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Optimizing sources of inspiration for innovation: a case study in concept generation process

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Abstract: The conceptual distance between the inspiration source and the design subject affects the performance of idea generation. Despite many studies about the significance of distant or near sources of inspiration to boost design creativity, which source of inspiration plays a greater role remains unclear. This paper explores the benefit of incorporating both distant and near sources of inspiration in concept generation in a design studio context. An idea-generation process is implemented in a third-year industrial design studio for three years. The project outcome indicates a potential advantage in guiding students to collect and organize diverse inspirational sources to improve their design productivity and quality. While the distant source of inspiration advocates the ideas' novelty and originality, the near source of inspiration supports design quality and details in further development.

Keywords: passion; inspiration; concept generation; creativity

1. Introduction

The designer's creative process of generating ideas is a domain filled with research studies in the design community. In the process of ideation, designers usually do not generate new designs completely from scratch. Instead, they learn from existing designs, integrate and transform multiple elements into something new (Jasson & Smith, 1991) (Marsh, Ward, & Landau, 1999). As an effective way to spark innovation, "different sources of inspiration have been a focus on the study for years about the relevance between the inspiration source and the productivity of idea generation" (Eckert & Stacey, 1998). Researchers try to identify which type of sources that impact the idea generation process in a greater positive way (Chan, Dow, & Schunn, 2015). Inspirations are generally categorized into two sources: "incidental knowledge from daily experiences, and intentional learning in a particular domain" (Purcell & Gero, 1996). Both sources of inspiration play a role in the designers' creative process. Forms of inspiration is another matter being investigated. While inspirations can take many forms such as texts, audios, tactile senses, sketches, diagrams, works of art, designers tend to work

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better with visual forms (Keller, Pasman, & Stappers, 2006) (Cheng, Megge, & Schoormans, 2014). While research has shown that rich visual inspirations enable designers to create more original designs than lacking supplementary sources of inspiration (Goldschmidt & Smolkov, 2006), “inspirational texts also improve the quality of design solutions in terms of originality” (Goldschmidt & Sever, 2011).

1.1 Near and Distant Sources of Inspiration

Conceptual distance is a term to describe how different the inspirational stimuli or analogy is from the design subject or the problem domain (Chan, Dow, & Schunn, 2015). Most sources of inspiration can be characterized as a near or distant source of inspiration. “Near or distant sources of inspiration influence the idea generation process in different ways” (Chan, Dow, & Schunn, 2015). So, which type of inspiration will likely play a greater role in the creative process? What are the best sources of inspiration for the design? Current studies show a mixed view of both sources in supporting the creative design process. Many researchers, mostly studying the role of analogy in creative problem solving, proposed that far sources of inspiration are likely to be the best source for aiding creative breakthroughs (Gentner & Markman, 1997); (Ward, 1998). Specifically, a process called “Conceptual Leap Hypothesis” is established by consistently identifying creative discoveries such as George Mestral’s invention of Velcro by analogy to burdock root seeds (Freeman & Golden, 1997). However, other recent studies show “an equivalent benefit from near and distant sources of inspiration” (Enkel & Gassmann, 2010). While distant sources were more impactful in the middle of the ideation process, “distant sources not always led to more novel ideas” (Tseng, Moss, Cagan, & Kotovsky, 2008). In some cases, research revealed that “distant sources of stimuli even caused lower novelty and quality of ideas than near sources” (Fu, et al., 2013). Other studies also propose that “conceptual distance of the inspiration sometimes does not matter, but the within-domain expertise is a primary driver of creative cognition.”. The study indicates that creative design ideas are more likely to come from relying on a predominant source (Chan, Dow, & Schunn, 2015).

Due to methodological limitations (Chan, et al., 2011), a lack of statistical power (Chiu & Shu, 2012), and substantial problem variation in different studies (Goldschmidt & Smolkov, 2006) (Liikkanen & Perttula, 2008), more empirical work is called to investigate “the functional factors of inspiration sources” (Chan, Dow, & Schunn, 2015). On the other side, for design concept generation, the supporting role of both distant and near sources of inspiration have been validated explicitly in all studies. In design education, a more relevant question is how to utilize both sources of inspirations to support and enhance students’ idea generation.

1.2 Inspiration versus Fixation

While stimuli are widely exploited as inspirational sources in the idea generation with positive outcomes, studies have also revealed that consulting existing designs may instead negatively impact the quality of the design solution. When individuals are given a solution example as a reference, they often tend to produce solutions similar to the example

provided. This effect is called “Design Fixation” (Crilly, 2015). Since Jansson and Smith’s first study, the idea of design fixation has fascinated researchers from different fields. “The interpretation of design fixation has been narrowed or broadened from its original meaning” (Youmans & Arciszewski, 2014). While narrower interpretations focus on designers’ tendency to build new concepts that conform to a shown example (Finke, 1996), “broader interpretations consider any cognitive or process interference that affects the design work” (Perttula & Sipilä, 2007).

To be more relevant to the ideation generation process in this study, fixation in design refers to “the phenomenon that designers adhere to a couple of existing ideas or concepts unconsciously” (Jansson & Smith, 1991). It is a broad phenomenon commonly seen in engineering, industrial, and architecture designs (Jansson & Smith, 1991) (Purcell & Gero, 1996). Experiments demonstrated that participants without being exposed to a solution example, tend to generate more novel ideas. The more individuals learn from the referencing examples, the smaller the number of ideas they can generate. On the other side, through studying existing examples, participants will likely improve their designs in terms of quality (Sio, Kotovsky, & Cagan, 2015). Studies also show that expert designers will likely be aware of and recognize their fixation episodes. They learn about causes and indicators of fixation which can help them to be more sensitive and “guard them against such fixation episodes in the future” (Crilly, 2015). With a respect to the fixation risk discussed in the literature, the ideation process in this study was designed to avoid or minimize the chances of fixation by delaying the introduction of near sources of inspiration to students.

1.3 Sketching Abstraction

Sketching is an essential step in the designers’ creative process. Studies approve that sketching plays a critical role not just in documenting and communicating ideas but affecting a designer’s creativity in idea generation. “In sketching, two mental processes revealed themselves as critical in the creative process: Restructuring and Combining.” (Verstijnen, Hennessey, Leeuwen, Hamel, & Goldschmidt, 1998). These two processes are imperative in the idea generation process. Design experts consciously combine and restructure their ideas to achieve high productivity and quality. In terms of sketching behavior, some expert designers tend to create simple sketches and rapidly generate a high number of sketches in the early stage of ideation. To avoid distracting designers from focusing on a few ideas, sketch rendering, perspective drawing, and high-level details should be delayed in the early stage of sketching (Linsey, et al., 2011) (Booth, Elkin, Karthik, & Tahira, 2016).

A sketching process in capturing certain characteristics of objects in an abstractive way is understood as a generic abstraction (Zhang & Norman, 1994). The study shows “generic abstraction through sketching is an effective exploration strategy that fosters creativity in design” (Dogan & Nersessiam, 2010). With an intent to enhance students’ creativity in ideation, a generic abstraction process through sketching was integrated into the ideation process in this study.

2. Method: an individual passion-driven process

With an intent to take advantage of both near and distant sources of inspiration, an idea generation process is devised to incorporate activities exploiting both sources. The course framework is shown in figure 1. Both distant and near sources of inspiration were integrated into a parallel process.

Figure 1 A concept generation process is driven by distant and near sources of inspiration.

Intentionally, the research activity was designed to tap into students' passion for design as a distant source of inspiration. Specifically, students were asked to search for things that interest them the most in design including man-made products or natural objects. These things were represented by images. Through comparing and grouping, these objects were summarized into several key attributes with visual representations. The outcome was developed into one imageboard. Then through a visual-abstraction drawing exercise, these attributes and visuals were simplified into basic sets of lines, shapes, and symbols. Based on these abstract drawings, students started their initial idea generation with an attempt to transform them into a surface or form for sitting. In terms of utilizing near sources of inspiration, a study on the same or similar product samples was included on a parallel but delayed path. Students were given opportunities to examine good design products in person. In addition to a general exploration, students were required to conduct a focused examination of products through a sketching process including perspective drawings of the whole piece as well as detailed drawings of parts of the product. Based on the learning from the literature, near sources of inspiration were planned mainly to support students in further design development. After the concept generation, both sources of inspiration were integrated into the concept development and final design execution.

To manage a project through this process with clear and visible indicators in each step, a tangible and straightforward simple product is selected as the design challenge for the experimentation. It is to design a chair with a set of criteria as following:

- A chair of the original design should be aesthetically pleasing.
- Create an offering that can be marketed to the context of residential and/or contract trade.
- Any material or combination of materials will be accepted.
- The chair should be appropriate for manufacturing, fiscally feasible, and suitable for mass production.

The generally open design requirement provided a wide space for students' ideation exercise.

3. Case study

This method was applied to the same project in an industrial design junior studio in the fall of 2017, 2018, and 2019. The class size ranges from 14 to 16 students. Since the detailed project description, learning process, and requirement remains virtually the same in three studios, the detailed narrative of the case study will not hinge on by years, but be treated as one case.

STEP 1. PERSONAL INTEREST EXPLORATION.

Students were instructed to search for their interests in design and reflect on subjects they are most passionate about. The subject is open to everything including objects, memorable experiences, enjoyed activities, and so on. Students had a week to conduct this activity. They were tasked to identify three to five key attributes in adjectives representing their interests. Then they would collect a set of visual images embodying these attributes, compile them onto an imageboard. Their board should be structured by the attributes. Figure 2 shows three samples of students' exercise. The theme of the board a. is power. Primary attributes are sharply rising, high contrast, aggressive and angular. The image collection covers a wide range of things from movie characters to architectures. The theme of the board b. is music. This student plays drums in a band and loves music. His board is filled with flowing music notes in all forms. The theme of board c. is nature. Primary attributes are layered lively forms, heavy vs. light, manipulation of materials, soft vs. hard, asymmetric patterns. The board is occupied by striking natural landscapes and creatures.

Figure 2 A collection of individual's interests visualized as a distant source of inspiration.

STEP 2. VISUAL ABSTRACTION

When the board was completed, students were advised to transform the essence of their visual interests on the board into simplified abstractive forms composed of dots, lines, planes, and surfaces. This drawing exercise was limited in 15 minutes. Students were instructed to focus on the quantity but not the quality of ideas. They did not have much time to draw more details but go through a brief visual reduction process to translate visual elements into simple lines and forms. Although their drawings were minimal and abstract, most of them captured the essence of visual elements successfully. As shown in figure 3, simple lines and curves were mostly seen in drawings. Figure 3 shows two sample drawing collections. Drawings on board a. are done by the student inspired by music as shown in figure 2. Drawings on board b. are done by the student inspired by nature. While most of the students learned and mastered this abstraction process, a few students had trouble to simplify their visuals to abstract representations. They tend to draw more detailed forms shown on their image boards. Board c. is such an example. The students' original inspirations are many animals. Images of specific animal heads, overall body, and body parts were noted in detailed sketches.

Figure 3 Examples of visual abstraction.

STEP 3. CONCEPT GENERATION

Based on their abstractive drawings, students started sketching their chair concepts. To avoid inhabitation in concept generation by a confined concept of chair analogy, the established concept of 'Chair' was replaced by 'a sitting surface' in this exercise. This exercise was also timed within 15 minutes. Again, they were instructed to focus on the quantity but not the quality of drawings. Under the influence of their inspirational drawings, in simple lines and forms, students tried to draw as many concepts as possible, but not spend much time in drawing details.

Figure 4 An example of students' initial ideation concept

STEP 4. EXPLORATION ON NEAR SOURCES OF INSPIRATION

While students were generating their initial concepts, they were led to a local Design Within Reach (DWR) showroom to study chairs and furniture. This showroom showcases about 50 well-designed chairs including some classic modern designs. Students were instructed to conduct sketching exercise onsite and drew a minimal 5 chairs from multiple perspectives.

To improve students' chair design vocabulary, analytical sketching exercise was designed into this process. Right after the field trip to DWR, students were asked to draw their most favorite 5 chairs from the memory in two different perspectives plus 3 details of each chair. This exercise was timed for 30 minutes but extended to 45 minutes. Most students faced a challenge to draw from memory with relatively high quality and accuracy.

Figure 5 Onsite study at a Design Within Reach showroom.

STEP 5. FURTHER DEVELOPMENT

After onsite study and drawing exercises, students gained more knowledge about the fundamentals of designing a chair: sizing and proportion, sitting topologies, joineries, materials, and sitting ergonomics. They were prepared to develop their concepts into final designs in terms of applying the real materials to a full-scale prototype. Through iterations of drawings and prototypes, the chair structures were modified and developed with enough strength to sustain a person up to 250 lbs. The chair designs were also finalized with real materials and finishes. By the end of the project, students were required to build a fully functional appearance prototype which will be reviewed in a jury.

Figure 6 An example of design development from initial concept sketches to the final prototype.

3.1. Design Assessment

Each year, students' works were reviewed by a panel of jurors composed of a mix of professional designers and design faculties. Studio instructors were excluded from the final review to avoid subjective views. The same review sheet was used through three years as shown in figure 5. Jurors evaluated students' designs based on 5 listed criteria: originality, aesthetic quality, functionality, craftsmanship, and feasibility for mass production. More rating details were listed in the sheet for the juror's reference.

PROJECT NAME:

CRITERIA	SCORE
ORIGINALITY A CHAIR/FURNITURE OF THE ORIGINAL DESIGN, CREATING A STRONG SOUL	
AESTHETICS QUALITY CHAIR/FURNITURE MUST BE AESTHETICALLY PLEASING	
FUNCTIONALITY SCALES, PROPORTION, SITTING ERGONOMICS	
CRAFTSMANSHIP THE QUALITY OF MAKING: APPROPRIATE PROCESS, MATERIALS, FINISHES, DETAILS	
MASS PRODUCTION FISCALLY FEASIBLE AND SUITABLE WITHIN THE CONSTRAINTS OF MASS PRODUCTION	
(1-5 RATING SCALE: 1 IS POOR, 2 IS AVERAGE, 3 IS GOOD, 4 IS EXCELLENT, 5 IS EXCEPTIONAL)	

Figure 7 Jury evaluation criteria.

Juror's review summary is shown in table 1. Based on the assessments performed by the jurors, overall, students' work's scored 4 out of 5 in originality over three years and scored 3.92 in aesthetic quality. Students who fully engaged in the concept generation path, likely created more original work comparing to the rest of the students. On the other side, a few students had a hard time to follow through the process and quickly settled on a few ideas at the beginning, likely their designs were a close interpretation or iteration of some existing chairs.

Table 1 Mean values of jury assessment based on the rating scale of 1 to 5.

Criteria	2017	2018	2019	Average
Originality	3.75	4	4.25	4
Aesthetic quality	3.25	4	4.5	3.92
Functionality	3.5	4	4	3.83
Craftsmanship	3.25	3.5	3.75	3.5
Mass production	3.25	3.5	3.5	3.41

An external evaluation was realized through a design competition. For two years, some students' designs were recommended to participate in a furniture design competition which

is a nationwide competition open to all design institutions. Both years, student's designs were recognized by the competition judges. In 2018, for the first time to participate in this competition as a school, Michael L. Dillon's chair 'ERGO' won the first place. In 2019, Dymon Johnson's chair 'LUFT' won second place. Both chairs are shown in figure 8.

Figure 8 The Furniture Design Competition winners: ERGO, the first place in 2018, LUFT, second place in 2019.

4. Observation and discussion

This process has been implemented over three years in a junior industrial design studio in the fall semester. Three years of experimentation revealed some results consistently in terms of affecting the ideation process by the distant and near source of inspiration.

4.1. Observation

Based on their reactions and performance through the process, students can be divided into three groups. The first group of students represents the majority of students. They were relaxed and immersed themselves into the process, engaged in drawing exercises in every step. They were not necessarily best sketchers and their sketches were not the best ones either. But they produced most concepts in the stage of transforming visual attributes to abstract sketching and then to the initial concepts. Their concepts were rated high in originality as well. As an example, figure 9 shows a students' process presenting a clear path from key attributes and distant inspirational images to initial concepts. The student demonstrated well in terms of abstracting the key visuals into lines and forms, then translating them into the concepts. This outcome indicated that the distant source of inspiration likely contributes to the quality and novelty of the initial concepts.

Figure 9 An example showing the concept generating path: visual interests, abstractions, concepts.

The second group was a few students in the studio. They reacted oppositely from the first group and almost completely shut themselves off from this process. They were constantly looking for a comfort stage in every step. As quickly as possible they settled down on a few concepts, and fixed on a design concept early and through the rest of the project. Their designs were evaluated low in novelty and originality. Two examples are shown in figure 10. Two students were from two different studios, but both followed through a similar process as described above. They fixed on their final design at the early stage of ideation and rejected any changes. One student's sketches were mostly a repetition of a couple of similar concepts through the process. The other student has produced a low number of sketches in design refinement once his mind fixed on one concept.

Figure 10 Two examples of design fixation.

The third group was another small cluster of students. Their reaction to the process and performance fell between the first two groups. They engaged in most activities through the process with a limitation in energy and concentration. The reasons behind this are varied. Some students were not fully engaged due to a lack of interest in the design subject. Some were not productive in personal interest exploration so they did not prepare well for the idea generation.

4.2. Discussion

Every year, a short survey was conducted at the end of the project to collect students' feedback followed by a group discussion about the survey questions and outcome. 7 questions were asked in the survey as shown in table 2. The question is rated at a scale of

1-10. 1 represents 'strongly disagree', 10 represents 'strongly agree'. On average, students recognized a positive impact on their concept generation through this process. Most of them are favorable to their performance in terms of effort and the design outcome. Key responses from students are boiled down as follows:

Table 2 The mean values of the survey result for over 3 years.

Question	Score (average over three years)
The inspiration board is effective to identify my passion for design.	8.5
The sketching abstraction process from inspiration to ideas is easy to follow.	7
This sketching abstraction process is helpful for my concept generation.	8
I am challenged in this process to find my true passion for design.	6.5
The process helps generate a large number of concepts.	9
The process helps generate novel concepts.	8.5
The focused chair study helps me to understand the chair design basics.	9

Particularly, students concur that this method helped them to generate a high quantity of concepts strategically. They are often required to generate a high number of concepts in studio projects. Due to a lack of effective approach and strategy, it is challenging for them to reach a self-satisfied quantity and quality in ideation. In this process, students appreciated and enjoyed the method of exploring their interests in design which became a noticeable stimulation to motivate them in design and provided them streams of inspiration. Some students liked the fast pace sketching based on the abstract sitting surface concept which contributed more constraint-free ideas. Both factors helped them to be liberated from a captive concept of designing a chair.

Another notable factor is that this process helped students to reflect on their true passion for design as a distant source of inspiration. The procedure of personal interest exploration allowed students to think over objects, designs, and attributes that excite them and visualize them through an analytical process. Most of the students' final designs were some forms of inspiration from this study. This process made a considerable contribution to the novelty in design ideas.

The survey result also indicates that studying near sources of inspiration is effective in supporting students' further concept development. Students' response to the survey question is consistent with the author's observation. During the design development, students' learning from the existing chairs and furniture in terms of structure, proportion, ergonomic sitting typology, etc., were naturally transformed in helping them develop their designs. Since their design concepts are already set in a clear theme, this process helped them to further refine their designs without altering their design direction or changing their original design ideas.

During the discussion, some students suggested allocating more time to concept sketching. While a majority of students enjoyed the process with better productivity and quality, students with a strong fixation during the exercise rated medium or low in the survey with less interest since it did not make a strong connection with them and brought not so much change to their normal way of design.

4.3. Limitations and Future Work

The practice of this concept generation process demonstrates that strategically managing distant and near sources of inspiration have the potential to positively impact students' creative performance. With a deeper understanding of the effects from varied sources through the process and knowledge to apply them at the right time, it will likely improve students' productivity and creativity in ideation. While the distant source of inspiration advocates the ideas' novelty and originality, the near source of inspiration supports design quality and details in further development.

This study is limited to a small number of participants (a total of 57 students over three years) and one testing design subject. The timing of introducing distant and near sources of inspiration was not carefully planned and evaluated. Due to the limited time allowed in the studio teaching context, both paths were running with a partial overlap. Near sources of inspiration might affect students' initial idea generation in some cases. While the case study over three years demonstrates a fruitful success in teaching and learning, there is a need to conduct a comparative study between this process and a conventional concept generation process to further investigate the strength and the weakness of this method. Further experimentation is called to hone in the process to be an effective teaching tool in the exploration of design concepts.

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