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Community Empowerment in MSME Craft Production Based on Conventional Method and Innovation with 3D Printing

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Abstract

Micro, Small, and Medium Enterprises (MSME) play a strategic role in the economic growth of Padang City, particularly in the handicraft sector, which represents both cultural identity and a vital source of local economic activity. However, technological limitations and low production efficiency remain major obstacles to improving the competitiveness of local crafts in the global market. This Community Engagement Program or Pengabdian kepada Masyarakat (PkM) aims to integrate conventional production method with 3D printing technology with as an effort to enhance product quality, efficiency, and design innovation. The implementation method includes identifying the potential and challenges faced by craftsmen, conducting training on the use of 3D printing, and providing mentoring in the design and production processes. This approach combines the artistic touch and craftsmanship of conventional manual techniques with the precision and speed of digital technology. The results show an improvement in craftsmen' ability to utilize digital technology for prototyping and developing new designs that are more responsive to market trends. Furthermore, the training and equipment facilitation supports continuous knowledge transfer, strengthening the innovation capacity and independence of MSME. The combination of traditional skills and modern technology not only produces products with high aesthetic value but also opens opportunities for market expansion and increased economic value. Therefore, the application of 3D printing has proven to be an effective innovative solution for enhancing the competitiveness and sustainability of the local handicraft sector in the era of the digital creative industry.

Keywords: MSME, Conventional Method, 3D Printing, Product Innovation, Production Technology

1. Introduction

Micro, Small, and Medium Enterprises (MSME) are a vital component of the economy of Padang City and Indonesia as a whole. At the local level, MSME contribute to creating jobs, reducing unemployment rates, and improving community welfare. MSME also play a significant role in the development of the creative economy and tourism in Padang. Nationally, MSME contribute more than 60% to Gross Domestic Product (GDP) and absorb approximately 97% of the total workforce, making them a major driver of economic growth and social stability [1]. The handicraft sector in Padang has significant economic and cultural value. Traditional crafts, such as songket and carvings, serve not only as economic products but also as symbols of Minangkabau cultural identity [2]. These products are often used in traditional ceremonies and celebrations, making them an integral part of community life. From an economic perspective, Padang crafts have great potential for export, attracting international markets with their uniqueness and high artistic quality [3]. Despite their potential, MSME in Padang crafts face various challenges. Limited technology is a barrier to increasing production efficiency and quality. Limited production capacity often limits MSME ability to meet greater market demand. Furthermore, product competitiveness in the global market needs to be improved through innovation and designs that align with market trends. Support in the form of training, technology access, and financing is essential to help MSME overcome these challenges and increase their competitiveness.

Conventional craft production methods used by local craftsmen involve various techniques passed down through generations, such as wood carving, bamboo weaving, metal carving, and clay shaping. These techniques reflect a cultural heritage and specialized craftsmanship that require high manual skills and a deep understanding of the materials used [4]. The main advantage of these methods is the uniqueness and authenticity of the resulting products, which have high artistic value and often reflect the cultural identity of the producing region [5]. Traditional craft products, such as Minangkabau songket and Jepara wood carvings, are known worldwide for their distinctive beauty and intricate details. However, conventional production methods have several disadvantages, particularly in terms of efficiency and productivity. The lengthy processing time and reliance on manual skills

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make large-scale production difficult. In addition, production costs can increase due to the longer processing time required and the involvement of skilled labor that is not easily available [6] . These challenges are further exacerbated by competition in the global market, where modern craft products produced with advanced technology can offer more competitive prices and shorter production times [7]. A study by Ambarwati and Kusuma (2022) showed that local craftspeople often face obstacles in increasing production capacity and adapting product designs to suit international market trends [8]. Data from this study indicate that without support in the form of technological training and access to modern resources, many craft MSME in certain regions experience stagnation in product development and struggle to compete with foreign producers. Hidayat and Syahrul (2023) noted that the integration of technology such as CAD (Computer-Aided Design) or other modern production methods can be a solution to increase production efficiency without sacrificing the traditional elements of craft products [9].

3D printing, also known as three-dimensional printing, is a technology for creating physical objects by sequentially adding layers of material based on a digital model. This technology enables craftspeople and small industries to produce items with high precision and intricate designs, which are difficult to achieve with conventional methods [10]. In the context of craft production, 3D printing offers significant advantages, such as design flexibility that allows for the creation of complex shapes and detailed ornaments, as well as efficiency in material use that can reduce production waste [11]. Thus, the use of 3D printing helps MSME increase the scale and quality of their production, while saving operational costs. Another benefit of 3D printing is the increased speed of the production process, where the time for creating prototypes or initial models can be significantly reduced compared to manual techniques [12]. This is very useful for craft MSME who want to adapt their products to changing market trends. On the other hand, conventional production methods still have advantages, such as the unique character and feel of the craftsman's hand, which is valued in craft products with high cultural value [8].

The current problem with conventional method used in the partner MSME tends to be slower and more expensive in the long run. The integration of 3D printing technology with conventional methods opens up opportunities to create craft products that combine modern and traditional advantages. For example, 3D printing can be used to create rapid prototypes or specific parts of a product, while finishing is done manually to add an authentic artistic touch [7]. This hybrid approach can increase product competitiveness in local and international markets, strengthen cultural identity, and remain relevant in the era of globalization [13]. In addition, the adoption of this technology requires training and adaptation, which can be challenging for traditional craftsmen who are not yet familiar with modern equipment [6].

The MSME partner that will be empowered in this activity is Kampung Akrilik, located in Gunung Pangilung District, Padang City, West Sumatra. Kampung Akrilik Thematic Village is one of the themed villages designated by the Mayor of Padang. On November 11, 2021, the Mayor of Padang met with the Research and Community engagement Institute of Padang University to initiate a support program for the themed village to ensure the program's success. The academic community is expected to play an active role in realizing the vision of Padang City as a "Civilized City Based on Education, Trade, Superior Tourism, and Competitiveness." The Tridharma of Higher Education (Teaching, Research, and Community Engagement) efforts are expected to contribute to the achievement of the Regional Medium-Term Development Plan and the Padang City Mission for the 2019-2024 period. Specifically, these efforts include: (1) improving the quality of education to produce a loyal, creative, innovative, and competitive workforce; (2) encouraging inclusive economic growth in Padang City; and (3) making Padang City a center for trade and the creative economy [14].

The objective of empowering MSME is to help improve the productivity, quality, and competitiveness of their products by integrating modern technologies, such as 3D printing, with long-standing conventional production methods. The application of this technology allows craftsmen to create more complex and precise designs that are difficult to achieve with traditional techniques alone. With 3D printing, the production process can become more efficient, reduce material waste, and speed up production times. This technology also opens up opportunities for MSME to reach a wider market by offering unique and innovative products. While conventional methods maintain cultural values and traditional skills, the integration of modern technology helps increase production capacity and competitiveness in the global market. Training and access to this technology are crucial to ensure that MSME can adapt to technological changes and remain relevant in the ever-evolving industry [15], [16].

The aims and objectives of community engagement activities with the theme of Community Empowerment in MSME Craft Production Based on Innovation with 3D Printing and Conventional Method in Acrylic Craft MSME include the following.

Product Diversification – Assisting MSME in developing a variety of acrylic craft products through the introduction of innovative designs that can be produced with 3D printing.

Knowledge and Technology Transfer – Providing training and guidance to MSME on how to use 3D printers, design software, and conventional production processes to improve their skills.

Production Cost Efficiency – Introducing technologies that can reduce production costs and material waste, and optimize the use of raw materials through a combination of conventional and innovative production methods.

2. Literature Review

Thematic villages are a residential area revitalization approach that prioritizes participatory and innovative concepts to improve the quality of life of local communities. In Padang City, the development of thematic villages involves various aspects, such as community participation, cultural preservation, and improving the local economy. Thematic villages are generally developed to address environmental and social problems in urban areas, including Padang City. This initiative involves a sustainable approach by emphasizing local identity, improving public facilities, and empowering local communities [17].

The concept of thematic villages is based on a social innovation plan consisting of three stages. The first step is to map the problem, namely: the community gathers to seek initiatives/ideas to develop their village to create jobs and increase local community participation. The second step is to identify the village theme by finding a group of people interested in working on an idea or theme together in their village. Next, the third stage is the description and coordination of the idea or theme, which is then modified by various actors involved until finally implemented in practice in the Marga area. Based on the three stages of implementing the thematic village concept, it is also explained that thematic villages can develop based on the feasibility of the idea or theme. It can also be influenced by factors such as economic and social characteristics, the existence of raised local potential, external financial support, initiatives from community leaders, the community, increased income and community initiatives [18].

The implementation of thematic villages in Padang City is also associated with socio-economic benefits, such as increasing community income through community-based tourism and the development of MSME [19]. In addition, thematic villages are able to create a sense of pride and togetherness among residents, thereby improving the quality of social relations. Despite having many benefits, the development of thematic villages in Padang City is faced with challenges such as limited resources, minimal active participation from several community groups, and infrastructure constraints. The suggested solution is to improve training programs for residents and strengthen support from the local government.

Conventional methods in craft production refer to techniques that have been practiced by craftsmen. These techniques include manual sculpting, clay modeling, wood carving, and weaving. The hallmark of this method is the use of manual skills that require high expertise and considerable experience to achieve quality results. The resulting products often have a personal touch and details that cannot be imitated by machine-based mass production, making them unique and reflecting local cultural values [20]. The main advantage of this method lies in the authenticity of the results and their high artistic value.

Products made with conventional techniques reflect characteristics of cultural heritage and local identity, which are often sought after by consumers seeking products with historical or ethnographic value. Research shows that traditional craft products have a particular appeal in the tourism market and among consumers concerned about sustainability and authenticity [21]. However, these methods have drawbacks, particularly in production efficiency. The time-consuming process and reliance on individual skills often result in high production costs and limited production capacity. This presents a major challenge for traditional craftspeople in facing competition with products produced using modern technologies, such as 3D printing, which can mass-produce more cost-effectively and time-efficiently [22].

3D printing, or three-dimensional printing, is an additive manufacturing technology used to create three-dimensional objects from digital models. The process involves gradually adding material, layer by layer, to create the desired shape. This technology has revolutionized the manufacturing and craft industries by enabling rapid prototyping and more flexible and efficient production. 3D printing allows craftspeople and small manufacturers to create intricate and detailed designs that are difficult to achieve with conventional methods [23]. In the context of craft production, the application of 3D printing offers significant advantages, such as savings in time and production costs. With this technology, craftspeople can produce prototypes that can be quickly modified and customized, thereby reducing the time needed to test and develop new designs.

The community engagement carried out by Fatchurrohman et al. (2023) in Kampung Acrylic in Padang City aims to develop new, innovative acrylic craft products and improve the local economy [24]. The team began by identifying potential new products that could be developed. They also found that one of the main problems was the lack of products with new designs. As a solution, the team introduced three-dimensional printing technology, known as 3D

Printing. This technology allows the development of plastic products tailored to customer demand. One of the tangible results achieved is the design and development of key chains using 3D Printing techniques. These results demonstrate the high enthusiasm of the craftsmen to explore the use of 3D Printing in their crafts.

In addition, 3D printing allows the use of a wide variety of materials, from plastics to resins, allowing for high flexibility in the final product. Another advantage of 3D printing in craft production is the ability to create products with precise details without requiring in-depth manual skills. This makes the technology very useful in combining traditional elements with modernized production processes, thus increasing the competitiveness of craft products in the global market [25]. On the other hand, despite its many advantages, this technology still faces challenges in terms of hardware costs and the availability of certain materials that may not be suitable for every type of craft.

The use of 3D printing in craft production and other industries brings various significant benefits, especially in terms of increased precision, design flexibility, and cost savings. One of the main advantages of 3D printing is its ability to create objects with high precision. This technology allows for the creation of very intricate and accurate details, which are difficult to achieve with conventional manufacturing methods. This precision not only improves the quality of the final product, but also enables innovation in more complex designs [26]. This provides a competitive advantage for craftsmen and small manufacturers who want to offer unique and high-quality products to their consumers. In addition to precision, 3D printing provides extraordinary design flexibility.

The layer-by-layer printing process allows designers to create shapes and structures that would be impossible with traditional techniques. This flexibility supports more creative product development and higher personalization, allowing manufacturers to tailor products to consumer preferences or specific market needs [25]. In the craft industry, the ability to design and produce prototypes quickly also allows craftspeople to iterate designs quickly without long wait times, speeding up the product development cycle [27].

3. Implementation of PkM

The PkM implementation method included combining conventional methods and 3D printing technology in crafts, creating a holistic approach and utilizing the advantages of each method to produce products with aesthetic value and high efficiency. Previous models that were made conventionally were redrawn and redesigned using Computer-Aided Design (CAD) techniques. The next process involved the application of 3D printing in product manufacturing, which allowed for a fast and high-precision production process, while manual touches in the finishing stage were maintained to ensure that the products retained their unique character and artistic value. This approach enabled craftsmen to explore more creative designs, in which modern elements of 3D printing technology were combined with traditional styles rich in cultural heritage.

Knowledge and skills transfer was also a crucial element in integrating these two methods. Through training and learning sessions, traditional craftsmen were trained to use 3D printing technology, thereby enhancing their ability to meet the challenges of the modern market while maintaining their traditional skills. This combination of modern technology and traditional craftsmanship allowed the artisans to create highly unique products, effectively bridging innovation and cultural preservation. The field training took place on the 2nd of October 2025, with 19 participants, and located at Gunung Pangilun, Padang, West Sumatra.

The methods used in PkM activities are explained in detail as follows.

Identification of Potential and Problems – this stage involved identifying potential resources within the community, such as the basic skills of craftsmen, the availability of raw materials, and potential market opportunities for craft products. In addition, problems faced by the craftsmen were identified, including a lack of product innovation, low production efficiency, and limited knowledge of new technologies.

Design of Training for Craftsmen – the findings from this initial assessment served as the foundation for designing the next phase of the program. By understanding the craftsmen's existing capabilities and the specific challenges they faced, the PkM team was able to develop targeted interventions that addressed both skill gaps and technological limitations. This ensured that subsequent activities, particularly training and workshops, were tailored to the participants' real needs and could deliver practical, sustainable improvements to their production processes.

Implementation of Training and Skill Development – The next stage focused on providing intensive training on 3D printing technology, which included the introduction of hardware, software, and basic techniques of 3D printing. A workshop was also organized to integrate 3D printing technology with conventional production methods in the craft-making process.

4. Results and Discussion

The results obtained from this PkM demonstrated the team's contribution to MSMEs in product design,

product development, and mentoring activities. Product design played a crucial role in producing outcomes that were both visually appealing and functionally effective. This process combined creativity, aesthetics, and an understanding of user needs. With the appropriate design approach, products were developed not merely for appearance but also to ensure comfort, efficiency, and usability. Each element, from form and color to material selection was carefully crafted to optimize the user experience.

Furthermore, technological advancements such as 3D printing significantly accelerated the design and prototyping stages. This technology enabled designers to evaluate multiple product forms and functions prior to mass production. However, conventional methods remained valuable, particularly in maintaining the uniqueness and precision of the final product. By integrating these two approaches, product design became more innovative, efficient, and competitive within the modern market context.

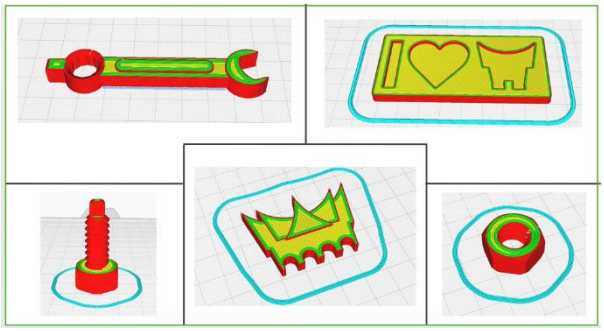

Figure 1. Souvenir Design in the Ultimaker Cura Software. Source: Computer Data, 2025

Product development through innovation was a key focus in efforts to enhance the creativity and competitiveness of local craftsmen. Through the application of 3D printing technology, craftsmen were encouraged to experiment with various product shapes, motifs, and functions that were previously difficult to achieve using conventional methods. This technology enabled a more flexible design process and produced prototypes in a shorter timeframe, allowing new ideas to be quickly tested and adapted to consumer needs.

Besides serving as a platform for creativity, this activity also aimed to foster an innovative mindset in facing the dynamics of the modern market. Craftsmen were guided to identify trends, understand customer preferences, and adapt digital technology in product development. Thus, the use of 3D printing not only increased production efficiency but also opened up opportunities for the creation of new, unique, aesthetically pleasing, and competitive works.

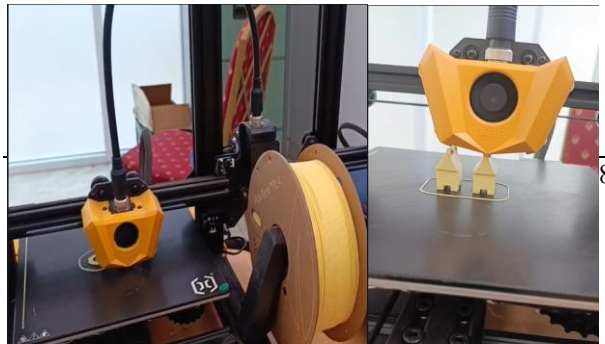

Figure 2. 3D Printing Souvenir Printing Process. Source: Field Data, 2025

Figure 3. Finished Product. Source: Field Data, 2025

Production mentoring provided direct support to craftsmen in applying the 3D printing techniques they had learned. This activity included intensive guidance from the product design stage through the final production process. Through a practical approach, craftsmen were guided to understand how 3D printing technology could improve time efficiency, shape accuracy, and overall production quality.

Furthermore, this mentoring served as a means of knowledge transfer and human resource capacity building in the crafts sector. Craftsmen were not only guided in mastering technical aspects but also encouraged to think creatively to optimize designs to meet market needs. Thus, 3D printing-based production mentoring was expected to encourage innovation in local products that were more modern, competitive, and had high economic value.

In addition, the program had a social impact on the MSME by empowering local craftsmen to become more self-sufficient, increasing their productivity, and expanding their market reach through innovative, technology driven products. It also fostered community collaboration and strengthened the local creative economy by linking traditional craftsmanship with modern manufacturing methods. To ensure the continuity of the program, partnerships with local government, educational institution, and private sector stakeholders were planned to provide ongoing support. This sustainability strategy aimed to create a long-term ecosystem that nurtures innovation, enhances

competitiveness, and promotes inclusive economic growth of the MSME.

Figure 4. Training and Mentoring Activities in the Acrylic Village, Padang City. Source: Field Data, 2025

Technology facilitation was provided by utilizing 3D printing equipment and raw materials needed for the production process. This activity gave craftsmen the opportunity to directly utilize modern technology that had previously been difficult for them to access. Assistance was provided not only on the use of the equipment but also on understanding its working principles, setting printing parameters, and selecting materials appropriate to the characteristics of the resulting product.

In addition to providing facilities, this activity also focused on equipment maintenance training to ensure sustainable use. Craftsmen were guided in performing basic maintenance, detecting minor damage, and maintaining print quality. With this facilitated access to technology, it was hoped that creative industry players could increase productivity, expand design innovation, and strengthen the competitiveness of local products in the digital era and smart manufacturing.

5. Conclusion

In conclusion, this PkM combines conventional methods and 3D printing technology as a holistic approach to craft development. The integration of these two methods enables the creation of products that are not only efficient and precise but also possess aesthetic value and the distinctive character of handcrafted artistry. Through training and mentoring, the craftsmen are introduced to modern technology that accelerates the design and production process while preserving traditional values.

This program also included identifying potentials and challenges, skills training, and facilitating 3D printing equipment for craftsmen. As a result, MSMEs were able to develop more creative, innovative, and market-competitive product designs. Intensive mentoring encouraged craftsmen to understand the practical application of technology, increase productivity, and strengthen the competitiveness of local products through a synergy between digital innovation and the preservation of traditional culture.

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