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Innovating aromatherapy candles from used cooking oil for student entrepreneurship

Siti Atwano Pisriwati[1], Deny Hadi Siswanto[2], Nurcahyo Yogyanto[3]
[1,2,3] SMA Muhammadiyah Mlati, Sleman, Indonesia
sitipisriwati51@guru.sma.belajar.id[1], denysiswanto11@guru.sma.belajar.id[2], nurcahyoyogyanti71@guru.sma.belajar.id[3]

ABSTRACT

Improper disposal of used cooking oil can harm the environment and disrupt aquatic ecosystems. A creative solution is repurposing it into aromatherapy candles, which offer relaxation and health benefits. This study aims to educate 11th-grade science students at SMA Muhammadiyah Mlati on reusing used cooking oil through aromatherapy candle-making training. The program involves raising awareness of the environmental risks of used cooking oil and conducting hands-on workshops where students create candles infused with essential oils such as patchouli and lemon, which also serve as natural mosquito repellents. The findings indicate a significant increase in students' interest in aromatherapy candle-making and entrepreneurship, as reflected in the rising interest levels after training. Moreover, this initiative fosters environmental awareness and opens opportunities for waste-based entrepreneurship. Therefore, producing aromatherapy candles from used cooking oil can help reduce pollution while enhancing students' skills and entrepreneurial mindset. Continuous support from schools and relevant institutions is essential to expand similar sustainable waste management programs.

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ABSTRAK

Pembuangan minyak goreng bekas yang tidak tepat dapat merusak lingkungan dan mengganggu ekosistem perairan. Solusi kreatifnya adalah dengan memanfaatkannya kembali menjadi lilin aromaterapi, yang menawarkan manfaat relaksasi dan kesehatan. Penelitian ini bertujuan untuk mendidik siswa kelas 11 MIPA di SMA Muhammadiyah Mlati tentang penggunaan kembali minyak goreng bekas melalui pelatihan produksi lilin aromaterapi. Penelitian ini melibatkan peningkatan kesadaran tentang risiko lingkungan dari minyak goreng bekas dan lokakarya langsung di mana siswa membuat lilin yang diresapi dengan minyak esensial seperti nilam dan lemon, yang juga berfungsi sebagai pengusir nyamuk alami. Hasil program menunjukkan peningkatan yang signifikan dalam minat siswa terhadap pembuatan lilin aromaterapi dan kewirausahaan, seperti yang ditunjukkan oleh peningkatan tingkat minat pasca pelatihan. Selain itu, inisiatif ini menumbuhkan kesadaran lingkungan dan membuka peluang untuk kewirausahaan berbasis limbah. Oleh karena itu, memproduksi lilin aromaterapi dari minyak goreng bekas dapat membantu mengurangi polusi sekaligus meningkatkan keterampilan dan pola pikir kewirausahaan siswa. Dukungan berkelanjutan dari sekolah dan lembaga terkait sangat penting untuk memperluas program pengelolaan limbah berkelanjutan serupa.

Kata Kunci: *kewirausahaan; lilin aromaterapi; minyak goreng bekas; pelatihan*

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INTRODUCTION

The use of used cooking oil is one of the significant threats to human health and environmental sustainability. Repeated use of this oil may lead to increased free fatty acids, an unpleasant odor, and food taste and nutritional content degradation. When heated above 95°C, oil can produce high peroxide radicals. These compounds can react with oxygen and trigger oxidation processes in human body tissues (Tufail et al., 2024). Such reactions significantly increase the risk of chronic diseases, including cardiovascular disorders and cancer. Therefore, the public must know the dangers of reusing used oil. People must also consider safer and more beneficial alternatives for managing used cooking oil.

Besides its impact on human health, discarding used cooking oil irresponsibly can cause significant ecological issues (Zhang et al., 2024). When poured into drainage systems, the oil does not dissolve in water and usually forms a layer on the surface. This condition increases the water's Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) levels. As a result, dissolved oxygen levels drop, affecting aquatic life. Reduced oxygen also prevents sunlight penetration, which is vital for the survival of underwater organisms (Chemat et al., 2023). Over time, these changes can lead to the death of aquatic species and disrupt the ecosystem balance (Pulungan et al., 2024). Thus, when managed correctly, people must begin to see used cooking oil as a waste and a valuable resource.

Cooking oil can be used through a filtering process to restore its clarity. Typically, this process involves several steps, including sedimentation, activated carbon filtration, and chemical treatment to remove food particles and impurities (Abonyi et al., 2024). Although the oil may appear more straightforward after processing, its chemical structure remains damaged due to repeated heating and oxidation. As a result, the filtered oil is still unsafe for reuse in cooking. A better alternative is to repurpose the oil into environmentally friendly non-food products. Some examples include biodiesel, natural soap, and aromatherapy candles. These solutions reduce waste and offer added value through sustainable product development.

One creative and sustainable product that can be made from used cooking oil is aromatherapy candles. The manufacturing process involves mixing filtered used oil with paraffin wax, essential oils, and natural coloring agents (Damayanti et al., 2024). Commonly used essential oils include lavender, peppermint, and eucalyptus due to their calming effects and ability to improve sleep quality. These candles are widely used in homes, spas, and wellness centers for their soothing ambiance. In addition to their aesthetic and functional benefits, they help reduce dependency on petroleum-based candles. Therefore, turning used cooking oil into aromatherapy candles is an environmentally friendly and economically valuable solution. It promotes responsible waste management while offering a valuable and marketable product.

Essential oils such as patchouli and lemon, known for their mosquito-repellent properties, can be blended into aromatherapy candles made from used cooking oil (Hilabi et al., 2024). This combination makes the aromatherapy candles a beauty and health product and an environmentally friendly solution to mosquito problems without harmful chemicals. With relatively

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low production costs and easily accessible raw materials, producing aromatherapy candles based on waste cooking oil can become a promising business opportunity, especially for communities seeking to utilize household waste more productively.

In order to raise students' awareness and abilities in managing used cooking oil, a training session on creating aromatherapy candles was held for 11th-grade students at SMA Muhammadiyah Mlati. The initiative seeks to inform students about the negative impact of used cooking oil on health and the environment. Moreover, the program offers practical experience in transforming waste oil into products with economic potential. Earlier studies have indicated that such skill-oriented programs can effectively enhance students' comprehension of sustainability and entrepreneurial principles (Daraojimba et al., 2023). Another study found that using used cooking oil waste to create value-added products reduces environmental pollution and fosters an entrepreneurial mindset among students (Ayubi et al., 2024; Kestiara et al., 2024).

The training commenced with an educational segment that outlined the adverse effects of used cooking oil, emphasizing its role in environmental degradation and health hazards when improperly reused or discarded. Participants were also introduced to alternative uses of waste oil, such as in producing biodiesel, soap, and candles. After the theoretical explanation, students engaged directly in the candle-making process, beginning with material selection and blending essential oils, then molding and packaging. This experiential learning approach deepened students' comprehension and fostered their innovation and entrepreneurial spirit. By engaging directly in the process, students gained a sense of ownership and confidence in their ability to innovate with sustainable materials (Syah et al., 2025).

Beyond its educational benefits, this program also opened up possibilities for students and the surrounding community to explore small-scale business ventures. With the rising popularity of aromatherapy products, candles made from waste cooking oil can potentially become a sustainable and competitive product in the market (Setiawan et al., 2024; Wahyuni et al., 2024). To maximize the impact of this initiative, continued support from schools, local businesses, and relevant institutions is crucial in helping students refine their skills and explore the commercial potential of their creations. By fostering a culture of sustainability and entrepreneurship, schools can empower students to think beyond conventional career paths and consider eco-friendly business opportunities as viable alternatives.

This training initiative's positive outcomes can be a reference for other educational institutions aiming to incorporate environmental awareness and entrepreneurial skills within their teaching programs. Schools can cultivate an environmentally conscious and economically independent generation by teaching students to convert waste into valuable products. Additionally, initiatives like this can contribute to broader public awareness about responsible waste management, particularly regarding waste cooking oil (Arifin et al., 2024). Ultimately, utilizing waste cooking oil for aromatherapy candle production is an innovation that benefits the environment and holds significant economic potential. Through programs like this, students can acquire valuable skills beyond the classroom, transforming waste management from a theoretical concept into a practical, everyday solution for a cleaner and healthier world.

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Literature Review

Aromatherapy Candles

Aromatherapy candles are items infused with essential oils and aromatic compounds that are recognized for promoting relaxation and offering several health advantages. Their rising popularity is attributed to their capacity to foster a calming environment and support overall wellness. Aromatherapy utilizes the vapor from these essential oils when the candles are burned; it is a natural approach to alleviating stress, elevating mood, and encouraging a sense of calm (Koutsoumanis et al., 2022). The calming scents emitted by these candles can positively affect the human nervous system, helping to alleviate anxiety, improve sleep quality, and even enhance concentration. Essential oils used in aromatherapy candles are derived from specific plant extracts, such as lavender, peppermint, and chamomile, each of which possesses unique therapeutic properties. Lavender is well known for its calming and sleep-inducing effects. Peppermint is commonly used to improve focus and relieve headaches. At the same time, chamomile is often associated with stress relief and emotional balance (Abonyi et al., 2024).

Besides offering health-related advantages, aromatherapy candles also function as natural insect deterrents, serving as an environmentally friendly substitute for chemical repellents. Several essential oils like eucalyptus, patchouli, and lemon have been scientifically validated for their ability to repel insects, making them effective in keeping mosquitoes and other pests away from indoor and outdoor environments (Vora et al., 2024). Unlike conventional insect repellents that contain synthetic chemicals like DEET, which may pose health risks when used excessively, aromatherapy candles infused with natural essential oils offer a safer and more pleasant solution. The soothing fragrances enhance relaxation and create a protective barrier against insects, making them ideal for use in homes, outdoor gatherings, and camping activities.

Creating aromatherapy candles offers considerable business potential because of the straightforward production process and the easy availability of raw materials. In recent years, the candle-making sector has experienced notable expansion, fueled by growing consumer demand for wellness-focused and environmentally sustainable products. Traditional candles are typically made from paraffin wax, a petroleum-derived substance that releases harmful toxins when burned. However, recent studies have explored alternative materials, such as waste cooking oil, as a more sustainable base for candle production (Tarso et al., 2025; Wibowo et al., 2025). Repurposing used cooking oil for candle-making not only provides an eco-friendly solution but also helps address the issue of waste disposal, as improperly discarded cooking oil can contribute to environmental pollution.

Waste Cooking Oil

Used cooking oil has been used repeatedly for frying, resulting in a substantial decline in quality due to continuous exposure to high heat. This repeated use triggers chemical reactions such as oxidation, hydrolysis, and polymerization, which produce hazardous substances including free radicals, trans fatty acids, and peroxide compounds that can endanger human health (Suryani et al., 2025). The prolonged and repeated heating of cooking oil results in the breakdown of

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beneficial unsaturated fatty acids and the formation of toxic byproducts. These chemical changes affect the taste and smell of the oil and contribute to the production of carcinogenic substances. Studies have shown that consuming food fried in reused oil is associated with an increased risk of degenerative diseases, including cardiovascular disorders, hypertension, and various types of cancer, particularly those affecting the digestive system (Chen et al., 2024).

From an environmental standpoint, incorrect cooking oil disposal can lead to serious harm, mainly affecting aquatic and terrestrial ecosystems. When waste oil is poured directly into drainage systems or water bodies, it does not dissolve in water but instead forms a thin layer on the surface (Falasifah et al., 2024). This oil layer blocks oxygen penetration into the water, which is essential for aquatic life, leading to the suffocation of fish and other organisms. Additionally, waste cooking oil contains high concentrations of fats and grease, contributing to increased chemical oxygen demand (COD) and biological oxygen demand (BOD) in water sources. Elevated COD and BOD levels indicate the presence of organic pollutants that accelerate eutrophication. This process leads to excessive algal growth, depletion of oxygen levels, and the eventual collapse of aquatic ecosystems.

To reduce the adverse effects of used cooking oil, various research initiatives have suggested creative approaches to recycle and transform it into valuable goods. One of the most widely researched solutions is converting waste cooking oil into biodiesel, an environmentally friendly alternative fuel for diesel engines (Tarso et al., 2025). The transesterification process transforms waste cooking oil into biodiesel, significantly reducing greenhouse gas emissions compared to conventional fossil fuels. In addition to its role in sustainable energy production, waste cooking oil can be processed into various value-added products. For instance, it can be utilized in the production of soap, where the saponification process converts oil and an alkali solution into biodegradable cleaning products (Astutik et al., 2025). Similarly, waste cooking oil can be transformed into aromatherapy candles, offering an eco-friendly alternative to traditional paraffin-based candles while contributing to the wellness industry.

Student Entrepreneurship

Engaging in entrepreneurial activities provides students with a vital platform to cultivate economic competencies and enhance their understanding of financial literacy and independence from an early age. The integration of entrepreneurship education within the school curriculum aims to foster an entrepreneurial mindset and equip students with the practical abilities required to manage small businesses based on creativity and innovation (Suryani et al., 2024). Through structured learning experiences, students gain exposure to essential business concepts, including financial management, risk assessment, and market analysis. By engaging in entrepreneurial activities, students can cultivate resilience, adaptability, and problem-solving skills-key competencies that are highly valuable in professional and personal development. Moreover, as they navigate the challenges of running a business, they develop a sense of accountability and responsibility, which prepares them for future economic participation, whether as entrepreneurs or professionals in various industries (Putri et al., 2024).

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To effectively nurture entrepreneurial potential among students, schools can implement various initiatives such as Market Day, business incubation programs, and partnerships with local entrepreneurs. Market Day allows students to showcase and sell their products, giving them real-world experience in customer interaction, pricing strategies, and sales techniques. Business incubation programs provide mentorship and structured support, guiding students through business planning, product development, and financial management. Collaborations with local entrepreneurs further enrich students' learning experiences by offering insights into industry trends, marketing strategies, and sustainable business practices (Siswanto et al., 2024; Tarso et al., 2024). Additionally, participation in entrepreneurship fosters the development of essential soft skills, such as effective communication, leadership, collaboration, and negotiation abilities. These skills enhance students' entrepreneurial success and prepare them for diverse career paths, equipping them with the confidence and experience needed to thrive in competitive professional environments (Afandi et al., 2024).

In many cases, student-led entrepreneurial ventures are inspired by local resources and the specific needs of their communities. A compelling example is the innovative use of waste cooking oil to produce environmentally friendly aromatherapy candles. Students gain hands-on business experience and contribute to sustainable waste management solutions by transforming a commonly discarded material into a valuable product. This initiative aligns with the principles of green entrepreneurship, which emphasize creating economically viable and environmentally responsible products. Students develop a deeper understanding of environmental conservation and circular economy principles through such projects, reinforcing their role as responsible and innovative societal contributors (Hanama et al., 2024).

METHODS

Aromatherapy candle-making training using cooking oil was held on January 18, 2025, at SMA Muhammadiyah Mlati on Jalan Magelang KM 7, Sinduadi, Mlati, Sleman. This activity was attended by 28 grade XI students and divided into four stages: preparation, theory delivery, candle-making practice, and evaluation. The following is a picture of the implementation stages.

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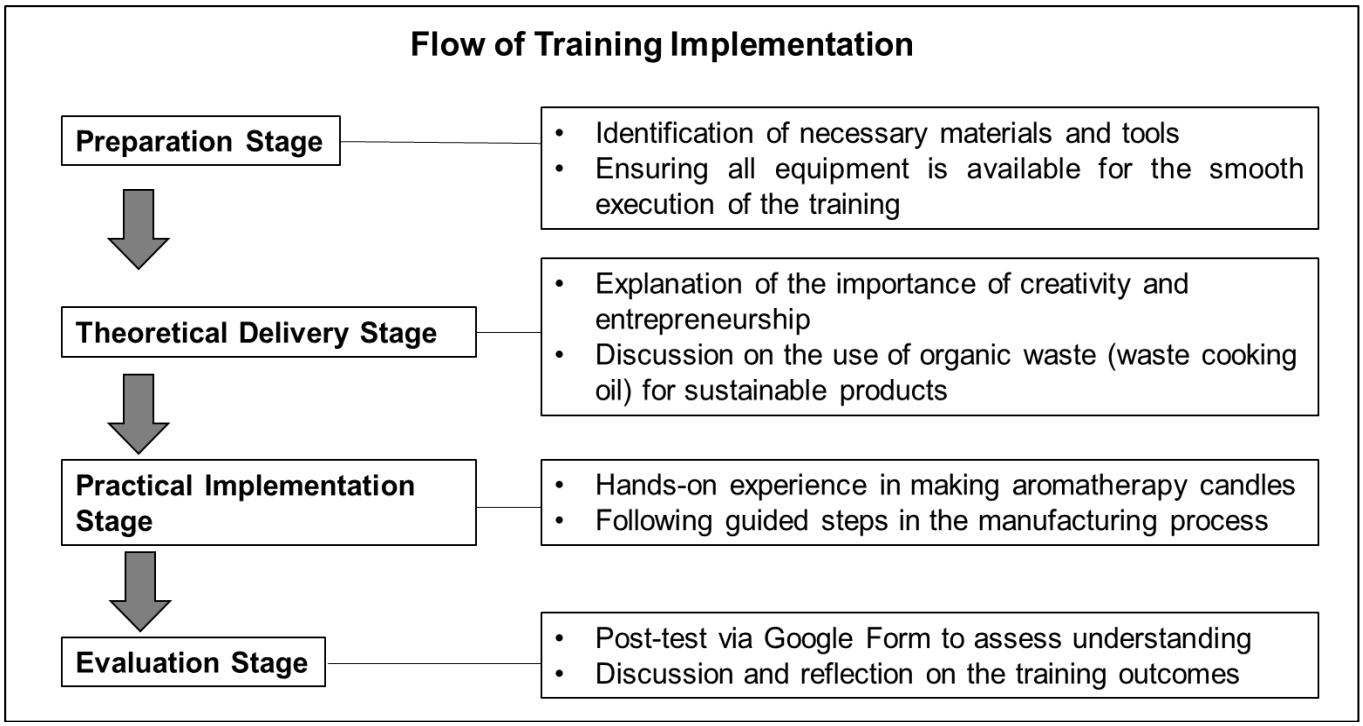

Figure 1. Training Implementation Flow
Source: Community services 2025

The flowchart of the implementation of this program illustrates the four main stages in the training of making aromatherapy candles from used cooking oil: preparation, delivery of theory, practice of making, and evaluation. In the preparation stage, participants identify the materials and tools needed and ensure that all equipment is available so that the training can run smoothly. Furthermore, in the delivery of theory stage, the speaker explains the importance of creativity and entrepreneurship and discusses using organic waste, primarily used cooking oil, as a sustainable product. After understanding the basic concepts, participants move on to the practice stage, where they directly make aromatherapy candles by following the predetermined steps. Finally, in the evaluation stage, participants take a post-test via Google Forms to measure their understanding, followed by discussion and reflection on the training results. This approach ensures that students gain theoretical insights and practical skills in entrepreneurship and creating environmentally friendly products.

RESULTS AND DISCUSSION

The activity began with a lecture session delivered by the resource person, focusing on the fundamental theories of entrepreneurship. This theoretical approach aimed to deepen students' understanding of entrepreneurial concepts and stimulate their interest and motivation in becoming entrepreneurs. During the session, students were introduced to ideas such as creativity and innovation in business. They learned how these elements are essential for developing unique products. Moreover, the session highlighted how waste materials like used cooking oil can be transformed into valuable economic goods.

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Chemically, candles are organic ester compounds formed through an esterification process by the fatty acids contained in them (Putri et al., 2024). In this training, cooking oil was used as the base material for making aromatherapy candles; however, before being used, the oil had to go through a purification process to produce a better quality candle product. In the candle-making process, various color options, such as red, blue, and yellow, and fragrance options, like apple, lavender, and jasmine, were available. With these variations in color and scent, it was hoped that students would be more creative in creating products that would appeal to potential consumers.

The aromatherapy candle-making practical session was carried out according to the established procedures. Students actively and enthusiastically participated in every stage of the candle-making process, from mixing the ingredients to adding color and shaping the candles. The resource person also provided direct guidance and assisted students who encountered difficulties during the process (Siswanto & Andriyani, 2024; Syah et al., 2024). During the practice, some students demonstrated good skills in making aromatherapy candles, indicating that they could understand and apply the material taught effectively.

This training program improved students' technical skills in candle-making and offered them practical experience in managing a small business utilizing recycled materials. The activity encouraged students to explore creative ideas in designing marketable products with commercial potential. As a result, the training served as a platform to cultivate both technical competencies and an entrepreneurial mindset, equipping students with a solid foundation for future pursuits. Evaluation results revealed increased student motivation to delve into entrepreneurship, with post-training surveys showing that many students expressed interest in launching their candle-making businesses. This outcome highlights the program's effectiveness in enhancing awareness of waste-based business opportunities while providing hands-on experience supporting real-world application and personal development.

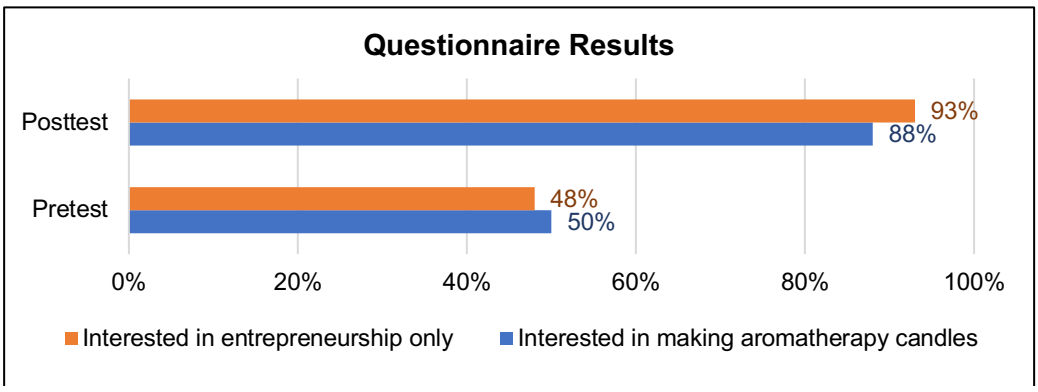

Figure 2. Questionnaire Results
Source: Community services 2025

The evaluation results demonstrated a notable rise in students' interest in aromatherapy candle-making and entrepreneurship following the training. Before the training, only 50% of students expressed interest in creating aromatherapy candles. However, after participating in the program, that number increased significantly to 88%. A similar trend was observed in entrepreneurial interest, which rose from 48% before the training to 93% afterward. These findings suggest that the training effectively enhanced students' knowledge and practical skills. More importantly, it

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succeeded in boosting their enthusiasm toward business activities. The increase in motivation indicates that students are now more aware of the potential in utilizing used cooking oil as a basis for sustainable entrepreneurial ventures.

In addition, the training session revealed a strong enthusiasm among students as they produced aromatherapy candles using cooking oil. They showed increased motivation to explore new experiences, demonstrated persistence, and began to cultivate creative and innovative thinking in developing entrepreneurial ideas. The program effectively strengthened their comprehension, broadened their knowledge, and enhanced their skills in entrepreneurial theory and the practical candle-making process. Every student could complete all phases of the activity from beginning to end. Moving forward, students are encouraged to refine their aromatherapy candle products further. They are also expected to explore various marketing approaches to help promote and distribute their creations to a broader audience (Hatmoko et al., 2024).

Discussion

The results of this study indicate that the aromatherapy candle-making training, based on the utilization of used cooking oil, successfully enhanced students' understanding and skills in entrepreneurship. The lecture method used in the initial stage of the training served as a structured and effective way to introduce students to a broad range of entrepreneurial concepts, from basic definitions and characteristics of entrepreneurs to practical applications in real-world scenarios. Through these theoretical sessions, students were able to reflect critically on the role of creativity and innovation in identifying business opportunities, particularly in transforming waste into valuable products. They were also introduced to strategies for recognizing market needs and addressing social and environmental challenges through entrepreneurial action. This comprehensive exposure deepened their understanding of entrepreneurship and sparked a sense of purpose and relevance in their learning experience. This is consistent with research that states that understanding entrepreneurship theory can increase students' interest in entrepreneurship, especially when accompanied by relevant hands-on practice (Adigwe et al., 2023).

In the practical session of aromatherapy candle-making, students showed high enthusiasm and active involvement at each stage, from purifying the used cooking oil to mixing the ingredients, coloring, and adding fragrance. The hands-on nature of the activity allowed students to directly engage with the material, experiment with their creativity, and learn from real-time feedback and observations. Students worked collaboratively in groups, fostering communication and teamwork skills essential in entrepreneurial settings. They also demonstrated curiosity and perseverance, particularly when encountering challenges in production, such as balancing fragrance intensity or achieving a consistent texture. The post-test results revealed that students' understanding reached 93%, indicating a significant increase in their entrepreneurial interest and conceptual grasp compared to before the training. This finding is supported by previous research, which indicated that practice-based activities can improve students' skills in entrepreneurship and reinforce their understanding of the concepts taught (Lestari et al., 2022; Widyastuti et al., 2024).

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Additionally, the training encouraged students to think creatively and innovatively when creating products with marketable value. With the variety of colors and scents in candle-making, students were more motivated to explore new ideas that could enhance the product's appeal in the market. This creative process involved testing different scent combinations, using eco-friendly dyes, and designing candles with distinct shapes and packaging that could attract potential buyers. Students were free to personalize their creations, which made them more invested in the outcomes and more attentive to consumer preferences. These activities strengthened their innovation skills and taught them how to adapt and respond to changing market demands. This outcome aligns with research showing that practical entrepreneurship experiences can boost students' critical and innovative thinking skills essential in business (Palupi et al., 2023).

This training provided technical skills in making aromatherapy candles and offered insights into environmentally-based business concepts. Students were introduced to the idea that waste materials, such as used cooking oil, can be processed into economically valuable products, thus creating sustainable business opportunities. Through discussion and reflection, they learned how such practices contribute to environmental conservation and promote social responsibility. By recognizing the potential of household waste, students were encouraged to consider sustainability not as a limitation but as a competitive advantage in business. This eco-conscious approach fostered a deeper understanding of the importance of circular economy principles and instilled values of environmental stewardship in the participants. This is reinforced by research stating that environmental-based entrepreneurship education can raise students' awareness of the importance of utilizing waste as a resource to create new economic value (Yuan et al., 2022).

As a follow-up to this training, students are expected to develop their aromatherapy candle products further and learn marketing strategies to make them known to the broader public. Beyond refining product quality, students should be encouraged to explore more advanced entrepreneurial skills, such as attractive packaging design, establishing product branding, pricing strategies, and managing small business operations. They must also understand how to leverage digital platforms, including social media, e-commerce, and content marketing, to reach a broader audience and build customer loyalty. These skills are crucial for their long-term growth as entrepreneurs in an increasingly digital and competitive market. Thus, this training not only enhances technical skills but also shapes an entrepreneurial mindset that can be a valuable asset for students in the future (Siswanto et al., 2024). With support from various stakeholders, such as schools, entrepreneurship communities, parents, and local government, this program has the potential for further development to allow more students to benefit from this inspiring and empowering educational experience.

CONCLUSION

The data indicates a notable improvement in students' comprehension, knowledge, and entrepreneurial skills. This progress is evident from the post-training evaluation results, which reached 93%, and the observational data collected during the sessions. Students displayed strong enthusiasm throughout the workshop, which covered theoretical concepts of entrepreneurship and hands-on practice in making aromatherapy candles. Every participant was

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actively engaged at each stage of the training, contributing to the smooth and effective implementation of the activities. Their creativity and entrepreneurial mindset showed growth, especially as they discovered that the candle-making process was more straightforward and accessible than they had initially assumed. Students expressed greater enjoyment and engagement during practical sessions than during purely theoretical learning without direct application. It is recommended that universities offer more entrepreneurship training opportunities, both in online and offline formats, to equip students with practical skills that are beneficial for their future endeavors. This way, students enhance their cognitive development and improve their psychomotor abilities and affective competencies.

AUTHOR'S NOTE

The author declares that there is no conflict of interest regarding the publication of this article and confirms that the data and content of the article are free from plagiarism.

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