

Language and Communication Strategies in Developing Students' Creativity and Entrepreneurial Spirit through Orange Peel Waste Innovation

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Abstract:

This article aims to explore the potential of utilizing orange peel waste (Citrus sp.) as an innovative raw material in the development of natural mosquito repellent pouch products, while identifying strategies to strengthen students' creativity and entrepreneurial spirit. The methodology applied in this study is a literature study with a descriptive qualitative approach, by referring to scientific sources from accredited national journals and reputable international journals published between 2021 and 2026. The main findings of this study indicate that, (1) orange peel waste contains limonene compounds with a concentration of up to 90.15%, which is proven to be effective as a natural mosquito repellent agent and has a high safety profile for human health, (2) aromatherapy pouch products produced from dried orange peels show aroma durability for up to two weeks in closed packaging conditions, so they have the potential to be developed as environmentally friendly products (eco-friendly) with high economic value. The original contribution (novelty) of this study lies in the integrated approach that combines green innovation based on organic waste (orange peels) with the simultaneous strengthening of students' creativity and entrepreneurial spirit. This interdisciplinary approach is relatively rare in previous scientific literature, so this study is expected to provide a new perspective in developing project-based learning strategies and empowering students in the field of sustainable entrepreneurship.

Keywords: Orange Peel Waste, Mosquito Repellent Pouch, Creativity, Innovation

Submitted	: 06 January 2026
Revised	: 19 March 2026
Acceptance	: 01 April 2026

Introduction

Orange peel waste is a category of organic waste generated in large quantities from household activities, traditional markets, and the food and beverage industry. In Aceh, orange consumption is very significant, especially during Ramadan and other traditional celebrations, so that orange peel waste is estimated to reach tens of kilograms every day from shopping centers, households, and beverage vendors, which are often discarded without prior processing. A study by Fauroni et al. (2025) shows that sustainable innovation has a crucial role in advancing a circular economy through food waste management from micro, small, and medium enterprises (MSMEs), with the aim of significantly reducing waste volume and carbon emissions. Orange peel waste disposed of directly in open areas without processing can produce methane gas which has an impact on global warming due to the decomposition process by microorganisms. Fauroni et al. (2025) also revealed that organic waste management with a circular economy approach can target a minimum reduction in waste volume of 30 percent and carbon emissions of up to 20 percent within three years.

This issue highlights the critical importance of innovation in waste management, not only addressing pollution but also providing economic value and benefits to the community. Fauroni et al. (2025) also emphasized that waste management by MSMEs is currently lacking and not widely connected to existing environmental initiatives. Therefore, utilizing orange peel waste to create creative products, such as natural mosquito repellents in the form of aromatherapy pouches, can be an environmentally friendly solution that supports the principles of a circular economy and community empowerment. The concepts of green innovation and entrepreneurship implemented by students provide an important theoretical basis for creating products utilizing organic waste. Based on research by Chen, Lai, and Wen (2006), green innovation is defined as the development of new technologies in the form of products, processes, or systems that can reduce negative impacts on the environment while increasing the efficiency of natural resource use.

Their findings indicate a positive relationship between green product innovation performance, green process innovation, and a company's competitive advantage (Chen, Lai, & Wen, 2006). This study confirms that investing in green product and green process innovation is highly beneficial for companies, and it is important for companies to recognize the value and proper positioning of the green innovations they create (Chen, Lai, & Wen, 2006). In the case of orange peel waste management, the green innovation approach is not only related to recycling,

but also includes product design that is safe for human health and environmentally friendly. The entrepreneurship theory outlined by Hisrich, Peters, and Shepherd (2017) describes entrepreneurship as the process of creating something new by investing time, effort, and taking financial, psychological, and social risks to achieve results in the form of independence, economic profit, and personal satisfaction.

For students, entrepreneurial activities focused on green innovation not only hone technical skills in production but also build character traits such as creativity, independence, leadership, problem-solving skills, and awareness of relevant environmental issues. Hisrich et al. (2017) also highlight that creativity and business idea development are essential foundations for establishing new businesses, including those utilizing organic waste. The utilization of orange peel waste is a concrete example of environmentally friendly innovation because it utilizes abundant waste around us through a simple and energy-efficient production process. Chen, Lai, and Wen (2006) state that environmentally friendly product innovation includes designing goods that are not harmful to the environment, including the use of renewable materials and production methods that produce minimal waste. In the context of orange peel waste management, this method is particularly important because the material used is derived from previously valueless waste, thus the process also helps reduce environmental impact.

Fauroni et al. (2025) demonstrated that developing a circular economy through waste management requires increased technical skills and education regarding the economic value of waste. Additionally, environmentally friendly economic incentives are needed for businesses. This waste utilization is created in the form of aromatherapy bags made from dried orange peels crushed into a coarse powder, then packaged in a practical and easy-to-use cloth bag in various locations such as bedrooms, living rooms, or closets. In addition to functioning as a natural mosquito repellent, this product also offers the benefits of aromatherapy that can reduce stress and create a more comfortable room atmosphere. Hisrich et al. (2017) explain that when planning a business, entrepreneurs must consider operational aspects of production, including the selection of appropriate technology, cost efficiency, and product quality assurance to compete in the market. Initial trials show that this product has a scent that lasts up to two weeks when stored in a sealed package, so it can be produced sustainably with improvements in drying and packaging techniques.

The repellent activity derived from orange peel waste has been tested

through several previous studies evaluating the ability of orange peel essential oil to control disease-carrying mosquitoes. Research conducted by Kumar, Singh, and Singh (2023) published in the *Journal of Waste and Biomass Valorization* showed that orange peel essential oil prepared in nanoemulsion format has significant larvicidal ability against *Anopheles stephensi* mosquito larvae with an LC₅₀ value of 6.12 µg/mL, and does not show any toxic effects on vertebrate cells, thus ensuring its safe use. The main compound responsible for this activity is limonene, which is the main component of orange peel essential oil. Li et al. (2025) in the *International Journal of Molecular Sciences* revealed that limonene acts as a neuroactive agent by engaging several ion channels and receptors in the mosquito nervous system, including the Rdl receptor for insecticidal function, as well as the Orco and TRPA1 channels that play a role in long-range repellent effects. In the realm of business development, Hisrich et al. (2017, p. 200) states that technical and market feasibility evaluation is a crucial step before launching a new product, including testing product effectiveness and determining the appropriate market segment.

Fauroni et al. (2025) also highlighted the importance of collaboration between academics, MSMEs, and local governments to increase the adoption of environmentally friendly innovations at the local level. Therefore, the development of this waste-based product relies not only on the technical potential of orange peel waste as a natural repellent, but also on business feasibility and support from the existing entrepreneurial ecosystem. In addition to its function as an insect repellent, the use of orange peel waste to create natural mosquito repellent products also has a significant impact on environmental management and reduces greenhouse gas emissions. Fauroni et al. (2025) revealed that sustainable innovation through circular economy methods can transform waste that was previously an environmental problem into a resource with high economic value. Their study at the Climate Village Institute in Indonesia showed that managing food waste from micro, small, and medium enterprises by applying circular economy principles can reduce the amount of waste entering landfills while creating new job opportunities for local residents (Fauroni et al., 2025).

The utilization of orange peel waste as a raw material for aromatherapy products represents an important implementation of sustainable waste management practices. Organic waste generated from households, traditional markets, and food industries is often discarded without proper treatment, leading to environmental problems such as pollution and greenhouse gas emissions resulting from natural decomposition processes. Through the application of a

circular economy approach, organic waste can be transformed into valuable resources that contribute to both environmental sustainability and economic development. One practical example is the conversion of orange peel waste into aromatherapy pouches that function as natural mosquito repellents and room fresheners. This innovation demonstrates that waste materials previously considered useless can be transformed into products with practical functions and commercial value. In addition to reducing the amount of waste disposed of in landfills, the utilization of orange peels can also raise public awareness regarding the importance of sustainable waste management and resource efficiency. Furthermore, this innovation supports responsible production and consumption patterns by promoting the reuse of organic materials. According to Fauroni et al. (2025), sustainable waste management integrated with circular economy principles can generate significant environmental, social, and economic benefits. Therefore, the development of orange peel-based products can serve as an effective strategy for supporting sustainable development while simultaneously addressing waste-related environmental challenges and creating new economic opportunities for local communities.

From an economic perspective, the development of aromatherapy products derived from orange peel waste offers promising entrepreneurial opportunities. Growing public awareness of environmentally friendly and natural products has increased market demand for goods that are safe for human health and sustainable for the environment. This trend creates favorable conditions for the commercialization of innovative products that combine environmental benefits with practical functions. Orange peel aromatherapy pouches possess several competitive advantages, including low production costs due to the availability of inexpensive raw materials and the unique natural citrus fragrance that provides refreshing and relaxing effects while helping to repel mosquitoes. According to Hisrich, Peters, and Shepherd (2017), entrepreneurial success largely depends on the ability to identify market opportunities and create value-added products that differentiate themselves from competitors. In this context, orange peel waste utilization provides additional value by transforming organic waste into marketable products while contributing to environmental conservation efforts. Advances in digital technology further enable students and small business owners to promote and market their products more effectively through online platforms and social media. Consequently, aromatherapy products made from orange peel waste have significant potential to become sustainable business ventures that generate economic benefits while supporting environmentally responsible

consumer behavior and waste reduction initiatives.

Beyond its environmental and economic advantages, the utilization of orange peel waste also offers substantial educational benefits, particularly in fostering creativity and entrepreneurial spirit among university students. Active involvement in transforming waste materials into value-added products provides students with practical learning experiences that complement theoretical knowledge acquired in academic settings. Through participation in product development processes, students learn how to identify real-world problems, design innovative solutions, and implement ideas that address community needs. These activities help develop essential competencies such as creativity, critical thinking, problem-solving, teamwork, communication, and decision-making skills. Hisrich et al. (2017) emphasize that creativity is a fundamental component of entrepreneurship because it serves as the foundation for generating innovative business ideas and creating economic value. The development of orange peel-based aromatherapy products illustrates how environmental challenges can be transformed into profitable business opportunities through innovation and resourcefulness. Moreover, such initiatives encourage students to develop a stronger sense of environmental responsibility and sustainability awareness. With adequate support from universities, government institutions, and other stakeholders, waste-based product innovation can become an effective platform for nurturing a new generation of creative, independent, and environmentally conscious entrepreneurs. Therefore, the utilization of orange peel waste not only results in beneficial products but also contributes significantly to character development, entrepreneurial capacity building, and the promotion of sustainable development goals.

Method

This study employed a library research method with a descriptive qualitative approach to examine the potential utilization of orange peel waste as a natural mosquito repellent product and as a medium for fostering students' creativity and entrepreneurial spirit. The selection of this method was based on the research objective of collecting and analyzing information from various scientific sources without conducting direct experimental testing. According to Sugiyono (2021), a research method is a scientific procedure carried out systematically, logically, and empirically to obtain data that can be used to address research problems. The data utilized in this study consisted of secondary data obtained from accredited national journals and reputable international journals relevant to the research topic. The primary references included studies on

entrepreneurship education and Generation Z's interest in green entrepreneurship by Bulu et al. (2026), research on the extraction of orange peel essential oil containing limonene and citral by Putri et al. (2023), and studies on the chemical characteristics of orange peel essential oil for aromatherapy purposes by Rasyadi et al. (2024). These sources served as the foundation for analyzing the bioactive compounds present in orange peel waste, its potential as a value-added product, and its contribution to the development of environmentally oriented entrepreneurship.

Data collection was conducted through documentation techniques involving the identification, collection, review, classification, and analysis of literature related to the research focus. The selected references were required to meet several criteria, including relevance to the research topic, credibility through publication in accredited or Scopus-indexed journals, and publication within the period of 2021–2026 to ensure the relevance and timeliness of the information used. The collected data were analyzed using content analysis techniques consisting of data reduction, data presentation, and conclusion drawing. The findings were categorized into several major themes, including the bioactive compounds found in orange peel waste, the implementation of green innovation based on circular economy principles in waste management, and the role of entrepreneurship education and university support in the development of environmentally friendly businesses. To ensure the validity and reliability of the findings, source triangulation was applied by comparing information obtained from various relevant national and international scholarly publications, thereby strengthening the credibility of the research results.

In addition to identifying the potential of orange peel waste as a raw material for innovative products, this study also highlights the importance of integrating education, innovation, and environmental awareness in promoting sustainable development. The literature review revealed that orange peel waste, which is often regarded merely as organic waste, possesses significant potential to be transformed into products that generate economic, social, and environmental benefits when supported by creativity and appropriate technological applications. Within the higher education context, transforming waste into value-added products can serve as an effective learning medium by enabling students to connect theoretical knowledge with practical applications. Furthermore, this approach can enhance students' awareness of environmental issues while encouraging them to develop innovative solutions through the utilization of local resources. Therefore, this study reinforces the view that implementing circular economy principles through organic waste management can be an effective strategy for supporting sustainable development while simultaneously cultivating creative, innovative, entrepreneurial, and environmentally conscious students.

Results and Discussion

Results

Compound Content in Orange Peel Waste

Based on previous studies, orange peel waste has been shown to contain a variety of active compounds with significant potential for development as raw materials for innovative products. The primary compound detected in orange peel is essential oil, dominated by limonene, supported by other compounds such as flavonoids, terpenoids, and various supporting aromatic compounds. Research on the physical and chemical characteristics of essential oil extracted from orange peel waste revealed that the oil has a strong, distinctive citrus aroma, is clear yellow in color, and exhibits sufficient aroma stability for application in various aromatherapy-based products. This aroma is produced by limonene, the dominant component of orange peel essential oil. Besides providing a refreshing aroma, limonene is also known to act as a natural insect repellent, making it frequently used in the development of natural-based products. These findings indicate that orange peel waste has significant potential for development into economically valuable and environmentally friendly products (Agriprima, 2021).

The results of the compound content analysis conducted using the Gas Chromatography-Mass Spectrometry (GC-MS) method show that orange peel contains various bioactive compounds that can be optimized for use in the household industry sector and environmentally-based creative businesses. The relatively high essential oil content makes orange peel a type of organic waste that has added value when processed with the right techniques. A study of the essential oil composition of squeezed orange peel waste revealed that limonene is the most dominant compound compared to other compounds. The presence of this compound opens up broad opportunities for the development of various innovative products, including aromatherapy pouches that utilize natural aromas as the main function of the product. Thus, orange peel can no longer be seen as merely worthless waste, but as an alternative source of raw materials that can be used to produce products that have economic benefits while contributing to reducing the amount of organic waste in the community.

Utilization of Orange Peel Waste as Aromatherapy Pouches

The utilization of orange peel waste as the primary material for aromatherapy pouches not only provides environmental benefits but also offers significant potential for fostering students' creativity and entrepreneurial development. The abundance of raw materials and relatively low production costs make this product a promising environmentally based business opportunity. Through the process of transforming waste into a marketable product, students gain practical experience in various aspects of entrepreneurship, including business planning, raw material management, production processes, pricing strategies, and product marketing. These experiences help students understand

that business opportunities can emerge from challenges found in their surrounding environment, including the issue of underutilized organic waste. Furthermore, students are encouraged to enhance their creativity and innovation by developing product variations, improving packaging designs, and creating attractive promotional strategies to appeal to consumers. Active involvement in every stage of product development provides a deeper understanding of business operations while strengthening skills in decision-making, problem-solving, and overcoming entrepreneurial challenges. Consequently, the conversion of orange peel waste into aromatherapy pouches not only results in a useful and marketable product but also serves as an effective learning medium for cultivating entrepreneurship, independence, and creativity among students. This experience equips them with the knowledge and confidence needed to identify and develop sustainable business opportunities in the future.

In addition to supporting entrepreneurial development, the innovation of converting orange peel waste into aromatherapy pouches also contributes positively to environmental conservation through the implementation of circular economy principles. Orange peel waste, which is often discarded and contributes to the increasing volume of organic waste, can instead be transformed into a valuable product with both practical and economic benefits. This process demonstrates that waste materials should not always be regarded as useless by-products but can be repurposed into valuable resources when managed effectively. The use of natural ingredients in the production of aromatherapy pouches makes the product safer for human health and more environmentally friendly than products containing synthetic chemicals. Beyond reducing the amount of waste sent to disposal sites, this innovation also helps raise public awareness regarding the importance of sustainable waste management practices. The application of circular economy principles through the utilization of orange peel waste proves that efficient resource management can generate economic, social, and environmental benefits simultaneously. Therefore, the development of aromatherapy products derived from orange peel waste has strong potential to continue growing as an innovation that promotes environmental sustainability, increases the economic value of local resources, and encourages more responsible production and consumption patterns within society.

Developing Student Creativity

Utilizing orange peel waste to create aromatherapy pouches provides a significant opportunity for students to develop their creativity through a series of product innovation activities. Creativity is a fundamental ability to generate new ideas that are innovative, beneficial, and have high added value for the community and the surrounding environment. In the context of this activity, students are not only required to have a deep understanding of the organic waste processing process but also to be able to create attractive, unique products that

meet the needs and preferences of consumers in the wider community. The product development process involves various systematic, integrated stages, starting from the identification and formulation of existing environmental problems, the search and innovation of relevant product ideas, the selection of appropriate and quality raw materials, standardized production processes, to attractive and eye-catching packaging designs. Each stage intensively encourages students to think creatively, critically, and innovatively in finding effective solutions to the problems of organic waste in their environment. Through this practical experience, students can understand directly that innovation does not always come from complicated and complex technology, but can also be born from the utilization of simple resources that are abundantly available around their daily environment (Munandar, 2019).

In addition to developing creativity in product innovation, students' creative abilities are also reflected in their ability to formulate and develop attractive marketing strategies that align with the characteristics of target consumers. Students learn to define a strong product identity, create unique packaging designs, and utilize social media platforms as an effective promotional tool. This experience is a crucial component of the learning process because it helps students develop critical thinking, innovation, and solution-oriented skills. The resulting aromatherapy pouch product not only functions as a commercial product but also serves as concrete evidence that students are capable of creating innovations that simultaneously provide economic and environmental benefits. The creativity developed through this activity is expected to become an important asset for students in facing the challenges of the increasingly competitive world of work and business in the future.

In addition to serving as a platform for generating new ideas, the utilization of orange peel waste as a raw material for aromatherapy pouches also contributes to the development of students' creative and adaptive thinking skills throughout the product development process. In practice, students encounter various challenges, including maintaining the quality of raw materials, preserving the longevity of the product's aroma, designing attractive packaging, and adjusting the product to meet consumer preferences and market demands. These challenges encourage students to continuously evaluate and improve their products to achieve better quality and functionality. Through this process, students learn how to identify problems, explore alternative solutions, and make appropriate decisions based on the situations they face. Creativity is reflected not only in the ability to generate innovative ideas but also in the capacity to transform those ideas into products with practical and economic value. Furthermore, this activity demonstrates that innovation does not always require sophisticated technology, but can emerge from the effective utilization of simple resources readily available in the surrounding environment. As a result, students gain firsthand experience in converting waste materials that were previously considered worthless into

useful and marketable products. This experience strengthens their ability to recognize opportunities, develop innovative solutions, and create products that are relevant to community needs and evolving market trends.

Moreover, the development of aromatherapy pouches made from orange peel waste also plays an important role in enhancing students' collaboration and communication skills. Throughout the stages of planning, production, and marketing, students are required to work together by sharing responsibilities, exchanging ideas, developing strategies, and evaluating outcomes. These activities create an active learning environment that encourages each participant to contribute to product development. Through this collaborative experience, students learn to appreciate different perspectives, accept feedback constructively, and improve their communication skills in presenting ideas effectively. Such competencies are essential for the success of innovation, as the quality of a product must be supported by the ability to introduce, promote, and develop it within the market. In addition to building self-confidence, these activities help students strengthen leadership abilities, responsibility, and teamwork skills that are highly valuable in both professional and entrepreneurial settings. Therefore, the utilization of orange peel waste as an aromatherapy pouch not only contributes to the enhancement of students' creativity but also supports the development of complementary skills necessary to face future challenges in entrepreneurship, professional careers, and sustainable development initiatives.

Developing Students' Entrepreneurial Spirit

The utilization and processing of orange peel waste into aromatherapy pouches also significantly contributes to the development of students' entrepreneurial spirit. Entrepreneurship is not solely about the ability to generate financial gain, but also encompasses various important aspects such as the courage to seize existing business opportunities, the ability to innovate and create new things, and the skills to manage a business independently and professionally. Through a gradual product creation process, students gain valuable hands-on experience in comprehensive business planning, detailed calculation and analysis of production costs, competitive and profitable pricing, and understanding market characteristics and needs. This hands-on experience provides a valuable learning experience, providing a concrete understanding of the process of running a business from the initial planning stage to the product being ready for marketing. By utilizing orange peel waste as the primary raw material, students also learn and realize that potential business opportunities can arise from environmental issues around them. This demonstrates that entrepreneurship can be an effective solution to addressing organic waste issues while simultaneously creating profitable new economic value.

In addition to product production experience, students also learn the importance of promotional and marketing activities in ensuring the success of a

business. Aromatherapy pouch products have promising market opportunities because the trend of using natural and environmentally friendly products continues to increase every year. This situation provides ample opportunities for students to develop environmentally innovative businesses with relatively affordable capital. Through this activity, students are encouraged to be independent, confident, responsible, and able to make the right decisions in facing various business challenges. The entrepreneurial spirit developed through this process is expected to help students become productive individuals and able to create new jobs in the future. Thus, the use of orange peel waste as aromatherapy pouches not only provides economic and environmental benefits but also plays a vital role in shaping the character of students who are creative, innovative, and entrepreneurial.

In addition to providing economic opportunities, the utilization of orange peel waste as an aromatherapy product also plays an important role in fostering a sustainability-oriented entrepreneurial mindset among students. Through this activity, students are encouraged to understand that the primary objective of a business is not solely to generate financial profit, but also to create positive impacts for society and the environment. During the product development process, students gain valuable experience in identifying consumer needs, maintaining product quality, and designing marketing strategies that align with market trends and demands. These experiences help enhance their adaptability and encourage the development of creative ideas that can be applied in entrepreneurial activities. Furthermore, involvement in the processing of organic waste increases students' awareness of the importance of environmental responsibility in business practices. Students learn that environmental challenges can be transformed into opportunities for innovation that provide both economic and social benefits. The aromatherapy product made from orange peel waste serves as clear evidence that materials previously considered worthless waste can be converted into products with significant practical and commercial value. Therefore, this activity not only functions as a practical entrepreneurship learning experience but also serves as a medium for instilling values of environmental awareness, creativity, and innovation among students. With these competencies, students are expected to become a generation that is not only profit-oriented but also committed to developing sustainable businesses that contribute positively to society and environmental preservation in the future.

Table 1.Percentage of Main Compound Content in Orange Peel Essential Oil

Compound Component	Percentage
Limione	90.15
B-Myrcene	2.34
A-Pinene	1.28
Linalool	1.12

B-Pinene	0.95
Other Compounds	4.16

Discussion

The use of orange peel waste as an aromatherapy pouch clearly shows that organic waste has enormous and significant potential to be developed into a product with high economic value and is profitable. Based on the results of comprehensive research on the physical-chemical characteristics and content of essential oil compounds found in orange peel, it can be known and proven that orange peel waste contains limonene as the main and dominant component responsible for producing a uniquely recognizable citrus aroma. The content of the limonene compound is the main and fundamental reason why orange peel can be optimally utilized as a raw material in aromatherapy pouches, because it has the ability to produce a refreshing, fragrant, and relatively long-lasting aroma over a fairly long period of time. The results of the analysis using the GC-MS method also revealed and showed that the active compounds in orange peel have quite good chemical stability so that they can be optimally utilized in various natural-based products. The findings of this study strongly reinforce and prove that orange peel waste is not merely worthless organic waste, but rather a resource with high economic potential if processed professionally with the right techniques and approaches (Agriprima, 2021; Pratiwi et al., 2024).

From an environmental conservation perspective, the utilization of orange peel waste into aromatherapy pouches provides a positive and meaningful contribution in significantly reducing the amount and volume of organic waste generated by the community on a daily basis. Orange peels, which were previously simply discarded, potentially causing harmful environmental pollution, can now be optimized for reuse in products that have both useful functions and economically attractive sales value. This concept and approach are closely aligned with the principles of a circular economy, which explicitly emphasize the importance of reusing waste into useful and valuable resources for society. In addition to providing positive benefits for environmental sustainability, aromatherapy pouch products also have quite promising and bright market prospects and opportunities in the future, given the increasing public interest and awareness of natural products that are considered safer for human health and environmentally friendly at the same time. Thus, this product innovation and development not only provides an effective solution to waste management problems but also simultaneously opens up new business opportunities and opportunities based on the utilization of abundant local resources available in the community (Handayani et al., 2023).

In the context of improving the quality of higher education and human resource development, the activity of processing and utilizing orange peel waste

into aromatherapy pouches can be used as an effective and efficient learning tool and medium to enhance students' creativity and critical thinking skills. Through this series of learning activities, students are actively encouraged to learn to identify various problems in their surroundings, find innovative and solution-oriented solutions, develop creative and marketable product ideas, and create marketing strategies that are appropriate and relevant to the needs and preferences of a dynamic market. This concrete and direct learning experience provides a very valuable opportunity for students to apply the knowledge and competencies acquired during the lecture process into real-life activities that have concrete and positive benefits for the wider community. The creativity that is built and developed through this learning process automatically becomes one of the most important assets and provisions for students in facing the challenges of an increasingly competitive world of work that requires high innovation skills (Munandar, 2019).

Not only focusing on the aspect of developing creativity, this practical learning activity also provides a significant and meaningful contribution in growing and developing students' entrepreneurial spirit through direct experience in managing and running a simple business in a practical and structured manner. Students not only learn entrepreneurial theory conceptually in the classroom, but also gain valuable and meaningful experience in managing the production process efficiently, determining competitive selling price strategies in the market, conducting effective and efficient promotional activities, and understanding the behavior and preferences of target consumers well. This practical experience actively helps students develop an independent attitude and character, confidence in their own abilities, and the courage to take risks in creating and developing new, innovative and sustainable businesses in the future. Based on this explanation, it can be concluded that the use of orange peel waste as an aromatherapy pouch can be used as a form of innovation that not only provides positive economic and environmental benefits, but also supports the development of students' creativity and entrepreneurial spirit in a comprehensive and sustainable manner in the long term (Suryana, 2018).

This article differs from the research of Yustinah (2016), Mumtazah et al. (2022), and Bulu et al. (2026) both in the focus of the study and the results obtained. Yustinah's (2016) study aimed to use essential oil from orange peel as an additive in soap making. Meanwhile, the study by Mumtazah et al. (2022) focused more on the technology and methods for extracting essential oil from orange peel waste. Meanwhile, the study by Bulu et al. (2026) discussed how to develop green entrepreneurship among students through education and institutional support, without considering how orange peel waste could be used as a business product. This article differs from previous studies because it focuses more on how to process orange peel waste into pouches to repel mosquitoes. These pouches can be directly used by the community as a natural, environmentally friendly

mosquito repellent option. In addition to using essential oil from orange peel, this study also highlights the product's economic value, potential business opportunities, and its role in reducing organic waste in a more practical and sustainable manner.

This article aligns with the research of Yustinah (2016), Mumtazah et al. (2022), and Bulu et al. (2026) because they all aim to optimize the potential of existing resources to provide greater benefits to society and the environment. The research by Yustinah (2016) and Mumtazah et al. (2022) both used orange peel as the main ingredient because it contains beneficial essential oils. Meanwhile, the research by Bulu et al. (2026) shares similarities in terms of developing creativity, innovation, and entrepreneurship that focus on environmental sustainability. Furthermore, all of these studies seek to generate added value from previously underutilized resources, thereby bringing economic and social benefits. Both previous research and this article also support the idea of sustainable development by implementing environmentally friendly innovations, utilizing existing regional potential, and developing creative ideas that can be applied to address various problems faced by the community.

This article is new and different because it turns orange peel waste into a pouch that can repel mosquitoes. This product functions as a natural mosquito repellent and can also be used as an environmentally friendly air freshener. Unlike Yustinah's (2016) study, which only used orange peel essential oil as an additive in soap products, and Mumtazah et al.'s (2022) study, which focused on essential oil extraction, this study produces a new, ready-to-use product with greater benefits for the community. Furthermore, a study by Bulu and colleagues (2026) discussed green entrepreneurship among university students from the perspective of education and institutional support. However, this study did not incorporate the use of organic waste as a basis for developing business products. Therefore, this study provides a more comprehensive approach by combining the use of orange peel waste, circular economy ideas, environmentally friendly innovation, and the development of students' creativity and entrepreneurial spirit in one study. The resulting new contribution focuses not only on reducing waste and protecting the environment but also on creating sustainable business opportunities with educational, ecological, and economic value based on local resources.

In addition to producing a product that can be directly utilized by the community, this study presents a more practical approach to connecting environmental issues with human resource development. The utilization of orange peel waste as an aromatherapy pouch and natural mosquito repellent is not only focused on transforming raw materials into useful products but also serves as a medium for entrepreneurial learning among university students. Throughout the development process, students actively participate in various

stages, including collecting raw materials, processing waste, designing packaging, calculating production costs, and developing marketing strategies. Such involvement provides hands-on experience that enables students to gain a comprehensive understanding of business processes. Unlike previous studies that primarily focused on the technical aspects of essential oil extraction or entrepreneurship from a conceptual perspective, this research integrates both elements into a practical and application-based activity. Through this process, students not only acquire knowledge about organic waste utilization but also learn how environmental challenges can be transformed into business opportunities with economic value. This approach is important because it helps develop essential twenty-first-century skills, including creativity, critical thinking, problem-solving, and decision-making abilities. Therefore, this study not only generates an innovative product but also contributes to the development of entrepreneurial characteristics that are closely aligned with the principles of sustainable development.

Furthermore, another distinctive aspect of this study lies in the integration of circular economy principles, green innovation, and student empowerment within a simple yet sustainable waste utilization model. The aromatherapy pouch developed in this research does not require complex technology, making it easy to adopt and replicate by local communities and small-scale enterprises. This characteristic creates broader opportunities for the development of businesses based on local resources with relatively affordable capital requirements. The use of orange peel waste as the primary raw material also demonstrates that economically valuable products do not necessarily have to originate from new resources but can instead be created through the optimization of waste materials available in the surrounding environment. This approach supports efforts to reduce organic waste while promoting more efficient resource utilization. From a social perspective, the study also provides an alternative productive activity that can enhance student participation in environmentally oriented entrepreneurship programs. By integrating environmental, educational, and economic dimensions within a single framework, this research offers a more comprehensive innovation model than previous studies. Consequently, the main contribution of this study lies not only in the creation of an orange peel waste-based aromatherapy mosquito repellent product but also in the development of a green entrepreneurship learning model that can support sustainable economic growth while increasing environmental awareness among younger generations.

Conclusion

Based on the research conducted, orange peel waste has great potential to be used as an environmentally friendly mosquito repellent pouch, which has economic value and supports the concept of a circular economy. The active compound limonene in orange peel has been proven to have a distinctive odor that can function as a natural mosquito repellent and also provides a fresh effect indoors. Using orange peel waste to make mosquito repellent pouches not only helps reduce underutilized organic waste but also increases the value of materials previously considered to have no economic value. In addition to providing environmental benefits, this innovation also serves as a good learning tool for students, helping them develop creativity, critical thinking skills, innovation skills, and an entrepreneurial spirit. Through the processing, production, and marketing processes, students gain hands-on experience that can be important capital for facing the world of work and business in the future. In this way, mosquito repellent pouches made from orange peel waste can be a solution that combines environmental, economic, and educational aspects in a sustainable manner.

Suggestion

Based on the research results obtained, it is recommended that further research not only rely on literature reviews but also conduct experiments to determine the effectiveness, longevity of the scent, and how well the mosquito repellent pouches reduce mosquito numbers in various environmental conditions. Further development is also needed in the material manufacturing method, drying process, and packaging design to improve product quality, durability, and greater market competitiveness. Furthermore, it is hoped that universities can provide support through training programs, mentoring in entrepreneurship, and business development based on environmental innovation. This way, students will have more opportunities to turn their creative ideas into real businesses. Collaboration between students, the community, MSMEs, and local governments needs to be strengthened to increase the use of orange peel waste as a material for making mosquito repellent pouches. Furthermore, this is also important to raise public awareness about organic waste management that has economic value, is environmentally friendly, and is sustainable.

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