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Sensory Design and Design Thinking for Design Educating

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ABSTRACT

This paper aims to highlight the critical role of the interdisciplinary integration of sensory design and design thinking in education, particularly in educating designers. Through a literature review analysis, the paper explicates the importance of integrating sensory design and design thinking in design education and puts forward a didactic method to deal with specific problems encountered in design education. A case study conducted at the Sichuan Fine Arts Institute has been used as an experiment for a new didactic method. Students could choose any material and explored its sensory expressions, discovering emotional and narrative content. Then, students selected traditional handicrafts to enhance and add new sensory expressions, reinforcing and clarifying the emotional expressions. Ultimately defined the design theme and students' work were the final output. The purpose is to summarise the results and problems of teaching activities through an analysis of course content. The didactic method emphasises the student experience and the innovative design outcome. The didactic method was tested in design education, suggests possible development trends in the application of interdisciplinary education to provide the impetus for improving existing design education models.

Keywords: design education, design thinking, sensory design, didactic method, interdisciplinary

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1. Introduction

What a complex world we face today, designers seem to carry more responsibilities than ever. However, in terms of cultivating creative personnel, most universities are still in the exploratory stage (Yao and Ren, 2012), following a single, procedural approach to teaching and learning (Zhong, 2007), while multiple teaching activities lack knowledge on design concepts and methods (Chen and Zhan, 2010). As students are not sufficiently trained in the scientific methods associated with design (Norman, 2010; Ozkaynak and Ust, 2012), students cannot face these complex tasks and take responsibilities.

The 21st century is an era of innovation, where the focus will shift from repetition to creation and innovation. In the current transformation from Made in China-to-China Creation, school education emphasises cultivating innovative talents. Guiding students to think about design is a core task for education (Simon, 1996). Qian (2018) states that creative thinking refers to new thinking and distinctive thinking, which is the source of creativity. Scholars in some countries have proposed the idea of "Design Thinking (DT)" to promote innovation education and have carried out many practical studies (Lin and Shen, 2019). Design Thinking is a critical element in the development of innovation in the 21st century (Beckman and Barry, 2007). It provides educators with an innovative methodology for solving educational issues (Brown, 2013), but also a process of analysis and creation, including the exploration of problems, the conception of solutions, production, and evaluation (Lin and Shen, 2016). It is widely used to solve

complex problems in various fields such as engineering, health, business, social science, education and teaching.

With the advent of the experience economy era, society has widely recognized the value of sensory, be-called a new trend in design development. It is time to explore the sensory characteristics of the body, whether to design the city, architecture or daily necessities (Masayuki, 2003). As Spence (2011) highlights the importance of touch in product design, in particular, see Naoto Fukasawa's package design for simulating the texture and colour of natural fruits, as a reminder of consumer' nature experience (Yu and Mao, 2018). Similarly, a Japanese research group believes in the importance of sensory aspects in the interaction between human and product (Sonneveld, Ludden and Schifferstein, 2008). As a single product may contain multiple sensualities (Liu, Riccò and Calabic, 2019).

Multiple studies have been proposed on the interdisciplinary potential (Self, Evans, Jun and Southee, 2018; Kang 2008), so this paper aims to investigate the role of interdisciplinary research on design thinking and sensory design in design education and teaching activities. The purpose is to explore the interdisciplinary didactic method in design education, and a case study is also present at the end of the paper. Through a four-week teaching experiment, the sensory design was brought into the design education, integrating with design thinking models to explore the possibilities of innovative designs and new combinations of materials and traditional handicrafts. The didactic method aims to explore emotional expression, design methods as well as pedagogical values. Some suggestions are given for the further development of an interdisciplinary method.

2. Application of Sensory Design and Design Thinking in Education

2.1. Importance of Sensory Education in Design

The challenge of design work is facing the stripped vision from emotional cognition by industrial production and high-tech inventions (Pallasmaa, 2012), ignoring the value of other senses in design. Indeed, the primary sensory that influences our perception is visual, but other sensory can also create added value (Favre and November, 1979; Spence, Piqueras-Fiszman and Blumenthal, 2012; Riccò, Belluscio and Guerini, 2003). What people are interested in is not the physical objects, but the challenging experience process, which brought pleasurable emotion and experience with all our body by using all their senses (Shao, 2012)

All the sensory interactions need to be considered when performing certain functions by the designers (Riccò, 2014). Moholy-Nagy's pedagogy declares the development of the students' ability with visual, texture, sound and movement (Findeli,1990). In synesthetic design, there are numerous didactic activities have been carried out, between audio, visual and haptic for visual communication (Riccò, 2009; Riccò, Belluscio and Guerini, 2003), along with the study of taste and visual expression (Liu, Calabi and Riccò, 2018). And it also has a wide range of applications in higher education in a variety of disciplines, such as “Sensory Architectures” (Victoria Henshaw, Manchester University); “Making Sense” (Steve Ferzacca, University of Lethbridge); “Visualizing the Five Senses” (Jane Nisselson, New York University) (Liu, Calabi and Riccò, 2018).

Mainly, “for certain aspects of human experience are destined to remain incomprehensible to linguistic kinds of representation no matter how thick the textual description or how deep the textual analysis” (Cox, Irving and Wright, 2016, p.9). Sensory training helps students express their own emotions with design work（Zi and Liu, 2019）, such as the tactile emotion synaesthesia, discusses the natural effect of seeing soft texture as safety, roughness as unpleasant and danger (Ramachandran and Brang, 2008). There are many sensory applications

in design works. In particular, see Adi Toch's 2017 installation, Talk to Me, exploring how sound translates into gentle movement. Her explorations of object voicing and dialogue with objects can still be seen in her series of works, “Hold Out Your Hands” (2017) and “Red Sand Bowls” (2017). “It moves us from a visual apprehension of writing to an auditory one” (Cox, Irving and Wright, 2016, p.10), aim to evoke the sensory experience and the simultaneous presence of various sensory phenomena (MacDougall, 2005) and interaction of the senses (Merleau-Ponty, 2000). The sensory design could enrich student’s creativity and improve their ability to design. Therefore, the study of sensory design becomes fundamental for designers’ education.

2.2. Creative Value of Design Thinking in Education

Design thinking provides a process and method for putting forward ideas that can also be called new ideas or breakthroughs to solve complex problems in reality (Camacho, 2016). Simon (1996) defines design thinking as a process of seeking better solutions to existing conditions. Design thinking emphasises human values, problem clarity, familiar process, action tendency, all-round collaboration, and focus on experimentation and presentation (Plattner, 2010), which reflects the characteristics of design thinking (Zhang et al., 2019; Leinonen and Gazulla, 2014):

- Empathy, a human-centred philosophy
- Socialisation, a focus on social research of the problem
- Interaction, an emphasis on a non-linear iteration of solutions to inspire thinking and modify solutions
- Visualisation, a present in the form of visual works

By the end of the 20th century, educational institutions were increasingly aware that education is one of the most extensive and integrated artificial systems. Therefore, design thinking needs to be introduced into the education system to solve many fundamental problems (Koh et al., 2015). From the perspective of teachers, Henriksen (2017) integrates the Stanford University design thinking model with teacher training to creatively address complex education issues by developing their design thinking. From the perspective of curriculum implementation, Chen and Huang (2017) combines the design thinking model with the design of creative educational activities, thereby developing learners' ability to collaborate, problem analyses and creative thinking.

Many researchers have integrated design thinking model with some interdisciplinary courses to build new design thinking model suitable for the major, which not only facilitates the teaching and learning activities but also helps students absorb the knowledge more efficiently and master the skills better. Coley (2013) states that design thinking is a structured method, guiding people to solve real-world problems that include research, analysis, brainstorming, innovation and development to help people develop creative solutions. Design thinking has been applied to various courses, such as business (Glen et al., 2015), geography (Carroll et al., 2010), ideological and political theory (Sun and Shi, 2014), information technology (Zhu and Li, 2015), and online courses (Anderson et al., 2014). Janis Norman (2001) points out that introducing design thinking pedagogical model into educational practice in arts and science programs not only can help learners effectively organize their thoughts and actions and also can be used as a framework and catalyst for teaching and learning strategies that promote innovation, advanced thinking, teamwork, and genuine performance assessment.

Multiple teaching elements are considered in the design process to achieve the same teaching purpose (Liu, Calabi and Ricco, 2018) so that disciplines are interconnected with each other.

3. Interdisciplinary Didactic Method

A specific professional field cannot achieve design thinking; many critical keys of innovative solutions are necessarily the result of cross-disciplinary collaboration (Li et al., 2017). The educational application of design thinking has developed from an independent to an integrated teaching model (Lin and Shen, 2018). Design that emphasizes the senses rather than other disciplines (Liu, Calabi and Riccò, 2018). As a manipulator of sensations, a designer who is able to work with texts, figures, but also with sounds, haptic, etc. to make a mutual congruence between them (Riccò, 2001). Sensory design helps students express abstract things, such as experiences and emotions, in a figurative form in an artwork. Therefore, by combining sensory design and design thinking disciplines, a new educational method is designed to improve teaching efficiency while helping students establish logical relationships and enhance their problem-solving skills.

The proposal of the didactic method is mainly based on some problems in the earlier experiment, which explores sensory expression in jewellery education (Zi and Liu, 2019). In the early 20th century, the Hasso Plattner Institute of Design at Stanford University put forward a design thinking model comprising five stages: Empathize, Define, Ideate, Prototype, Test (Plattner, Meinel and Leifer, 2018). Some researchers made supplements and additions based on the Design thinking model (Lugmayr et al., 2014; Araújo, Anjos and Silva, 2015; Ratcliffe, 2009). This paper aims to make supplements based on design thinking with the exploratory and instructive sensory design-related questions, to shape the design and thought process. The theoretical framework is divided into three stages (Figure 1).

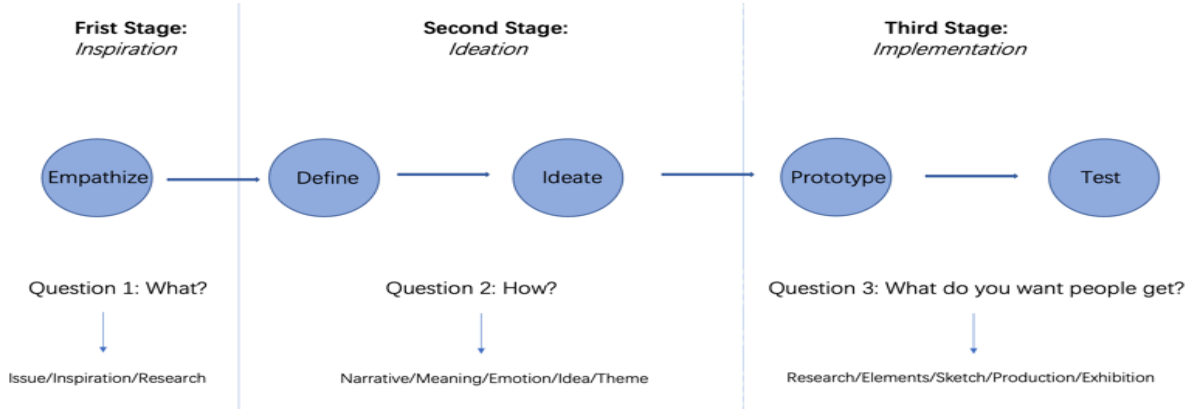

Figure 1: The Framework of Didactic Method
Source: Compiled by the research

– **First Stage**: Inspiration. This stage is based on Empathy in the Design Thinking module combined with Sensory Design, which aims to discover problems, find inspiration, and define and investigate the problem's direction by thinking the questions of "WHAT". During the teaching process, the teacher designs some "what" questions, identifying specific figurative senses. Guiding students to think and discover inspiration from sensory experiences, such as the tactile and visual. At this stage, teachers need to provide some methods to help students. For example, questionnaires and interviews can be used to in-depth "WHAT" questions, and brainstorming can also be used for divergent thinking.

– **Second Stage**: Ideation. This stage is based on the Design Thinking Model's two components, Define and Ideate, and the question 'HOW', to in-depth thinking about the senses in the first stage, such as emotions, narratives, experiences, histories and other specific and detailed information. In turn, the designer's self-expressed emotions or intentions are clarified, and finally, to find a clear design theme or concept. The primary purpose of this stage is to help students develop a design concept or theme. During the teaching process, the teacher designs

some “HOW” questions related to this section and guide students on how to think and research thoroughly.

– **Third Stage**: Implementation. This stage is the part where the design is developed, mainly based on the Prototype and Test in the Design Thinking Model combined with the questions, to further research on the theme of the second stage, searching for design elements, developing design sketches, experimenting, modelling and form a product prototype finally. The third question is “What do you want people to get” which helps the designers make choices and pinpoint the design direction to determine the specific implementation method. By designing specific questions, students are guided to clarify their expression form and intention to iterate and optimise their design work. Students can develop the innovation ability at this stage, and teachers offer some methods to help students find breakthrough points through case studies, questionnaires, and interviews, and collect opinions and suggestions for their work, which can also help students to continuous optimisations of the work.

4. Didactic Experiment: A Trial of Multiple Disciplines Method

As an experiment in interdisciplinary design education, a case study relevant to this paper was carried out at Sichuan Fine Arts Institute (Dec. 2020). The study, which lasted four weeks, focused on fourth-year students majoring in jewellery design (25 in total). The students in the fourth year have taken professional design courses and practical operation technique. In China, sensory design has not taken into every course in university and meanwhile, according to the feedback from the fourth-year students, the concept of sensory design is usually completely new for them. The experiment aimed to examine the students' acceptance of the concept of sensory design relating to design. In the meantime, it also aimed to analyse the difficulties encountered in the students' expression, providing some suggestions for interdisciplinary didactic methods.

The experiment was carried out in the course, namely Contemporary Jewellery Art. The course aims to explore innovations in jewellery based on the materials chosen by the students, exploring new ideas and craftsmanship. The artwork is an essential element in design education, and it also involves two critical elements: materials and crafts, which are also essential to consider as designers. Therefore, starting from the “Material” part as the first stage helps students complete the design.

The didactic activity was completed stage one and two tasks in the first two weeks, stage two tasks in the third week, and the fourth week's final stage, the experiment flow (Figure 2) and the details of the progress of the experiment (Table 1).

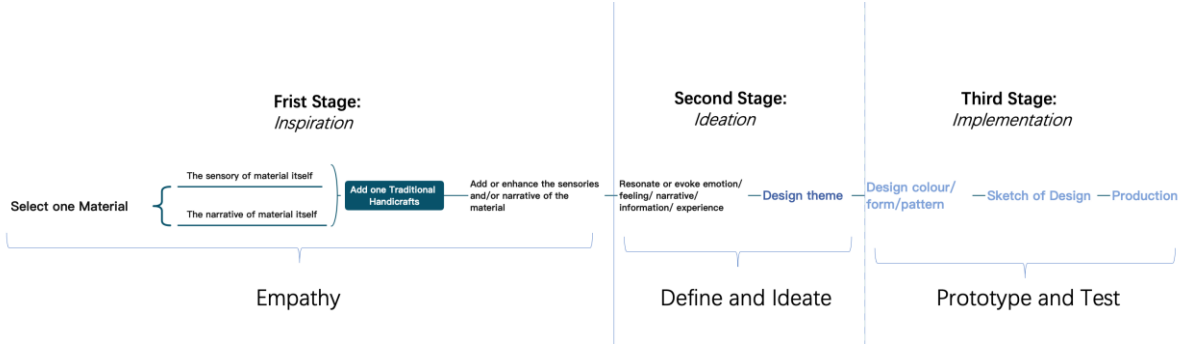

Figure 2: Experiment Flow
Source: Compiled by the research

Table 1.
Proceeding of the Experiment, Tasks and Questions

Part of Model	Task	Specific Questions	Proceeding	Stage
Material	Choose one material (metal or non-metal) to create ten pieces.	1. What material are you select? 2. What kind of particular qualities does the material have? 3. What kind of sensory does the material have? 4. What kind of particular context does the material invokes?	1. The students gain a deeper understanding of the material by analyzing what senses or sensory experience the material has. 2. The students invoke what kinds of emotion or narrative.	Stage One
Craft	1. Explore/ choose which traditional handicrafts could use with this material. 2. Create ten pieces by using material and handicrafts.	1. What kind of particular qualities do the handicrafts created or added? And what sensory experience or expression?	1. The students explore how to enrich the multisensory experience of material by using handicrafts.	Stage One
Empathy	Emotional Expression	1. What senses or sensory do you want to invoke? 2. What information or narrative do you want to invoke?	1. Formulating specific scenes to let the students frame their emotional feelings. 2. The students explore what kind of emotion or affection evoked by sensory experience.	Stage One
Ideation	Define the Design theme or concept	1. How the material itself comes with narrative, cultural and contextual association? (formed or manipulated)	1. The students define the theme or concept of the design and do further research.	Stage Two
Production	Design Visualization and Production	1. Do you want to invoke people's emotion? 2. Do you want people to have an understanding of the making experience? 3. How can you transmit the information, sensory experience, story, narrative etc. to others? a) Where are you going to display your work? b) Who is your viewer or audience? (age, background, nations, experiences, etc.)	1. Visualizing the concept, the students should consider three visual elements: colours, forms, texture. 2. The students should present their work by hand drawing and mention the size, colour, pattern, and material and handicrafts they choose. 3. The students have to finish the work according to the design draft, experience the sensory and make necessary modifications. 4. The students explore how being able to "read" and "construct" handicrafts and material narratives transmit design information to audiences and consider how to display the works to transmits the information of the works.	Stage Three

Source: Compiled by the research

Here below there is a summary of five students' work (Tab.2): three students are dedicated to the non-metal material, and the other two are dedicated to the metal material, along with the crafts they selected.

Table 2.
Students' work with Metal and Non-metal materials

Student	Material	Handicraft	Design work
1	Common Pistache	Pokerwork	
2	Foam	Cameo	
3	Hair (Chinese Brush)	Jie Tou (One part of making process of Chinese Brush)	
4	Copper	Enamel	
5	Copper	Crinkle Burning Process	

Source: Compiled by the research

5. Results and Discussion

5.1. Analysis of the Inspiration of the Questions of the Sensory Design to Students

Material

Student 2 chose foam as material, to create ten pieces with glue. The foam surface is corroded by the glue in varying degrees, bringing a visual sense of erosion to the student, while touch gives the student a sense of disgust (Figure 3). All the senses trigger an association with the decay of food. The dark green colour of the foam, coupled with the eroded surface texture, creates an association from the visual, tactile to smell. This process of sensory experience finally prompts an emotion for the student: disgust.

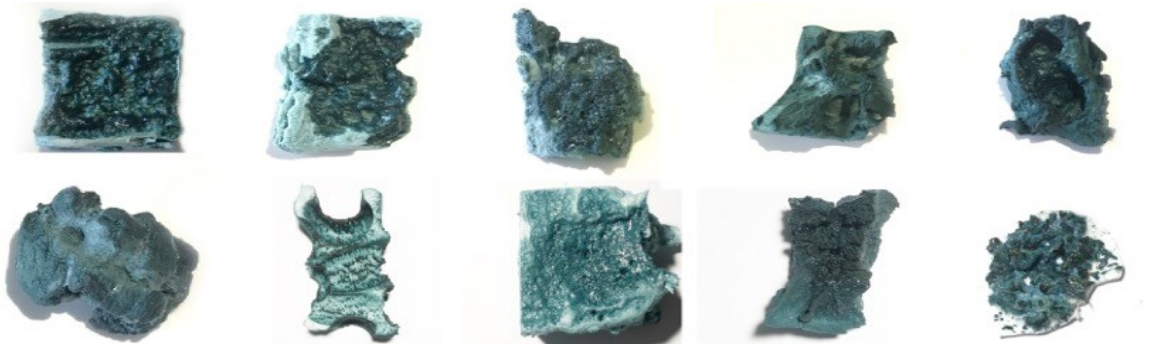

Figure 3: Material Experiment by Student 2
Source: Compiled by the research

Student 3 analysed the different materials of Chinese Brush to explore the tactile. Meanwhile, the various visual effects of the ink paintings present by using different Chinese Brush create more tactile (Figure 4).

Figure 4: Material Experiment by Student 3
Source: Compiled by the research

Handicrafts

Student 5 chose the Crinkle Burning Process as an handicraft for further exploration and completed ten pieces. The student had already found a sense of the wound through the earlier ten pieces (Figure 5), and in the second production, the Crinkle Burning Process intensified the sensory experience and emotional expression of the wound (Figure 6).

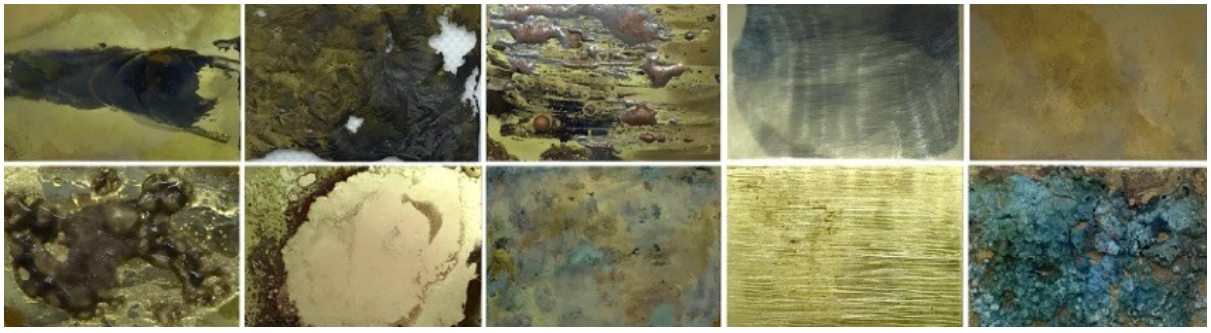

Figure 5: Material Experiment – Earlier Ten Pieces
Source: Compiled by the research

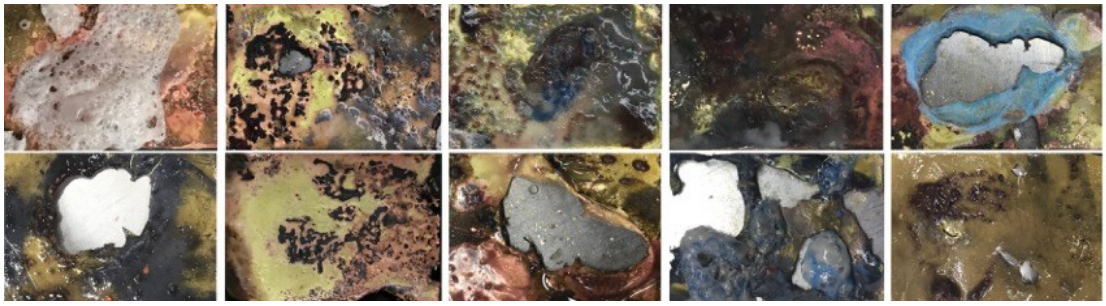

Figure 6: Experiment – Material and Handicraft
Source: Compiled by the research

5.2. Analysis the Problems of the Experiment

However, the more significant problem of the production section is that students' designs cannot make or complete by themselves (Fig.7). It also reflects the real problem that most students only design on paper (Sketch) and ignore the craft's support. Hence, two current issues are raised:

a) In design education, universities have attached great importance to practical courses, but students are not appropriately treated. They think as a designer only need to draw for their design on paper.

b) Students' coursework or graduation work is mostly done by a factory or a master, keeping their design content and thought, due to their skills cannot support them to complete the production independently.

Therefore, practical courses are essential in helping students advance and refine their designs and ultimately realise the design.

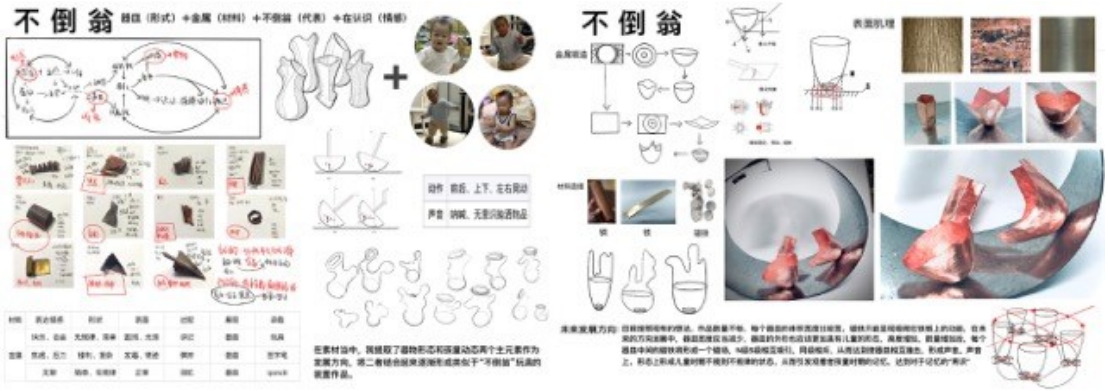

Figure 7: The problem between making and design
Source: Compiled by the research

6. Summary

Following the study, we conducted a group discussion and addressed several points that might produce suggestions for such an interdisciplinary method in education.

(1) Students are likely to choose familiar materials, such as copper and fabric, but they said it is not easy to manage or make innovative designs. However, through the consideration of guiding questions, they were able to gain a new understanding of materials, experimented with them and discovered other properties of materials to generated innovative ideas on raw materials.

(2) They are also more likely to choose an easy handicraft to reduce expression difficulty rather than the most appropriate handicrafts. However, by choosing any handicrafts to combine with previous materials, the students discovered more possibilities of materials and handicrafts that break away from their inherent cognition. Therefore, sensory design-related questions help students to carry out breakthrough thinking and create a new understanding of what they thought. More importantly, most of the students reflected that they have difficulty completing their final design work independently.

(3) Meanwhile, students also gave some feedback that they had not thought and researched in this way before, nor had they established such an in-depth design theme or concept. They used to limit the form of their designs by simple concept or theme. In the experiment, the students are guided to think and explore the materials' characteristics and properties through the sensory experience and the coordination and interaction between the senses, that is, synesthesia, to enrich the students' senses and carry out related thinking. Students are guided to find relevant narrative content from these sensory experiences, such as stories and events, and then analysing specific emotions. Finally, the emotions are expressed through one or more sensory forms.

(4) The students are guided through the sensory-guided questions in the whole workshop. Visual is an engaging and intuitive experience, but tactile expressions and experiences are the sensory experiences that convey more information, following by the sense of smell.

(5) Students, as designers, play a role in integrating information throughout the design process and finding the right way to transmit the expression of the message. It is vital to convey effective content, emotions and design themes to the audience in a resonant way.

7. Conclusion

The research emphasises how the interdisciplinary teaching method of design thinking and sensory design has been applied in design education, especially combined with a basic design to establish and cultivate the foundational skills of future designers. The experiment of sensory design in the course also received positive feedback. The sensory design could be more effective and play an essential role in educating designers, especially combined with other disciplines to integrate into the designer's higher education. As shown in the experiment, the didactic method that combined design thinking and sensory design helps and guides teachers in designing and optimising the curriculum to make courses innovative and meet the current needs of society and the learning situation of students. Meanwhile, it also facilitates students' the assimilation of complex concepts, enhancing their innovation ability. The research can serve as a reference for applying sensory design in design education as well as a case study for interdisciplinary teaching methods.

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