

Integrating Technology and Craftsmanship to Develop a Thai Fruit Carving Knife Using Design Thinking

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Abstract

This study aimed to develop the design model of a fruit carving knife which has desirable properties based on the needs of Thai skilled carvers by using design thinking that integrates aesthetics, functionality, and cultural identity. The study utilized a mixed methods research technique. Initially, 40 fruit carving experts were interviewed in-depth about the use of fruit carving knives, with data evaluated through content analysis to define user needs and design criteria. Guided by the design thinking stages of empathize, define, ideate, and prototype, a knife design model was developed, featuring the following physical and functional aspects of blade and grip: 1) a 50 mm straight blade with a cutting angle of 17-30 degrees made of high-carbon steel for maintaining sharpness and rust resistance, and 2) a round lightweight grip made of aluminum decorated with contemporary Thai patterns using laser techniques. User satisfaction with the developed design model was evaluated by 80 participants using a structured questionnaire. The results indicated high levels of satisfaction across blade performance, grip ergonomics, and aesthetic design, with overall satisfaction rated at a very high level. The findings demonstrate that the design thinking process is effective for developing craft tools that respond to user needs while supporting cultural preservation and practical use in both professional and educational contexts.

Keywords: craftsmanship, design thinking, technology, Thai fruit carving knife, intangible cultural heritage

Introduction

Fruit carving is a unique art form that is deeply rooted in Thai culture. It has exquisite patterns and a more than 700-year history, beginning as a high-class handicraft in the Sukhothai period and passed down through generations to the present day (DCP, 2016). These amazing carvings, which are the result of inspiration, have been developed into complex and delightful works of art (Chernbumroong et al., 2024). The Ministry of Culture of Thailand has officially registered fruit carving as a national cultural heritage,

and it is classed as an intangible cultural heritage (ICH) under the Convention for the Safeguarding of Intangible Cultural Heritage (UNESCO, 2022). Fruit carving is equally as important in other cultural domains. It requires ongoing knowledge transmission to the next generation, as well as the assistance of the private and public sectors (Li and Romainoor, 2024), especially within the educational system (Panprom et al., 2014). Fruit carving has evolved from a middle school subject to one of higher education, resulting in the development of advanced technology and talents, which make this career in great demand both domestically and internationally. In 2022, the expansion of the tourist industry led to increased competition among hotels, resulting in effective strategies for establishing competitive advantages, such as engaging professional fruit carvers to design exquisite restaurants and tableware (Calinao, 2020). The most crucial tool for creating these creative carvings is the carving knife (Hongrattanavorakit, 2022).

This ancestral wisdom, dating back approximately 700 years to the Sukhothai era, originated with the carving of fruits and vegetables as part of royal cuisine, for the nobility, and for special occasions to welcome important national figures. This tradition has been passed down to the present day, and Thai people commonly encounter it in various forms: as part of meals, in fruit platters, as side dishes and condiments, and as food containers (Nuanmeesri et al., 2022). Beautifully carved food items are akin to works of art that reflect Thai culture. These unique cultural heritage pieces are characterized by their exquisite artistry. Thai cuisine is not only renowned for its excellent taste but also for its visual appeal, which contributes to aesthetic pleasure. Notably, this beauty affects the senses, emotions, and cognition. Thus, food becomes more than just a response to the body's biological needs; it can also satisfy a "hunger for beauty" (Borghini and Baldini, 2021).

Cross-cultural exchange activities involving intangible cultural heritage, such as the art of fruit and vegetable carving, can foster understanding and appreciation among foreign visitors, contributing to ongoing global cultural development (Chen, 2022). The present study affirms fruit and vegetable carving as not merely a culinary technique but a valuable cultural asset that can foster cross-cultural understanding and appreciation (Songnearm, 2025). For the study of cultural tourism behavior and the enhancement of tourists' perceptions of Thai food and local culture, in this context, the art of fruit and vegetable carving is considered an integral part of Thai food culture, capable of creating memorable experiences for tourists (Chaigasem and Tunming, 2020). Furthermore, this research can contribute to the development of policies and practices related to promoting creative tourism.

Fruit carving knives are crucial to the quality of fruit and vegetable carvings. A good knife can create intricate and delicate designs more effectively. Sharp and appropriately sized knives make the carving process easier and faster, ensuring precision and control in the creation of detailed patterns. Thailand has a wide variety of fruit carving knives, with varying prices and quality (Sone, 2019; Hongrattanavorakit, 2022). Carvers often look for knives with special features to enhance their ability to carve fine details and use multiple carving techniques with one knife. For example, the flipping knife technique can be used to quickly and easily carve deep parts, resulting in more detailed works than ordinary carving. However, fruit carving knife makers are often unfamiliar with carving art, and fruit carving experts lack knowledge in making carving knives (Albors-Garrigós et al., 2018). This inconsistency means that the carving knives do not meet the expectations of professional carvers. This is a problem that is generally acknowledged but has not been seriously resolved.

The design thinking process is a user-centered solution, which has been applied in various fields, including the field of handicrafts (Kimbell, 2011; Grönman and Lindfors, 2021; Pandit and Agrawal,

2023). This holistic thinking method covers creative thinking, artistic principles, problem identification, and sociological understanding (Kimbell, 2012; Pratomo et al., 2021; Bender-Salazar, 2023). The five stages of the design thinking process are the following: empathize, define, ideate, prototype, and test (Figure 1). The process focuses on understanding and explaining problems, creating new concepts, and testing solutions with target groups (Choi et al., 2024; Dam and Teo, 2024). Attention is paid to users' needs, making full use of their extensive professional field. This approach can help to develop tools and products for protecting cultural heritage and meet the needs of contemporary users (Pattanapanithipong and Chandhasa, 2018; Gumulya et al., 2022). The conceptual framework and research methods of this study can be used as the design model of future innovation in the field of handicrafts, especially in the context of combining traditional crafts with modern knowledge and technology (Elsbach and Stigliani, 2018; Ginting et al., 2023). The researchers hope that this study can provide some inspiration and guidance for applying the design thinking process in other arts and crafts so as to contribute to cultural and economic innovation in Thailand.

DESIGN THINKING PROCESS

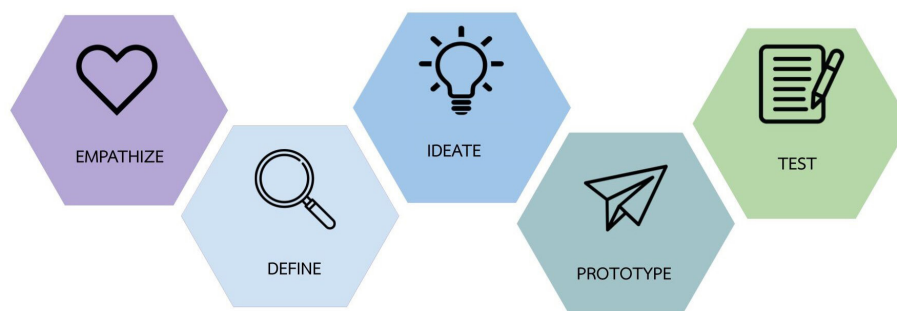


Figure 1 Design thinking process

Research Objectives

The purpose of this research was to study the issues encountered by fruit carving experts when using a fruit carving knife. This led to the design of a fruit carving knife tailored to the needs of the fruit-carving experts to achieve user-centric innovation through a design thinking process. In addition, the development approach for carving has taken into account the price that is suitable for users who may be both professional carvers and students using it for practice. And importantly, this development still maintained the context of cultural conservation. It was then followed by an evaluation of the satisfaction with the developed design model of this knife.

Research Process and Methods

This study used a combination of research methods separated into two phases and five steps. The first phase was qualitative research, which included steps 1-4. The second phase was quantitative research, which included step 5, involving testing (Figure 2).

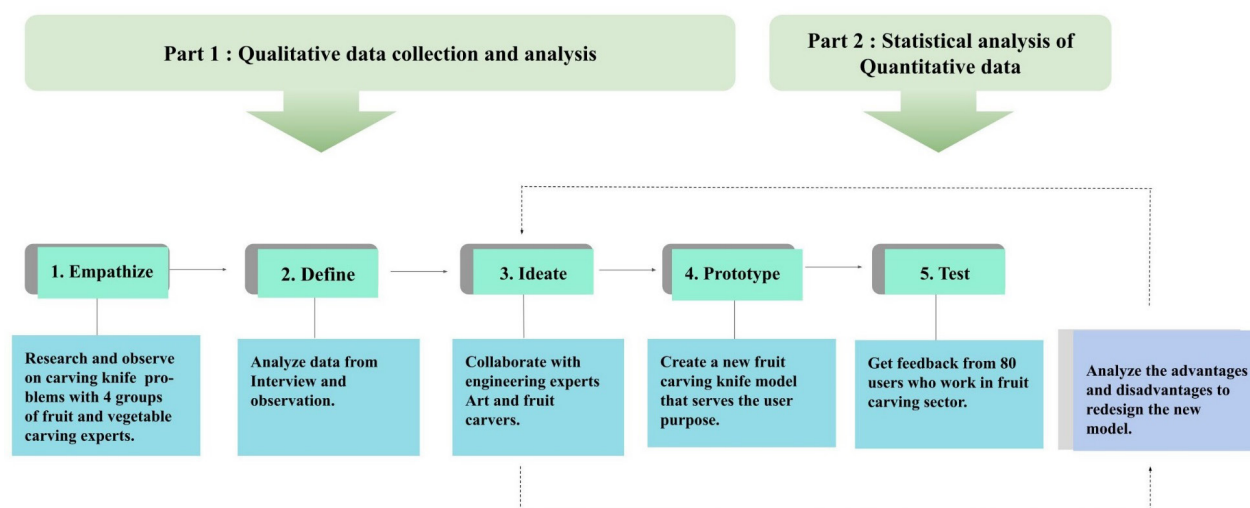


Figure 2 The design thinking process developed for this research study

Empathize

Data from in-depth interviews were collected from the specific fruit carving experts who provided essential details for analysis. The fruit carving experts were selected based on their experience. There were 40 participants divided into four groups of 10, including fruit carvers or chefs working in restaurants, teachers who taught fruit carving, students with experience in national fruit carving competitions, and middle school students who had participated in fruit carving competitions. Interview questions were checked for validity by three experts, and the data were analyzed using content analysis, classification, and interpretation.

Define

The researchers summarized the issues raised during the interviews and observations by using content analysis, and they found correlations based on application needs and carving knife design directions.

Ideate

The researchers synthesized the data to create new answers and alternative options by presenting a diversity of perspectives. To summarize suggestions and select the best design, a brainstorming session was held with materials science specialists from the Faculty of Engineering and Fine Arts as well as researchers with expertise in fruit carving.

Development Design Model

The researchers used concepts from the “ideate” stage to create a developed design model of a Thai fruit carving knife with the necessary traits and qualities.

Testing

To investigate user satisfaction with the fruit carving knife development design model, a select group of 80 people with general fruit carving skills was drawn, comprising four groups of 20: carvers, carving teachers, university students, and secondary school students. A questionnaire was used to assess

satisfaction with the Thai fruit carving knife developed design model. Three professionals evaluated the questionnaire for validity. A five-level Likert scale was used. Data were analyzed through frequencies, means, and standard deviations.

Results

Based on the research objectives, which were to study the issues surrounding the use of fruit carving knife among experts, to design a fruit carving knife according to expert requirements using a design thinking process, and to evaluate satisfaction with the developed design model of a Thai fruit carving knife, the findings were those detailed below.

Empathize: Data Collected from Specific Groups

The researchers conducted a semi-structured open-ended interview with the sample focusing on understanding, empathizing, repeating questions, and observing the main issues as described below.

1. Experience and background in carving

The interviewees had experience in fruit carving ranging from 3 to 30 years. Their motivation for carving came from close people such as friends or teachers. The number of knives they owned depended on the frequency of use and the budget available. For example, hotel workers and teachers, who used the knives frequently, had 3-5 carving knives per person and purchased them at higher prices (\$27.38-\$41.06 per knife). In contrast, students, with limited budgets, had about 1-2 knives per person and purchased them at lower prices (\$8.21-\$13.69 per knife). The goals of each group of carvers are different. For example, people who work in hotels have the intention of spreading national arts and culture and want to develop their skills to compete in higher-level carving competitions such as those at the international level. As for teachers, they emphasize transferring knowledge to the new generation and inventing styles and patterns to continuously develop carvings. As far as students are concerned, they hope to improve their craft, participate in higher-level competitions and engage in carving work to earn extra income. The most important thing is that every group has a great love and passion for carving works.

2. Current production of carving knives

There are two types of carving knives produced today. The first type is custom-made knives produced by skilled craftsmen, which are more expensive, take longer to produce, and offer beauty according to the buyer's preference, but every knife may not meet quality standards since they are handmade. The second type is mass-produced industrial carving knives, which are generally cheaper but of lower quality. Carvers with budgets often order knives from craftsmen or occasionally from websites, seeking advice from those who have previously purchased them.

3. Characteristics of currently used carving knives

Typical blade shapes are straight and curved. The hotel fruit carvers use the knives every day, so they have to sharpen them constantly, causing the blades to become thin and shorter. This makes it difficult to control the direction precisely, making the knives unsuitable for carving huge parts, so a knife with a short blade is used to carve small pieces. Teachers in educational institutions note that the length and thickness of the blade significantly affect the quality of the carvings. Students face issues with thick and highly curved blades because of limited budgets, and often buy cheaper knives which they use for all types of carvings. A common problem across all groups is that very sharp blades tend to rust easily.

4. Aesthetic and ergonomic considerations

Carving knives are held like a pen with a round grip. However, there are two common varieties of carving-knife grips for sale: round grip and flat grip. For detailed work, carvers prefer the round grip for better ease of use. The grips are made of metal, wood, or plastic. The expert carvers group wanted both their work and their carving knives to be visually appealing because they would be performing demonstrations and carving exhibitions at important occasions on a regular basis. As a result, they decided to use a knife with a unique Thai design.

5. Desired characteristics of carving knives

Experts prioritize sharpness above all. Other desired features include durability, rust resistance, suitability for carving intricate patterns, being lightweight, having aesthetic appeal with Thai designs, and affordability (Figure 3).



Figure 3 (a) The common types of carving knives available in the market (b) A rusted blade
(c) Peeled-off Thai-pattern stickers

Define: Identifying Issues or Problem

A design thinking approach was used to meet the first objective of the study, which was to investigate problems with specialists' usage of blades for fruit cutting. Experts from four groups were interviewed in-depth during the "empathize" phase on the following four topics: their background and experience in carving, the features of the knives that are currently in use, ergonomic and aesthetic considerations, and the ideal knife specifications. These realizations guided the "define" phase, in which researchers compiled the issues from observations and interviews, and looked for connections with the design objectives and user application needs shown in Table 1.

Table 1 Summary of issues and solutions regarding carving knife

Criterion	Problem	Solution	Significance
Blade			
Physical	A curved blade cannot carve intricate patterns well.	The blade should be designed to carve intricate patterns effectively.	The blade pattern affects the beauty of the carving work.
Functional	Very sharp blades are prone to rusting, while blades that do not rust tend to be sharp for only a short time.	Long-lasting sharpness of the blade should be ensured, and the rusting process should be minimized.	The ideal blade has to be sharp, and the material used to make it has to be of good quality. It should be sharp for a long time and not rust.
Grip			
Physical	Thai-pattern stickers on grips were not durable and wooden grip was not attractive.	The knife grip should be beautifully designed and durable.	The knife grip has to be decorated with beautiful patterns which do not peel rub off easily; most carvers prefer beautiful Thai patterns.
Functional	The round-grip knife was more effective but expensive, while a flat-handled one was cheaper but could not be used to carve intricate patterns.	A carving knife should have a round grip.	The knife grip has to be round and cheap, but quality materials which carve intricate patterns are more effective than flat-handled ones.

Ideate: Brainstorming

In this phase, the research team synthesized information to generate new answers and alternatives through the proposal of diverse and varied ideas, leading to a collective conclusion. The study of issues and needs related to carving knives led to a brainstorming session with experts in materials science from the Faculty of Engineering, art scholars, and researchers who provided insights related to carving. Together, they explored new ideas and selected the most feasible designs, consistent with Pandit and Agrawal (2023). This collaborative knowledge creation increased confidence, created mutual value, and opened opportunities for future cooperation. This led to a joint brainstorming session, supplemented by a review of relevant documents, to find precise solutions and propose design ideas for carving knife models according to the needs of professional carvers, as described in the paragraphs below.

1. Blade design

Based on the conclusions from the brainstorming sessions with the research team and engineering professors, it was proposed that a carving knife should be designed with a straight blade tip, 50 mm in length. The straight blade shape allows for detailed carving, and the blade length is suitable for both teenagers and adults, making it usable by all groups of carvers. This blade length can be used to carve large fruits such as watermelon, cantaloupe, and other similarly sized fruits, as well as smaller pieces for consumption or plate decoration.

2. Blade sharpness

The most suitable material for the blade, considering its intended use, is high-carbon steel. This material, containing between 0.06 and 1.4 percent carbon, offers the highest strength and lowest toughness among carbon steels. It is commonly used after hardening and tempering, especially in applications requiring wear resistance and sharpness for cutting. This type of steel is used to make cutting tools and molds, as well as knives, razors, saw blades, springs, and high-strength wires (Varshney et al., 2016; Koval et al., 2021). Generally, the cutting edge of a knife has a two-dimensional contact area

depending on the radius of the blade tip (Schuldt et al., 2016). In this study, the cutting angle of the blade was adjusted to a slope of 17-30 degrees, based on the recommendations of engineering experts. A lower slope angle results in a sharper blade but faster edge wear, while a higher slope angle provides less sharpness but slower edge wear.

3. Grip design

The most suitable handle design is a round grip. Research indicates that the percentage of normal force exerted at the tips of the thumb and index finger is higher than in other parts of the hand, gradually decreasing from the fingertips to nearby areas (Banuvathy and Varadhan, 2021; Chen et al., 2022). A round grip facilitates knife rotation and manipulation for carving intricate patterns, including deep cuts such as flower stamens and detailed motifs. Engineering experts recommended using aluminum with a diameter of 12 mm and a length of 100 mm, aligning with the properties of aluminum: a density of approximately 2.70 g/cm³, a light weight (one-third that of steel), ease of rolling into sheets, good thermal and electrical conductivity, excellent surface coating, and oxidation resistance. Additionally, it is non-toxic.

4. Aesthetics of the grip

The most desired patterns among the sample group were traditional Thai and contemporary Thai designs, reflecting the valuable fine arts and uniqueness of Thai culture, linked to ancient beliefs (Virunanont, 2020). Art experts proposed incorporating contemporary Thai painting designs to convey Thai identity while integrating global elements. The prominent features include closed and open lotus flowers, symbolizing land, prosperity, or birth, with continuous patterns of traditional Thai motifs, such as *Phum Khao Bin*, a geometrical pattern featuring leaves and flowers, and swirling patterns to enhance elegance (Clark, 2020). By blending traditional and contemporary Thai styles, the design can convey modern aesthetics. Regarding the handle color, the sample group preferred colors that conveyed solemnity, elegance, and grandeur, in line with Thai painting principles. Art experts suggested using white, black, pearlescent, silver, gold, and dark red, with laser techniques to ensure the durability of the patterns.

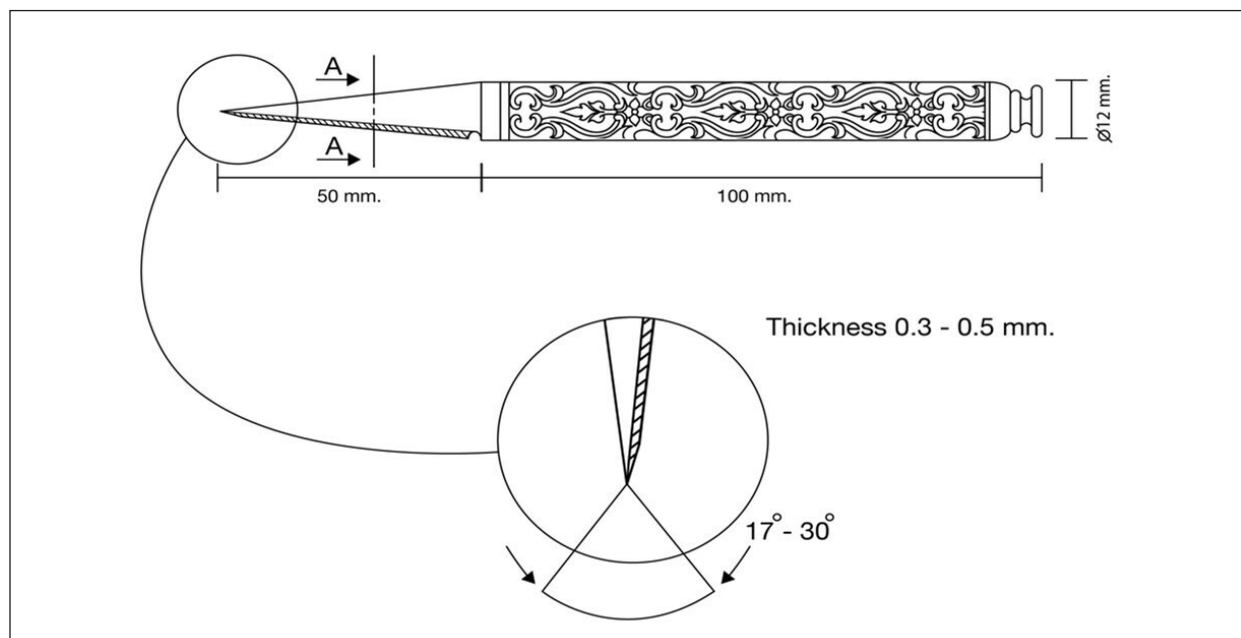
Development Design Model: Creating a Developed Design Model of a Thai Fruit Carving Knife

The second objective was to create a fruit carving knife based on expert specifications. This goal matched the requirements of the “ideate” phase, the third stage of the design thinking process. By presenting a variety of ideas from brainstorming sessions with specialists in materials science, engineering, fine arts, and research offering in-depth insights on fruit carving, researchers synthesized data to create new possibilities and solutions. Following this procedure, concepts were summed up and the best design was chosen to move forward with in the “development design model” phase, in accordance with the information shown in Table 2.

Table 2 Improvement points of a Thai fruit carving knife according to the requirements of professional carvers

Criterion	Desired carving knife	Improvement points of Thai fruit carving knife
Blade		
Physical	The blade was of sufficient length, straight, and robust, allowing for intricate carving details.	The blade length has to be 50 mm to accommodate users of all ages, with a cutting-edge angle of 17-30 degrees.
Functional	The blade retains sharpness for a long time and is resistant to rust.	The material used to make the blade has to be a high-carbon stainless steel, which retains sharpness for a long time and is resistant to rust.
Grip		
Physical	The grip contains Thai patterns, or patterns adapted from traditional Thai designs.	The grip contains contemporary Thai patterns in silver, gold, black, and pearl colors, which are solemn colors of traditional Thai artistry.
	The grip is durable and non-fading.	Intricate contemporary Thai pattern designs have to be achieved using laser engraving techniques.
Functional	The round grip of the knife is comfortable, and its lightweight design makes it easy to handle.	The grip has to be round and made of lightweight aluminum.

The developed design model of the fruit carving knife was summarized and selected by the research team as the final model for satisfaction evaluation of the sample in the next stage (Figure 4, Figure 5).

**Figure 4** Bevel angle of the blade of the developed Thai fruit carving knife

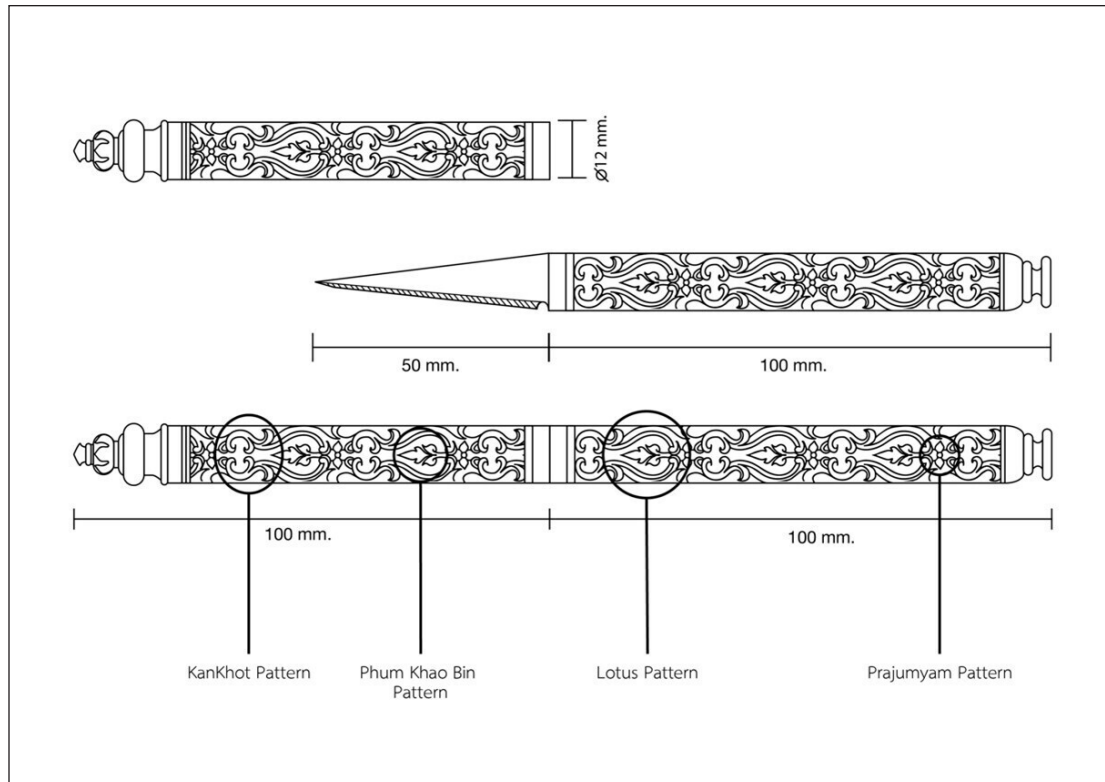


Figure 5 The developed design models of Thai fruit carving knives

Statistical Analysis of Quantitative Data

This phase employed quantitative research with a sample group of 80 participants. A questionnaire was used to measure satisfaction with the developed design model of Thai fruit carving knives using a Likert-type scale with five levels of intensity (1-5). Data were analyzed using frequency, mean, and standard deviation. The satisfaction evaluation results are shown in Table 3.

Table 3 The results of user satisfaction with the developed design model of Thai fruit carving knife

Criterion	Mean/S.D. (N = 80)				Score	Level
	Carvers	Lecturers	University students	High school students		
Blade design	4.07 (0.78)	4.72 (0.44)	4.28 (0.62)	4.26 (0.89)	4.33 (0.76)	Very satisfied
Blade sharpness	4.21 (0.86)	4.65 (0.54)	4.46 (0.57)	4.50 (0.62)	4.45 (0.69)	Very satisfied
Blade-grip characteristics	4.21 (0.83)	4.62 (0.61)	4.46 (0.68)	4.54 (0.65)	4.45 (0.74)	Very satisfied
Grip aesthetics	3.93 (0.99)	4.42 (0.77)	4.22 (0.67)	4.61 (0.62)	4.75 (0.51)	Extremely satisfied
Satisfaction level	4.09 (0.90)	4.55 (0.64)	4.28 (0.72)	4.49 (0.69)	4.37 (0.77)	Very satisfied

The evaluation of user satisfaction with the fruit-and-vegetable-carving knife design models, developed using the design thinking process, showed that the model possesses features and characteristics that highly meet user needs. The overall average satisfaction score was 4.37 out of 5, which fell into the “very satisfied” category. The aesthetics of the handle received the highest satisfaction score of 4.75, indicating “extremely satisfied.” The intricate Thai-inspired patterns on the knife handle led users to highlight their appreciation of its beauty and a design that prominently reflected Thai identity. Both the handle and blade sharpness received an average satisfaction score of 4.45, which also fell into the “very satisfied” category. Users particularly favored the lightweight aluminum round handle, which provided comfort and maneuverability during use. The sharpness of the high-carbon steel blade facilitated precise and detailed carving. The average satisfaction score for the blade design was 4.33, indicating “very satisfied.” The 50 mm straight blade with a sharpness angle of 17-30 degrees was deemed suitable for carving a variety of fruit sizes and patterns, from large pieces to intricate patterns, garnering acceptance from users across all age groups.

When comparing satisfaction scores among different user groups, teachers had the highest satisfaction across all aspects, with an average score of 4.55. This was followed by middle school students (4.49), college students (4.28), and professional carvers (4.09). This data indicate potential differences in perspectives and needs among user groups, suggesting further studies to tailor designs to meet specific group requirements more effectively.

In summary, the satisfaction evaluation results indicate that the design thinking process is highly effective in developing carving knives that meet user requirements. By integrating aesthetic appeal, functionality, and cultural identity, this research inspires innovative Thai craftsmanship that stands out in both value and quality.

Discussion

The purpose of this research was to study the characteristics of fruit-and-vegetable-carving knives according to the needs of professional carvers, found using a design thinking approach. The results of the research showed that the average satisfaction with the fruit carving knife design model was very satisfactory, and every aspect was rated at the highest level, especially the elegance of the knife handle, which obtained the highest average. However, this result contradicts those of the interviews, which indicated that carvers preferred sharp carving knives initially. However, the evaluation findings indicated that the score was merely at a high level. This might be due to the fact that the scope of the satisfaction assessment stage for the fruit carving knife design model was limited to assessing design satisfaction. The next step will be to create real carving knives. Because it involves tools and takes time to create, the study results on blade sharpness will be more obvious when the sample is given the opportunity to use a real knife prototype. In terms of the elegance of the knife handle, the design is clearly visible on the assessment form. As a result, it produced the highest levels of satisfaction.

At the end of the questionnaire, the researcher raised some questions about the practicality and cost-effectiveness of the carving knife design model. The results of the research concluded that the sample group was highly satisfied (4.35) with the overall practicality and cost-effectiveness of the carving knife design model. However, regarding the price of 27.51 USD, satisfaction was relatively low, especially among students and student groups. The price that the researcher set for the questionnaire may have been

too high for this group. Moreover, they made additional suggestions regarding the price of carving knives, which they felt should be around 13.75 USD. This will be a point of review for the next iteration of the design thinking process. The production of carving knives for students should be improved so that they can buy them at reasonable prices. Furthermore, study findings on handle aesthetics imply that the aesthetic pattern of the knife handle has no impact on the attractiveness of the carved work. However, it portrays the beauty and uniqueness of Thailand. This carving knife is suitable for professional carvers who want to show off their fruit carving and Thai culture on special occasions. However, it might be better to produce carving knives for the student group by reducing the intricate pattern on the handle in order to reduce the price. This will be in the iterative process in the “ideate” step so that we can brainstorm together to solve the problem next time. As for the topic of the question about the color of the side of the knife, from the research results, the sample groups were most satisfied with the following colors in order: pearly gold, pearly dark red, pearly silver, and pearly black and white, respectively; this information will be used to develop a real carving knife prototype.

The design thinking process is an iterative thinking process, in which the results of the last stage of the work process are constantly reviewed to help redefine the problem and imagine alternatives or solutions that have never been encountered before. In the conceptual framework of the design thinking process of this study, the process iteration from evaluation results to brainstorming stage was defined. The research team believes that interdisciplinary collaboration is highly important for continuous development of work. This view is supported by Groth et al. (2022) who highlighted the necessity of interdisciplinary thinking within research teams to collaboratively solve problems. It is widely accepted that new knowledge is often discovered through cross-disciplinary studies, as we aim to achieve in this research, and it occurs at the intersection of craftsmanship and neuroscience. Unexpected mutual benefits may arise, aligning with the findings of Pandit and Agrawal (2023). They pointed out the positive impact of design thinking on collaborative creativity among stakeholders, leading to the creation of new knowledge in terms of cultural innovation in the development of design, particularly in the context of craftsmanship. Elsbach and Stigliani (2018) found that future research needs to study the experience characteristics of the design thinking process to improve our understanding of cultural change, emotional creation, strategic creation and organizational empathy. The result of this article is another research perspective on the relationship between handicrafts and the design thinking process. It has been found that the conceptual framework studied in this paper can effectively solve the problem of fruit carving knives and provide guidance for future applications in other work, depending on which stage the leader needs to reuse it in order to return to modify it as needed, which is in line with the principles of the Interactive Design Foundation (Dam and Teo, 2024). The design thinking process is one that needs to be run repeatedly in multiple stages in order to find a solution or the best choice for the target group so that the team has the opportunity to adjust and further improve the concept.

The research results show that the application of the design thinking process to develop a fruit carving knife design model that meets the needs of professional carvers has been successful. Interdisciplinary collaboration among experts in the fields of fruit carving, material science, engineering, and fine arts is the key factor required to realize a comprehensive and user-centered design method, which is in line with Bender-Salazar’s idea (Bender-Salazar, 2023) that the design thinking process is an effective way to identify and discover what is needed to solve complex problems through the collaboration of interdisciplinary teams.

The result is a high-quality carving knife, which combines aesthetics, practicality and cultural aspects, not only enhancing the user experience, but also playing an important role in the sustainable preservation of national cultural heritage, acquisition of cultural property and as an educational resource (Chernbumroong et al., 2024). This is consistent with previous research that emphasizes the importance of holistic design in developing handicraft tools (Grönman and Lindfors, 2021; Pandit and Agrawal, 2023).

An interesting finding is that the aesthetic design of the knife handle received the highest satisfaction rating, even surpassing that of the sharpness of the blade, which carvers initially considered the most important aspect in preliminary interviews. This result emphasizes the importance of aesthetics and cultural elements in tool design, as these components contribute significantly to the perception of user experience and quality. This aligns with the ideas of Elsbach and Stigliani (2018), who suggested that the characteristics of the design thinking process should be studied to understand how feelings and perceptions towards organizations are formed.

In addition, the conceptual framework and research methods of this study can be used as a guide for the innovative development of arts and crafts, emphasizing user participation and the use of rich professional knowledge, thus creating products that meet users' needs and preserving cultural heritage.

However, there are some limitations in this study, such as the relatively small sample size and only focusing on the design steps. In future research, more extensive user research may be conducted, covering the manufacturing process and actual use of carving knives, in order to verify and expand the understanding of the effectiveness of the development of arts and crafts tools in the design thinking process.

Conclusion

In conclusion, the application of the design thinking process in developing a Thai fruit carving knife design model tailored to the needs of professional carvers has been successful. The interdisciplinary collaboration among experts in fruit carving, materials science, engineering, and fine arts has resulted in a high-quality carving knife. The developed design model features a 50 mm straight high-carbon steel blade with a cutting angle of 17-30 degrees, ensuring long-lasting sharpness and rust resistance. The round lightweight aluminum grip, adorned with contemporary Thai patterns using laser techniques, provides both ergonomic comfort and visual appeal.

User satisfaction evaluations indicate high levels of satisfaction across all aspects, with an overall average satisfaction score of 4.37 out of 5. The aesthetics of the handle received the highest satisfaction score, emphasizing the importance of cultural elements in tool design. This research highlights the effectiveness of the design thinking process in creating tools that meet user requirements while preserving cultural heritage. Future research should expand user studies to include the manufacturing process and actual use of the carving knives to further verify and enhance the effectiveness of this approach.

The study demonstrates the potential for design thinking to foster innovation in the development of arts and crafts tools, ensuring that products meet user needs and contribute to the sustainable preservation of cultural heritage. This iterative, user-centric approach can serve as a model for future research and development in various fields of arts and crafts.

The results of this research led to the creation of a conceptual carving knife design model that will lead to the development of a carving knife prototype meeting the requirements of excellent functionality, outstanding cultural preservation, and affordability.

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