, 2020), as well as a medium to encourage active community participation in converting food waste into renewable energy (Chen, 2023).

From a scientific perspective, chemistry is the study of matter and its changes and is developed through experimental processes. In learning chemistry, three inseparable aspects are involved, namely chemistry as a process, attitudes, and knowledge in the form of concepts, facts, laws, principles, and theories. Despite its importance, chemistry is often perceived by students as a difficult subject because it is abstract and contains complex concepts compared to other subjects (Setiawati & Rahmawati, 2019). Essentially, chemical concepts encompass three interconnected levels of representation: macroscopic (observable properties), submicroscopic (particles that compose substances), and symbolic (chemical formulas and symbols).

Considering these challenges, one alternative learning innovation that can be implemented is the use of contextual learning media, such as "a plate of food." This learning media emphasizes food as part of students' daily lives and connects it with concepts of food chemistry, substance composition, chemical reactions, and the environmental impact of food management. Contextual approaches using real-life learning media have been shown to improve conceptual understanding and increase students' awareness of environmental issues (King et al., 2012). Through the use of "a plate of food" in chemistry learning, students are expected to understand the relationship between food choices, chemical processes, and their environmental consequences, including food waste and pollution. As a result, students not only learn theoretical chemistry concepts but also develop an attitude of environmental care through reflective and meaningful learning experiences. Learning media that are closely related to everyday life can thus help students build critical awareness and a sense of responsibility toward the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco Senior High School, chemistry learning has not yet fully integrated explicit environmental character education. Students tend to perceive chemistry as an abstract subject that is detached from everyday life, which leads to the underdevelopment of environmental values. This condition indicates the need for more contextual chemistry learning that is oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "a plate of food" learning media in chemistry education can improve the environmental awareness of eleventh-grade students at Don Bosco Senior High School. This study employed a qualitative descriptive approach to describe changes in students' attitudes and environmental awareness through a contextual learning process. It is expected that the findings of this study will contribute to the development of chemistry learning that not only emphasizes cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "a plate of food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during

the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The Research Instrument.

No	Category	Statement
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2.	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3.	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data Collection Techniques

Data collection in this study was conducted using several techniques, namely:

1. Observation

Observations were conducted during the chemistry learning process using the "a plate of food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the learning activities.

2. Interviews

Semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes.

3. Questionnaire

A questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning.

4. Documentation

Documentation was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data Analysis Techniques

Data analysis was conducted qualitatively using the following stages:

1. Data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation.
2. Data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze.
3. Conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

Findings

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher as a data in table 2.

Table 1. Participant responses per category

No	Category	Statement	Participant Respont
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1. Food menu criteria that students want	1. What was the last meal you had today?	Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability.
	2. Did you finish your last meal? Why?	The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience.
	3. In general, people choose food based on its taste. How do you choose your food?	In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by

	4. Based on your experience, what kind of food makes you (happy) to finish your meal?	habits, personal preferences, and various social and emotional factors. Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience.
2. Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly!	From the 54 students as respondents, there were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly.

3. Students' expectations and involvement in reducing food waste	2. What do you think we should do with our leftover food?	According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability
	3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why	Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action.
	4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts	Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations
	1. What do you expect from yourself regarding the condition of food waste in Indonesia?	The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste.

2. Are you willing to be involved in reducing food waste? Why?

Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security. Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future.

Discussion

This study aimed to explore how the application of "a plate of food" as a learning medium in chemistry education contributes to the development of students' environmental care character, particularly in relation to food waste awareness. The discussion interprets the research findings by linking them to relevant theories of contextual learning, character education, and environmental education.

Contextual Chemistry Learning and Student Engagement

The findings indicate that the use of "a plate of food" successfully created a more contextual and meaningful chemistry learning experience. By connecting chemical concepts to students' daily experiences with food consumption, students became more actively involved in classroom discussions and reflective activities. This supports the principles of context-based learning, which emphasize that students learn more effectively when scientific concepts are presented within real-life situations that are familiar and relevant to them. Increased engagement observed during the learning process suggests that contextual learning media can bridge the gap between abstract chemical concepts and practical environmental issues. These findings are consistent with the study by Sari (2025), which states that innovative learning approaches, particularly those supported by technology-based learning media, can improve teaching effectiveness, increase students' learning motivation, and strengthen their understanding, ultimately contributing to better academic achievement.

Development of Environmental Care Character through Food Waste Awareness

The research results show a positive shift in students' attitudes toward food waste after participating in the learning activity. Students demonstrated an increased awareness that food waste is not merely a personal habit but a broader environmental issue with ecological, economic, and social consequences. Students' ability to articulate the impacts of food waste, such as increased landfill accumulation, environmental pollution, and reduced resources, indicates growing environmental literacy. This finding aligns with character education theory, which states that moral knowledge, moral feelings, and moral actions are interconnected stages in character formation (Chowdhury, 2018; Purwaningsih, 2024).

Students' Responses as Indicators of Attitudinal Change

Analysis of student responses to open-ended questions revealed that the majority of students believe food should not be wasted and are willing to take action, such as finishing

their meals, sharing leftovers, or reminding others not to throw away food. These responses indicate an internalization of the value of environmental care, not merely compliance with classroom rules. The willingness to politely correct others and the desire to participate in food waste reduction efforts reflect the emergence of a sense of responsibility and social awareness, two key components of an environmentally conscious character. This process of internalizing values is also consistent with the findings of Rizal (2023) research, which showed that students' discipline character develops through treatment such as class agreements, instructor control, and discipline enforcement. This indicates that the students' display of disciplined behavior and environmental concern is a result of internalizing values when those values have become part of their self-identity and are reflected in time management, adherence to rules, and academic discipline.

Chemistry Education and Socioscientific Issues

Integrating the issue of food waste as a socioscientific issue in chemistry learning helps students understand the relevance of chemistry to environmental sustainability. Through discussions about food composition, chemical processes in food processing, and waste management, students are able to connect chemical knowledge with real-world environmental challenges. This finding aligns with previous research showing that socioscientific issues-based learning not only improves conceptual understanding but also develops students' ethical reasoning and decision-making abilities related to environmental issues (Nursyada et al., 2025). This approach also contributes to building social and environmental awareness, supporting scientific literacy, and developing 21st-century skills by helping learners understand scientific concepts more deeply and in a way that is relevant to everyday life. A scientifically literate individual is one who possesses the knowledge, skills, attitudes, perspectives, and values that are collectively needed by students (Rohmaya, 2022).

Implications for Chemistry Education Practice

The findings of this study suggest that chemistry education can play a significant role in character education when supported by appropriate learning media. Character education in chemistry learning is used to help achieve the goals of national education (Astari, 2018). The use of "a plate of food" demonstrates that simple, context-rich media can encourage students to reflect on their daily behaviors and their environmental impact. For chemistry teachers, this implies the importance of designing learning experiences that integrate chemical concepts with environmental and sustainability issues, thereby fostering both cognitive and affective learning outcomes. This aligns with Zuin (2021) research, which states that chemistry education is positioned as a strategic foundation for shaping a more sustainable society and economy through holistic, collaborative, and contextual education.

Comparison with Previous Research

The findings of this study are consistent with previous research emphasizing the effectiveness of contextual and environmental-based learning in science education. The learning medium, A Plate of Food, promotes learning achievement by reducing students' anxiety toward chemistry, improving their well-being, and connecting them with their surroundings (Simanjuntak et al., 2023). This finding aligns with several studies reporting that integrating real-life contexts into chemistry learning can enhance students' engagement and environmental awareness. Sevia et al. (2018) found that context-based chemistry learning helps students connect abstract chemical concepts with everyday phenomena, leading to deeper understanding and more meaningful learning experiences. Similarly, King et al. (2012) reported that context-rich science instruction promotes students' ability to relate scientific knowledge to real-world environmental issues.

In terms of character and environmental education, the results of this study align with Macintyre et al. (2024), who emphasized that effective environmental education should not only increase knowledge but also foster attitudes and behaviors that support sustainability. The students' increased awareness of food waste and their willingness to take action reflect the stages of character development described by Andayani et al. (2025), which include moral knowing, moral feeling, and moral action. This suggests that the use of a plate of food successfully facilitated the internalization of environmental care values, similar to outcomes reported in earlier character education studies.

Furthermore, this study supports research on socioscientific issue-based learning. Hazari et al. (2013) demonstrated that learning activities centered on socioscientific issues, such as environmental and sustainability problems, can enhance students' moral reasoning and decision-making skills. In line with Sadler's findings, students in this study were able to articulate the environmental impacts of food waste and express a commitment to reducing it, indicating the development of both cognitive and affective learning outcomes.

Compared to previous studies that primarily employed quantitative or quasi-experimental designs, this research contributes additional insight through a descriptive qualitative approach. By analyzing students' open-ended responses, observations, and interviews, this study provides a more nuanced understanding of how environmental care character develops through chemistry learning. This qualitative depth complements earlier findings and highlights the value of qualitative methods in character and environmental education research.

Overall, this discussion highlights that the application of a plate of food as a learning medium in chemistry education is effective in promoting students' environmental care character and is consistent with, as well as supportive of, existing research in contextual learning, environmental education, and character development.

Conclusion

This study concludes that the use of "a plate of food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "a plate of food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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BUKTI KONFIRMASI REVIEW DARI EDITOR JURNAL DAN HASIL REVIEW

21 Januari 2026

Catatan perubahan:

Aspek	Awal Submit	Upload Artikel 1
Judul	<i>Improving the Character of Caring for the Environment in Students Through the “A Plate of Food” Learning Media Application</i>	<i>Enhancing Students’ Environmental Care Character through the Application of “A Plate of Food” as a Learning Medium in Chemistry Education</i>
Penulis	6 penulis	7 penulis, ditambah Lester E. Ropilla dari Don Mariano Marcos Memorial State University, Philippines
Afiliasi	Seluruh penulis dari Pendidikan Kimia FKIP UKI	6 penulis dari UKI + 1 penulis dari Filipina
Nama jurnal	Belum diarahkan ke jurnal tertentu	Sudah menggunakan template Jurnal Pendidikan Sains Indonesia (JPSI)
Abstrak	Lebih bersifat laporan kegiatan/FGD	Lebih akademik dan menegaskan qualitative descriptive method, 54 siswa, total sampling, observasi, wawancara, dan kuesioner
Metode	FGD sebagai metode utama	Dikembangkan menjadi qualitative descriptive research dengan observation, interview, questionnaire, documentation
Subjek penelitian	Siswa kelas XI SMA Don Bosco 1 Jakarta	54 siswa kelas XI, dengan teknik total sampling
Instrumen	3 kategori, 10 pernyataan	Tetap 3 kategori dan 10 pernyataan, tetapi sudah disusun dalam Table 1 Research Instrument
Pengumpulan data	Presentasi → diskusi → simulasi → Google Form	Ditambah penjelasan sistematis mengenai observasi, wawancara, kuesioner, dan dokumentasi
Analisis data	Belum dijelaskan secara sistematis	Sudah menggunakan data reduction, data presentation, conclusion drawing
Hasil	Berupa uraian jawaban siswa	Sudah dibuat Table 1. Participant responses per category dan uraian hasil
Pembahasan	Belum ada bagian pembahasan yang berdiri sendiri	Ditambahkan pembahasan akademik mengenai contextual chemistry learning, environmental care character, socioscientific issues, implications, dan comparison with previous research
Kebaruan/kontribusi	Belum terlalu terlihat	Lebih ditegaskan bahwa penelitian memberikan kontribusi melalui descriptive qualitative approach
Kesimpulan	Fokus pada kesadaran lingkungan dan food waste	Lebih diarahkan pada efektivitas “A Plate of Food” sebagai media pembelajaran kimia untuk penguatan karakter peduli lingkungan

Participants

Editor in Chief (gani)

Familia Simanjuntak (familia26)

Messages	
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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

Familia Novita Simanjuntak^{1*}, Leoni Sanga Lamsari Purba², St. Fatimah Azzahra³, Nova Irawati Simatupang⁴, Elferida Sormin⁵, Putri Anjani⁶.

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Article History:

Received date:
Received in revised from:
Accepted date:
Available online:

Citation:

Manyak, A.K., Budiman, T., Meutuwah, A., & Rayeuk, M. (20xx). The Importance of Knowledge about Disaster Management from an Early Age for Students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, xx(x), xx-xx

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Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "A Plate of Food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "A Plate of Food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "A Plate of Food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: chemistry education, environmental care character, learning media, A Plate of Food, qualitative research

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Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Learning media can be used as a tool in teaching and learning activities in the school environment (Nurfadhillah et al., 2021). The school environment is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner so as to achieve maximum results for both educators and students (Anggraini, 2017). The environment provides all human needs, such as food, drink, oxygen, and other life needs. So that humans always take advantage of the environment to meet basic needs and improve the quality of their lives. The school environment has a significant influence on the learning process and learning success both directly and indirectly. A supportive school environment is absolutely necessary to enable a quality learning process (Islamic & 2020, n.d.).

On February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Pendidikan & 2013, 2013). In accordance with the Environmental Regulation Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, which aims to create environmentally sound schools and foster an environmental culture. This implementation is based on three principles: educative, participatory, and sustainable (Latief et al., 2019). The Adiwiyata program is a step towards creating a school dedicated to educating students who value and foster an environmental culture (Fadlillah et al., 2018). A person's character needs to be developed in three stages: knowledge, practice, and habit (Aini et al., 2014). The character of environmental care is one of the aspects that must be implemented at all levels of education in schools. All school members must realize the importance of environmental protection and take steps to prevent environmental damage (Pedagogik et al., n.d.). The character of environmental care is an attitude that a person must have in order to develop and manage the environment so that it can be enjoyed indefinitely without causing environmental damage and is long-term (Hasanah et al., n.d.). The character of environmental care must be instilled regularly through learning, habituation, and exemplary behavior (Khotimah et al., 2019).

The character of environmental care cannot grow just like that, but it must be pursued continuously from an early age through real activities that are close to everyday life (Masturoh et al., 2020). To foster the character of environmental care, the most strategic step is through education. Realizing this, the school as an educational forum needs to instill and develop students' concern for the environment from an early age so that human resources are formed who can wisely utilize their potential in acting to create a conducive, ecological, sustainable environmental quality in a real and sustainable manner, of course in ways that are sympathetic, creative, and innovative by adhering to local cultural values and wisdom (Islam & 2018, n.d.). Improving the quality of education is highly dependent on the quality of human resources, especially teachers as a key component in the school environment (Sudjana et al., n.d.). A good teacher is a teacher who teaches professionally and must not only be able to teach well but must also be able to teach and be a role model for students. All teacher actions (both words and actions) are usually imitated by students. Teachers are not only in charge of conveying knowledge to students but can also help develop student character. The character of caring for the environment that is taught, such as teaching and reminding children not to litter and reminding children not to leave food.

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Food waste has a considerable impact on the environment, both directly and indirectly (Amelia et al., n.d.). Therefore, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste has a direct impact on the environment, both through the waste of natural resources and as a contribution to pollution and climate change. The character of caring for the environment is closely related to the awareness to reduce food waste and manage food waste in a more sustainable way, such as by recycling it into compost or sharing it with others (Sirfiandi, R. (2022). *Eksistensi Bank Sampah Dalam...* - Google Scholar, n.d.). A plate of food can be a learning medium or symbol that explains food consumption patterns in everyday life. A plate of food as part of human daily life can act as an educational medium that has a positive effect on pro-environmental habits or behavior. The application of the role of a plate of food can foster the character of environmental care; for example, the interpretation of a plate of food helps humans determine the nutritional content and the best portion to support their health and quality of life. In addition, a plate of food can involve the wearer in making decisions that save the earth. A plate of food acts as a data bank and can be chemistry learning material (Simanjuntak, 2020) to encourage active community participation in converting food waste into renewable energy (Jude et al., 2022). Chemistry is the study of matter and its changes. Chemistry is studied and developed based on experiments. There are three things that cannot be separated when studying chemistry, namely chemistry as a process (scientific results), attitude, and knowledge (concepts, facts, laws, principles, and theories). Chemistry is often considered a difficult subject by students because it is abstract and full of complex concepts compared to other subjects (MZ & Rahmawati, 2019). Chemical concepts basically utilize or cover three inseparable aspects of study: macroscopic (observable properties), submicroscopic (particles that make up a substance), and symbolic (chemical formulas and other chemical symbols).

One alternative learning innovation that can be implemented is the use of contextual learning media, such as "A Plate of Food." This learning media highlights the theme of food as part of students' daily lives and links it to concepts of food chemistry, substance composition, chemical reactions, and the impact of food management on the environment. A contextual approach through real-life learning media has been shown to improve conceptual understanding and raise students' awareness of environmental issues (King et al., 2012). The use of "A Plate of Food" in chemistry lessons is expected to encourage students to understand the relationship between food choices, the chemical processes involved, and their consequences on the environment, such as the formation of food waste and pollution. Through this learning process, students not only learn theoretical chemistry concepts but also develop a caring attitude toward the environment through reflection and meaningful learning experiences. Learning media that are relevant to everyday life can help students develop critical awareness and responsibility for the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco High School, chemistry lessons have not yet fully integrated explicit environmental character education. Students tend to understand chemistry as an abstract concept separate from everyday life, resulting in underdevelopment of environmental values. This situation indicates the need for efforts to provide more contextual chemistry lessons that are oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "A Plate of Food" learning media in chemistry education can improve the environmental awareness of 11th grade students at Don Bosco Senior High School. This study used a qualitative descriptive approach to describe changes in students' attitudes and awareness of the environment through a contextual learning process. It is hoped that the results of this study can contribute to the development of chemistry learning that not only focuses on cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "A Plate of Food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The Research Instrument.

No	Category	Statement
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2.	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3.	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data Collection Techniques

Data collection in this study was conducted using several techniques, namely:

1. Observation

Observations were conducted during the chemistry learning process using the "A Plate of Food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the learning activities.

2. Interviews

Semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes.

3. Questionnaire

A questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning.

4. Documentation

Documentation was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data Analysis Techniques

Data analysis was conducted qualitatively using the following stages:

1. Data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation.
2. Data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze.
3. Conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

Findings

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher as a data in table 2.

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Table 1. Participant responses per category

No	Category	Statement	Participant Respont
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food?	Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability. The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience. In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These

		findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by habits, personal preferences, and various social and emotional factors.
	4. Based on your experience, what kind of food makes you (happy) to finish your meal?	Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience.
2. Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly!	From the 54 students as respondents, there were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students

	thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly.
2. What do you think we should do with our leftover food?	According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability
3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why	Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action.
4. Based on your knowledge and information obtained from	Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food

	social media, what are the impacts of food waste? Please name three impacts	waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations
3. Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?	The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste. Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future.

Discussion

This study aimed to explore how the application of "A Plate of Food" as a learning medium in chemistry education contributes to the development of students' environmental care character, particularly in relation to food waste awareness. The discussion interprets the research findings by linking them to relevant theories of contextual learning, character education, and environmental education.

Contextual Chemistry Learning and Student Engagement

The findings indicate that the use of "A Plate of Food" successfully created a more contextual and meaningful chemistry learning experience. By connecting chemical concepts to students' daily experiences with food consumption, students became more actively involved in classroom discussions and reflective activities. This supports the principles of context-based learning, which emphasize that students learn more effectively when scientific concepts are presented within real-life situations that are familiar and relevant to them. Increased engagement observed during the learning process suggests that contextual media can bridge the gap between abstract chemical concepts and practical environmental issues.

Development of Environmental Care Character through Food Waste Awareness

The results show a positive shift in students' attitudes toward food waste after participating in the learning activities. Students demonstrated an increased awareness that food waste is not merely a personal habit but a broader environmental problem with ecological, economic, and social consequences. Their ability to articulate the impacts of food waste—such as increased waste accumulation, environmental pollution, and resource depletion—indicates the development of environmental literacy. This finding aligns with character education theory, which posits that moral knowledge, moral feelings, and moral actions are interconnected stages in character formation.

Students' Responses as Indicators of Attitudinal Change

Analysis of students' responses to open-ended questions revealed that most students believed food should not be wasted and expressed a willingness to take action, such as finishing their meals, sharing leftover food, or reminding others not to waste food. These responses suggest an internalization of environmental care values rather than mere compliance with classroom rules. The willingness to reprimand others politely and the desire to be involved in reducing food waste reflect the emergence of responsibility and social awareness—key components of environmental care character.

Chemistry Education and Socioscientific Issues

Integrating food waste as a socioscientific issue within chemistry learning helped students understand the relevance of chemistry to environmental sustainability. Through discussions on food composition, chemical processes in food preparation, and waste management, students were able to connect chemical knowledge with real-world environmental challenges. This supports previous findings that socioscientific issue-based learning can enhance not only conceptual understanding but also students' ethical reasoning and decision-making skills related to environmental problems.

Implications for Chemistry Education Practice

The findings of this study suggest that chemistry education can play a significant role in character education when supported by appropriate learning media. The use of "*A Plate of Food*" demonstrates that simple, context-rich media can encourage students to reflect on their daily behaviors and their environmental impact. For chemistry teachers, this implies the importance of designing learning experiences that integrate chemical concepts with environmental and sustainability issues, thereby fostering both cognitive and affective learning outcomes.

Comparison with Previous Research

The findings of this study are consistent with previous research emphasizing the effectiveness of contextual and environmental-based learning in science education. Several studies have reported that integrating real-life contexts into chemistry learning can enhance students' engagement and environmental awareness. (Sevian et al., 2018) found that context-based chemistry learning helps students connect abstract chemical concepts with everyday phenomena, leading to deeper understanding and more meaningful learning experiences. Similarly, (King et al., 2012) reported that context-rich science instruction promotes students' ability to relate scientific knowledge to real-world environmental issues. In terms of character and environmental education, the results of this study align with the findings of (MacIntyre et al., 2024), who emphasized that effective environmental education should not only increase knowledge but also foster attitudes and behaviors that support sustainability. The students' increased awareness of food waste and their willingness to take action reflect the stages of character development described by (Kurniawan et al., 2017), which include moral knowing, moral feeling, and moral action. This suggests that the use of "*A Plate of Food*" successfully facilitated the internalization of environmental care values, similar to outcomes reported in earlier character education studies.

Furthermore, this study supports research on socioscientific issue-based learning. (Hazari et al., 2013) demonstrated that learning activities centered on socioscientific issues, such as environmental and sustainability problems, can enhance students' moral reasoning and decision-making skills. In line with Sadler's findings, students in this study were able to articulate the environmental impacts of food waste and express a commitment to reducing it, indicating the development of both cognitive and affective learning outcomes.

Compared to previous studies that primarily employed quantitative or quasi-experimental designs, this research contributes additional insight through a descriptive qualitative approach. By analyzing students' open-ended responses, observations, and interviews, this study provides a more nuanced understanding of how environmental care character develops through chemistry learning. This qualitative depth complements earlier findings and highlights the value of qualitative methods in character and environmental education research.

Overall, this discussion highlights that the application of "A Plate of Food" as a learning medium in chemistry education is effective in promoting students' environmental care character and is consistent with, as well as supportive of, existing research in contextual learning, environmental education, and character development.

Conclusion

This study concludes that the use of "A Plate of Food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "A Plate of Food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

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Article History:

Received date:
Received in revised from:
Accepted date:
Available online:

Citation:

Manyak, A.K., Budiman, T., Meutuwha, A., & Rayeuk, M. (20xx). The Importance of Knowledge about Disaster Management from an Early Age for Students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, xx(x), xx-xx

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Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "A Plate of Food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "A Plate of Food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "A Plate of Food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: chemistry education, environmental care character, learning media, A Plate of Food, qualitative research

Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Learning media can be used as a tool in teaching and learning activities in the school environment (Nurfadhillah et al., 2021; Starr & Riemann, 2022). The school environment is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner so as to achieve maximum results for both educators and students (Anggraini, 2017). The environment provides all human needs, such as food, drink, oxygen, and other life needs. So that humans always take advantage of the environment to meet basic needs and improve the quality of their lives (Aversa et al., 2016). The school environment has a significant influence on the learning process and learning success both directly and indirectly. A supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020).

On February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Isnaeni, 2013). In accordance with the Environmental Regulation Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, which aims to create environmentally sound schools and foster an environmental culture. This implementation is based on three principles: educative, participatory, and sustainable (Latief et al., 2019). The Adiwiyata program is a step towards creating a school dedicated to educating students who value and foster an environmental culture (Fadlillah et al., 2018). A person's character needs to be developed in three stages: knowledge, practice, and habit (Aini et al., 2014). The character of environmental care is one of the aspects that must be implemented at all levels of education in schools. All school members must realize the importance of environmental protection and take steps to prevent environmental damage (Purwanti, 2017). The character of environmental care is an attitude that a person must have in order to develop and manage the environment so that it can be enjoyed indefinitely without causing environmental damage and is long-term (Bonnett, 2018). The character of environmental care must be instilled regularly through learning, habituation, and exemplary behavior (Khotimah et al., 2019; Riyanto et al., 2023).

The character of environmental care cannot grow just like that, but it must be pursued continuously from an early age through real activities that are close to everyday life (Masturoh et al., 2020). To foster the character of environmental care, the most strategic step is through education. Realizing this, the school as an educational forum needs to instill and develop students' concern for the environment from an early age so that human resources are formed who can wisely utilize their potential in acting to create a conducive, ecological, sustainable environmental quality in a real and sustainable manner, of course in ways that are sympathetic, creative, and innovative by adhering to local cultural values and wisdom (Qutni et al., 2021). Improving the quality of education is highly dependent on the quality of human resources, especially teachers as a key component in the school environment. A good teacher is a teacher who teaches professionally and must not only be able to teach well but must also be able to teach and be a role model for students. All teacher actions (both words and actions) are usually imitated by students. Teachers are not only in charge of conveying knowledge to students but can also help develop student

character. The character of caring for the environment that is taught, such as teaching and reminding children not to litter and reminding children not to leave food.

Food waste has a considerable impact on the environment, both directly and indirectly (Amelia et al., 2019). Therefore, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste has a direct impact on the environment, both through the waste of natural resources and as a contribution to pollution and climate change. The character of caring for the environment is closely related to the awareness to reduce food waste and manage food waste in a more sustainable way, such as by recycling it into compost or sharing it with others (Sirfiandi, 2022). A plate of food can be a learning medium or symbol that explains food consumption patterns in everyday life. A plate of food as part of human daily life can act as an educational medium that has a positive effect on pro-environmental habits or behavior. The application of the role of a plate of food can foster the character of environmental care; for example, the interpretation of a plate of food helps humans determine the nutritional content and the best portion to support their health and quality of life. In addition, a plate of food can involve the wearer in making decisions that save the earth (Metekohy et al., 2022). A plate of food acts as a data bank and can be chemistry learning material (Simanjuntak, 2020) to encourage active community participation in converting food waste into renewable energy (Jude et al., 2022). Chemistry is the study of matter and its changes. Chemistry is studied and developed based on experiments. There are three things that cannot be separated when studying chemistry. namely chemistry as a process (scientific results), attitude, and knowledge (concepts, facts, laws, principles, and theories). Chemistry is often considered a difficult subject by students because it is abstract and full of complex concepts compared to other subjects (MZ & Rahmawati, 2019). Chemical concepts basically utilize or cover three inseparable aspects of study: macroscopic (observable properties), submicroscopic (particles that make up a substance), and symbolic (chemical formulas and other chemical symbols).

One alternative learning innovation that can be implemented is the use of contextual learning media, such as "A Plate of Food." This learning media highlights the theme of food as part of students' daily lives and links it to concepts of food chemistry, substance composition, chemical reactions, and the impact of food management on the environment. A contextual approach through real-life learning media has been shown to improve conceptual understanding and raise students' awareness of environmental issues (King et al., 2012). The use of "A Plate of Food" in chemistry lessons is expected to encourage students to understand the relationship between food choices, the chemical processes involved, and their consequences on the environment, such as the formation of food waste and pollution. Through this learning process, students not only learn theoretical chemistry concepts but also develop a caring attitude toward the environment through reflection and meaningful learning experiences. Learning media that are relevant to everyday life can help students develop critical awareness and responsibility for the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco High School, chemistry lessons have not yet fully integrated explicit environmental character education. Students tend to understand chemistry as an abstract concept separate from everyday life, resulting in underdevelopment of environmental values. This situation indicates the need for efforts to provide more contextual chemistry lessons that are oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "A Plate of Food" learning media in chemistry education can improve the environmental awareness of 11th grade students at Don Bosco Senior High School. This study used a qualitative descriptive approach to describe changes in students' attitudes and awareness of the environment through a contextual learning process. It is hoped that the results of this study can contribute to the development of chemistry learning that not only focuses on

cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "A Plate of Food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The Research Instrument.

No	Category	Statement
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2.	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3.	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data Collection Techniques

Data collection in this study was conducted using several techniques, namely:

1. Observation

Observations were conducted during the chemistry learning process using the "A Plate of Food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the learning activities.

2. Interviews

Semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes.

3. Questionnaire

A questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning.

4. Documentation

Documentation was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data Analysis Techniques

Data analysis was conducted qualitatively using the following stages:

1. Data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation.
2. Data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze.
3. Conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher.

The first criterion is **the food menu that students want**. This category consists of 4 statements, namely:

1. **What was the last meal you had today?**

Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to

obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability. The study found that 88% of students considered multiple factors when choosing food, including mood, taste, aroma, appearance, nutritional value, texture, price, and calorie content. This indicates that food choice among students is a multidimensional decision-making process. From a descriptive qualitative standpoint, students do not rely solely on taste preferences but negotiate between emotional states, health awareness, and practical considerations. This complexity reflects what (Vermeir & Verbeke, 2006) describe as the interaction between personal values, situational factors, and behavioral intentions in sustainable consumption. Such complexity may explain why mismatches between expectations and actual food experience sometimes result in unfinished meals and food waste

2. Did you finish your last meal? Why?

The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience. Most students stated that they finished their last meal. The reasons given included the food being nutritious, having good taste, and representing appreciation for their mother's cooking. These responses indicate that finishing food is not merely a physical response to hunger but is also shaped by emotional and social values. Qualitatively, this finding suggests that food consumption is embedded within moral and relational contexts. Gratitude toward the person who prepared the meal and the perceived value of food encourage students to finish what they eat. This aligns with findings by (Stancu et al., 2016) who noted that emotional attachment and perceived value of food significantly reduce the likelihood of food waste.

3. In general, people choose food based on its taste. How do you choose your food?

In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by habits, personal preferences, and various social and emotional factors. The study found that 88% of students considered multiple factors when choosing food, including mood, taste, aroma, appearance, nutritional value, texture, price, and calorie content. This indicates that food choice among students is a multidimensional decision-making process.

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the interaction between personal values, situational factors, and behavioral intentions in sustainable consumption. Such complexity may explain why mismatches between expectations and actual food experience sometimes result in unfinished meals and food waste

4. Based on your experience, what kind of food makes you (happy) to finish your meal?

Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience. Students reported that they were most likely to finish foods that tasted good, matched their personal preferences, looked appealing, were their favorites, and were perceived as healthy. These responses emphasize that satisfaction in eating is influenced by both sensory and emotional factors. This finding supports the view that food functions beyond fulfilling physiological needs, serving also as a source of emotional satisfaction. According to (Schanes et al., 2018), positive eating experiences significantly reduce food waste, as satisfaction increases the likelihood that food will be consumed fully. Thus, food enjoyment plays a critical role in shaping waste-related behavior

In the second criterion, **students' responses about the action of disposing of food waste**. This category consists of 4 statements, namely:

1. In your opinion, should we throw away food? Why?

Please explain briefly! In this question, there are 54 students as respondents. There were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly. Qualitatively, this finding reveals a moral divide between individual preference and collective responsibility. While some students justify waste based on personal satisfaction, most perceive food as a valuable resource that should not be discarded carelessly. This perception aligns with the argument by (Gustavsson et al., 2011) that food waste is increasingly understood as an ethical and environmental issue rather than merely a personal choice.

2. What do you think we should do with our leftover food?

According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability. This finding indicates that students possess practical knowledge about waste reduction strategies, even if such strategies are not consistently practiced. As noted by (Aschemann-Witzel et al., 2015), awareness of food waste solutions does not always translate into behavior, highlighting the gap between knowledge and action in food consumption practices.

3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why

Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action. This reluctance illustrates a social barrier to collective action. Although students disapprove of food waste, they tend to avoid social intervention. This finding reflects the attitude-behavior gap described by (Vermeir & Verbeke, 2006), where individuals support sustainable values but hesitate to act when social risks or discomfort are involved

4. Based on your knowledge and information gained from social media, what are the impacts of food waste? Please name three impacts

Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations. This awareness is consistent with global discussions on food waste as a contributor to environmental degradation and climate change (Hall et al., 2009). Qualitatively, students view food waste as a systemic problem with long-term consequences, rather than an isolated individual behavior.

The third criterion is **students' expectations and involvement in reducing food waste**. This category consists of 2 statements, namely:

1. What do you expect from yourself regarding the condition of food waste that occurs in Indonesia

The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste. Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security.

2. Are you willing to be involved in food waste reduction? Why

Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future. Finishing food can be a strong foundation and not only relates to healthy eating habits but also has a big impact on environmental character building, especially for students in schools. It can be part of a broader character education where students are taught to value natural resources, understand the social and environmental impacts of their actions, and encourage them to have a responsible attitude towards food consumption. In the school context, the implementation of this habit can contribute to the formation of students who are more environmentally conscious and more concerned about social issues around them. Students expressed hopes that food waste in Indonesia would decrease and that society would become more educated and aware of its negative impacts. All respondents stated that they were willing to be involved in reducing food waste, citing environmental, social, and economic reasons. This finding reflects a strong sense of moral responsibility and readiness for participation. According to (Schanes et al., 2018) young people's willingness to engage in food waste reduction is a critical foundation for developing sustainable food systems. However, this willingness must be supported by structural interventions and social norms to result in lasting behavioral change.

Conclusion

This study concludes that the use of "A Plate of Food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "A Plate of Food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

Article History:

Received date:
Received in revised from:
Accepted date:
Available online:

Citation:

XXX. (20xx). The Importance of Knowledge about Disaster Management from an Early Age for Students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, xx(x), xx-xx

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Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "A Plate of Food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "A Plate of Food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "A Plate of Food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: chemistry education, environmental care character, learning media, A Plate of Food, qualitative research

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Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Learning media can be used as a tool in teaching and learning activities in the school environment (Nurfadhillah et al., 2021; Starr & Riemann, 2022). The school environment is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner so as to achieve maximum results for both educators and students (Anggraini, 2017). The environment provides all human needs, such as food, drink, oxygen, and other life needs. So that humans always take advantage of the environment to meet basic needs and improve the quality of their lives (Aversa et al., 2016). The school environment has a significant influence on the learning process and

learning success both directly and indirectly. A supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020).

On February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Isnaeni, 2013). In accordance with the **Environmental Regulation Number 5 of 2013** concerning Guidelines for the Implementation of the Adiwiyata Program, which aims to create environmentally sound schools and foster an environmental culture. This implementation is based on three principles: educative, participatory, and sustainable (Latief et al., 2019). The Adiwiyata program is a step towards creating a school dedicated to educating students who value and foster an environmental culture (Fadlillah et al., 2018). A person's character needs to be developed in three stages: knowledge, practice, and habit (Aini et al., 2014). The character of environmental care is one of the aspects that must be implemented at all levels of education in schools. All school members must realize the importance of environmental protection and take steps to prevent environmental damage (Purwanti, 2017). The character of environmental care is an attitude that a person must have in order to develop and manage the environment so that it can be enjoyed indefinitely without causing environmental damage and is long-term (Bonnett, 2018). The character of environmental care must be instilled regularly through learning, habituation, and exemplary behavior (Khotimah et al., 2019; Riyanto et al., 2023).

The character of environmental care cannot grow just like that, but it must be pursued continuously from an early age through real activities that are close to everyday life (Masturoh et al., 2020). To foster the character of environmental care, the most strategic step is through education. Realizing this, the school as an educational forum needs to instill and develop students' concern for the environment from an early age so that human resources are formed who can wisely utilize their potential in acting to create a conducive, ecological, sustainable environmental quality in a real and sustainable manner, of course in ways that are sympathetic, creative, and innovative by adhering to local cultural values and wisdom (Qutni et al., 2021). Improving the quality of education is highly dependent on the quality of human resources, especially teachers as a key component in the school environment. A good teacher is a teacher who teaches professionally and must not only be able to teach well but must also be able to teach and be a role model for students. All teacher actions (both words and actions) are usually imitated by students. Teachers are not only in charge of conveying knowledge to students but can also help develop student character. The character of caring for the environment that is taught, such as teaching and reminding children not to litter and reminding children not to leave food.

Food waste has a considerable impact on the environment, both directly and indirectly (Amelia et al., 2019). Therefore, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste has a direct impact on the environment, both through the waste of natural resources and as a contribution to pollution and climate change. The character of caring for the environment is closely related to the awareness to reduce food waste and manage food waste in a more sustainable way, such as by recycling it into compost or sharing it with others (Sirfiandi, 2022). A plate of food can be a learning medium or symbol that explains food consumption patterns in everyday life. A plate of food as part of human daily life can act as an educational medium that has a positive effect on pro-environmental habits or behavior. The application of the role of a plate of food can foster the character of environmental care; for example, the interpretation of a plate of food helps humans determine the nutritional content and the best portion to support their health and quality of life. In addition, a plate of food can involve the wearer in making decisions that save the earth (Metekohy et al., 2022). A plate of food acts as a data bank and can be chemistry learning material (Simanjuntak, 2020) to encourage active community participation in converting food waste into renewable energy (Jude et al., 2022). Chemistry is the study of matter and its changes. Chemistry is

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studied and developed based on experiments. There are three things that cannot be separated when studying chemistry. namely chemistry as a process (scientific results), attitude, and knowledge (concepts, facts, laws, principles, and theories). Chemistry is often considered a difficult subject by students because it is abstract and full of complex concepts compared to other subjects (MZ & Rahmawati, 2019). Chemical concepts basically utilize or cover three inseparable aspects of study: macroscopic (observable properties), submicroscopic (particles that make up a substance), and symbolic (chemical formulas and other chemical symbols).

One alternative learning innovation that can be implemented is the use of contextual learning media, such as "A Plate of Food." This learning media highlights the theme of food as part of students' daily lives and links it to concepts of food chemistry, substance composition, chemical reactions, and the impact of food management on the environment. A contextual approach through real-life learning media has been shown to improve conceptual understanding and raise students' awareness of environmental issues (King et al., 2012). The use of "A Plate of Food" in chemistry lessons is expected to encourage students to understand the relationship between food choices, the chemical processes involved, and their consequences on the environment, such as the formation of food waste and pollution. Through this learning process, students not only learn theoretical chemistry concepts but also develop a caring attitude toward the environment through reflection and meaningful learning experiences. Learning media that are relevant to everyday life can help students develop critical awareness and responsibility for the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco High School, chemistry lessons have not yet fully integrated explicit environmental character education. Students tend to understand chemistry as an abstract concept separate from everyday life, resulting in underdevelopment of environmental values. This situation indicates the need for efforts to provide more contextual chemistry lessons that are oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "A Plate of Food" learning media in chemistry education can improve the environmental awareness of 11th grade students at Don Bosco Senior High School. This study used a qualitative descriptive approach to describe changes in students' attitudes and awareness of the environment through a contextual learning process. It is hoped that the results of this study can contribute to the development of chemistry learning that not only focuses on cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "A Plate of Food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The Research Instrument.

No	Category	Statement
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1. Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2. Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3. Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data Collection Techniques

Data collection in this study was conducted using several techniques, namely:

1. Observation

Observations were conducted during the chemistry learning process using the "A Plate of Food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the learning activities.

2. Interviews

Semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes.

3. Questionnaire

A questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning.

4. Documentation

Documentation was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data Analysis Techniques

Data analysis was conducted qualitatively using the following stages:

1. Data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation.
2. Data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze.
3. Conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher.

The first criterion is **the food menu that students want**. This category consists of 4 statements, namely:

1. What was the last meal you had today?

Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability. The study found that 88% of students considered multiple factors when choosing food, including mood, taste, aroma, appearance, nutritional value, texture, price, and calorie content. This indicates that food choice among students is a multidimensional decision-making process. From a descriptive qualitative standpoint, students do not rely solely on taste preferences but negotiate between emotional states, health awareness, and practical considerations. This complexity reflects what (Vermeir & Verbeke, 2006) describe as the interaction between personal values, situational factors, and behavioral intentions in sustainable consumption. Such complexity may explain why mismatches between expectations and actual food experience sometimes result in unfinished meals and food waste

2. Did you finish your last meal? Why?

The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking).

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Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience. Most students stated that they finished their last meal. The reasons given included the food being nutritious, having good taste, and representing appreciation for their mother's cooking. These responses indicate that finishing food is not merely a physical response to hunger but is also shaped by emotional and social values. Qualitatively, this finding suggests that food consumption is embedded within moral and relational contexts. Gratitude toward the person who prepared the meal and the perceived value of food encourage students to finish what they eat. This aligns with findings by (Stancu et al., 2016) who noted that emotional attachment and perceived value of food significantly reduce the likelihood of food waste.

3. In general, people choose food based on its taste. How do you choose your food?

In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by habits, personal preferences, and various social and emotional factors. The study found that 88% of students considered multiple factors when choosing food, including mood, taste, aroma, appearance, nutritional value, texture, price, and calorie content. This indicates that food choice among students is a multidimensional decision-making process.

From a descriptive qualitative standpoint, students do not rely solely on taste preferences but negotiate between emotional states, health awareness, and practical considerations. This complexity reflects what (Vermeir & Verbeke, 2006) describe as the interaction between personal values, situational factors, and behavioral intentions in sustainable consumption. Such complexity may explain why mismatches between expectations and actual food experience sometimes result in unfinished meals and food waste

4. Based on your experience, what kind of food makes you (happy) to finish your meal?

Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience.

Students reported that they were most likely to finish foods that tasted good, matched their personal preferences, looked appealing, were their favorites, and were perceived as healthy. These responses emphasize that satisfaction in eating is influenced by both sensory and emotional factors. This finding supports the view that food functions beyond fulfilling physiological needs, serving also as a source of emotional satisfaction. According to (Schanes et al., 2018), positive eating experiences significantly reduce food waste, as satisfaction increases the likelihood that food will be consumed fully. Thus, food enjoyment plays a critical role in shaping waste-related behavior

In the second criterion, **students' responses about the action of disposing of food waste**. This category consists of 4 statements, namely:

1. In your opinion, should we throw away food? Why?

Please explain briefly! In this question, there are 54 students as respondents. There were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly. Qualitatively, this finding reveals a moral divide between individual preference and collective responsibility. While some students justify waste based on personal satisfaction, most perceive food as a valuable resource that should not be discarded carelessly. This perception aligns with the argument by (Gustavsson et al., 2011) that food waste is increasingly understood as an ethical and environmental issue rather than merely a personal choice.

2. What do you think we should do with our leftover food?

According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability. This finding indicates that students possess practical knowledge about waste reduction strategies, even if such strategies are not consistently practiced. As noted by (Aschemann-Witzel et al., 2015), awareness of food waste solutions does not always translate into behavior, highlighting the gap between knowledge and action in food consumption practices.

3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why

Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action. This reluctance illustrates a social barrier to collective action. Although students disapprove of food waste, they tend to avoid social intervention. This finding reflects the attitude-behavior gap described by (Vermeir & Verbeke, 2006), where individuals support sustainable values but hesitate to act when social risks or discomfort are involved

4. Based on your knowledge and information gained from social media, what are the impacts of food waste? Please name three impacts

Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations. This awareness is consistent with global discussions on food waste as a contributor to environmental degradation and climate change (Hall et al., 2009). Qualitatively, students view food waste as a systemic problem with long-term consequences, rather than an isolated individual behavior.

The third criterion is **students' expectations and involvement in reducing food waste**. This category consists of 2 statements, namely:

1. What do you expect from yourself regarding the condition of food waste that occurs in Indonesia

The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste. Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security.

2. Are you willing to be involved in food waste reduction? Why

Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future. Finishing food can be a strong foundation and not only relates to healthy eating habits but also has a big impact on environmental character building, especially for students in schools. It can be part of a broader character education where students are

taught to value natural resources, understand the social and environmental impacts of their actions, and encourage them to have a responsible attitude towards food consumption. In the school context, the implementation of this habit can contribute to the formation of students who are more environmentally conscious and more concerned about social issues around them. Students expressed hopes that food waste in Indonesia would decrease and that society would become more educated and aware of its negative impacts. All respondents stated that they were willing to be involved in reducing food waste, citing environmental, social, and economic reasons. This finding reflects a strong sense of moral responsibility and readiness for participation. According to (Schanes et al., 2018) young people's willingness to engage in food waste reduction is a critical foundation for developing sustainable food systems. However, this willingness must be supported by structural interventions and social norms to result in lasting behavioral change.

Conclusion

This study concludes that the use of "A Plate of Food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "A Plate of Food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

Article History:

Received date:
Received in revised from:
Accepted date:
Available online:

Citation:

Manyak, A.K., Budiman, T., Meutuwah, A., & Rayeuk, M. (20xx). The Importance of Knowledge about Disaster Management from an Early Age for Students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, xx(x), xx-xx

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Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "a plate of food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "a plate of food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "a plate of food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: chemistry education, environmental care character, learning media, a plate of food, qualitative research

Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Therefore, learning media can be used as an important tool in teaching and learning activities within the school environment (Nurfadhillah et al., 2021).

The school environment itself is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner in order to achieve maximum results for both educators and students (Anggraini, 2017). In a broader context, the environment provides all human needs, such as food, drink, oxygen, and other necessities of life. Consequently, humans continuously utilize the environment to meet basic needs and improve their quality of life. In this regard, the school environment has a significant influence on the learning process

and learning outcomes, both directly and indirectly. Thus, a supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020).

As a response to the importance of environmental awareness within educational settings, on February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Wardani, 2020). In accordance with Environmental Regulation Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, this program aims to create environmentally sound schools and foster an environmental culture. The implementation of the Adiwiyata program is based on three main principles, namely educative, participatory, and sustainable principles (Latief et al., 2019). Through these principles, the Adiwiyata program serves as a concrete step toward creating schools that are dedicated to educating students who value and actively cultivate an environmental culture (Fadlillah et al., 2018).

In line with the objectives of environmentally oriented education, a person's character needs to be developed through three stages: knowledge, practice, and habit (Aini et al., 2014). For students who are still in the developmental stage, this process requires a more intensive approach, such as individual mentoring, the provision of role models by teachers and peers, and the implementation of experiential learning methods to enhance the understanding and application of values (Andayani, 2025). One important character value that needs to be developed is environmental care, which should be implemented at all levels of education in schools. Accordingly, all school members need to be aware of the importance of environmental protection and take concrete steps to prevent environmental damage (Purwanti, 2017). An environmentally conscious character reflects an attitude that enables individuals to manage and preserve the environment sustainably without causing long-term damage (Hasanah & Afianah, 2021). Therefore, the character of environmental care must be consistently instilled through learning activities, habituation, and exemplary behavior (Pane, 2016).

However, the character of environmental care does not develop automatically; rather, it must be cultivated continuously from an early age through real activities that are closely related to everyday life (Masturoh et al., 2020). Education plays a strategic role in fostering this character. Recognizing this role, schools as educational institutions need to instill and develop students' concern for the environment from an early stage. Through this effort, human resources can be formed who are able to utilize their potential wisely in creating a conducive, ecological, and sustainable environmental quality in real and lasting ways, while still adhering to local cultural values and wisdom (Arisona, 2022).

The effectiveness of education is greatly influenced by the quality of human resources, particularly teachers, who are a key component of the school environment (Sudjana & Wijayanti, 2018). Teachers are not only required to professionally master teaching skills but also to serve as role models for their students. According to Simanjuntak et al. (2023), chemistry teachers need to provide more space for students to express the difficulties and doubts they experience during the learning process. This is important because teachers' words and behavior are often imitated by students, making teachers central figures not only in the transfer of knowledge but also in shaping students' character. Various perspectives emphasize the importance of character education, which receives strong cultural and professional attention (Chowdhury, 2018). One concrete form of character education is cultivating environmental awareness, which can be instilled through consistent guidance from teachers, such as reminding students not to litter and to reduce food waste (Astari, 2018).

In this context, food waste emerges as a relevant environmental issue, as it has a considerable impact on the environment both directly and indirectly (Amelia et al., 2019). Consequently, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste contributes to environmental degradation through the waste of natural resources and its role in pollution and climate change. Therefore, the development of environmental care character is closely linked to awareness of reducing food waste and managing it in more sustainable ways, such as recycling it into compost or sharing it with others (Oktarina, 2021).

One contextual approach that connects daily behavior with environmental awareness is the use of a plate of food as a learning medium or symbol that explains food consumption patterns in everyday life. As part of human daily activities, a plate of food can function as an educational medium that positively influences pro-environmental habits and behaviors. The interpretation of a plate of food can foster environmental care character by helping individuals determine appropriate nutritional content and portion sizes that support health and quality of life, while also encouraging decisions that contribute to environmental preservation. Furthermore, a plate of food can serve as a data bank and a source of chemistry learning material (Simanjuntak, 2020), as well as a medium to encourage active community participation in converting food waste into renewable energy (Chen, 2023).

From a scientific perspective, chemistry is the study of matter and its changes and is developed through experimental processes. In learning chemistry, three inseparable aspects are involved, namely chemistry as a process, attitudes, and knowledge in the form of concepts, facts, laws, principles, and theories. Despite its importance, chemistry is often perceived by students as a difficult subject because it is abstract and contains complex concepts compared to other subjects (Setiawati & Rahmawati, 2019). Essentially, chemical concepts encompass three interconnected levels of representation: macroscopic (observable properties), submicroscopic (particles that compose substances), and symbolic (chemical formulas and symbols).

Considering these challenges, one alternative learning innovation that can be implemented is the use of contextual learning media, such as "a plate of food." This learning media emphasizes food as part of students' daily lives and connects it with concepts of food chemistry, substance composition, chemical reactions, and the environmental impact of food management. Contextual approaches using real-life learning media have been shown to improve conceptual understanding and increase students' awareness of environmental issues (King et al., 2012). Through the use of "a plate of food" in chemistry learning, students are expected to understand the relationship between food choices, chemical processes, and their environmental consequences, including food waste and pollution. As a result, students not only learn theoretical chemistry concepts but also develop an attitude of environmental care through reflective and meaningful learning experiences. Learning media that are closely related to everyday life can thus help students build critical awareness and a sense of responsibility toward the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco Senior High School, chemistry learning has not yet fully integrated explicit environmental character education. Students tend to perceive chemistry as an abstract subject that is detached from everyday life, which leads to the underdevelopment of environmental values. This condition indicates the need for more contextual chemistry learning that is oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "a plate of food" learning media in chemistry education can improve the environmental awareness of eleventh-grade students at Don Bosco Senior High School. This study employed a qualitative descriptive approach to describe changes in students' attitudes and environmental awareness through a contextual learning process. It is expected that the findings of this study will contribute to the development of chemistry learning that not only emphasizes cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "a plate of food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during

the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The Research Instrument.

No	Category	Statement
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2.	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3.	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data Collection Techniques

Data collection in this study was conducted using several techniques, namely:

1. Observation

Observations were conducted during the chemistry learning process using the "a plate of food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the learning activities.

2. Interviews

Semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes.

3. Questionnaire

A questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning.

4. Documentation

Documentation was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data Analysis Techniques

Data analysis was conducted qualitatively using the following stages:

1. Data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation.
2. Data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze.
3. Conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

Findings

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher as a data in table 2.

Table 1. Participant responses per category

No	Category	Statement	Participant Respont
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1. Food menu criteria that students want	1. What was the last meal you had today?	Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability.
	2. Did you finish your last meal? Why?	The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience.
	3. In general, people choose food based on its taste. How do you choose your food?	In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by

	4. Based on your experience, what kind of food makes you (happy) to finish your meal?	habits, personal preferences, and various social and emotional factors. Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience.
2. Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly!	From the 54 students as respondents, there were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly.

3. Students' expectations and involvement in reducing food waste	2. What do you think we should do with our leftover food?	According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability
	3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why	Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action.
	4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts	Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations
	1. What do you expect from yourself regarding the condition of food waste in Indonesia?	The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste.

2. Are you willing to be involved in reducing food waste? Why?

Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security. Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future.

Discussion

This study aimed to explore how the application of "a plate of food" as a learning medium in chemistry education contributes to the development of students' environmental care character, particularly in relation to food waste awareness. The discussion interprets the research findings by linking them to relevant theories of contextual learning, character education, and environmental education.

Contextual Chemistry Learning and Student Engagement

The findings indicate that the use of "a plate of food" successfully created a more contextual and meaningful chemistry learning experience. By connecting chemical concepts to students' daily experiences with food consumption, students became more actively involved in classroom discussions and reflective activities. This supports the principles of context-based learning, which emphasize that students learn more effectively when scientific concepts are presented within real-life situations that are familiar and relevant to them. Increased engagement observed during the learning process suggests that contextual learning media can bridge the gap between abstract chemical concepts and practical environmental issues. These findings are consistent with the study by Sari (2025), which states that innovative learning approaches, particularly those supported by technology-based learning media, can improve teaching effectiveness, increase students' learning motivation, and strengthen their understanding, ultimately contributing to better academic achievement.

Development of Environmental Care Character through Food Waste Awareness

The research results show a positive shift in students' attitudes toward food waste after participating in the learning activity. Students demonstrated an increased awareness that food waste is not merely a personal habit but a broader environmental issue with ecological, economic, and social consequences. Students' ability to articulate the impacts of food waste, such as increased landfill accumulation, environmental pollution, and reduced resources, indicates growing environmental literacy. This finding aligns with character education theory, which states that moral knowledge, moral feelings, and moral actions are interconnected stages in character formation (Chowdhury, 2018; Purwaningsih, 2024).

Students' Responses as Indicators of Attitudinal Change

Analysis of student responses to open-ended questions revealed that the majority of students believe food should not be wasted and are willing to take action, such as finishing

their meals, sharing leftovers, or reminding others not to throw away food. These responses indicate an internalization of the value of environmental care, not merely compliance with classroom rules. The willingness to politely correct others and the desire to participate in food waste reduction efforts reflect the emergence of a sense of responsibility and social awareness, two key components of an environmentally conscious character. This process of internalizing values is also consistent with the findings of Rizal (2023) research, which showed that students' discipline character develops through treatment such as class agreements, instructor control, and discipline enforcement. This indicates that the students' display of disciplined behavior and environmental concern is a result of internalizing values when those values have become part of their self-identity and are reflected in time management, adherence to rules, and academic discipline.

Chemistry Education and Socioscientific Issues

Integrating the issue of food waste as a socioscientific issue in chemistry learning helps students understand the relevance of chemistry to environmental sustainability. Through discussions about food composition, chemical processes in food processing, and waste management, students are able to connect chemical knowledge with real-world environmental challenges. This finding aligns with previous research showing that socioscientific issues-based learning not only improves conceptual understanding but also develops students' ethical reasoning and decision-making abilities related to environmental issues (Nursyada et al., 2025). This approach also contributes to building social and environmental awareness, supporting scientific literacy, and developing 21st-century skills by helping learners understand scientific concepts more deeply and in a way that is relevant to everyday life. A scientifically literate individual is one who possesses the knowledge, skills, attitudes, perspectives, and values that are collectively needed by students (Rohmaya, 2022).

Implications for Chemistry Education Practice

The findings of this study suggest that chemistry education can play a significant role in character education when supported by appropriate learning media. Character education in chemistry learning is used to help achieve the goals of national education (Astari, 2018). The use of "a plate of food" demonstrates that simple, context-rich media can encourage students to reflect on their daily behaviors and their environmental impact. For chemistry teachers, this implies the importance of designing learning experiences that integrate chemical concepts with environmental and sustainability issues, thereby fostering both cognitive and affective learning outcomes. This aligns with Zuin (2021) research, which states that chemistry education is positioned as a strategic foundation for shaping a more sustainable society and economy through holistic, collaborative, and contextual education.

Comparison with Previous Research

The findings of this study are consistent with previous research emphasizing the effectiveness of contextual and environmental-based learning in science education. The learning medium, A Plate of Food, promotes learning achievement by reducing students' anxiety toward chemistry, improving their well-being, and connecting them with their surroundings (Simanjuntak et al., 2023). This finding aligns with several studies reporting that integrating real-life contexts into chemistry learning can enhance students' engagement and environmental awareness. Sevia et al. (2018) found that context-based chemistry learning helps students connect abstract chemical concepts with everyday phenomena, leading to deeper understanding and more meaningful learning experiences. Similarly, King et al. (2012) reported that context-rich science instruction promotes students' ability to relate scientific knowledge to real-world environmental issues.

In terms of character and environmental education, the results of this study align with Macintyre et al. (2024), who emphasized that effective environmental education should not only increase knowledge but also foster attitudes and behaviors that support sustainability. The students' increased awareness of food waste and their willingness to take action reflect the stages of character development described by Andayani et al. (2025), which include moral knowing, moral feeling, and moral action. This suggests that the use of a plate of food successfully facilitated the internalization of environmental care values, similar to outcomes reported in earlier character education studies.

Furthermore, this study supports research on socioscientific issue-based learning. Hazari et al. (2013) demonstrated that learning activities centered on socioscientific issues, such as environmental and sustainability problems, can enhance students' moral reasoning and decision-making skills. In line with Sadler's findings, students in this study were able to articulate the environmental impacts of food waste and express a commitment to reducing it, indicating the development of both cognitive and affective learning outcomes.

Compared to previous studies that primarily employed quantitative or quasi-experimental designs, this research contributes additional insight through a descriptive qualitative approach. By analyzing students' open-ended responses, observations, and interviews, this study provides a more nuanced understanding of how environmental care character develops through chemistry learning. This qualitative depth complements earlier findings and highlights the value of qualitative methods in character and environmental education research.

Overall, this discussion highlights that the application of a plate of food as a learning medium in chemistry education is effective in promoting students' environmental care character and is consistent with, as well as supportive of, existing research in contextual learning, environmental education, and character development.

Conclusion

This study concludes that the use of "a plate of food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "a plate of food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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We have reached a decision regarding your submission to Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education), "Enhancing Students’ Environmental Care Character through the Application of “A Plate of Food” as a Learning Medium in Chemistry Education".

Our decision is to: Accept Submission

[Jurnal Pendidikan Sains Indonesia \(Indonesian Journal of Science Education\)](#)

Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

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Article History:

Received date:

Received in revised from:

Accepted date:

Available online:

Citation:

Manyak, A.K., Budiman, T., Meutuwha, A., & Rayeuk, M. (20xx). The Importance of Knowledge about Disaster Management from an Early Age for Students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, xx(x), xx-xx

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Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "A Plate of Food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "A Plate of Food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "A Plate of Food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: chemistry education, environmental care character, learning media, A Plate of Food, qualitative research

Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Learning media can be used as a tool in teaching and learning activities in the school environment (Nurfadhillah et al., 2021). The school environment is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner so as to achieve maximum results for both educators and students (Anggraini, 2017). The environment provides all human needs, such as food, drink, oxygen, and other life needs. So that humans always take advantage of the environment to meet basic needs and improve the quality of their lives. The school environment has a significant influence on the learning process and learning success both directly and indirectly. A supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020.).

On February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Pendidikan & 2013, 2013). In accordance with the Environmental Regulation Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, which aims to create environmentally sound schools and foster an environmental culture. This implementation is based on three principles: educative, participatory, and sustainable (Latief et al., 2019). The Adiwiyata program is a step towards creating a school dedicated to educating students who value and foster an environmental culture (Fadlillah et al., 2018). A person's character needs to be developed in three stages: knowledge, practice, and habit (Aini et al., 2014). The character of environmental care is one of the aspects that must be implemented at all levels of education in schools. All school members must realize the importance of environmental protection and take steps to prevent environmental damage (Purwanti, 2017). The character of environmental care is an attitude that a person must have in order to develop and manage the environment so that it can be enjoyed indefinitely without causing environmental damage and is long-term (Hasanah et al., n.d.). The character of environmental care must be instilled regularly through learning, habituation, and exemplary behavior (Khotimah et al., 2019).

The character of environmental care cannot grow just like that, but it must be pursued continuously from an early age through real activities that are close to everyday life (Masturoh et al., 2020). To foster the character of environmental care, the most strategic step is through education. Realizing this, the school as an educational forum needs to instill and develop students' concern for the environment from an early age so that human resources are formed who can wisely utilize their potential in acting to create a conducive, ecological, sustainable environmental quality in a real and sustainable manner, of course in ways that are sympathetic, creative, and innovative by adhering to local cultural values and wisdom (Islam & 2018, n.d.). Improving the quality of education is highly dependent on the quality of human resources, especially teachers as a key component in the school environment (Sudjana et al., n.d.). A good teacher is a teacher who teaches professionally and must not only be able to teach well but must also be able to teach and be a role model for students. All teacher actions (both words and actions) are usually imitated by students. Teachers are not only in charge of conveying knowledge to students but can also help develop student character. The character of caring for the environment that is taught, such as teaching and reminding children not to litter and reminding children not to leave food.

Food waste has a considerable impact on the environment, both directly and indirectly (Amelia et al., n.d.). Therefore, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste has a direct impact on the environment, both through the waste of natural resources and as a contribution to pollution and climate change. The character of caring for the environment is closely related to the awareness to reduce food waste and manage food waste in a more sustainable way, such as by recycling it into compost or sharing it with others (Sirfiandi, R. (2022). *Eksistensi Bank Sampah Dalam...* - Google Scholar, n.d.). A plate of food can be a learning medium or symbol that explains food consumption patterns in everyday life. A plate of food as part of human daily life can act as an educational medium that has a positive effect on pro-environmental habits or behavior. The application of the role of a plate of food can foster the character of environmental care; for example, the interpretation of a plate of food helps humans determine the nutritional content and the best portion to support their health and quality of life. In addition, a plate of food can involve the wearer in making decisions that save the earth. A plate of food acts as a data bank and can be chemistry learning material (Simanjuntak, 2020) to encourage active community participation in converting food waste into renewable energy (Jude et al., 2022). Chemistry is the study of matter and its changes. Chemistry is studied and developed based on experiments. There are three things that cannot be separated when studying chemistry. namely chemistry as a process (scientific results), attitude, and knowledge (concepts, facts, laws, principles, and theories). Chemistry is often considered a difficult subject by students because it is abstract and full of complex concepts compared to other subjects (MZ & Rahmawati, 2019). Chemical concepts basically utilize or cover three inseparable aspects of study: macroscopic (observable properties), submicroscopic (particles that make up a substance), and symbolic (chemical formulas and other chemical symbols).

One alternative learning innovation that can be implemented is the use of contextual learning media, such as "A Plate of Food." This learning media highlights the theme of food as part of students' daily lives and links it to concepts of food chemistry, substance composition, chemical reactions, and the impact of food management on the environment. A contextual approach through real-life learning media has been shown to improve conceptual understanding and raise students' awareness of environmental issues (King et al., 2012). The use of "A Plate of Food" in chemistry lessons is expected to encourage students to understand the relationship between food choices, the chemical processes involved, and their consequences on the environment, such as the formation of food waste and pollution. Through this learning process, students not only learn theoretical chemistry concepts but also develop a caring attitude toward the environment through reflection and meaningful learning experiences. Learning media that are relevant to everyday life can help students develop critical awareness and responsibility for the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco High School, chemistry lessons have not yet fully integrated explicit environmental character education. Students tend to understand chemistry as an abstract concept separate from everyday life, resulting in underdevelopment of environmental values. This situation indicates the need for efforts to provide more contextual chemistry lessons that are oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "A Plate of Food" learning media in chemistry education can improve the environmental awareness of 11th grade students at Don Bosco Senior High School. This study used a qualitative descriptive approach to describe changes in students' attitudes and awareness of the environment through a contextual learning process. It is hoped that the results of this study can contribute to the development of chemistry learning that not only focuses on cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "A Plate of Food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The Research Instrument.

No	Category	Statement
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2.	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3.	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data Collection Techniques

Data collection in this study was conducted using several techniques, namely:

1. Observation

Observations were conducted during the chemistry learning process using the "A Plate of Food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the learning activities.

2. Interviews

Semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes.

3. Questionnaire

A questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning.

4. Documentation

Documentation was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data Analysis Techniques

Data analysis was conducted qualitatively using the following stages:

1. Data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation.
2. Data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze.
3. Conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

Findings

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher as a data in table 2.

Table 1. Participant responses per category

No	Category	Statement	Participant Respont
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food?	Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability. The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience. In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These

		findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by habits, personal preferences, and various social and emotional factors.
	4. Based on your experience, what kind of food makes you (happy) to finish your meal?	Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience.
2. Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly!	From the 54 students as respondents, there were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students

	thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly.
2. What do you think we should do with our leftover food?	According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability
3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why	Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action.
4. Based on your knowledge and information obtained from	Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food

	social media, what are the impacts of food waste? Please name three impacts	waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations
3. Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?	The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste. Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future.

Discussion

This study aimed to explore how the application of "*A Plate of Food*" as a learning medium in chemistry education contributes to the development of students' environmental care character, particularly in relation to food waste awareness. The discussion interprets the research findings by linking them to relevant theories of contextual learning, character education, and environmental education.

Contextual Chemistry Learning and Student Engagement

The findings indicate that the use of "*A Plate of Food*" successfully created a more contextual and meaningful chemistry learning experience. By connecting chemical concepts to students' daily experiences with food consumption, students became more actively involved in classroom discussions and reflective activities. This supports the principles of context-based learning, which emphasize that students learn more effectively when scientific concepts are presented within real-life situations that are familiar and relevant to them. Increased engagement observed during the learning process suggests that contextual media can bridge the gap between abstract chemical concepts and practical environmental issues.

Development of Environmental Care Character through Food Waste Awareness

The results show a positive shift in students' attitudes toward food waste after participating in the learning activities. Students demonstrated an increased awareness that food waste is not merely a personal habit but a broader environmental problem with ecological, economic, and social consequences. Their ability to articulate the impacts of food waste—such as increased waste accumulation, environmental pollution, and resource depletion—indicates the development of environmental literacy. This finding aligns with character education theory, which posits that moral knowledge, moral feelings, and moral actions are interconnected stages in character formation.

Students' Responses as Indicators of Attitudinal Change

Analysis of students' responses to open-ended questions revealed that most students believed food should not be wasted and expressed a willingness to take action, such as finishing their meals, sharing leftover food, or reminding others not to waste food. These responses suggest an internalization of environmental care values rather than mere compliance with classroom rules. The willingness to reprimand others politely and the desire to be involved in reducing food waste reflect the emergence of responsibility and social awareness—key components of environmental care character.

Chemistry Education and Socioscientific Issues

Integrating food waste as a socioscientific issue within chemistry learning helped students understand the relevance of chemistry to environmental sustainability. Through discussions on food composition, chemical processes in food preparation, and waste management, students were able to connect chemical knowledge with real-world environmental challenges. This supports previous findings that socioscientific issue-based learning can enhance not only conceptual understanding but also students' ethical reasoning and decision-making skills related to environmental problems.

Implications for Chemistry Education Practice

The findings of this study suggest that chemistry education can play a significant role in character education when supported by appropriate learning media. The use of "*A Plate of Food*" demonstrates that simple, context-rich media can encourage students to reflect on their daily behaviors and their environmental impact. For chemistry teachers, this implies the importance of designing learning experiences that integrate chemical concepts with environmental and sustainability issues, thereby fostering both cognitive and affective learning outcomes.

Comparison with Previous Research

The findings of this study are consistent with previous research emphasizing the effectiveness of contextual and environmental-based learning in science education. Several studies have reported that integrating real-life contexts into chemistry learning can enhance students' engagement and environmental awareness. (Sevian et al., 2018) found that context-based chemistry learning helps students connect abstract chemical concepts with everyday phenomena, leading to deeper understanding and more meaningful learning experiences. Similarly, (King et al., 2012) reported that context-rich science instruction promotes students' ability to relate scientific knowledge to real-world environmental issues. In terms of character and environmental education, the results of this study align with the findings of (MacIntyre et al., 2024), who emphasized that effective environmental education should not only increase knowledge but also foster attitudes and behaviors that support sustainability. The students' increased awareness of food waste and their willingness to take action reflect the stages of character development described by (Kurniawan et al., 2017), which include moral knowing, moral feeling, and moral action. This suggests that the use of "*A Plate of Food*" successfully facilitated the internalization of environmental care values, similar to outcomes reported in earlier character education studies.

Furthermore, this study supports research on socioscientific issue-based learning. (Hazari et al., 2013) demonstrated that learning activities centered on socioscientific issues, such as environmental and sustainability problems, can enhance students' moral reasoning and decision-making skills. In line with Sadler's findings, students in this study were able to articulate the environmental impacts of food waste and express a commitment to reducing it, indicating the development of both cognitive and affective learning outcomes.

Compared to previous studies that primarily employed quantitative or quasi-experimental designs, this research contributes additional insight through a descriptive qualitative approach. By analyzing students' open-ended responses, observations, and interviews, this study provides a more nuanced understanding of how environmental care character develops through chemistry learning. This qualitative depth complements earlier findings and highlights the value of qualitative methods in character and environmental education research.

Overall, this discussion highlights that the application of "A Plate of Food" as a learning medium in chemistry education is effective in promoting students' environmental care character and is consistent with, as well as supportive of, existing research in contextual learning, environmental education, and character development.

Conclusion

This study concludes that the use of "A Plate of Food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "A Plate of Food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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DAN
FIX ARTIKEL
6 Februari 2026**

[JPSI] Editor Decision

2026-02-06 11:06 PM

Familia Simanjuntak, Elferida Sormin, St. Fatimah Azzahra, Nova Irawati Simatupang, Leoni Sanga Lamsari Purba, Putri Anjani:

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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

Article History:

Received date:
Received in revised from:
Accepted date:
Available online:

Citation:

Manyak, A.K., Budiman, T., Meutuwah, A., & Rayeuk, M. (20xx). The Importance of Knowledge about Disaster Management from an Early Age for Students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, xx(x), xx-xx

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Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "a plate of food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "a plate of food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "a plate of food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: chemistry education, environmental care character, learning media, a plate of food, qualitative research

Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Therefore, learning media can be used as an important tool in teaching and learning activities within the school environment (Nurfadhillah et al., 2021).

The school environment itself is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner in order to achieve maximum results for both educators and students (Anggraini, 2017). In a broader context, the environment provides all human needs, such as food, drink, oxygen, and other necessities of life. Consequently, humans continuously utilize the environment to meet basic needs and improve their quality of life. In this regard, the school environment has a significant influence on the learning process

and learning outcomes, both directly and indirectly. Thus, a supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020).

As a response to the importance of environmental awareness within educational settings, on February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Wardani, 2020). In accordance with Environmental Regulation Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, this program aims to create environmentally sound schools and foster an environmental culture. The implementation of the Adiwiyata program is based on three main principles, namely educative, participatory, and sustainable principles (Latief et al., 2019). Through these principles, the Adiwiyata program serves as a concrete step toward creating schools that are dedicated to educating students who value and actively cultivate an environmental culture (Fadlillah et al., 2018).

In line with the objectives of environmentally oriented education, a person's character needs to be developed through three stages: knowledge, practice, and habit (Aini et al., 2014). For students who are still in the developmental stage, this process requires a more intensive approach, such as individual mentoring, the provision of role models by teachers and peers, and the implementation of experiential learning methods to enhance the understanding and application of values (Andayani, 2025). One important character value that needs to be developed is environmental care, which should be implemented at all levels of education in schools. Accordingly, all school members need to be aware of the importance of environmental protection and take concrete steps to prevent environmental damage (Purwanti, 2017). An environmentally conscious character reflects an attitude that enables individuals to manage and preserve the environment sustainably without causing long-term damage (Hasanah & Afianah, 2021). Therefore, the character of environmental care must be consistently instilled through learning activities, habituation, and exemplary behavior (Pane, 2016).

However, the character of environmental care does not develop automatically; rather, it must be cultivated continuously from an early age through real activities that are closely related to everyday life (Masturoh et al., 2020). Education plays a strategic role in fostering this character. Recognizing this role, schools as educational institutions need to instill and develop students' concern for the environment from an early stage. Through this effort, human resources can be formed who are able to utilize their potential wisely in creating a conducive, ecological, and sustainable environmental quality in real and lasting ways, while still adhering to local cultural values and wisdom (Arisona, 2022).

The effectiveness of education is greatly influenced by the quality of human resources, particularly teachers, who are a key component of the school environment (Sudjana & Wijayanti, 2018). Teachers are not only required to professionally master teaching skills but also to serve as role models for their students. According to Simanjuntak et al. (2023), chemistry teachers need to provide more space for students to express the difficulties and doubts they experience during the learning process. This is important because teachers' words and behavior are often imitated by students, making teachers central figures not only in the transfer of knowledge but also in shaping students' character. Various perspectives emphasize the importance of character education, which receives strong cultural and professional attention (Chowdhury, 2018). One concrete form of character education is cultivating environmental awareness, which can be instilled through consistent guidance from teachers, such as reminding students not to litter and to reduce food waste (Astari, 2018).

In this context, food waste emerges as a relevant environmental issue, as it has a considerable impact on the environment both directly and indirectly (Amelia et al., 2019). Consequently, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste contributes to environmental degradation through the waste of natural resources and its role in pollution and climate change. Therefore, the development of environmental care character is closely linked to awareness of reducing food waste and managing it in more sustainable ways, such as recycling it into compost or sharing it with others (Oktarina, 2021).

One contextual approach that connects daily behavior with environmental awareness is the use of a plate of food as a learning medium or symbol that explains food consumption patterns in everyday life. As part of human daily activities, a plate of food can function as an educational medium that positively influences pro-environmental habits and behaviors. The interpretation of a plate of food can foster environmental care character by helping individuals determine appropriate nutritional content and portion sizes that support health and quality of life, while also encouraging decisions that contribute to environmental preservation. Furthermore, a plate of food can serve as a data bank and a source of chemistry learning material (Simanjuntak, 2020), as well as a medium to encourage active community participation in converting food waste into renewable energy (Chen, 2023).

From a scientific perspective, chemistry is the study of matter and its changes and is developed through experimental processes. In learning chemistry, three inseparable aspects are involved, namely chemistry as a process, attitudes, and knowledge in the form of concepts, facts, laws, principles, and theories. Despite its importance, chemistry is often perceived by students as a difficult subject because it is abstract and contains complex concepts compared to other subjects (Setiawati & Rahmawati, 2019). Essentially, chemical concepts encompass three interconnected levels of representation: macroscopic (observable properties), submicroscopic (particles that compose substances), and symbolic (chemical formulas and symbols).

Considering these challenges, one alternative learning innovation that can be implemented is the use of contextual learning media, such as "a plate of food." This learning media emphasizes food as part of students' daily lives and connects it with concepts of food chemistry, substance composition, chemical reactions, and the environmental impact of food management. Contextual approaches using real-life learning media have been shown to improve conceptual understanding and increase students' awareness of environmental issues (King et al., 2012). Through the use of "a plate of food" in chemistry learning, students are expected to understand the relationship between food choices, chemical processes, and their environmental consequences, including food waste and pollution. As a result, students not only learn theoretical chemistry concepts but also develop an attitude of environmental care through reflective and meaningful learning experiences. Learning media that are closely related to everyday life can thus help students build critical awareness and a sense of responsibility toward the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco Senior High School, chemistry learning has not yet fully integrated explicit environmental character education. Students tend to perceive chemistry as an abstract subject that is detached from everyday life, which leads to the underdevelopment of environmental values. This condition indicates the need for more contextual chemistry learning that is oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "a plate of food" learning media in chemistry education can improve the environmental awareness of eleventh-grade students at Don Bosco Senior High School. This study employed a qualitative descriptive approach to describe changes in students' attitudes and environmental awareness through a contextual learning process. It is expected that the findings of this study will contribute to the development of chemistry learning that not only emphasizes cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "a plate of food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during

the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The Research Instrument.

No	Category	Statement
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2.	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3.	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data Collection Techniques

Data collection in this study was conducted using several techniques, namely:

1. Observation

Observations were conducted during the chemistry learning process using the "a plate of food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the learning activities.

2. Interviews

Semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes.

3. Questionnaire

A questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning.

4. Documentation

Documentation was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data Analysis Techniques

Data analysis was conducted qualitatively using the following stages:

1. Data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation.
2. Data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze.
3. Conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

Findings

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher as a data in table 2.

Table 1. Participant responses per category

No	Category	Statement	Participant Respont
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1. Food menu criteria that students want	1. What was the last meal you had today?	Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability.
	2. Did you finish your last meal? Why?	The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience.
	3. In general, people choose food based on its taste. How do you choose your food?	In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by

	4. Based on your experience, what kind of food makes you (happy) to finish your meal?	habits, personal preferences, and various social and emotional factors. Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience.
2. Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly!	From the 54 students as respondents, there were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly.

3. Students' expectations and involvement in reducing food waste	2. What do you think we should do with our leftover food?	According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability
	3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why	Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action.
	4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts	Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations
	1. What do you expect from yourself regarding the condition of food waste in Indonesia?	The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste.

2. Are you willing to be involved in reducing food waste? Why?

Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security. Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future.

Discussion

This study aimed to explore how the application of "a plate of food" as a learning medium in chemistry education contributes to the development of students' environmental care character, particularly in relation to food waste awareness. The discussion interprets the research findings by linking them to relevant theories of contextual learning, character education, and environmental education.

Contextual Chemistry Learning and Student Engagement

The findings indicate that the use of "a plate of food" successfully created a more contextual and meaningful chemistry learning experience. By connecting chemical concepts to students' daily experiences with food consumption, students became more actively involved in classroom discussions and reflective activities. This supports the principles of context-based learning, which emphasize that students learn more effectively when scientific concepts are presented within real-life situations that are familiar and relevant to them. Increased engagement observed during the learning process suggests that contextual learning media can bridge the gap between abstract chemical concepts and practical environmental issues. These findings are consistent with the study by Sari (2025), which states that innovative learning approaches, particularly those supported by technology-based learning media, can improve teaching effectiveness, increase students' learning motivation, and strengthen their understanding, ultimately contributing to better academic achievement.

Development of Environmental Care Character through Food Waste Awareness

The research results show a positive shift in students' attitudes toward food waste after participating in the learning activity. Students demonstrated an increased awareness that food waste is not merely a personal habit but a broader environmental issue with ecological, economic, and social consequences. Students' ability to articulate the impacts of food waste, such as increased landfill accumulation, environmental pollution, and reduced resources, indicates growing environmental literacy. This finding aligns with character education theory, which states that moral knowledge, moral feelings, and moral actions are interconnected stages in character formation (Chowdhury, 2018; Purwaningsih, 2024).

Students' Responses as Indicators of Attitudinal Change

Analysis of student responses to open-ended questions revealed that the majority of students believe food should not be wasted and are willing to take action, such as finishing

their meals, sharing leftovers, or reminding others not to throw away food. These responses indicate an internalization of the value of environmental care, not merely compliance with classroom rules. The willingness to politely correct others and the desire to participate in food waste reduction efforts reflect the emergence of a sense of responsibility and social awareness, two key components of an environmentally conscious character. This process of internalizing values is also consistent with the findings of Rizal (2023) research, which showed that students' discipline character develops through treatment such as class agreements, instructor control, and discipline enforcement. This indicates that the students' display of disciplined behavior and environmental concern is a result of internalizing values when those values have become part of their self-identity and are reflected in time management, adherence to rules, and academic discipline.

Chemistry Education and Socioscientific Issues

Integrating the issue of food waste as a socioscientific issue in chemistry learning helps students understand the relevance of chemistry to environmental sustainability. Through discussions about food composition, chemical processes in food processing, and waste management, students are able to connect chemical knowledge with real-world environmental challenges. This finding aligns with previous research showing that socioscientific issues-based learning not only improves conceptual understanding but also develops students' ethical reasoning and decision-making abilities related to environmental issues (Nursyada et al., 2025). This approach also contributes to building social and environmental awareness, supporting scientific literacy, and developing 21st-century skills by helping learners understand scientific concepts more deeply and in a way that is relevant to everyday life. A scientifically literate individual is one who possesses the knowledge, skills, attitudes, perspectives, and values that are collectively needed by students (Rohmaya, 2022).

Implications for Chemistry Education Practice

The findings of this study suggest that chemistry education can play a significant role in character education when supported by appropriate learning media. Character education in chemistry learning is used to help achieve the goals of national education (Astari, 2018). The use of "a plate of food" demonstrates that simple, context-rich media can encourage students to reflect on their daily behaviors and their environmental impact. For chemistry teachers, this implies the importance of designing learning experiences that integrate chemical concepts with environmental and sustainability issues, thereby fostering both cognitive and affective learning outcomes. This aligns with Zuin (2021) research, which states that chemistry education is positioned as a strategic foundation for shaping a more sustainable society and economy through holistic, collaborative, and contextual education.

Comparison with Previous Research

The findings of this study are consistent with previous research emphasizing the effectiveness of contextual and environmental-based learning in science education. The learning medium, A Plate of Food, promotes learning achievement by reducing students' anxiety toward chemistry, improving their well-being, and connecting them with their surroundings (Simanjuntak et al., 2023). This finding aligns with several studies reporting that integrating real-life contexts into chemistry learning can enhance students' engagement and environmental awareness. Sevia et al. (2018) found that context-based chemistry learning helps students connect abstract chemical concepts with everyday phenomena, leading to deeper understanding and more meaningful learning experiences. Similarly, King et al. (2012) reported that context-rich science instruction promotes students' ability to relate scientific knowledge to real-world environmental issues.

In terms of character and environmental education, the results of this study align with Macintyre et al. (2024), who emphasized that effective environmental education should not only increase knowledge but also foster attitudes and behaviors that support sustainability. The students' increased awareness of food waste and their willingness to take action reflect the stages of character development described by Andayani et al. (2025), which include moral knowing, moral feeling, and moral action. This suggests that the use of a plate of food successfully facilitated the internalization of environmental care values, similar to outcomes reported in earlier character education studies.

Furthermore, this study supports research on socioscientific issue-based learning. Hazari et al. (2013) demonstrated that learning activities centered on socioscientific issues, such as environmental and sustainability problems, can enhance students' moral reasoning and decision-making skills. In line with Sadler's findings, students in this study were able to articulate the environmental impacts of food waste and express a commitment to reducing it, indicating the development of both cognitive and affective learning outcomes.

Compared to previous studies that primarily employed quantitative or quasi-experimental designs, this research contributes additional insight through a descriptive qualitative approach. By analyzing students' open-ended responses, observations, and interviews, this study provides a more nuanced understanding of how environmental care character develops through chemistry learning. This qualitative depth complements earlier findings and highlights the value of qualitative methods in character and environmental education research.

Overall, this discussion highlights that the application of a plate of food as a learning medium in chemistry education is effective in promoting students' environmental care character and is consistent with, as well as supportive of, existing research in contextual learning, environmental education, and character development.

Conclusion

This study concludes that the use of "a plate of food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "a plate of food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

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Enhancing Students' Environmental Care Character through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

DOI: <https://doi.org/10.24815/jpsi.v14i1.181>

243-254

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Enhancing Students' Environmental Care Character Through the Application of "A Plate of Food" as a Learning Medium in Chemistry Education

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Article History:

Received date: January 19 2026

Received in revised from: January 28 2026

Accepted date: February 2 2026

Available online: February 6 2026

Citation:

Simanjuntak, F.N., Purba, L.S.L., Azzahra, S.F., Simatupang, N.I., Sormin, E., Anjani, P., & Ropilla, L.E. (2026). Enhancing Students' Environmental Care Character Through the Application of "a Plate of Food" As a Learning Medium in Chemistry Education. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 14(1), 243-254

Abstract. Chemistry education is not only oriented towards mastering scientific concepts, but also plays an important role in shaping students' character, particularly their environmental stewardship. This study aims to describe the improvement of students' environmental stewardship through the application of the "a plate of food" learning media in chemistry learning. This learning media links the concept of food chemistry with everyday environmental issues, such as food management, waste reduction, and sustainable consumption. This study used a qualitative descriptive method. The research subjects were 54 11th-grade students from Don Bosco High School, selected using a total sampling technique. Data collection was carried out through observation, interviews, and an environmental stewardship questionnaire. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The study's results indicate that using the "a plate of food" media in chemistry instruction can increase students' awareness of the importance of protecting the environment. This is reflected in changes in students' attitudes toward managing food waste, increased awareness of waste issues, and students' understanding of the relationship between chemical concepts and environmental issues. Therefore, the "a plate of food" learning medium can be an effective tool for strengthening environmental awareness in chemistry education. This research is expected to contribute to the development of innovative chemistry learning oriented toward character education and environmental sustainability.

Keywords: Chemistry education, environmental care character, learning media, a plate of food, qualitative research

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Introduction

In this era of technological development, the use of learning media is still less varied. Learning media is a tool that can support the teaching and learning process so that the meaning of the message conveyed is clearer and teaching and learning objectives are achieved effectively and efficiently. Learning media is a learning resource that helps teachers enrich students' insights. Learning media that is attractive to students can be a stimulus for students in the learning process. Therefore, learning media can be used as an

important tool in teaching and learning activities within the school environment (Nurfadhillah et al., 2021).

The school environment itself is an environment where the teaching and learning process from basic education to higher education is carried out in a systematic, programmed, and planned manner in order to achieve maximum results for both educators and students (Anggraini, 2017). In a broader context, the environment provides all human needs, such as food, drink, oxygen, and other necessities of life. Consequently, humans continuously utilize the environment to meet basic needs and improve their quality of life. In this regard, the school environment has a significant influence on the learning process and learning outcomes, both directly and indirectly. Thus, a supportive school environment is absolutely necessary to enable a quality learning process (Wardani, 2020).

As a response to the importance of environmental awareness within educational settings, on February 21, 2006, the Ministry of Environment and the Ministry of National Education introduced a green school culture through the Adiwiyata program (Wardani, 2020). In accordance with Environmental Regulation Number 5 of 2013 concerning Guidelines for the Implementation of the Adiwiyata Program, this program aims to create environmentally sound schools and foster an environmental culture. The implementation of the Adiwiyata program is based on three main principles, namely educative, participatory, and sustainable principles (Latief et al., 2019). Through these principles, the Adiwiyata program serves as a concrete step toward creating schools that are dedicated to educating students who value and actively cultivate an environmental culture (Fadlillah et al., 2018).

In line with the objectives of environmentally oriented education, a person's character needs to be developed through three stages: knowledge, practice, and habit (Aini et al., 2014). For students who are still in the developmental stage, this process requires a more intensive approach, such as individual mentoring, the provision of role models by teachers and peers, and the implementation of experiential learning methods to enhance the understanding and application of values (Andayani, 2025). One important character value that needs to be developed is environmental care, which should be implemented at all levels of education in schools. Accordingly, all school members need to be aware of the importance of environmental protection and take concrete steps to prevent environmental damage (Purwanti, 2017). An environmentally conscious character reflects an attitude that enables individuals to manage and preserve the environment sustainably without causing long-term damage (Hasanah & Afianah, 2021). Therefore, the character of environmental care must be consistently instilled through learning activities, habituation, and exemplary behavior (Pane, 2016).

However, the character of environmental care does not develop automatically; rather, it must be cultivated continuously from an early age through real activities that are closely related to everyday life (Masturoh et al., 2020). Education plays a strategic role in fostering this character. Recognizing this role, schools as educational institutions need to instill and develop students' concern for the environment from an early stage. Through this effort, human resources can be formed who are able to utilize their potential wisely in creating a conducive, ecological, and sustainable environmental quality in real and lasting ways, while still adhering to local cultural values and wisdom (Arisona, 2022).

The effectiveness of education is greatly influenced by the quality of human resources, particularly teachers, who are a key component of the school environment (Sudjana & Wijayanti, 2018). Teachers are not only required to professionally master teaching skills but also to serve as role models for their students. According to Simanjuntak et al. (2023), chemistry teachers need to provide more space for students to express the difficulties and doubts they experience during the learning process. This is important because teachers' words and behavior are often imitated by students, making teachers central figures not only in the transfer of knowledge but also in shaping students' character.

Various perspectives emphasize the importance of character education, which receives strong cultural and professional attention (Chowdhury, 2018). One concrete form of character education is cultivating environmental awareness, which can be instilled through consistent guidance from teachers, such as reminding students not to litter and to reduce food waste (Astari, 2018).

In this context, food waste emerges as a relevant environmental issue, as it has a considerable impact on the environment both directly and indirectly (Amelia et al., 2019). Consequently, the wise management of food waste is closely related to the character of environmental care (Kasri et al., 2021). Food waste contributes to environmental degradation through the waste of natural resources and its role in pollution and climate change. Therefore, the development of environmental care character is closely linked to awareness of reducing food waste and managing it in more sustainable ways, such as recycling it into compost or sharing it with others (Oktarina, 2021).

One contextual approach that connects daily behavior with environmental awareness is the use of a plate of food as a learning medium or symbol that explains food consumption patterns in everyday life. As part of human daily activities, a plate of food can function as an educational medium that positively influences pro-environmental habits and behaviors. The interpretation of a plate of food can foster environmental care character by helping individuals determine appropriate nutritional content and portion sizes that support health and quality of life, while also encouraging decisions that contribute to environmental preservation. Furthermore, a plate of food can serve as a data bank and a source of chemistry learning material (Simanjuntak, 2020), as well as a medium to encourage active community participation in converting food waste into renewable energy (Chen, 2023).

From a scientific perspective, chemistry is the study of matter and its changes and is developed through experimental processes. In learning chemistry, three inseparable aspects are involved, namely chemistry as a process, attitudes, and knowledge in the form of concepts, facts, laws, principles, and theories. Despite its importance, chemistry is often perceived by students as a difficult subject because it is abstract and contains complex concepts compared to other subjects (Setiawati & Rahmawati, 2019). Essentially, chemical concepts encompass three interconnected levels of representation: macroscopic (observable properties), submicroscopic (particles that compose substances), and symbolic (chemical formulas and symbols).

Considering these challenges, one alternative learning innovation that can be implemented is the use of contextual learning media, such as "a plate of food." This learning media emphasizes food as part of students' daily lives and connects it with concepts of food chemistry, substance composition, chemical reactions, and the environmental impact of food management. Contextual approaches using real-life learning media have been shown to improve conceptual understanding and increase students' awareness of environmental issues (King et al., 2012). Through the use of "a plate of food" in chemistry learning, students are expected to understand the relationship between food choices, chemical processes, and their environmental consequences, including food waste and pollution. As a result, students not only learn theoretical chemistry concepts but also develop an attitude of environmental care through reflective and meaningful learning experiences. Learning media that are closely related to everyday life can thus help students build critical awareness and a sense of responsibility toward the environment (Hazari et al., 2013).

Based on initial observations at Don Bosco Senior High School, chemistry learning has not yet fully integrated explicit environmental character education. Students tend to perceive chemistry as an abstract subject that is detached from everyday life, which leads to the underdevelopment of environmental values. This condition indicates the need for more contextual chemistry learning that is oriented toward character building. Therefore, this study was conducted to describe how the implementation of the "a plate of food"

learning media in chemistry education can improve the environmental awareness of eleventh-grade students at Don Bosco Senior High School. This study employed a qualitative descriptive approach to describe changes in students' attitudes and environmental awareness through a contextual learning process. It is expected that the findings of this study will contribute to the development of chemistry learning that not only emphasizes cognitive aspects but also supports the strengthening of environmental awareness as part of the goals of sustainable education.

Methods

This study employed a qualitative descriptive method. This method was chosen because the study aimed to in-depth describe the learning process and changes in students' environmental awareness following the implementation of the "a plate of food" learning media in chemistry education. The qualitative approach allows researchers to understand phenomena holistically based on students' experiences, attitudes, and responses during the learning activities. This research was conducted at Don Bosco High School. The subjects were 54 eleventh-grade students. The subject selection technique used total sampling, meaning all students in one grade level were selected as subjects, allowing the data to accurately depict the overall condition of the class.

The research instrument used by researchers consisted of 3 categories, which were developed into 10 statements, which describe in Table 1.

Table 1. The research instrument

No	Category	Statement
1.	Food menu criteria that students want	1. What was the last meal you had today? 2. Did you finish your last meal? Why? 3. In general, people choose food based on its taste. How do you choose your food? 4. Based on your experience, what kind of food makes you (happy) to finish your meal?
2.	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly! 2. What do you think we should do with our leftover food? 3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why 4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts
3.	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia? 2. Are you willing to be involved in reducing food waste? Why?

Data collection in this study was conducted using several techniques, namely: 1) Observations were conducted during the chemistry learning process using the "a plate of food" media. The purpose of these observations was to directly observe student behavior, attitudes, and engagement that reflected environmentally conscious character during the

learning activities. 2) Interviews; semi-structured interviews were conducted with several students and chemistry teachers. The interviews aimed to obtain in-depth information regarding students' views, experiences, and responses to the use of learning media and perceived changes in environmental attitudes. 3) Questionnaire; a questionnaire was used as supporting data to describe students' environmental attitudes after participating in the learning process. The questionnaire was structured in the form of statements related to environmental behavior and attitudes in the context of chemistry learning. 4) documentation; was used to supplement the research data, including photographs of learning activities, teacher notes, and learning materials used during the study.

Data analysis was conducted qualitatively using the following stages: 1) data reduction, which is the process of selecting, focusing on, and simplifying data obtained from observations, interviews, questionnaires, and documentation. 2) data presentation, which is organizing the data into a narrative description so that it is easy to understand and analyze. 3) conclusion drawing, which is formulating the meaning and findings of the research based on the analyzed data

Results and Discussion

Findings

At every level of education, schools should implement environmental stewardship. All students should show concern for the environment by improving the quality of the environment, raising awareness about the importance of caring for the environment, and trying to prevent damage. Education about caring for the environment is instilled from a young age in students so that they can manage natural resources wisely and feel responsible for the benefit of future generations. When the character becomes mentally strong and has concern for the environment, one's behavior in daily life will be based on this. The results obtained after the research was conducted will be discussed in accordance with the division of criteria made by the researcher as a data in Table 2.

Table 2. Participant responses per category

No	Category	Statement	Participant Respont
1	Food menu criteria that students want	1. What was the last meal you had today?	Based on the students' responses, the last foods consumed included rice with chicken, rice with egg, fried rice, bread with jam, fried noodles, sweet potatoes, spaghetti, sausages and nuggets, soup, and corn. These results indicate that the respondents have a diverse eating pattern, with a tendency to choose foods that are practical and easy to obtain. This finding provides a general overview of students' eating habits in daily life and reflects the need for a variety of foods that are tailored to individual preferences and time availability.
		2. Did you finish your last meal? Why?	The student's answer to this question was yes, and the reason for finishing the food was because it was nutritious, delicious, and appreciated Mom's cooking. From the answers given by the students, it can be concluded that the factors that influence students' habits in finishing their meals involve a combination of physical needs (hunger and nutrition) and emotional aspects (good taste and appreciation of parents' cooking). Taste, nutritional value, and gratitude towards the person who cooked

			are interconnected elements in students' eating habits. It also shows that eating habits are not only influenced by physical factors but also by emotional and social aspects that enrich their eating experience
		3. In general, people choose food based on its taste. How do you choose your food?	In response to this question, researchers obtained varied responses. A total of 88% of students stated that their food choices were influenced by various considerations, including mood, taste, flavor, food appearance, nutritional content, texture, price, and calorie content. Based on these findings, it can be concluded that students' decisions in choosing food are influenced by a combination of various factors. Taste is no longer the only major consideration, but is also influenced by emotional, visual, and practical aspects. In addition, awareness of nutritional value and food texture characteristics also plays a role in the decision-making process. These findings show that food selection is a complex process, which is not only based on taste preferences, but also involves considerations of health, aesthetics, and personal circumstances. Thus, individual eating patterns are greatly influenced by habits, personal preferences, and various social and emotional factors
		4. Based on your experience, what kind of food makes you (happy) to finish your meal?	Food that tastes good, suits individual tastes, looks appealing, is a favorite, and is beneficial to health is the answer given by students to this question. Based on these responses, it can be concluded that students' happiness in consuming food is not only influenced by taste, but also by emotional and health factors. Food that is delicious, suits individual preferences, has an appealing appearance, is a favorite, and provides health benefits are the main factors that cause feelings of pleasure when eating. Therefore, an enjoyable eating experience for students involves a combination of physical factors, such as taste, appearance, and nutritional value, as well as emotional factors, such as personal taste and attachment to favorite foods. These findings indicate that food not only serves to fulfill physiological needs, but also plays a role in providing emotional satisfaction that contributes to the overall quality of the eating experience
2	Student responses on food waste	1. In your opinion, should we waste food? Why? Please explain briefly!	From the 54 students as respondents, there were 10 students who answered that it was okay to throw away food if the food was not good, not worth eating, not tasty, and not to taste. While the rest of the respondents answered that it is not allowed on the grounds that it can damage the environment, they must appreciate food and be grateful because they can still eat, and there are many out there who cannot eat. From the results of students' answers, it can be concluded

	that the majority of students think that throwing away food should not be done. They emphasized the importance of appreciating food, being grateful for what is available, and being aware of the negative impacts that food wastage can have, both environmentally and socially. Although a small number of students thought it was acceptable to throw food away if it was not tasty or not to their taste, the more dominant view was not to waste food and to be wiser in managing food consumption. This shows the importance of being aware of the value of food and how we should treat food more responsibly
2. What do you think we should do with our leftover food?	According to the students, leftover food can be thrown away, left alone, given to pets, or stored and eaten again; it should be spent, and some suggested reprocessing. Based on the answers above, the best thing to do is to reprocess the leftovers or store them for another meal. This not only reduces food wastage but also provides economic and environmental sustainability benefits. Throwing away leftover food should be avoided as much as possible, as apart from harming ourselves, it also has an impact on the environment. Therefore, it is important for us to be wiser in managing our food, whether by reprocessing, storing, or feeding it to our pets, in order to reduce waste and support sustainability
3. When in certain circumstances and conditions, you see someone who deliberately throws away food or does not finish the food they take themselves, would you reprimand that person? Why?	Students' response to this question is that they tend to say no. The reason is because they think it is not their business, they do not know the person, and they do not care. The reasons are because, according to the students, it is none of their business; they do not know the person, they do not care, they are too lazy to reprimand, they do not dare, they do not want to get into trouble with others, and they let it be the person's personal business until he/she is aware of his/her own behavior. Students' responses to this situation show a tendency to avoid intervention, although in some contexts, reprimanding can be a good action to raise social and ethical awareness. However, barriers such as not wanting to get involved, fear of conflict, or not feeling it is personal often prevent one from taking such action
4. Based on your knowledge and information obtained from social media, what are the impacts of food waste? Please name three impacts	Food scarcity, environmental pollution, global warming, disease, waste generation, and pollution are students' answers to some of the impacts of food waste. The impacts of food waste are very diverse, ranging from food scarcity to environmental and health impacts. Reducing food waste is not just about saving resources; it is also about preserving the environment and ensuring prosperity for future generations

3	Students' expectations and involvement in reducing food waste	1. What do you expect from yourself regarding the condition of food waste in Indonesia?	The student expectations obtained by the researcher on this statement are that food waste will be reduced and the community will be educated and more aware and wise about the negative impacts of food waste. Students' hopes to reduce food waste in Indonesia reflect a desire to create greater positive change in terms of resource management, the environment, and social welfare. Educating the public and raising awareness is an important step towards achieving this goal. By reducing food waste, Indonesia can take further steps towards sustainability and create a more positive impact on the environment and global food security
		2. Are you willing to be involved in reducing food waste? Why?	Yes, I am willing is the answer that the researcher got from the respondents, arguing that food waste reduction is an action that should be done consciously because of its far-reaching impact on the environment, society, and the economy. As a human being, getting involved in food waste reduction is a good step towards a more sustainable future

Discussion

This study aimed to explore how the application of “a plate of food” as a learning medium in chemistry education contributes to the development of students’ environmental care character, particularly in relation to food waste awareness. The discussion interprets the research findings by linking them to relevant theories of contextual learning, character education, and environmental education.

Contextual Chemistry Learning and Student Engagement

The findings indicate that the use of “a plate of food” successfully created a more contextual and meaningful chemistry learning experience. By connecting chemical concepts to students’ daily experiences with food consumption, students became more actively involved in classroom discussions and reflective activities. This supports the principles of context-based learning, which emphasize that students learn more effectively when scientific concepts are presented within real-life situations that are familiar and relevant to them. Increased engagement observed during the learning process suggests that contextual learning media can bridge the gap between abstract chemical concepts and practical environmental issues. These findings are consistent with the study by Sari (2025), which states that innovative learning approaches, particularly those supported by technology-based learning media, can improve teaching effectiveness, increase students’ learning motivation, and strengthen their understanding, ultimately contributing to better academic achievement.

Development of Environmental Care Character through Food Waste Awareness

The research results show a positive shift in students' attitudes toward food waste after participating in the learning activity. Students demonstrated an increased awareness that food waste is not merely a personal habit but a broader environmental issue with ecological, economic, and social consequences. Students' ability to articulate the impacts of food waste, such as increased landfill accumulation, environmental pollution, and reduced resources, indicates growing environmental literacy. This finding aligns with character education theory, which states that moral knowledge, moral feelings, and moral actions are interconnected stages in character formation (Chowdhury, 2018; Purwaningsih, 2024).

Students' Responses as Indicators of Attitudinal Change

Analysis of student responses to open-ended questions revealed that the majority of students believe food should not be wasted and are willing to take action, such as finishing their meals, sharing leftovers, or reminding others not to throw away food. These responses indicate an internalization of the value of environmental care, not merely compliance with classroom rules. The willingness to politely correct others and the desire to participate in food waste reduction efforts reflect the emergence of a sense of responsibility and social awareness, two key components of an environmentally conscious character. This process of internalizing values is also consistent with the findings of Rizal (2023) research, which showed that students' discipline character develops through treatment such as class agreements, instructor control, and discipline enforcement. This indicates that the students' display of disciplined behavior and environmental concern is a result of internalizing values when those values have become part of their self-identity and are reflected in time management, adherence to rules, and academic discipline.

Chemistry Education and Socioscientific Issues

Integrating the issue of food waste as a socioscientific issue in chemistry learning helps students understand the relevance of chemistry to environmental sustainability. Through discussions about food composition, chemical processes in food processing, and waste management, students are able to connect chemical knowledge with real-world environmental challenges. This finding aligns with previous research showing that socioscientific issues-based learning not only improves conceptual understanding but also develops students' ethical reasoning and decision-making abilities related to environmental issues (Nursyada et al., 2025). This approach also contributes to building social and environmental awareness, supporting scientific literacy, and developing 21st-century skills by helping learners understand scientific concepts more deeply and in a way that is relevant to everyday life. A scientifically literate individual is one who possesses the knowledge, skills, attitudes, perspectives, and values that are collectively needed by students (Rohmaya, 2022).

Implications for Chemistry Education Practice

The findings of this study suggest that chemistry education can play a significant role in character education when supported by appropriate learning media. Character education in chemistry learning is used to help achieve the goals of national education (Astari, 2018). The use of "a plate of food" demonstrates that simple, context-rich media can encourage students to reflect on their daily behaviors and their environmental impact. For chemistry teachers, this implies the importance of designing learning experiences that integrate chemical concepts with environmental and sustainability issues, thereby fostering both cognitive and affective learning outcomes. This aligns with Zuin (2021) research, which states that chemistry education is positioned as a strategic foundation for shaping a more sustainable society and economy through holistic, collaborative, and contextual education.

Comparison with Previous Research

The findings of this study are consistent with previous research emphasizing the effectiveness of contextual and environmental-based learning in science education. The learning medium, A Plate of Food, promotes learning achievement by reducing students' anxiety toward chemistry, improving their well-being, and connecting them with their surroundings (Simanjuntak et al., 2023). This finding aligns with several studies reporting that integrating real-life contexts into chemistry learning can enhance students' engagement and environmental awareness. Sevia et al. (2018) found that context-based

chemistry learning helps students connect abstract chemical concepts with everyday phenomena, leading to deeper understanding and more meaningful learning experiences. Similarly, King et al. (2012) reported that context-rich science instruction promotes students' ability to relate scientific knowledge to real-world environmental issues.

In terms of character and environmental education, the results of this study align with Macintyre et al. (2024), who emphasized that effective environmental education should not only increase knowledge but also foster attitudes and behaviors that support sustainability. The students' increased awareness of food waste and their willingness to take action reflect the stages of character development described by Andayani et al. (2025), which include moral knowing, moral feeling, and moral action. This suggests that the use of a plate of food successfully facilitated the internalization of environmental care values, similar to outcomes reported in earlier character education studies.

Furthermore, this study supports research on socioscientific issue-based learning. Hazari et al. (2013) demonstrated that learning activities centered on socioscientific issues, such as environmental and sustainability problems, can enhance students' moral reasoning and decision-making skills. In line with Sadler's findings, students in this study were able to articulate the environmental impacts of food waste and express a commitment to reducing it, indicating the development of both cognitive and affective learning outcomes. Compared to previous studies that primarily employed quantitative or quasi-experimental designs, this research contributes additional insight through a descriptive qualitative approach. By analyzing students' open-ended responses, observations, and interviews, this study provides a more nuanced understanding of how environmental care character develops through chemistry learning. This qualitative depth complements earlier findings and highlights the value of qualitative methods in character and environmental education research. Overall, this discussion highlights that the application of a plate of food as a learning medium in chemistry education is effective in promoting students' environmental care character and is consistent with, as well as supportive of, existing research in contextual learning, environmental education, and character development.

Conclusion

This study concludes that the use of "a plate of food" as a learning medium in chemistry education helps improve students' environmental care character. By connecting chemistry concepts with daily issues related to food and food waste, students were able to better understand the relationship between chemistry and environmental problems. The findings show that students developed greater awareness of food waste, showed more responsible attitudes toward managing food, and expressed willingness to participate in efforts to reduce food waste. Learning activities using real-life contexts encouraged students to be more active, reflective, and engaged during chemistry lessons. In summary, "a plate of food" is a simple and effective learning medium that supports chemistry learning while fostering students' environmental awareness and responsible behavior.

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