

Utilization of waste cooking oil as a raw material for aromatherapy candle production to support green industry development

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ABSTRACT

Waste cooking oil is a household waste that has the potential to cause environmental pollution when disposed of improperly. One alternative waste management strategy is to convert it into value-added products, such as aromatherapy candles. This study aims to describe the utilization of waste cooking oil as a raw material for aromatherapy candle production in supporting green industry development through Project-Based Learning (PjBL) at SDN Semanan 12 Pagi. This research employed a qualitative descriptive method. The research participants consisted of 15 fourth-grade students, one teacher, and one facilitator from the Tersenyum Program of Rumah Sosial Kutub. Data were collected through interviews, observations, and documentation. Data analysis followed the Miles, Huberman, and Saldaña model, which includes data condensation, data display, and conclusion drawing and verification. Data validity was ensured through source triangulation and technique triangulation. The findings indicate that the activity of transforming waste cooking oil into aromatherapy candles was successfully implemented through the Project-Based Learning approach. Observation results showed that all student groups achieved a good performance category, with scores of 70,67%, 80,00%, and 76,00%, respectively. Interview results revealed that students understood the negative environmental impacts of waste cooking oil, were able to follow the stages of aromatherapy candle production, and demonstrated creativity and collaboration throughout the activity. Furthermore, the project provided contextual learning experiences by transforming waste materials into environmentally friendly and useful products. It can be concluded that the utilization of waste cooking oil as a raw material for aromatherapy candle production can serve as an alternative project-based learning activity that supports green industry development, enhances students' creativity, and fosters environmental awareness from an early age.

Keywords: Waste Cooking Oil; Aromatherapy Candles; Project-Based Learning; Green Industry.

ABSTRAK

Minyak jelantah merupakan limbah rumah tangga yang berpotensi menimbulkan pencemaran lingkungan apabila dibuang secara sembarangan. Salah satu upaya pengelolaan limbah yang dapat dilakukan adalah memanfaatkannya menjadi produk bernilai guna, seperti lilin aromaterapi. Penelitian ini bertujuan mendeskripsikan pemanfaatan minyak jelantah sebagai bahan baku pembuatan lilin aromaterapi dalam mendukung pengembangan program green industry melalui

pembelajaran berbasis *Project-Based Learning* (PjBL) di SDN Semanan 12 Pagi. Penelitian ini menggunakan metode deskriptif kualitatif. Subjek penelitian terdiri atas 15 siswa kelas IV, 1 guru, dan 1 fasilitator Program Tersenyum dari Rumah Sosial Kutub. Data dikumpulkan melalui wawancara, observasi, dan dokumentasi. Analisis data menggunakan model Miles, Huberman, dan Saldaña yang meliputi kondensasi data, penyajian data, serta penarikan kesimpulan dan verifikasi. Keabsahan data diperoleh melalui triangulasi sumber dan triangulasi teknik. Hasil penelitian menunjukkan bahwa kegiatan pemanfaatan minyak jelantah menjadi lilin aromaterapi dapat dilaksanakan dengan baik melalui pendekatan *Project-Based Learning*. Hasil observasi menunjukkan seluruh kelompok memperoleh kategori baik dengan nilai 70,67%, 80,00%, dan 76,00%. Hasil wawancara menunjukkan bahwa siswa memahami dampak negatif minyak jelantah terhadap lingkungan, mampu mengikuti tahapan pembuatan lilin aromaterapi, serta menunjukkan kreativitas dan kerja sama selama kegiatan berlangsung. Selain itu, kegiatan ini memberikan pengalaman belajar yang kontekstual melalui pemanfaatan limbah menjadi produk yang bernilai guna dan ramah lingkungan. Disimpulkan bahwa pemanfaatan minyak jelantah sebagai bahan baku pembuatan lilin aromaterapi dapat menjadi alternatif pembelajaran berbasis proyek yang mendukung pengembangan program *green industry*, meningkatkan kreativitas siswa, serta menumbuhkan kepedulian terhadap lingkungan sejak usia sekolah dasar.

Kata Kunci: Minyak Jelantah; Lilin Aromaterapi; Pembelajaran Berbasis Proyek; *Green Industry*

INTRODUCTION

Waste cooking oil is one of the environmental problems generated by household activities and culinary businesses. Improper disposal of waste cooking oil into drainage systems or directly onto the soil can reduce environmental quality, disrupt aquatic ecosystems, and potentially pose risks to public health (Azme et al., 2023; Faimi & Tampubolon, 2023; Mulyaningsih & Hermawati, 2023). Therefore, appropriate management of waste cooking oil is essential to prevent it from becoming a source of environmental pollution. In addition to minimizing its negative environmental impacts, effective waste management can also generate products with practical and economic value.

One widely adopted approach to managing waste cooking oil is its conversion into value-added products, such as biodiesel, soap, and aromatherapy candles. Previous studies have demonstrated that aromatherapy candles provide functional benefits as a source of relaxation through fragrance while also possessing economic value as decorative products and souvenirs (Putra et al., 2025; Suharyani et al., 2023; Wardani et al., 2021). Furthermore, the process of transforming waste cooking oil into aromatherapy candles can serve as an educational medium for increasing public awareness regarding the importance of sustainable waste management practices (Arief Setyo Nugroho et al., 2023; Forijati et al., 2025).

In the educational context, environment-based learning plays a crucial role in fostering environmental awareness and responsibility from an early age (Kharisma et al., 2025). Education is not limited to classroom-based instruction but can also utilize the surrounding environment as a meaningful learning resource (Deda Widianoro & Minsih, 2023). Learning activities that are connected to real-life environmental issues can enhance student engagement, critical thinking skills, creativity, and environmental responsibility (Husain, 2025; Rosnaningsih & Putra, 2025). From a broader perspective, waste management practices based on reuse and recycling are closely aligned with the principles of green industry. Although the concept of green industry is commonly associated with industrial sectors, its principles can be adapted within educational settings to cultivate environmental awareness and sustainability-oriented behaviors from an early age. Schools can serve as strategic environments for

implementing these values through environmentally oriented activities that are closely related to students' daily lives.

Previous studies have reported that the utilization of waste cooking oil as a raw material for aromatherapy candle production can improve creative skills and enhance understanding of waste management practices (Pristiani et al., 2025; Puspitasari et al., 2024). However, most existing studies have primarily focused on the technical aspects of product manufacturing or community training programs. Research examining the integration of waste cooking oil utilization with the promotion of green industry concepts in elementary school settings remains limited. This condition indicates a research gap that warrants further investigation.

This study was conducted at SDN Semanan 12 Pagi, which has implemented the "Tersenyum" Program (Terima Sedekah Minyak Jelantah Untuk Mereka) as an initiative to support responsible waste cooking oil management (Dumas et al., 2022). The existence of this program provides an opportunity to develop learning activities that integrate waste management practices with environmental education in schools. Unlike previous studies that mainly focused on product processing techniques or community training activities, this study positions the utilization of waste cooking oil as part of an environment-based learning activity conducted within the school setting. Through this activity, students actively participate in the process of producing aromatherapy candles, thereby fostering environmental awareness, creativity, and meaningful learning experiences.

Based on the aforementioned background, this study aims to describe the utilization of waste cooking oil as a raw material for aromatherapy candle production in supporting the development of a green industry program at SDN Semanan 12 Pagi.

METHODS

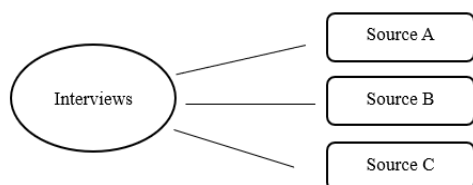
Type and Design

This study employed a qualitative descriptive method to provide an in-depth description of the process of utilizing waste cooking oil for aromatherapy candle production and its implementation within environment-based learning activities at SDN Semanan 12 Pagi. A qualitative approach was selected to explore and describe social phenomena in their natural settings based on the experiences, perceptions, and activities of the research participants. Data were collected through direct engagement with participants in authentic learning contexts, enabling the researchers to obtain a comprehensive understanding of the processes and meanings that emerged throughout the activity (Mochamad Nashrullah et al., 2023; Reza & Azis, 2023).

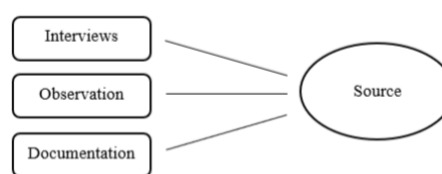
The study was conducted through the implementation of Project-Based Learning (PjBL), an instructional approach that actively engages students in completing a real-world project involving the transformation of waste cooking oil into aromatherapy candles. Through this learning activity, students were expected to develop an understanding of waste management practices and the application of green industry principles in a contextual and meaningful manner (Apriliani et al., 2025; Magdalena et al., 2025).

To ensure the credibility and trustworthiness of the findings, data validation was conducted through source triangulation and methodological triangulation. Source triangulation was applied by comparing information obtained from different participants, while methodological triangulation involved the use of multiple data collection techniques,

including interviews, observations, and documentation. These procedures were employed to enhance data accuracy and strengthen the validity of the research findings (Nurfajriani et al., 2024; Susanto et al., 2023).



Picture 1. Source Triangulation
Source: (Nurfajriani et al., 2024)



Picture 2. Technique Triangulation
Source: (Nurfajriani et al., 2024)

Data and Data Sources

The data used in this study consisted of primary and secondary data. Primary data were obtained directly from the research participants, while secondary data were derived from relevant supporting documents.

The primary data sources included one fourth-grade teacher at SDN Semanan 12 Pagi, fifteen fourth-grade students, and one representative from Rumah Sosial Kutub who served as a facilitator of the “Tersenyum” Program (Terima Sedekah Minyak Jelantah Untuk Mereka) in West Jakarta. These participants were selected based on their direct involvement in the implementation of the waste cooking oil utilization project for aromatherapy candle production conducted through the Project-Based Learning (PjBL) approach.

Secondary data were obtained from supporting documents, including archives of the “Tersenyum” Program, activity documentation, and partnership documents between SDN Semanan 12 Pagi and Rumah Sosial Kutub. These documents were used to complement and verify the information collected from the primary data sources.

Data collection technique

This study was conducted at SDN Semanan 12 Pagi, West Jakarta. The participants consisted of 15 Grade 4 students who were involved in the learning activities of transforming waste cooking oil into aromatherapy candles. Participant selection was carried out using a purposive sampling technique, in which informants were chosen based on their direct involvement in the research activities. The key informants included Stefanie Dumas as the facilitator of the “Tersenyum” Program (Rumah Sosial Kutub, West Jakarta), Nur Hidayati, S.Pd. as the Grade 4 teacher at SDN Semanan 12 Pagi, and M. Al Farel At-Talah as a student representative.

Data were collected through interviews, observations, and documentation. Interviews were conducted to obtain in-depth information regarding participants’ perspectives, experiences, and understanding of the research topic (Intifada Zahroh et al., 2025; Rivaldi et al., 2023). Observation was employed to directly examine participants’ activities and the learning context during the implementation of the Project-Based Learning activities (Ardiansyah et al., 2023). In addition, documentation was used as a supporting technique to strengthen the research data. The documentation included photographs of learning activities

and the aromatherapy candle production process, as well as supporting documents such as cooperation agreements between Rumah Sosial Kutub and SDN Semanan 12 Pagi. These documents were used to corroborate and validate the findings obtained from interviews and observations.

The research instruments consisted of interview guidelines, observation sheets, and documentation formats. The interview guidelines were used to systematically guide the data collection process, while the observation sheets were used to record students' activities during the learning process.

Data analysis

The data in this study were analyzed using the interactive model proposed by Miles, Huberman, and Saldaña, which consists of three main stages: data condensation, data display, and conclusion drawing and verification (Miles et al., 2014). This analytical framework was employed to obtain a comprehensive understanding of the utilization of waste cooking oil as a raw material for aromatherapy candle production through the Project-Based Learning (PjBL) approach.

The first stage, data condensation, involved the process of selecting, focusing, simplifying, and organizing the data obtained from the field. At this stage, data collected from the teacher, students, and representatives of Rumah Sosial Kutub were categorized into key themes, namely the utilization of waste cooking oil, the process of aromatherapy candle production, and the strengthening of green industry concepts.

The second stage, data display, involved presenting the condensed data in the form of narrative descriptions and supporting documentation. This stage facilitated the identification of patterns, relationships, and emerging findings during the research process.

The third stage, conclusion drawing and verification, involved interpreting the displayed data to answer the research focus. The conclusions were continuously verified through source triangulation and methodological triangulation by comparing data obtained from interviews, observations, and documentation to ensure the credibility of the findings.

In addition, this study was conducted after obtaining permission from SDN Semanan 12 Pagi and Rumah Sosial Kutub. All participants were informed about the objectives of the study and voluntarily agreed to participate in interviews and observations. The data collected were used solely for research purposes and were kept confidential in accordance with ethical research principles.

RESULTS AND DISCUSSION

The results of this study indicate that the utilization of waste cooking oil as a raw material for aromatherapy candle production at SDN Semanan 12 Pagi was effectively implemented through the Project-Based Learning (PjBL) approach. The learning activities were conducted in groups using Student Worksheets (LKPD) as a learning guide. The tools used included a portable stove, pan, stainless spoon, and candle molds, while the materials consisted of waste cooking oil, stearin, soy wax modifier, candle dye, fragrance oil, wicks, and wick holders.

Observation results were conducted on 15 Grade 4 students divided into three groups, each consisting of five students. The assessment was based on 15 indicators, including students' understanding of the "Tersenyum" Program, engagement in activities, preparation

of tools and materials, technical skills in processing materials, creativity in product development, teamwork, and understanding of the environmental benefits of waste cooking oil management.

Table 1. Observation Results

Group	Total Score	Percentage	Category
Group 1	53	70.67%	Good
Group 2	60	80.00%	Good
Group 3	57	76.00%	Good

Based on Table 1, all groups achieved a “Good” category in the implementation of the aromatherapy candle-making activity. Group 2 obtained the highest score (80.00%), followed by Group 3 (76.00%) and Group 1 (70.67%). These findings indicate that most students were able to follow the procedural steps of candle production appropriately.

The production process began with filtering waste cooking oil to remove impurities. The oil was then heated to reduce unpleasant odors before being mixed with stearin and soy wax modifier until fully dissolved. Subsequently, dye and fragrance oil were added, and the mixture was poured into molds equipped with wicks until solidified.

Interview results with representatives from Rumah Sosial Kutub revealed that the waste cooking oil utilization program aims not only to reduce environmental pollution but also to foster environmental awareness among students. The facilitator emphasized that improperly managed waste cooking oil may cause serious environmental and health issues. The activity was considered beneficial as students were able to understand that household waste can be transformed into useful and economically valuable products.

Teacher interviews indicated that this activity supported contextual learning in elementary education. The teacher stated that students became more environmentally aware, creative, and capable of understanding waste-to-product transformation. Students were also given freedom to determine the color, shape, and fragrance of the candles, resulting in diverse creative outputs. This aligns with the characteristics of Project-Based Learning, which emphasizes learner autonomy and creativity.

Student responses further confirmed these findings. Students demonstrated an understanding that waste cooking oil should not be disposed of improperly due to its environmental impact. They also recognized the “Tersenyum” Program as an initiative for collecting and reusing waste cooking oil. This reflects active student engagement in the learning process, which is essential for meaningful learning experiences.

These findings are consistent with previous studies stating that Project-Based Learning enhances students’ engagement and promotes experiential learning based on real-life environmental problems (Puspitasari et al., 2024; Sahroni et al., 2022). Furthermore, PjBL has been shown to improve students’ creative thinking skills in elementary education (Aulia, 2023). Through direct involvement in waste processing activities, students not only gained conceptual knowledge about environmental pollution but also learned practical solutions to address it.

In addition, this study demonstrates the implementation of green industry principles within the school context. Green industry emphasizes resource efficiency, waste reduction, and the production of environmentally friendly goods. In this study, these principles were not only introduced theoretically but also practiced directly through learning activities. This supports (Xi & Wang, 2022), who found that PjBL-based activities enhance students' environmental awareness and pro-environmental behavior through contextual learning experiences.

Overall, the findings suggest that the utilization of waste cooking oil as a raw material for aromatherapy candle production can serve as an effective contextual learning strategy in elementary education. This activity promotes creativity, collaboration, environmental awareness, and meaningful learning experiences among students.

CONCLUSION

This study demonstrates that the utilization of waste cooking oil as a raw material for aromatherapy candle production can be effectively integrated into Project-Based Learning (PjBL) activities at SDN Semanan 12 Pagi. The activity provided students with contextual learning experiences through the transformation of household waste into environmentally friendly and value-added products.

The findings from observations and interviews indicate that students were able to follow the stages of candle production effectively, demonstrate creativity in product development, and develop an understanding of the importance of proper waste cooking oil management in reducing environmental pollution. In addition, the activity promoted collaboration among students and increased their environmental awareness. The utilization of waste cooking oil into aromatherapy candles also reflects the implementation of green industry principles through waste reduction and the creation of value-added products (Dwi Kurniawati et al., 2024).

Furthermore, the implementation of the Project-Based Learning approach successfully enhanced students' active engagement in the learning process. This was reflected in students' enthusiasm, teamwork skills, and observation results showing that most groups achieved a "Good" category in the practical activities. These findings are consistent with previous studies stating that PjBL places students at the center of learning and enables them to develop creativity through project-based activities (Pangestu et al., 2024; Titin Nuraeni et al., 2023). Students also demonstrated a solid understanding of the waste processing stages and their environmental impacts. Supporting worksheets (LKPD) effectively facilitated students' participation in both conceptual understanding and active learning processes (Rahmawati & Fadlillah, 2024).

Overall, the activity not only improved students' practical skills but also fostered creativity, responsibility, and environmental awareness. Therefore, the utilization of waste cooking oil as a raw material for aromatherapy candle production can be considered an innovative learning alternative that supports environmental education and character development in elementary school students.

For future research, it is recommended that studies involve a larger number of participants and explore more deeply the impact of such activities on students' creativity, environmental awareness, and skill development using different research approaches.

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