Thinking in Interdisciplinary Design Teams Based on Workshop

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Abstract. The era we are facing today, pushing design to the process of paradigm shift, the transformation of thinking is particularly important, so mindset shifting become an inevitable problem. In order to study the shifting of mindset, this research launched a "fair-themed" extending over 2 days' workshop. Four teams solving a service design problem in workshop have been studied, which providing us with the empirical observation of how teams change their mindset from industrial thinking to service thinking. Firstly, we find the trigger point and push point of mindset shifting, and then we examine the factors work on (spur, accelerate or delay) this process. Multiple, coordinated research methods, including spot observations, structured interviews, oral analysis were used. we would like to provide a reference for cultivating the interdisciplinary talents in the information era.

Keywords: Mindset shifting · Transformation nodes · Interaction behavior · Knowledge sharing · Boundary spanning

1 Introduction

Service Design is an emerging, new holistic, multi-disciplinary, integrative field focused on the creation of well thought through experiences using a combination of intangible and tangible mediums. Service design as a new domain, emphasizes multidisciplinary cooperation in order to make it possible to innovative and competitive co-creation, and with the characteristics of brand-new, strong integrity. It combines different methods and tools from various disciplines. It is a new way of thinking as opposed to a new stand-alone academic discipline. Service design as a practice generally results in the design of systems and processes aimed at providing a holistic service to the user. This cross-disciplinary practice combines numerous skills in design, management and process engineering [1].

Service design in essence is a kind of design thinking mindset. Industrial thinking is characterized by tangible, visible, product-related, and dominated by function and visual performance. While, service thinking is intangible, invisible, emphasizing service flow process, whole system, and putting user experience in the first place. The era we are facing today, makes the design into the process of paradigm shift, which requires designers to change design thinking from tangible to intangible. It is in essence a change of design thinking. Therefore, whether in the field of design or in the field of education, the transformation of thinking is particularly important, so mindset shifting

becomes an inevitable problem. A mindset is dynamic. It tends to expand into complexity by a widening process and shrink into simplicity by a narrowing process. Switching from one set of cognitions to another is a universal nature of human mind, although there are marked differences in the nature and extent of switching as a function of, among other factors, cultural imperatives [2]. The thinking process of designers is one of the most important issues in design research [3]. The thinking activity of designers is a brain activity, which can not be directly observed and described; Trying to analysis the thinking process and mindset of designers, difficulties occur because we have no direct measures to inspect the process in the designer's brain. Besides the implicity, design thinking also has complex, fine-grained, dynamic features. This bringing huge challenges to the research of design thinking.

The creation of innovative service design often requires the exploration and integration of dynamic and diverse knowledge from multiple domains, disciplines and contexts among specialists. In the field of service design, it is widely acknowledged that design teams increasingly include participants from different domains who must explore and integrate their specialized knowledge in order to create innovative and competitive services. These participants come to the design situation with pre-existing patterns of work activities, specialized work languages. Participants' unique past experiences, specialized work language, and differences in work patterns, perceptions of quality and success, organizational priorities, and technical constraints may cause them to challenge or contest one another's contribution. This phenomenon, characterized as 'contested collaboration' [4], can lead to conflict and has a negative impact on the quality of the design process and design outcomes. Design participants need to explore and integrate these differences. Thus communication, including integration of specialized knowledge and negotiation of differences among team participants, has emerged as a fundamental component of the design process. Human communication is a dynamic process in which one person consciously or unconsciously affects the cognition of another through materials or agencies in symbolic ways. The effectiveness of design communication becomes critical for designers in sharing design information, in decision-making and coordinating design tasks. The necessity of communication is based on the possibility of different cognition of representations by different participants as well as conveying new information [5]. Thus, good team communication can promote the transformation of design thinking. Language-based communication has been argued to play a principal role although the structuring of communication as scaffolds for knowledge construction has never been measured directly [6].

During the design process, team participants often sharing knowledge about the current (and evolving) task, service context, design context, stemming from their past knowledge. Participant's knowledge sharing behaviors (KSBs), making the experience or knowledge of one unit transmitted to the other unit. And knowledge sharing is considered as a process in which one unit is affected by the knowledge and expertise of another unit. Sharing knowledge is an important process in enhancing organizational innovativeness and performance. A research was conducted by Rivera-Vazquez et al. [13] to investigate overcoming cultural barriers for innovation and knowledge sharing [7]. To a certain extent, it will accelerate the transformation of the design thinking of the whole team and affect the final design output. The concept of knowledge sharing is getting more and more attention in the research and practice of knowledge management

[8]. Wang et al. [12] aimed to study the impact of knowledge sharing on firm performance and the mediating role of intellectual capital. Kumar and Rose [14] examined the factors that contribute to knowledge sharing behavior, Kamaşak and Bulutlar [15] explored the effects of knowledge sharing on innovation [7]. The sharing of system structure and task knowledge positively and significantly influence task performance and group performance, whereas interpersonal relationship knowledge sharing positively and significantly influences group performance.

2   Method

In this paper, our purpose is to find factors works on the mindset shifting by launching and focusing on the "fair-themed" extending over 2 days' workshop, which provided us with the empirical observation of how teams change their mindset from industrial thinking to service thinking and its influential factors (spurred, accelerated or delayed the mindset shifting process).

2.1   Participants

A total of 17 graduate students (mean age: 22.764 years, SD: 0.831, male: 5, female: 12) participated in the workshop extending over 2 days. All participants (come from different design backgrounds, including Industrial Design, Visual Communication Design, Furniture Design and Mechanical Design, Automation, etc. mainly major in industrial domain) had no service design background and were divided into four groups (g1 to g4), g1, g2, g3 each consisting of four participants, g4 five participants, and were required to design a service system based on the theme of "fairness". No participant was assigned any particular role in the task.

2.2   Procedure

The main purpose of this workshop is to find how participants and groups change their mindset from industrial thinking to service thinking, and factors accelerated or slowed this transformation process. To spur the transformation of mindset, the teacher will preach some basic features, introduce some tools and methods, and related knowledge of service design to participants. Besides, give comments on each group's design outcomes of each stage. This "fair-themed" workshop is divided into the following stages:

Stage 1, Case Finding Period: *Participants were required to find unfair cases in the field of service design.*
    Teacher A preached "individual-stakeholders-local community-society", guided participants change their design concerns from individual to stakeholders and local community, even to society and the world, take more considerations about the system and service ecosystem. Teacher B preached "product & experience & service" (PES) flow chart, intended to change participants' focus from product itself to user

experience, and then transit from user-experience centered mindset gradually to a service ecosystem that users and service providers are both satisfied. Besides, introduce brainstorming methods to participants.

Stage 2, Pain Point and Context Period: *Participants used brainstorming to make a deeper exploration, to dig out the situation and pain points behind these unfair cases. Made clear of problem scope and generated preliminary design opportunities.*

Two teachers (A+B) made comments on the outcomes of each group in stage 2. Introduce Customer Journal Map, Value Statement to participants.

Stage 3, Solution and Rank Period: *Participants took comprehensive consideration of all kinds of stakeholders, and used Customer Journal Map, proposed solutions revolve around the problem scope, and write Value Statement of solutions. Then made a comparison and rank among those various solutions and choose the optimal one.*

Two teachers made comments on the solutions of each group in stage 3. Introduce story board and business canvas methods to participants.

Stage 4, Complete and Perfect Solution Period: *Completed and perfected the selected solution, submitted the final design.*

Two teachers made comments on the final solutions of each group in stage 4.

PS: There were presentations after each stage, each group presented their periodical outcomes.

2.3 Date and Analysis

This study applies grounded theory to examine the factors involved in the process of mindset shifting. Grounded theory is emphasized that conclusion must be traced back to the original data, must be based on empirical facts. In this research we utilized data from actual workshop and participants to develop systematic theories. Firstly, we collected all the original documents (such as sketches, brainstorming maps, power point slides, etc.), and we also recorded the video of each group's presentation (there were presentations after each stage, 4 * 4 totally 16 segment videos). Secondly, we took the approach of spot observation (real time and dynamic observation of each group's design process), some findings were observed and recorded in time. Thirdly, we conducted 30 min. long structured interviews with 8 participants (each group selected 2 participants) at the end of this workshop. This 'retrospective' research aimed to examine each group's design process and mindset shifting more deeply. Examples of studies that have taken this approach include Curtis et al. [9] Peng [10]. Finally, we used "oral analysis" approach to analyze the aforementioned interview materials.

3 Results

In this study, we use the aforementioned methods to examine the process of mindset shifting and factors worked on this process in the real workshop. The members of the four teams come from different design backgrounds, mainly from industrial design, and no one from the service design background. Thus they must to break the original

industrial mindset and transform to service thinking mindset to give a satisfying service solution. After empirical observations combine with deep analysis of dates, we primarily find that all groups have successfully transformed into service design thinking mindset through this workshop. While the speed and quality of the transformation of each group is not the same. There are some factors can accelerate or slow mindset shifting process, and affect the quality of transformation, and thus affect the final design outcomes.

Figure 1 shows each groups' mindset transformation process in workshop.

GROUPS	ISLS	PES	Brainstorming	Comments	Customer Journal Map	Value Statement	Comments	Story Board	Business Canvas	Comments
G1	▶	↻	▶	▶	▶	▶	▶	▶	▶	▶
G2	▶	▶	▶	↻	▶	▶	▶	▶	▶	▶
G3	▶	▶	▶	▶	▶	▶	↻	▶	▶	▶
G4	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶

↻ Trigger point   ▶ Driving point

Fig. 1. Four groups' mindset transformation process in workshop

3.1 The Drive Point and Trigger Point of Mindset Shifting

Figure 1 shows that there are two key nodes which play an important role in the process of mindset shifting. One is "Driving point", a quantitative transformation node, which means service design mindset to be continuously strengthened while original thinking mindset to be weakened. Another is "Trigger point", a qualitative transformation node, means completely jumping out of the original mindset and growing into service mindset. Figure 1 also shows that the trigger point and driving point of each team are very different and the speed of mindset transformation is not the same.

G1's trigger point was spurred by teacher's preaching of PES flow chart (Product-Experience-Service). In case finding period, G1 mainly found product-related cases, focusing on the unfair situations caused by product itself. After the preach of PES, G1 gradually transited to service design thinking, they understood that product is one part of the service flow, is a touch point of service eco-system. Thus G1 gradually considered design problem with the system thinking. For G2 and G3, their mindset shifting was both spurred by teachers' comments. After stage 1 and stage 2, they all failed to transform their mindset to service thinking. Their mindset was still limited in the area of product design. Pain points and contexts that G2 had proposed, were all focused on the improvement or redesign of one product, falling into the black hole of product. While G2 started the transformation process after listening to teachers' comments on their outcomes of Pain point and Context period. Instead of transformation, G3 continue caught into "product" black hole until the end of stage 3, when teachers gave comments on their design solutions. G4, before case finding period, G4 participants searched the definition of service design and gathered some existed service cases, applied this definition and cases to their own design scheme in later design

process. Thus, at the beginning of this workshop, G4 already started to use service thinking to solve unfair service problems. Therefore, G4 had no clear trigger point in this work-shop. Moreover, because they were too dependent on the searched definition and cases, their mindset was framed, showing low activity. Driving Point can strengthen service design thinking and accelerate transformation process. Tools such as customer journal map and business canvas, helped participants to think design problems with service thinking.

Figure 2 shows mindset shifting process of four groups.
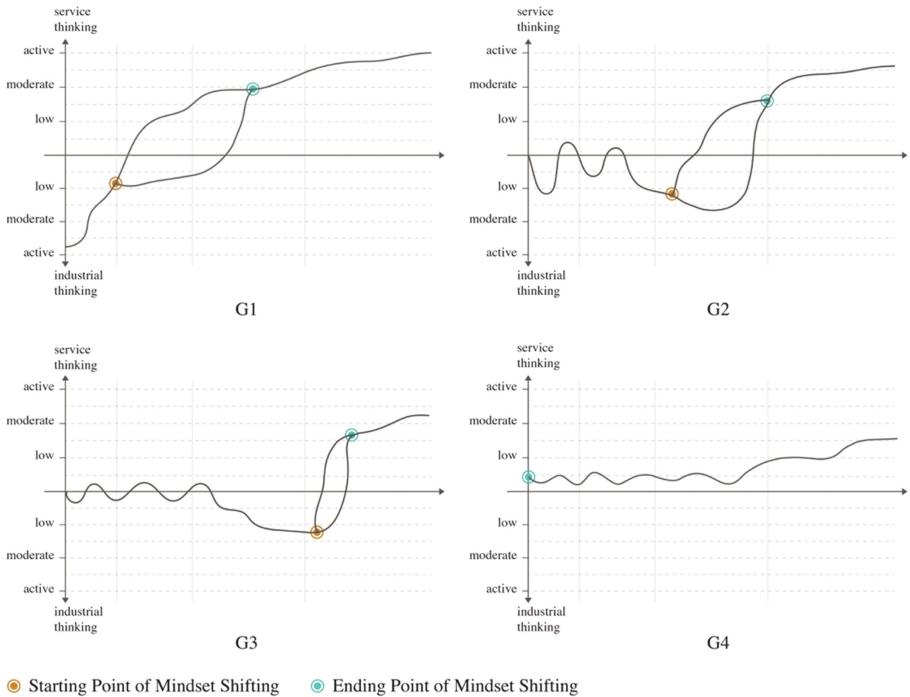
Fig. 2. Mindset shifting process of four groups

We also find that G2 and G3 both caught into the "product" black hole at the beginning, and their trigger point were all teachers' comments. There existed industrial design thinking and service design thinking at the beginning, and then completely transformed into the service design thinking. However, the trigger point of G2 is earlier than G3, and service thinking is more active than G3. What factors affect the rate and quality of transformation of thinking in the team?

3.2   Intragroup Interactions in Design Collaboration

In order to study factors that affect the speed of mindset shifting, we use oral analysis to analyze structured-interview materials, and combine with the natural observation of participants' behavior in workshop. Authors took communication and interaction behaviors among team members as the breakthrough point. Participants' unique past experiences, specialized work language, and differences in work patterns, etc. may cause them to challenge or contest one another's contribution. This phenomenon, characterized as 'contested collaboration'. Team members need to coordinate and integrate these differences across organizational, task, discipline and personal boundaries. In this coordinating process, we find that within the groups there exist 'communication conflicts' and 'coordination breakdowns'. When the communication conflict escalates to a certain extent, it will lead to coordination breakdown, which has a negative impact on the design process and the quality of design outcomes.

Communication conflicts are inevitable because team members must integrate their own different thoughts and ideas. The research of this paper is based on the theory of Amason and Sapienza, they divided conflicts into cognitive conflict and affective conflict, abbreviated as C conflict and A conflict. Cognitive conflict is task-oriented disagreement arising from differences in perspective. Affective conflict is individual-oriented disagreement arising from personal disaffection [11]. Factors influencing conflicts include communication skills of individuals, existing incentive systems, team emotional atmosphere, different representational formats, and norms for individual behavior, and mores.

We eventually dig out five typical interaction behaviors of team communication in the context of design situation. As shows in Table 1. And on the basis of Amason and Sapienza's research (C conflict and A conflict), we deeply analyze those interaction behaviors' attributes and orientations.

Table 1. Five typical interaction behavior

		A, B represent some person(s)
No-communication breakdown		
PS	Idea persuade	A attempt to change B's thoughts, attitudes, aims at letting B accept A's idea. Result usually shows that A's idea are reserved while B's discarded
IG	Idea integration	A, B integrate their own existing idea through discussion and coordination
		Result usually shows that the generation of idea (A+B)
CB	Idea co-building	A, B have no idea, but through cooperation, construct a new idea together
		Results usually shows that the generation of brand-new idea C
Appear communication breakdown		
IR	Idea ignorance	Have no interests on others' idea or proposal, A, B have no mutual interaction, develop independent
AT	Idea attack	Blindly deny other's views

Orientations: The reason behind behavior is divided into cognition-oriented or emotional-oriented.

Attributes: In order to distinguish the role of those intragroup interactions, we further analyze attributes behind them. We concluded that there are three attributes, respectively:

1. Aggressive, usually time-consuming and inefficient, such as Idea Persuade.
2. Constructive, foster productive, conducive to the creation of more good ideas, promote the design process, such as idea integration, idea co-building.
3. Conflictive, the ideas or actions of one are either resisted by or unacceptable to another. Usually leads to friction, disagreement, or discord arising within a group. Such as idea ignorance, idea attack.

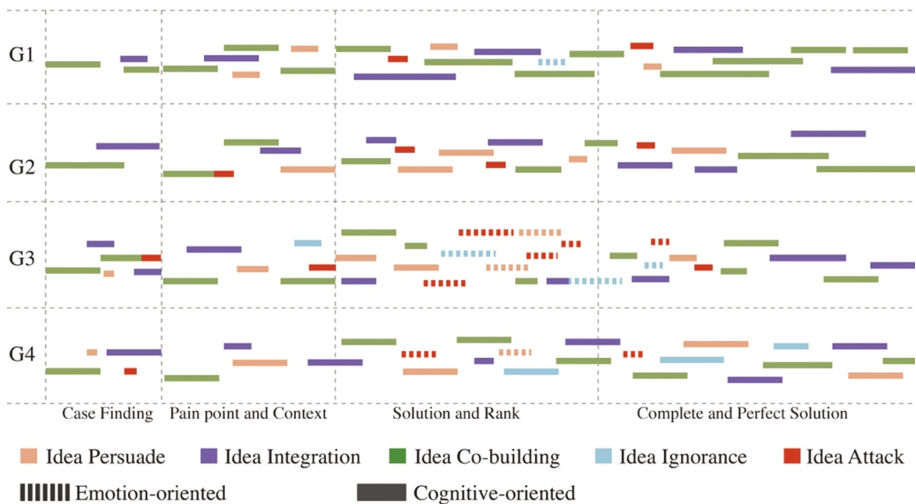Based on the time axis of the workshop, intragroup interactions of 4 groups are showed in Fig. 3.

Fig. 3. Intragroup interaction behaviors of 4 groups

Results show that the high-performance group, they have more complex interactive behavior network, and constructive behavior is always interwoven within it. Moreover, frequency and intensity of constructive behaviors were significantly better than that of ordinary groups. Besides, most of this constructive interactions are cognition-oriented, few is based on emotion.

On the contrary, interactions within ordinary group, often shows high frequency on idea persuade, idea ignorance and idea attack. Besides, intragroup communication conflicts are mainly emotional oriented. However, emotional oriented interaction often leads to lengthy and invalid arguments, and further leads to tension, confrontation, hostility and other negative emotions in group. The most typical one is G3, in stage 2, pain point and context period, team members start to appear aggressive and conflictive

interactions, but those are mainly based on cognitive orientation. While in stage 3, solution and rank period, constructive interactions are disappeared and replaced by emotional oriented aggressive and conflictive interactions (mainly idea persuade, idea attack and idea ignorance), accompanied with coordination breakdowns. This high frequency of emotional based aggressive and conflict interactions leads to bad atmosphere within group. The result is that group splits into two opposites, the two parties dispute and do not compromise.

High frequency of emotional oriented aggressive and conflictive interactions, and low frequency of cognitional oriented constructive interactions, may explain why G2's mindset shifting process is faster and better than G3. In this part, we conclude that emotional oriented interactions can hinder the shifting of mindset, and constructive interactions can improve design efficiency and influence the final design outcomes.

3.3   Knowledge Sharing

Nowadays, knowledge becomes the key component of competitive advantage and the main factor to enhance productivity and improve organizations. Knowledge sharing which may occur through formal collaboration or in informal everyday interaction. Due to the cross disciplinary nature of the service, knowledge sharing behavior is especially essential to creative outcomes. In this workshop, we also noticed that participant's knowledge sharing behaviors (KSBs), making explicit and/or implicit experiences or knowledge of one unit transmitted to the other unit, could accelerate the process of mindset shifting. Knowledge sharing as a human behavior, embedded with ideas and skills, can facilitate knowledge for innovation at workplace. Indeed, knowledge sharing is considered as a basic facilitator for knowledge management which helps in achieving organization goals.

"A little spark can cause a conflagration". In this workshop, each team's design goal is to design a service system. One members' past-existed or new-acquired knowledge, which connected to service design, transits to the other members of the team through KSBs, promoting others' understanding and absorption of service design, expanding the diversity of personal thinking. Furthermore, promoting their mindset shifting process, and eventually impacting on the whole team's mindset. In this study, we found that in high-performance group, their KSBs were significantly abundant than ordinary groups. The most typically is G1, the amount of KSBs is significantly higher than other groups. And one member of G1 has participated in a service project, her KSBs greatly promote the whole team's mindset shifting. And these frequently KSBs also improve the quality of thinking transformation.

Thus, we concluded that the more frequencies of knowledge sharing behavior and the more complex of sharing network, the faster the process of mindset shifting. While, the thin spread of application domain knowledge will inhibit the transformation of team's mindset and affect the design output.

3.4 Boundary Spanning

In this workshop, participants are asked to think outside the box of industrial design and think about the design problem with service thinking. That means participants must jump out the circle of industrial design and jump into the circle of service design. And we define this behavior as "boundary spanning". Research also shows that groups who have trans-boundary movements tend to have higher thinking activity than those who haven't. The most typical is G4, at the beginning of this workshop, G4 already started to use service thinking to solve unfair service problems. Thus this group did not go through boundary spanning, unlike other groups with multiple switching from industrial domain to service domain (or from service domain to industrial domain). G4 participants searched the definition of service design and gathered some existed service cases, applied this definition and cases to their own design scheme in later design process. However, we find that G4's mindset seems to be framed and level of thinking activity is low, the reserve strength for innovation are weak. Although G4 is the first group to complete the process of mindset shifting, while the quality of the mindset shifting is inferior to other groups.

Results from these studies positively relate high boundary spanning activity to high project performance. Groups who have gone through boundary spanning, could understand the difference between service design and industrial design more deeply, and the final design output is more inclined to service, and with higher quality. Instead, non-boundary spanning groups, their thinking activity shows inactive, and their final outputs is inferior to high-boundary spanning groups.

4 Conclusion

In this research we utilize data from actual workshop, design participants to develop systematic theories. In this "Design for fairness" workshop, 4 teams' mindset shifting process are studied. Firstly, we find that all groups have successfully transformed into service design thinking mindset through this workshop. And there are two key nodes which play an important role in the process of mindset shifting. One is "Driving point" and another is "Trigger point". Moreover, the trigger point and driving point of each team differed significantly and the speed of mindset transformation is not the same. Then we further analyze intragroup communications and interactions, dig out five typical interaction behaviors of team communication in the context of design situation, 3 attributes (aggressive, constructive, conflictive) and 2 orientations (emotion-oriented, cognition-oriented). Results show that the efficiency and effective of mindset shifting significantly are influenced by intragroup communications and interactions. High frequency of constructive interactions, low frequency of aggressive and conflictive interactions will promote the efficiency of mindset shifting. Besides, emotion-oriented interactions are negatively correlated, cognition-oriented interactions are positively with the shifting effectiveness. In this workshop, we also noticed that the more frequent knowledge sharing behavior and the more complex the sharing network, the faster the process of mindset shifting. Finally, results from these studies positively relate high boundary spanning activity to high project performance and high mindset transformation.

There are some limitations. First, as the sample size of this study consisted of only 4 groups, significant findings should be interpreted with caution. Moreover, the efficiency and effectiveness of various trigger point and driving point was not well researched and requires further study. However, our results are instructive for mindset shifting, and bear implications for training and practice in education and design related fields. We would like to provide a reference for cultivating the interdisciplinary talents in the information era.

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