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Ranti An Nisaa Ms.

*Department of Biology Education, Faculty of Teacher Training and Education, Muhammadiyah Prof. Dr. Hamka University, Jakarta, Indonesia, ranti.anisa@uhamka.ac.id*

Dewi Pudji Rahayu Ms.

*Department of Accounting, Faculty of Economics and Business, Muhammadiyah Prof. Dr. Hamka University, Jakarta, Indonesia, dewirahayu@uhamka.ac.id*

*See next page for additional authors*

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# Exploring DIY Urbanism: Housewives' Participation in Recycling Used Cooking Oil for Candle Making in Tangerang, Indonesia

Ranti An Nisaa,<sup>1\*</sup> Dewi Pudji Rahayu,<sup>2</sup> Suci Lestari<sup>1</sup>

<sup>1</sup>Department of Biology Education, Faculty of Teacher Training and Education, Muhammadiyah Prof. Dr. Hamka University, Jakarta, Indonesia

<sup>2</sup>Department of Accounting, Faculty of Economics and Business, Muhammadiyah Prof. Dr. Hamka University, Jakarta, Indonesia

\*Correspondence email: [ranti.anisa@uhamka.ac.id](mailto:ranti.anisa@uhamka.ac.id)

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## Abstract

This study explores the do-it-yourself (DIY) project in an urban context, a candle making with recycled used cooking oil (UCO), aiming to empower housewives in Gaga Village, Tangerang, Indonesia. UCO, a household waste material, becomes a trigger for this project because it pollutes the environment and reduces soil fertility if discarded unresponsibly. In this scenario, involving the participation of urban housewives can be a way to address this issue. Urban housewives have spare time between their daily activities and present great potential in such a project. Recycling UCO for candle-making material arguably can increase the family's economic capacity and, at the same time, reduce environmental pollution. This project, which involved four stages—preparation, implementation, monitoring, and evaluation—is assessed to examine the response of the participating housewives. The assessment employed a qualitative study, examining the project based on pre- and post-test conditions. The results show an increase in knowledge of UCO by 81.1%, utilization of UCO by 82.1%, understanding of making UCO candles by 39.3%, and understanding of economic opportunities from making UCO candles by 80.9%. Even though the DIY activity is highly interesting for housewives, 78.6% still do not know whether candle-making can be considered an economic opportunity. Through this program, other productive and creative DIY activities can also be identified that can be an extra income for their families without leaving the house. It can be concluded that further intensive and interactive training is necessary to empower housewives with further potential economic opportunities.

## Keywords:

DIY urbanism; housewives' participation; used cooking oil; candle making; economic empowerment

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## 1. Introduction

This paper explores the environmental-based project with a do-it-yourself (DIY) approach to involve and empower housewives in a local urban context, seeking potential economic opportunities at the same time. Environmental movement and carrying out various innovations through local and micro approaches receive more attention from numerous scholars, one of which is related to DIY activities (Schlosberg & Coles, 2016). DIY

practices have led to the emergence of new materials to design for products, technologies, and production (Rognoli et al., 2015). Furthermore, DIY material design and reuse of waste provide the opportunity to produce new products with different features. These products can be recycled or used not only once but repeatedly (Alarcón & Llorens, 2018), thereby minimizing losses and increasing their usefulness. This DIY movement starts with product and then materials design, which can be done individually or in groups. Designers continuously develop their materials by using the principles of reducing, recycling, and reusing materials when the product life cycle ends. In such movements, the possibility that the economic benefits multiply is available.

One of the DIY practices is DIY urbanism, which has initially been related to small-scale, low-cost, and intentionally functional modification of city space. The idea of DIY urbanism has gained legitimacy as a physical intervention in urban space or social acceptance of appropriate behavior (Volont, 2019). This concept involves the creative use of new materials with other substances as components and can modify or develop versions of existing materials, for example, household waste such as coffee grounds, egg shells (Rognoli et al., 2015), and used cooking oil (UCO), which can be used as a component for making candles (Adhani & Fatmawati, 2019; Nugraheni et al., 2022). From an environmental perspective, this candle is sustainable because it utilizes natural cycles (Castro, 2020) from UCO waste that must not be consumed again.

In Indonesia, cooking oil is one of the staples in everyday life and is used to prepare various types of food. Unfortunately, this high use of cooking oil can lead to repeated usage for purposes of conservation (Oko et al., 2020). Cooking oil that has been previously used is called UCO, which is considered waste because it contains carcinogenic compounds during frying. UCO is not suitable for consumption, even those that are cleared up like new cooking oil (Eriviana et al., 2018). The recommendation is not to fry cooking oil more than three times to prevent the formation of free fatty acid levels that have the potential to trigger inflammation and oxidative stress if consumed (Adhani & Fatmawati, 2019).

High fatty acids in UCO are formed due to the hydrolysis of triglycerides during frying at temperatures of 160 °C–200 °C to produce free fatty acids, diglycerides, monoglycerides, and glycerol, which leads to its poor quality. Thus, UCO must not be disposed of as waste because it can disturb the environment and clog waterways (Mardina et al., 2012). If the temperature in the waterways decreases, oil compaction may increase and inhibit the flow rate of water. Further effects cause flooding and water pollution. UCO that is dumped on the ground changes the color of the soil and increases the pH of the land. The high acidity of the soil reduces the absorption of important nutrients such as carbon and nitrogen, thereby affecting the presence of aerobic bacteria that play a role in the nitrogen cycle (Kamilah et al., 2015).

However, UCO has been widely used to make other materials and products such as soap, biodiesel, bioplastics, and lastly, candles, which are the easiest to produce. The solution for handling UCO is to recycle it into other usable products, such as biodiesel fuel (Hadrah et al., 2018; Panadare & Rathod, 2015; Rahadiani et al., 2018; Raqeeb & R., 2015; Uddin et al., 2013) and other raw material bioplasticizers. Application of chemicals derived from UCO can be used as energy vectors. In addition, UCO can be used as a solvent for pollutant agents (Manu et al., 2019), plasticizers, polyurethane foam, surfactants,

and asphalt rejuvenators (Awogbemi et al., 2021), stearic acid and lubricant (Tsai, 2019), soap (Hajar et al., 2016; Haqq, 2019; Intan et al., 2022; Mustakim et al., 2020; Pristya et al., 2020; Wahyuni & Wulandari, 2020), and aromatherapy or decorative candles (Adhani & Fatmawati, 2019; Astuti et al., 2021; Delta, 2021; Martha et al., 2022; Rusdi & Kurniawan, 2021; Widoretno et al., 2021). The simple and easy DIY recycling project of UCO is transforming it into candles. Candles are commonly used for lighting such as in homes and offices. In addition, candles are also widely used for religious purposes and special celebrations as decorations (Ojewumi et al., 2019). In the present study, the focus of activities is candle making.

Given the above situations and the crucial role of women in the creative industry (Setyaningsih et al., 2012), a community project related to the idea was planned and developed in Tangerang, Indonesia. The fact that as much as 55.6% of the UCO came from housewives who lacked knowledge of its other uses (Nadirawati & Muthmainnah, 2010), shows the gap between theoretical know-how and practicality in waste treatment and its potential use. Thus, this program was intended to empower the potential of housewives who have free time between their daily tasks. By carrying out this candle-making activity, it is expected that women can gain not only economic benefits but also awareness to maintain healthy environmental sustainability.

## **2. Engaging Housewives in DIY Community Project**

The COVID-19 pandemic had a large economic impact globally, including Indonesia. It is recorded that in October–November 2020, as many as 74.3% of community households experienced a decrease in income (Putri, 2021), particularly households in urban areas. In March 2020, the poor population in Tangerang Regency reached 242,020 people (6.23%), an increase of 48,050 people compared with the previous year (Badan Pusat Statistik Kota Tangerang, 2021). With the COVID-19 pandemic spanning the past two years, the poor population in Tangerang Regency continued to increase by 7.12%, or approximately 272,000 people (Fikri, 2021). Therefore, various methods have been implemented to restore the economy of affected residents, one of which is to foster motivation and interest in entrepreneurship (Sairin et al., 2021).

Entrepreneurship requires a way of thinking, analyzing, and acting that refers to opportunities in business that are not limited to certain groups. Given this context, the community service team embraced the community, especially housewives in RT 01 RW 015 of Gaga Village, to take part in the use of UCO in candle making as an economic opportunity. Since entrepreneurial activities can be carried out by housewives who are members of the PKK (*Pemberdayaan Kesejahteraan Keluarga*, an institutionalized activity to empower family welfare), this project involved the PKK of Gaga Village through activities every week in the form of recitations and social gatherings.

In RT 01 RW 015, Gaga Village, Larangan District, Tangerang, most of the women are housewives who have a high school background and at the time have free time between their daily activities to supplement their family income. However, the main problem for housewives in RT 01 is the lack of skills that can be used as the main capital to improve the economy. This problem arises because people believe that improving the family economy requires high capital. This belief can be seen from the high interest of the community to

take part in government assistance programs for self-employed residents, even though entrepreneurship requires skills that must be trained and developed.

A relatively large number of housewives can be invited and involved in the project to gain the opportunity to hone their skills through creative training on decorative candles made from UCO. Such activities do not require a high level of education and allow for flexible hours. Aside from increasing public awareness of the importance of protecting the environment and health, the partners are interested in this service because of the economic benefit. By providing training in making candles from UCO, the community can gain the opportunity to increase their income for the family. The community is introduced to the technique of cleansing UCO before processing it into various products, which is considered quite easy and simple as it only requires a few simple tools.

This activity was attended by 14 housewives in RT 01. Their age ranged from 36–62 years. Figure 1a shows that the age groups are 36–44 years old (28%), 45–54 years old (36%), and 54–62 years old (36%). Most of the housewives in RT 01 have completed high school (50%) and a few reached elementary (7%) and undergraduate (7%) education (Figure 1b). Given their high school education, many of the participants in Gaga Village are housewives (72%), employed as teachers (9%), and household assistants (19%) (Figure 1c).

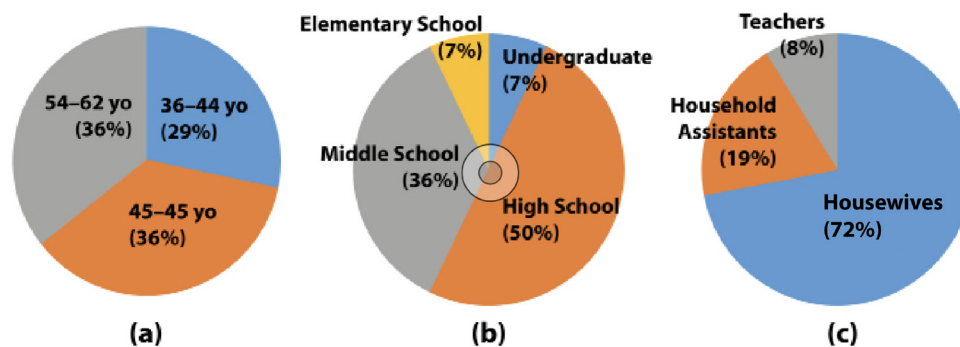


Figure 1. The profile of the participants based on (a) age range; (b) level of education; and (c) participants' occupation

### 3. DIY Community Project: Recycling Process of UCO

This section describes the process of recycling UCO into candles and the tools and materials needed for the process of making. Various methods of making candles are widely available in the literature. However, this process generally consists of three stages, namely, (1) cleaning; (2) mixing; and (3) cooling (Yuarini et al., 2021). Before starting the process of UCO recycling into candles, there are tools and materials to be prepared.

#### 3.1 Tools and materials

The tools and materials for making candles with mixed ingredients from UCO are generally simple and easy to obtain, both from shops and marketplaces. Several marketplaces even provide packages for making candles that can be used immediately. The tools are a stove, a special pot for heating wax, a filter, a shot glass, and a wick (Figure 2). These tools can be adjusted according to availability or changed to other, simpler items. For example, the special candle pot can be replaced with another aluminum container, such as a milk



can. In addition, the containers are not limited to shot glasses but can also be other heat-resistant containers such as glass bowls, cans, or even egg shells.



Figure 2. Tools required for candle-making

The materials aside from the UCO are the bleaching earth, paraffin wax, fragrance oil (other fragrance extracts), and crayon oil pastel dyes (Figure 3). The first three are the main materials needed for making candles, while fragrances and dyes are additional ingredients for variations in aroma and color. Apart from paraffin wax, soy wax can also be used (Ojewumi et al., 2019) and is also widely sold online. To produce various aromas, several fragrances are made from essential oils or items such as orange peel (Rangkuti et al., 2020) and lime leaves (Rusdi & Kurniawan, 2021). Candles with varying aromas that are soothing and refreshing are generally called aromatherapy candles (Shofi, 2019).



Figure 3. The main ingredients for making candles from UCO

### 3.2 Cleaning of UCO

Cooking oil is repeatedly processed, resulting in unpleasant physical, taste, and scent changes (Haqq, 2019). Thus, cleaning is necessary such that the wax does not smell. One method of cleaning UCO is adsorption, which is easy to implement and economical. The material used for adsorption is called an adsorbent (Oko et al., 2020). The cleaning of UCO in this activity uses bleaching earth or clay or bentonite as a type of clay with the main composition of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ , bound water,  $\text{Ca}^{2+}$  ions, magnesium oxide, and iron oxide that are commonly used in cooking oil refining (Rio et al., 2009).

After the cleaning process, the UCO is slowly heated. The heated UCO is added with the bleaching earth to be mixed together. After leaving the UCO 24 hr, it creates a sediment at the bottom of the liquid (Figure 4). The liquid itself is the clean UCO which is ready for further use.



Figure 4. Process of cleaning UCO and the result of cleaning UCO

In cleaning UCO, apart from bleaching earth, other adsorbent materials are charcoal from ironwood sawdust (Oko et al., 2020), charcoal from rice husks (Nasrun et al., 2017), coconut fiber and straw (Pakpahan et al., 2013), noni (Putra et al., 2012), papaya seeds (Nusa & Sipahutar, 2018), *kepok* banana peels (Erviana et al., 2019), moringa seeds (Alamsyah et al., 2017), and sugarcane bagasse (Hajar et al., 2016).

### 3.3 Mixing UCO with paraffin wax and cooling

The paraffin wax is also heated inside an aluminum bowl until it melts (Figure 5). The clean UCO is poured into the bowl and mixed together with the melted paraffin wax. Other substances such as fragrance oil and coloring materials, like a small piece of crayon, can be added into the mixture, to give odor or visual characteristics for the candle. All of the ingredients should be stirred. After reaching an intended consistency, the liquid can be poured into a container, such as small glass or shot glass, that is already prepared with a wick positioned in the middle of the container. When the liquid harden, the wick can be trimmed and the candle can be considered ready as a product.



Figure 5. Paraffin melting, mixing, and cooling of UCO candles

## 4. Method of Assessing the Community Project

This community project was carried out in three stages: preparation, implementation, and monitoring and evaluation. In this project, the preparation was conducted through surveys and preliminary meetings with the leader of the community to coordinate the following activities. The preparation includes partner surveys, coordination with partners, preparation of materials and equipment, and preparation of invitations for residents. During the project implementation, some assistance from source persons was needed in the form of training. It was done through lectures, discussions, and demonstrations.

Practice is needed to build an understanding of the effect of UCO, its cleaning, and candle-making techniques. The implementation stage, which is the core of this activity, includes filling in pre-test questions, participant identification, providing material, and demonstration of activities.

This study was carried out through community service activities and assessed by employing descriptive statistical methods as the last stage of the project. Using a cross-sectional approach, the participants' conditions were assessed before and after treatment through candle-making activities. Evaluation is carried out to determine the success of the activity from the results of the pre-test and post-test questions given before and after the activity, respectively, and the opinion questionnaire given after the activity. In assessing the project implementation, there are four aspects to be seen: (1) the general knowledge of UCO and its utilization; (2) the know-how of candle making process from UCO; (3) the awareness of economic potential from such activity; and (4) general response from the participants of the project. These items are in the form of a questionnaire with the responses "yes," "no," and "don't know" given before (pre-test) and after the activity (post-test). The number and percentage of answers of "yes" are calculated and displayed in a pie chart. The differences in the results obtained between the pre-test and post-test are compared in the form of a bar chart and used as an indicator of the achievement of knowledge understanding. The opinion questionnaire for evaluating activities takes the form of statements regarding participant satisfaction. Each statement is given the options "strongly disagree," "disagree," "agree," and "strongly agree." Each answer is added up and presented as a percentage and in a bar chart.

## 5. Results and Discussion

### 5.1 Preparation phase

The team surveyed their partner's conditions to determine the problems that occurred during the activity. Priority problems that need to be addressed are the lack of skills that can help the citizens in general and housewives in particular. Coordination with partners for permitting activities was carried out in this case by the head of RT 01. The head of RT 01 and the team leader determine the location or place, target participants, and training time (Figure 6). The team prepared the necessary tools and materials, while RT 01 prepared invitations to be conveyed to residents in general and women in particular as participants who can attend and participate in training activities. In addition, the team carries out pre-activity by cleaning UCO first so that it can be used immediately during the training activities. This cleaning requires a minimum of 24 hours using minerals from bleaching earth.

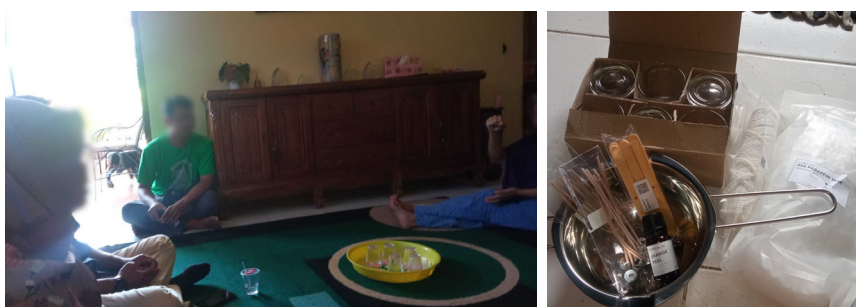


Figure 6. Coordination with the head of RT 1 community and preparing tools and materials for making candle



## 5.2 Workshop session

The activity was held on Sunday, 05 February 2023 from 09.00–12.00 WIB in the hall of the local building. The activity begins with participants filling out pre-test questions, which are designed to determine their initial understanding of the material and practice. The resource persons provided training materials to 14 participants, all housewives, in RT 01. The material was given in the form of a presentation consisting of three topics, namely, understanding the effect of UCO by Dr. Suci Lestari, M.Pd., techniques for making candles from a mixture of UCO by Ranti An Nisaa, M.Pd., and continued with discussing business opportunities from zero waste activities related to the economic advantages of UCO candles as a product with high selling value by Dewi Pudji Rahayu, SE., M.Sc. The role of lecturers is to disseminate knowledge through community service activities (Ahmad, 2016) and demonstrate the practice of cleaning UCO before processing it into candles. The housewives followed the technique of candle making using the provided tools and materials, accompanied by the resource persons and the community service team (Figure 7).



Figure 7. Workshop sessions through a series of presentations and demonstrations of making candles from UCO

## 5.3 Monitoring and evaluation stage

Monitoring is carried out by directly observing activities, giving opinion questionnaires as a form of evaluation of activities and answering post-test questions to measure the achievement of understanding activities. Follow-up monitoring is carried out by directly monitoring the creation of UCO candles by the participants taking part in the training (Figure 8).



Figure 8. The resulting candle of the workshop is shown by the participants

This training activity continues inviting housewives to produce UCO candles in their homes (Figure 9). The potential of housewives in such small businesses can be a solution to improve their skills and ultimately increase their income (Setyaningsih et al., 2012).



Figure 9. The positive response from the participants, showing their candle products created at home

The success of the activity can be determined from the results of the pretest and post-test questions given before and after the activity, and the opinion questionnaire given after the activity. The following are the four aspects of the project that were assessed: (1) the general knowledge of UCO and its utilization; (2) the know-how of candle making process from UCO; (3) the awareness of the economic potential of the activity; and (4) general response from the participants.

#### 5.4 General knowledge of UCO and utilization of UCO

Knowledge about UCO revolves around its definition, dangers for health and the environment, and its reuse for frying food. The reuse of UCO for frying food was only asked in the pre-test questions. All participants understood the meaning of UCO (100%) and did not use UCO repeatedly to fry food (100%). The housewives already understand that reusing UCO is unhealthy for consumption. This result is shown in Figure 10, which shows that on average more than 70% of them know the dangers of UCO, especially for health, such as repeated use of cooking oil can affect the quality and nutritional value of fried food, which can affect nutrition. Apart from that, continued disposal of cooking wastes into the environment can cause environmental pollution.

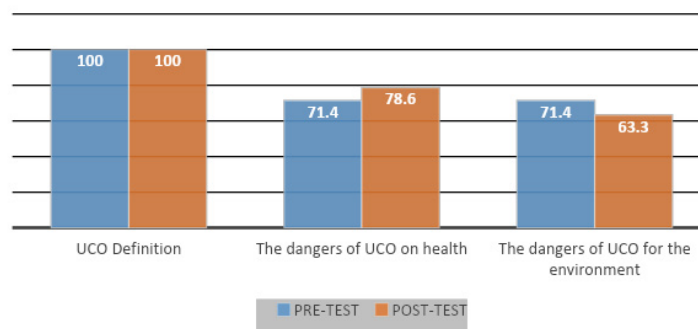


Figure 10. General knowledge of UCO before and after the workshop

This positive action is influenced by the education level of housewives, who reached the standard high school with studies in biology and chemistry. This finding is consistent with Simatupang (2019), which illustrates the proper attitudes (72%) and actions (66%) of housewives toward utilizing UCO. Such knowledge is hoped to provide a reference for taking positive action. It is believed that knowledge is related to formal education whereas higher education is hoped to widen such knowledge. However, those with low education cannot be considered to have low knowledge, as increased knowledge is not only obtained from formal education but also non-formal training (Rayhana & Triana, 2017). Housewives

generally have much spare time and do not have many activities outside the home, and thus they can look for information via the Internet if they wish (Agatha et al., 2022).

Most housewives (92.9%) know about the use of UCO, which ranges from UCO being made into various types of products in general and candles in particular (Figure 11). Despite the increase in the understanding of housewives regarding the use of UCO in other products and candles before and after the activity, this increase is the same between the two surveys. Figure 11 shows that housewives have started to learn that UCO can be used for other products such as biodiesel, bioplasticizers, soap, and others by 92.9% compared with their previous responses (71%).



Figure 11. General knowledge of utilizing UCO before and after the workshop

The findings are the same in terms of the understanding that UCO can also be used as a material for making candles, namely, 92.9% compared with the previous responses (71%). This increase occurred because housewives had been given material regarding UCO and its potential utilization. The material presented by the resource persons has succeeded in achieving the objectives of the community service activities. This is in accordance with Riduwan (2016) who stated that universities do not only provide services but must also be able to convey science and technology directly to the community to enable them to solve problems and meet the community's needs. In addition, Inayati and Dhanti (2021) reported that from an economic perspective, the production of candles such as aromatic candles from UCO can provide considerably high income, given that the costs incurred are not too large and the production results have economic value.

### 5.5 Know-how of making candles from UCO

Through the pre-test, results show that 86% of housewives have never made candles from UCO (Figure 12) and thus the opportunity to teach the know-how of making candles from UCO is greater.

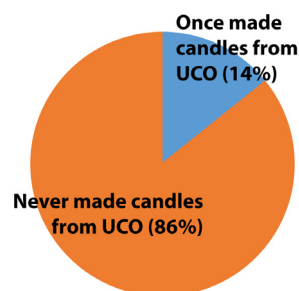


Figure 12. Initial survey related to the know-how and experience making candles from UCO

Figure 13 shows the knowledge gained by housewives on how to make candles from UCO before and after the activity. The results show that although the housewives improved their understanding of how to make candles from UCO, this improvement is considered low because it is below 50%. Thus, half of the housewives still do not understand how to make candles from UCO and believe that the process is difficult. This result is in contrast to the community service activities carried out by Shofi (2019), where candle-making was 100% successful.

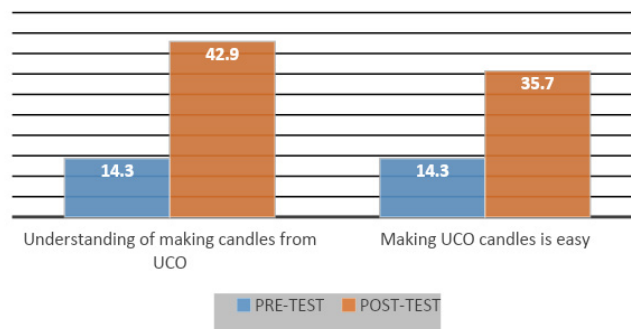


Figure 13. Understanding of making candles from UCO before and after the workshop

### 5.6 Awareness of the economic potential of candles from UCO

The choice of making candles is a consideration because the tools and materials needed are quite affordable and easy to obtain even from the surrounding environment and shops. Candles also have more functions such as lighting, relaxing effects, decorations, and repelling flies (Adhani & Fatmawati, 2019). This belief was reinforced by the opinions of all participants who thought that candles were needed in society (100%). One of the housewives in RT 01 already has a home industry for making candles from UCO but still lacks manpower, and thus the economic opportunities for making candles are wide open.

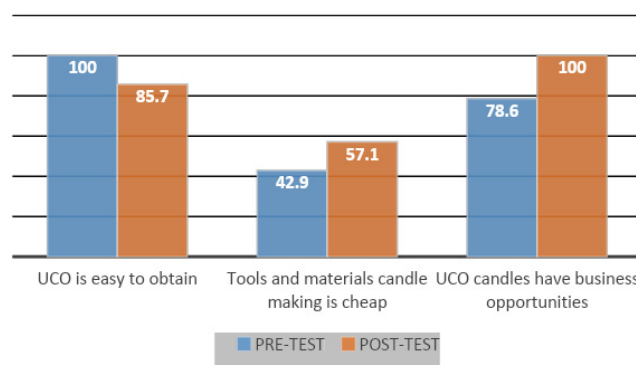


Figure 14. Awareness of the economic potential of UCO candles before and after the workshop

Figure 14 shows that after the activity, 85.7% of participants considered UCO easy to obtain, the tools and materials for making candles were affordable (57.1%), and making UCO candles presented business opportunities (100%). As stated by Awogbemi et al. (2021), UCO offers a cost-effective, cheap, available, and sustainable raw material for the production of inexpensive and environmentally friendly candles. This saving potential can be the starting point for creating high-value DIY products (Volont, 2019) from UCO candles. The presence of UCO has also been proven to reduce the high cost of biodiesel production and generate additional income for households and small-scale enterprises

(Awogbemi et al., 2021). Despite the large economic opportunity for candles, most housewives still do not know how to plan making candles as a business opportunity. As many as 79% of housewives who have attended the training admit that they have no plans to turn UCO candles into a business opportunity (Figure 15).

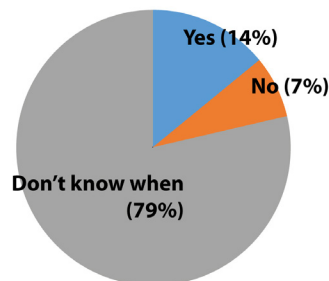


Figure 15. Candle-making plans as a business opportunity

The age of housewives in this activity generally ranges from 45–62 years old (Figure 1). Agatha et al. (2022) stated that housewives aged 34–47 have poor household waste management, while those aged 48–60 are in a poor and lower category. This result indicates that housewives in this training activity still believe that they do not have time to process UCO and usually throw it away.

### 5.7 General evaluation of DIY project of making candle

Based on the activities that have been carried out, the results are obtained as shown in Figure 16 based on the results of the post-test. The highest result (82.1%) was obtained in increasing knowledge regarding the utilization of UCO in other products while the lowest result (39.3%) was in how to make candles from UCO. This finding is contradictory because even though all post-test results showed an average score above 80%, most participants still did not understand how to make candles. The possible reason is that most of the participants (86%) had no experience in making candles from the start (Figure 12). In addition, during the activity, many participants were not focused on listening to the material and most of them were reluctant to participate in the candle-making. As seen in Figures 10–11, only a few participants practiced making candles. These findings serve as evaluation material for the team for future activities to have hands-on practice while holding games or an ice-breaker to entice active participation.

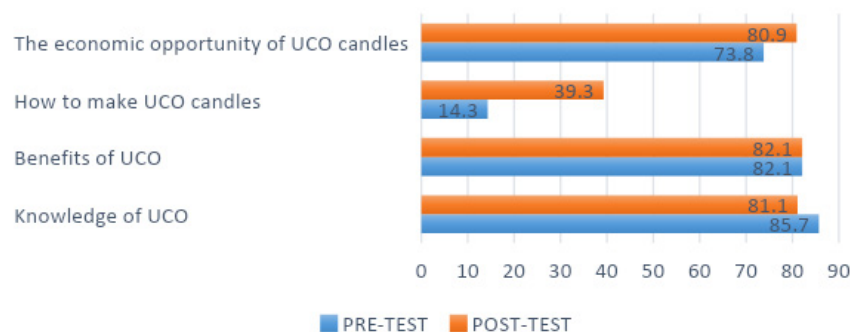


Figure 16. Results in the candle-making activity



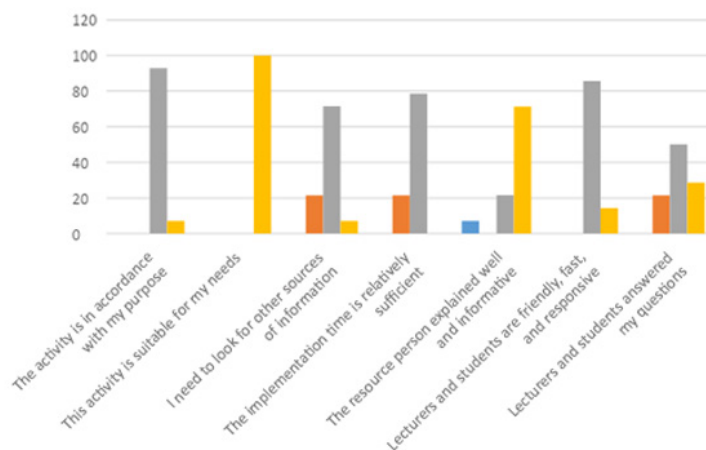


Figure 17. Percentage of participants' responses to the activity

The evaluation is based on an opinion poll after the activity. The purpose of the questionnaire is to determine the benefits of the training for the participants. Figure 17 shows the responses of activity participants. The highest response from the participants was 100%, indicating that they strongly agree that the candle-making activity activities can fulfill their needs. The need here is for candle-making skills that can enable them to gain economic opportunities in the future. The participants strongly agree that the lecturers are friendly, fast in teaching, responsive (85.7%), can answer participant questions clearly, and easily understood (50%). The activity encouraged the participant to agree to find other sources of information to increase their knowledge of making candles from UCO (71.5%). People with high curiosity emerge because of gaps and limited knowledge to solve problems in their lives (Puspita & Ati, 2013).

As a form of sustainability, the team provided grants to participating partners in the form of a set of candle-making tools to help develop their skills and increase their economic opportunities (Figure 18). This simple set of tools is expected to enable participants to create DIY candle products using modern production techniques (Rognoli et al., 2015). This candle can also be considered a sustainable effort to protect the environment because it reuses waste materials (Castro, 2020). In addition, further assistance may be provided to the participants (14%) who expressed interest in making UCO candles a business opportunity (Figure 15). Understanding how to process UCO can also be a provision for making other oil-based products such as soap (Intan et al., 2022; Pangestika et al., 2021) and biodiesel (Mannu et al., 2020; Rahadiani et al., 2018; Raqeeb & R., 2015; Uddin et al., 2013; Yuarini et al., 2021) or for opening a UCO recycling community (Tsai, 2019; Widyaningsih, 2021).



Figure 18. The ceremonial activity after the project is conducted along with providing grants for the community

Based on the assessment of the activities that have been carried out, we hope that partners can continue to carry out candle-making activities, especially housewives. The participation of housewives plays a major role in developing urban activities in the community, given that they have the potential to improve the welfare of their families in particular and society in general.

## **6. Conclusion**

This study successfully exemplify the employment of DIY projects for the community, particularly in the urban context, which can positively contribute to further economic potential for the housewives. It can be concluded that due to its simple method and tools, as well as engaging activity, the potential of the housewives in environmental as well as economic contribution can be recognized. In this activity, housewives learn that UCO can be used in producing other products, one of which is candles. Despite that many housewives still do not understand how to make candles with UCO, with the new understanding of the economic potential of UCO, more than half of the housewives believe that UCO is easy to obtain while half believe that the tools and materials for making candles are affordable. In addition, all the participating housewives say that UCO candles have quite promising business opportunities.

The participation of housewives in candle making from UCO presents them with the opportunity to help reduce environmental pollution to increase their economic status from such skills. The fact that all of this understanding is reversed by the opinion of most housewives who state that they have no plans to make candles as a business could be an obstacle for such a DIY project for the community. The sustainability of such a program is challenged in a way that such a project cannot be programmed as a one-time project but needs longer and more intensive engagement between the initiator of the project and the community. Further training needs to be carried out more intensively and interactively such that all participants become interested in candle making with UCO, packaging, and marketing training. Moreover, understanding UCO can open up opportunities for its use in other products such as soap, and aromatherapy candles, or in opening a small-scale cooking oil waste recycling community.

This DIY community project has increased the understanding of housewives' knowledge and utilization of UCO, candle making with UCO, and the economic opportunities of UCO candle making. This understanding can be a provision for housewives to take advantage of the economic opportunities of utilizing UCO to make candles. Despite its limitation of partial engagement of housewives, there are potentials of employing DIY approaches in an urban context as it becomes part of their everyday life instead of planning monumental and massive community project that could takes more cost and energy.

### **Author Contribution**

Ranti An Nisaa surveyed the activities, explored the needs of residents, and determined activities that could meet the needs of residents which required the skill of making candles with used cooking oil. Ranti also discussed with partner leaders regarding activity locations and prepared invitations for activities to be distributed to residents, conducted pre-activities by clearing used cooking oil and making candles for demonstration needs, provided training materials and demonstrations about candles making from used cooking

oil, provided tool grants to residents, and monitored the activities of residents who make candles in their homes through the Whatsapp group.

Dewi Pudji Rahayu contributed to linking the potential of used cooking oil with economic opportunities, preparing the tools and materials needed for activities, increasing the number of instruments to be distributed to activity participants, and providing training materials on economic opportunities from used cooking oil and decorative candles, as well as analyzing the results of the instrument questions and activity questionnaires.

Suci Lestari contributed to designing pretest and post-test instruments related to knowledge about used cooking oil and how to make candles, designing opinion polls on activities that have been carried out, providing training materials on used cooking oil and its dangers, and compiling activity reports to be reported to university institutions.

For the preparation of the manuscript, all authors contributed to determining the results of the activity to the conclusion of the activity.

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### **Declaration of Conflicting Interest**

The authors declare there is no conflict of interest.

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### Author Biography

**Ranti An Nisaa** is a lecturer in the Department of Biology Education, Faculty of Teaching and Education, Muhammadiyah Prof. Dr. Hamka University (UHAMKA), Jakarta, Indonesia. She received her master's degree in the Department of Biology Education, Faculty of Mathematics and Natural Sciences, Indonesian University of Education (UPI), Bandung, Indonesia. Their current field placement is with Muhammadiyah Prof. Dr.

Hamka University. She is interested in biology education and biological sciences. (<https://orcid.org/0009-0002-8435-2670>)

**Dewi Pudji Rahayu** is a lecturer in the Department of Biology Education, Faculty of Teaching and Education, Muhammadiyah Prof. Dr. Hamka University (UHAMKA), Jakarta, Indonesia. She received her master's degree in the Department of Biology Education, Faculty of Mathematics and Natural Sciences, Indonesian University of Education (UPI), Bandung, Indonesia. Their current field placement is with Muhammadiyah Prof. Dr. Hamka University. She is interested in biology education and biological sciences. (<https://orcid.org/0000-0002-4270-1900>)

**Suci Lestari** a lecturer in the vocational Department of Taxation, Faculty of Business and Economics, Muhammadiyah Prof. Dr. Hamka University (UHAMKA), Jakarta, Indonesia. She received her master's degree in Economics Science from Pascasarjana School of University Gadjah Mada, Yogyakarta, Indonesia. Her current field placement is with Muhammadiyah Prof. Dr. Hamka University. Her interest is in Public Sector Finance and Taxation. (<https://orcid.org/0000-0002-0244-3150>)