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Creative Exploration through Idea Sketches in the Product Design Process: A Case of the Designers Highly Skilled in Digital Technologies

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Abstract

For developing the creativity support system, to understand human creative activity is crucial. In the field of product design, current designers aimed at creating novel user experiences have been recently prevalent for designers to generate ideas rather than determine user needs. Therefore, dialogues between the designers and users tend to be valued in gathering user requirements. This research aims to investigate the designer's exploration by interpretation of idea sketches by reflection. Three cases are discussed: the designer tried to create awareness on how designers can understand the users' real requirements through dialogue, to find inexplicit requirements of the users, and to generate the images from the users' denial comments. To investigate idea generation processes, a designer investigated their own sketches and determined key points of detecting the users' real requirements. This paper also discusses the influence of digital design technologies from the perspective of creativity.

Keywords: design process, creativity, product design, idea sketches, reflection method

1 Introduction

In recent decades, creativity support systems have made remarkable progress. Accordingly, research discussions have accumulated at important conferences (e.g., KICSS, ACM C&C, DCC, and others) to gain knowledge on how to support human creativity. Design creativity is one of the subjects of discussion. So far, a system to support divergent thinking was proposed which was also effective to the designers [1]. Also, cognitive features of the designers and systems to support the, at the initial stage of the conceptual product design were proposed [2, 3]. Those previous studies showed valuable suggestions and applicability for considering effective support systems or tools for enhancing creativity of the product designers. Besides, the recent product design has been tended more digitized and its conceptual stage has been tended more user oriented by a business development of internet services [4]. It is important to discuss the recent product designers' process which was shifted in the upcoming digital era, especially for considering more functional computational support systems for them.

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2 Trends in Studying Creativity in the Design Process

User experience design (UXD) has been a popular method used in creating valuable products in markets [5]. However, it is still an uncertain method in forming a product design process methodology. Experience is a practical event in the human mind, usually expressed as impressions. Therefore, a system that captures user impressions provides advantages in the design process. The Semantic Differential Method (SDM) is a useful method to capture such impressions [6].

However, to capture impressions before the real experience is difficult by using SDM or any other method, because these methods gather data by comparing different product design prototypes. In other words, they are only available post-design and do not work in the early stages of prototype design. Moreover, capturing data by these methods requires much time. Since the recent trends emphasize faster processes, the agile process is more widely applied to determine appropriate user experiences. Design thinking is an agile process applied to understand the inexplicit needs of users. A quick cycle of creating prototypes and user testing comprises a core part of this process [7]. Such rapid prototyping is remarkably effective in creating a faster design cycle with user feedback.

The transition from conventional design to UXD demonstrates the switch in design requirements, from explicit to implicit. In other words, to demonstrate the design characteristics that can find "creative solutions" to requirements, one must "discover problems" to discover latent requirements. "Problem discovery" requires a deep understanding of users and noticing their latent demands. Therefore, communication with users is critical in the design process. User-involved design effectively achieves such communication.

On the other hand, the perspective of creativity advocates for strengthening product design processes that make use of the designer's imagination rather than rendering the designer a translator of the user's mind. That is, to be more creative, the design process must be optimally composed and driven by the designer. Previous studies have reported that it is effective for designers to empathize with users to explore their latent needs. In this process, design sketches support the designer's thinking process [8]. Traditionally, design sketches have been a major part of the product design process, especially in industrial design education schemes, because it was believed that creative design solutions could be found by "thinking while drawing." Hence, drawing various design sketches was expected to enhance design ability. Previous studies have provided knowledge about the design process obtained through investigations of traditional designers.

Most importantly, digital technology has changed the traditional way of thinking about the design process. Clearly, digital technologies have contributed to efficiency in the design process; however, its effects on creativity have not been adequately discussed in the literature. Particularly, digitization has changed the points at which sketches are the most effective in the design process.

3 Aim and Methods

This paper presents a series of case studies aimed at investigating the creative process of design, focusing on accomplished designers highly skilled in digital technologies. We applied a self-

survey method comprising the reflections of the author who extended the "personnel survey," and observations of the co-author [8]. We consider this method effective for a detailed investigation and for studying creativity including inner motivation [9]. However, objectivity is not guaranteed in self-survey methods such as reflection. To address this problem, we also applied the observation method by another researcher to validate the designer's reflections. In addition, from a creativity point of view, it is necessary to identify the essential function of the hand-drawn sketch in a design process that has digital technology at its core. Therefore, the designer's considerations provide meaningful information compared to previous studies that obtained data from inexperienced design students.

When we consider the design process as a creative technique, we infer that people have different affinities with digital technology. This research particularly targets advanced users who can use digital technology as a tool. This restriction enables us to discuss the stage at which digital technology contributes to creativity in the design process as "an extension of the body." The object of the reflections and observations comprises a series of notes and sketches rendered during the design process. In addition, we also referred to the data of modeling by digital design as applied by the same designer (co-author).

4 Characteristics of the Design Process

To create an innovative product, a step-by-step design process is applied from idea generation to production. As explained above, creating as many concept sketches as possible in the first stages of product design has traditionally been described as a fundamental process in design education. When creating concept sketches, professional designers (or design students) must learn to understand user requirements as well as applicability, functionality, value, and form.

However, the latest digital technologies have enabled designers to think about applicability, function, value, and form while modeling. Thus, they no longer must represent the detailed product form on sketches. Hence, concept sketches have become increasingly important as a medium for expressing the essence of the dialogue between designers and users, rather than the shaping. Figure 1 shows two types of design processes. The former is a traditional process, and the latter is a highly digitized design process. This study focuses on the importance of sketching in the latter with the hypothesis that technology can help shift the process from the former to the latter to allow the human effort to focus on more important creative points. In fact, some designers who heavily apply digital technologies in their process do not create hand-drawn sketches and conduct this important step in their minds.

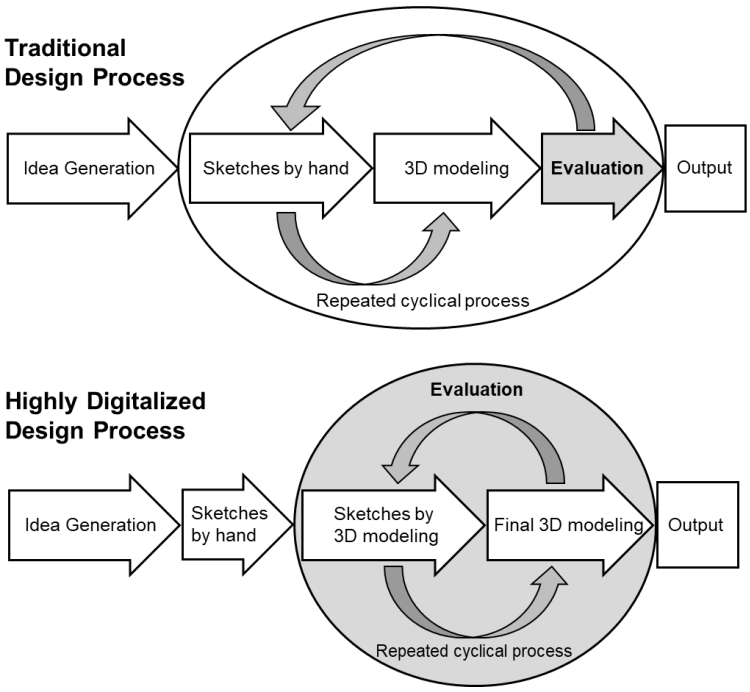

Figure 1: Design processes: applied by a traditional designer and by a designer highly skilled in digital technologies

5 Design Cases

We used three cases of product design designed by one of the authors to investigate the features of the design process applied by a designer highly-skilled in digital technologies. Each case is explained with a focus on the role of sketches to enhance creativity in the ideation stage. Through the integration of identified issues among the sketches of the three cases, we discuss the meaning of digital technologies for human creativity in the final section of this paper. Time line of the three design cases is shown in Tabe 1. These three cases are the most recent examples of the subject designers' work, and thus were judged to be suitable for reflection because the designers' memories of the design were vivid and detailed.

Project	Project period	Time of Sketch	Time of 1st reflection	Time of 2nd reflection
Design Case 1	April 2017 - November 2019	April 2018	June 2021	April 2022
Design Case 2	July 2019 - March 2020	September 2019	February 2022	On Going
Design Case 3	February 2020 - June 2020	April 2020	May 2022	On Going

Table 1: Timeline of the three design cases

5.1 Design Case 1: Healthcare UXD

The first case is a UXD case for a healthcare product that eagers to make confirmability of the user. Product design in healthcare particularly requires designers to be aware of latent user demands. In particular, one of the products expected in the healthcare field is useful for QoL. This design case addresses the problem of urinary leakage. The number of people affected by prostate cancer is increasing in Japan. Furthermore, this disease is difficult to detect, as the patients show no symptoms in its early stages. However, post-operative urinary incontinence has been reported. In many cases, the patients recover to a level that does not interfere with their daily lives in about three months. However, in rare cases, recovery is delayed, and some patients suffer from urinary incontinence for a long time. These patients must always carry a large number of diapers when going out, which affects their quality of life.

We carried out this design case starting in April 2017. By listening to users' explicit requests, presenting the design draft shown in Figure 2, listening to their unpleasant experiences, and empathizing with them, we started designing healthcare goods based on the quality of life (QoL) problems shared. Figure 3 shows the design solution sketches based on the dialogues among the participating users, designers, doctors, and healthcare goods companies. As shown in Figure 3, the detailed form was finalized, and the product design was released to the medical design market in November 2019. Number of the sketches by the designer on Design Case 1 was 46, each of them was confirmed by the designer at the reflection session. On the reflection session, the marked part was paid attention by the designer, to understand the meanings or reasons of the idea. (see Figure 2)

Figure 2: Sketches of Design Case 1

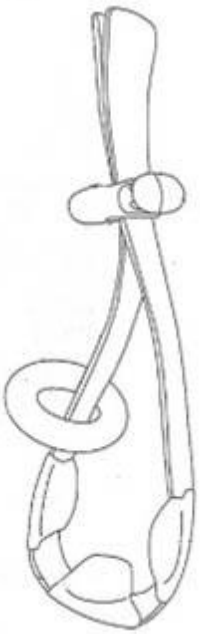

Figure 3: Final sketch

5.2 Design Case 2: A Sensor Device to Be Used in Healthcare

Various sensors have been developed to catch signals generated by the human body and prevent diseases. gases generated by stress with high-performance sensors. We are still in the development stages and aiming for commercialization. Figure 4 shows some of the initial sketches in the sensor design process. Figure 5 shows a prototype of the working model.

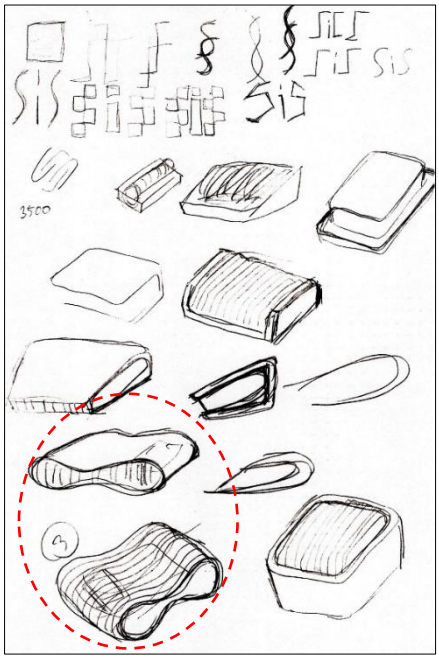

Figure 4: Sketch of Sensors for healthcare

Figure 5: Prototype of healthcare model

The designer reflected own idea generation process by checking the sketches (February 2022). While the designer had made idea sketches with taking a note during the dialogue with a client to imagine the scenes of the users who might be laying down on a bed in a group home for senior people, the designer didn't need to make exact shapes of it on sketches. Namely, rough sketches were more effective to support creative exploration rather than the precise sketches likely a visual model representation. Number of the sketches by the designer on Design Case 2 was 37, each of them was confirmed by the designer at the reflection session. On the reflection session, the marked part were paid attention by the designer, to understand the meanings or reasons of the idea. (see Figure 4) The designer considered the environment in which the product would be placed from the rough sketch, selected a soft shape that would not cause discomfort in the environment, and then created several qualified shape patterns in digital space, from which the final product shape was generated.

5.3 Design Case 3: Smell Sensor for a Factory

The third product design case is that of a sensor device for a factory, which requires designing for use by multiple people in a more public space. Figure 6 show sketches of the designer for finding a reasonable model for such a public situation. Sketches were made in April 2020. Figure 7 shows a prototype of the working model.

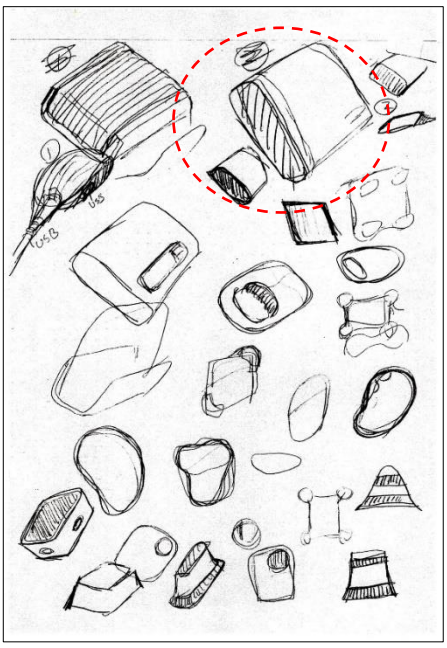

Figure 6: Sketch of model for factory

Figure 7: Prototype of factory model

The designer recognized how to get a hint of strategy of the product design for this unclear requirement at the reflection session which was conducted from February to May 2022. The features of the users requirement are expressed in their denial comments; such as "NOT too showy ", "NOT pressure" "NOT old-fashioned but NOT too simple" and so on. The designer realized when designing that each comment didn't address any concrete goals but they suggested a similar tendency of qualitative direction. "While those denial expressions were uncertain, they led the designer's exploration process more complex at the conceptual level" was a abtaled reflection by the designer. Number of the sketches by the designer on Design Case 3 was 41, each of them was confirmed by the designer at the reflection session. On the reflection session, the marked part were paid attention by the designer, to understand the meanings or reasons of the idea. (see Figure 6) In this case, the designer selected a shape from the rough sketches that was compatible with the environment in which the device would be installed, the size of the built-in sensor, and the conditions of use. Based on the selected basic shape, detailed shapes with different shapes were repeatedly created in digital space, and the shape that best met the conditions was selected.

6 Discussion and Findings (Conclusion)

6.1 Integrated Knowledge from the Three Design Cases

Our previous study aimed to promote awareness of the co-creation process within the framework of UXD and conducted practical research to grasp the structure of awareness cited in Case 1 of this paper. Based on our previous study, in this study, we planned a series of design process cases to discuss the meaning of sketches as represented in Figure 1.

We confirmed how the value of sketches changed in the design process as hypothesized: A designer highly skilled in digital technologies does not need to make hand-drawn sketches as done in the traditional design process for shaping products or determining functions and values; however, they make rough sketches and take notes while in dialogue with users or clients. Although the time spent making hand-drawn sketches is reduced, the sketches showed the initial points for exploring the process to reach a goal of product image by a designer.

We mentioned that "concept sketches are becoming increasingly important as a medium for expressing the essence of the dialogue between designers and users, rather than the shaping"; however, the reflections by the designer of this study attributes another meaning to sketches as a medium of a dialogue with the users. The hand-drawn sketches are essential in the exploration stages of the design process. Therefore, this study claims that "a minimal and the most creative process of product design is the designer's own exploration process," which is essential and demonstrated by hand-drawn sketches.

Other two cases provided another meaning of idea sketches, more enhancing the designer's creative exploration to identify the valuable design ideas, because the users' requirements were uncertain. Notably, the designer recognized such enhancement at the reflection session which was the post design process.

6.2 Fun in the Design Process

We hypothesized that the functions of hand-drawn sketches have changed given a more digitized design process. We verified this hypothesis based on case reports of processes collected from practicing designers. Furthermore, the designers' reflections confirmed that, in the traditional product design process, paper and pen are the extensions of only the designer's hand. It was an easy method but a confusing process to use the same media of paper for realization and exploration. In contrast, in the case of digitized design processes, the digital tools serve as the extension of the designer's body, which is a super hand which is beyond a limitation of a movement of handling. Furthermore, the results demonstrated that the hand-drawn content is more focused on the designer's own exploration process. As such, both extend the body in a different sense, "the super hand" and "view for oneself," and each, independently, allows for deeper immersion, bringing fun and joy to the design process.

In the design process, it is important that each designer uses the tools and methods that suit their characteristics and tastes. Especially in an age when digital design is flourishing, this study's findings demonstrate that it would not be appropriate to position sketches in the design process in a traditional way of thinking. The knowledge obtained from this research will be useful for the future development of technologies for supporting creative activities employed in the design process.

6.3 Effectiveness and Prospects of the Digital Design Process

The digital tool used by the subject designers was 3D CAD software from Ashlar Vellum. This tool has an intuitive interface that sensitively translates the designer's intentions into shape.

This study discusses the specificity and usefulness of the tool in replacing some of the hand-drawn sketches in the digital space. The further back in the design process, the more difficult it becomes to revise, but this case study proved that waste due to backtracking can be greatly reduced if revisions are made in a digital space. In order for this digital process to spread in the future, further development of digital tools and ingenuity on the part of designers themselves will be necessary. We hope that this study will be of some help in this regard.

References

[1] Kobkrit Viriyayudhacorn, Susumu Kunifuji, Mizuhito Ogawa, A comparison of four association Engines in divergent thinking Support system on Wikipedia, KICSS 2010 - Proceedings of The Fifth International Conference on Knowledge, Information and Creativity Support Systems, 2010

[2] Yukari Nagai, Deny W. Junaidy, Empowering cognitive fixedness, Proceedings of the 9th ACM Conference on Creativity & Cognition, pp291-294, 2013

[3] Julia Kantorovitch, Ilkka Niskanen, Anastasios Zafeiropoulos, Aggelos Liapis, Jose Miguel Garrido Gonzalez, Alexandros Didaskalou & Enrico Motta, Knowledge Extraction and Annotation Tools to Support Creativity at the Initial Stage of Product Design: Requirements and Assessment, KICSS 2016 - Proceedings of The Fifth International Conference on Knowledge, Information and Creativity Support Systems, 2016

[4] KQ Anh, Yukari Nagai, LM Nguyen , Extracting customer reviews from online shopping and its perspective on product design, Vietnam Journal of Computer ScienceVol. 06, No. 01, pp. 43-56, 2019

[5] Norman, D. A., Emotional Design: why we love (or hate) everyday things. Basic Books, New York, 2004

[6] Shang H Hsu, Ming C Chuang, Chien C Chang, A semantic differential study of designers' and users' product form perception, International Journal of Industrial Ergonomics, 25(4), 375-391, 2000

[7] Yukari Nagai, Critical issues of advanced design thinking: Scheme of synthesis, realm of out-frame, motive of inner sense, and resonance to future society, Creativity, Design Thinking and Interdisciplinarity pp 115–13, Springer, 2017

[8] Authors, Yukari Nagai, Kodaka Yasuyuki, Research on designer's awareness in the co-creation process, JCS 2020-Proceedings of The 42th Conference on Japan Creativity Society, 2020

[9] Yukari Nagai, Toshiharu Taur, Koutaro Sano, Research Methodology for the Internal Observation of Design Thinking through the Creative Self-formation Process, Design Creativity 2010, pp 215–222, Springer, 2010