Collaboration within Student Design Teams Participating in Architectural Design Competitions

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RESEARCH

This paper investigates design collaboration with reference to convergent and divergent idea generation processes in architectural design teams entering a design competition. Study of design teams offer a unique opportunity to investigate how creativity is fostered through collaborative work. While views of creativity often relate creativity to individual originality, collaboration requires different designers to work together towards one common design idea and consider as many different ideas as possible. In collaborative design, it would be easier to offer a variety of ideas but equally difficult to establish a consensus on a single idea. To investigate the role of convergent and divergent thinking in the design process, we interviewed three groups of architecture students who participated in competitions as a team. Interviews were analysed thematically to investigate how the teams overcame spatial, temporal, conceptual, and technological barriers. We conclude that the barriers and roles of members in design collaboration interact with convergent and divergent concept generation.

Key words
collaboration, architecture, design practice

Introduction

Collaboration has an important role in architectural design (Larsson, 2003) and collaborative work can enhance creativity through facilitating diversity of ideas (Fischer, 2005). Winer and Ray (1994) state that "collaboration is a process that gets people together and work together in new ways" (p.10). Furthermore, as Cuff (1991) puts it rightly so, architecture is a social practice whose artifacts are constructed "…by the hands of individual architects, their coworkers, the organisations they work within, the array of contributors from clients to consultants and their colleagues, and by larger socioeconomic forces that affect the profession" (p.13). Studies in design increasingly emphasise the role of collaborative work in design and looks into the dynamics of collaboration in design. Cuff (1991) states that "if good design is to emerge from groups, we must acknowledge the situation and learn as much as we can about it in order to work together effectively" (p.13). Creativity in design, however, is associated with individuality at the highest level. What we know about design activity stems from studies of individual designers (Cross & Cross, 1995). While views of creativity often relate creativity to individual originality, collaboration requires different designers to work together towards one common design idea and consider as many different ideas as possible.

This study investigates collaboration within student design teams participating in architectural design competitions. Competitions often have fixed deadlines, specific set of requirements, and they force members of the team to be the best among a large number of other competitors. Given the strained structure of competitions, most designers establish either short-term or long-term collaborations with other designers. Study of design teams offer a unique opportunity to investigate how creativity is fostered through collaborative work. Creativity may require exploration of a wide variety of alternatives during the conceptual phase of design before one gets fixated on a single idea. In collaborative design, one might think it would be easier to offer a variety of ideas but equally difficult to establish a consensus on a single idea.

This study focuses on two research issues. First, most of the successful projects in architectural competitions are group works. We would like to know how successful design teams work in deciding on a single design idea and in elaborating that idea. Second, we would like to investigate how design teams with different characteristics manage to maximise the number of alternatives (divergent thinking) while keeping in mind that out of these alternatives one single idea need to be followed in the subsequent phases of design (convergent thinking). Guilford (1973) describes creativity in reference to convergent and divergent thinking and he distinguishes them as follows: "Convergent thinking…is aimed toward a single correct answer. Divergent thinking is inquiring, searching around, often leading to unconventional and unexpected answers…" (p.1).

To investigate the role of convergent and divergent thinking in the design process, we interviewed three groups of architecture students who participated in competitions as a team. We interviewed the groups separately following a semi-structured interview format. Each team was interviewed with all the team members present during the semi-structured interview because we wanted to observe and understand the communication and relationships among them. In addition to interviews, we also collected all sketches, notes, and digital files from the design process.

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Creativity, convergent and divergent thinking

According to Finke et al. (1992) creativity consists of first generating novel cognitive structures, with retrieving, associating, synthesising, converting and constituting analogies, and second of exploring the creative implications of new structures, with binding findings, interpreting, deducing, altering context, and theory testing. Ashton-James and Chartand (2009) point out the importance of convergent and divergent thinking in creativity as follows: "being creative requires both convergent and divergent thinking capabilities to differing degrees depending upon the nature of the problem" (p.1036). According to Cropley (2006), creative thinking involves "generation of novelty (via divergent thinking) and evaluation of the novelty (via convergent thinking)" (p.391).

According to Ashton-James and Chartand (2009) divergent thinking is related to the capability of altering between 'mental categories' and 'perspectives'. It simplifies "wide browsing ability (thinking outside of the box) and the creation of dissimilar, freely related ideas" (Guilford, 1950, p. 1036). In contrast to divergent thinking, convergent thinking does not leave any room for ambiguity (Cropley, 2006). In creative problem solving, convergent and divergent thinking styles offer different advantages. Convergent thinking enables collaboration (Larey & Paulus, 1999), while divergent thinking supports novelty and thinking about a problem from different perspectives (Nemeth & Rogers, 1996).

As Basadur et al., (2000) state creative thinking may occur through iterations between divergent and convergent thinking. Divergent thinking enhances the search for several ways of progress and the invention of new ideas, strategies, and links. Convergent thinking process enhances the combination and improvement of ideas generated in the divergent thinking process. From divergent thinking to convergent thinking, the emphasis changes from searching to operation and trying out. Main difference between convergent and divergent thinking is that convergent thinking mostly "generates orthodoxy" and divergent thinking usually "generates variability" (Cropley, 2006, p. 391). Runco (2003) points out that divergent and convergent thinking should work together. Cropley (2006) states that "convergent thinking is a prerequisite for effective divergent thinking" (p.400) and that "divergent thinking and convergent thinking seem to add something to each other" (p.401).

For both individual designers and design teams the iterative process between divergent and convergent thinking poses difficulty. Designers sometimes fixate on an idea too early or they explore too many ideas without deciding on a single idea at a timely fashion. On one hand the exploration needs to be widened, on the other hand there needs to be focus in the exploration.

Creativity in collaboration

Fischer (2005) states the necessity of collaboration for creativity and knowledge sharing as follows: "Creativity grows out of the relationship between individuals and their work, and from the interactions between an individual and other human beings. Because complex problems require more knowledge than any single person possesses, it is necessary that all involved stakeholders participate, communicate, collaborate, and learn from each other" (p.128). Collaboration in architectural design requires collaborating designers working together to solve design problems and reach at one product.

Designers have to manage both 'when to carry out particular tasks', and 'what tasks to undertake' (Vera, Kvan, West, & Lai, 1998, p. 504) during the design process. Creativity can occur anywhere and anytime, therefore, collaborating designers have to cope with "spatial (across distance), temporal (across time), conceptual (across different communities of practice), and technological (between persons and artifacts) barriers" (Fischer, 2004, p. 152).

What is known about design activity and design processes originate from studies of individual designers (Cross & Cross, 1995). Compared to working alone, working in a team introduces different problems and possibilities for designers. Cross and Cross (1995) state that while communication is one of the major and most acknowledged problems in collaboration there are others that are as important. They list the following as other potential areas of problems in collaboration: "(1) Roles and relationships; (2) Planning and acting; (3) Information gathering and sharing; (4) Problem analysing and understanding; (5) Concept generating and adopting; and (6) Conflict avoiding and resolving" (Cross & Cross, 1995, p. 144).

Methodology

We conducted semi-structured focus interviews with three teams of architectural students who had entered design competitions (Table 1). In addition to focus interviews, we collected documents from the design process such as members' sketches, notes, digital files, and model photographs. The students were second and third year students at the time of the interviews and they had entered competitions during the previous summer. In two of the teams there were four students (Team A and B)

Table#1	Number of team members	Member #	Gender of Team Members	Grades	Competition Name	Competition Descriptions
Team A	4	1. A1 2. A2 3. A3 4. A4	F M M M	2nd 2nd 2nd 2nd	Design for Kadıköy Pier and Its Surroundings	National, Student, Idea Competition
Team B	4	1. A1 2. A2 3. A3 4. B4	M M M M	3rd 3rd 3rd 3rd	Urban Dreams 5: Re-evaluation of EGO Hangars and Its Site	National, Student, Idea Competition
Team C	3	1. A 2. B 3. C	F F M	3rd 3rd 3rd	Çuhadaroğlu 2011 Competition: "Urban Face Off Platform Idea"	National, Student, Idea Competition

Table 1. Team members and participated competitions

and the third (Team C) had three members. The first two teams had almost exactly the same composition. From the first competition to the second, only one student dropped out of the team and a new one joined the group. Students formed their teams on their own and prepared for the competitions outside of the school hours. The competitions were student competitions open to all interested students from Turkey.

We decided to interview with these teams because, first the teams had participated in the competitions recently before the interviews were conducted; second the competition projects were already completed; third the teams were constituted spontaneously; and fourth they were accessible.

The reason why we conducted interviews was because we inquired about team members' perceptions of how the collaboration worked for each team. Furthermore, we interviewed the members together following the format of focus group interview because we wanted to observe the discussion to evolve spontaneously among team members and to understand the style of communication and relationships among them. The interviews included seven questions that were open-ended. The aim of the interviews was to disclose the design process of the teams to understand their idea generation process and their consensus building. During interviews we were investigating how each team managed to widen the exploration as much as possible (divergent thinking) and how they manage to achieve a consensus on a single idea (convergent thinking). Second, we also asked the members of the teams to describe their individual performances and roles in the design process. Third, we inquired what the members would change or keep if they were going to participate in a competition again.

The interviews covered three topics: how the teams were organised, how responsibilities were shared, and how divergence and convergence were achieved. The settings of the interviews were selected as such that students would feel comfortable in an informal atmosphere. The collected additional material provided primary sources for reconstructing the design process for each team.

Results and discussion

Collaboration in the design teams

One common strategy for all the interviewed teams to overcome spatial barriers (Fischer, 2004) was to work in the same place. Teams A and B lived and worked in the same places during the whole competition. Contrary to the other teams, Team C worked in different places at the beginning, later they moved to the same place to avoid spatial barriers. One of the members of Team C stated that "in the beginnings we were working separately, at our homes. Later, we realised we couldn't communicate well and we decided to move to school. We stayed at school for a while. But in the last two days we worked in different places, because each of us knew their responsibilities'."

When working in the same place but at different times, temporal barriers (Fischer, 2004) were overcome by leaving messages or sketches on a board or paper. Information gathering and sharing (see Cross & Cross, 1995; Klein & Lu, 1989) was sustained by creating common work environments such as hanging a large size

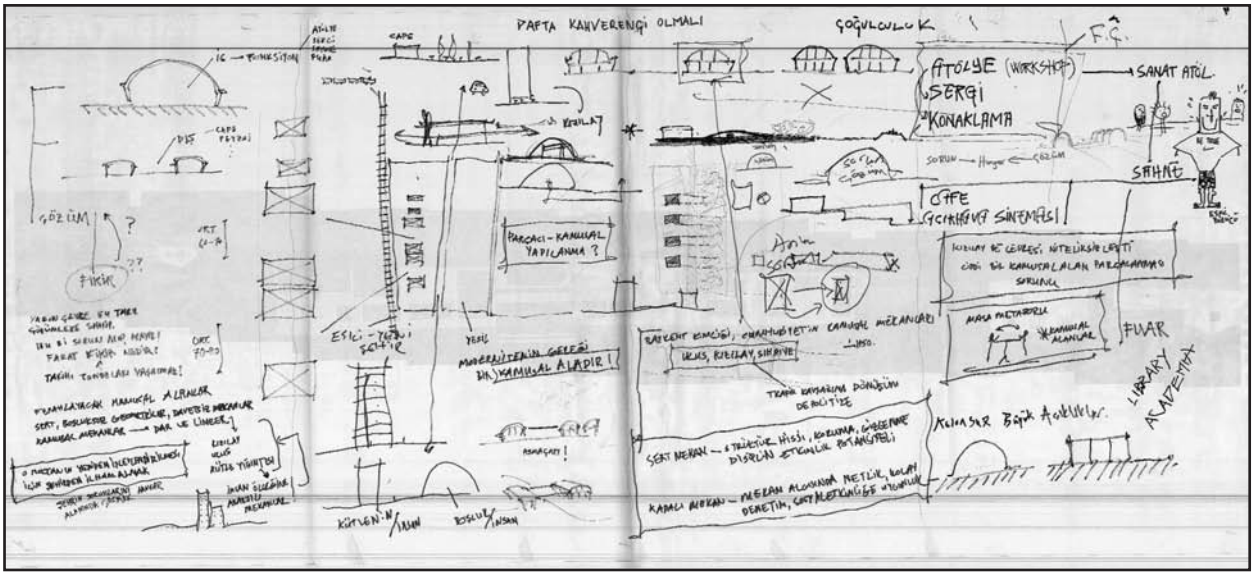

Figure 1. Shared white board facilitating idea sharing through words.
Source: Team B. (2011)

paper on a wall to write and sketch ideas (figure 1). A member of Team A stated that "we were together all the times. We had a paper hung on the wall. Every one of us was sketching or writing their ideas and thoughts on the paper". The shared big white board (figure 1) was used as a discussion board and message board. A member of Team A mentioned that "we were encouraging those who were not self-confident, and kept giving them the pencil to sketch. Anyone of us could step in while working on the sketch papers. I think, while discussing on the project, having a pencil in our hands to sketch ideas instantly was an advantage". Moreover, Team B used the board for recording all members' ideas and sketches to check until the end of the process. Team A also used a similar board but the board (figure 2) was not always hung on the wall. The board was used for concept generation and discussion. Although Team C used a logbook to share ideas, temporal barriers could not be overcome without working in the same place.

Teams used the World Wide Web and their lecturers' advises whenever they needed more information and clarification. The misunderstandings were resolved through trying out ideas by sketching design ideas.

Although the groups tried to plan their working process, they didn't specifically felt pressured to follow their plan. This made one of the teams loose time. Even when all steps were planned, there were plenty of unpredicted issues such as controversies among the members on design ideas or indecisiveness about presentation styles or insufficiency about aimed design representation methods.

Conceptual problems (Fischer, 2004) emerged repeatedly among team members in spite of attending the same architecture school and being in the same class. The teams followed a trial-and-error heuristics to cope with conceptual problems or they determined and followed what the majority of them believed in. A common member of Team A and B stated that "when we had disagreements about a design idea, I was mentioning the deficiencies or inaccurate points of the project". Each interviewed team utilised different strategies of problem analysis and definition. Although there was one design problem for each competition, each member focused and

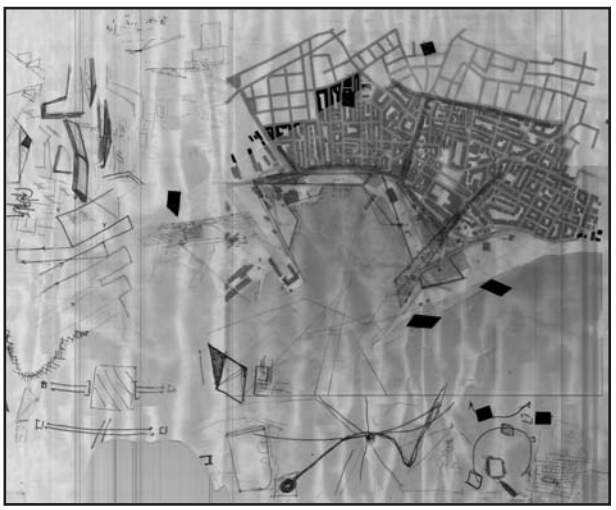

Figure 2. Shared white board facilitating idea sharing through sketches.
Source: Team A. (2011)

emphasised a different aspect of the same problem. In Team A and B, the analysis of the problem was conducted and discussed on a big white board (figure 1 and figure 2), while Team C preferred writing or sketching in a notebook, which they used more like a logbook. Even when the team members kept finding different problems of the design task description, they managed to achieve a consensus on a single solution that they kept and developed until the end.

Roles and relationships (see Cross & Cross, 1995) were shaped informally as a result of their friendship from the school environment. One of Team A members indicated that "…we realised from studio works that we can work as a group, and then we asked ourselves why we do not participate in a competition. It is important to share our ideas among us without any hesitation…" The team members shared responsibilities spontaneously according to their strengths and personalities. Those who were curious ensured diversity in idea generation and those who were punctual with time emphasised the discipline in the teamwork. One member of Team A shouldered the responsibility of making plans and following them throughout the process spontaneously. When this member dropped out of the team during a second competition, Team B encountered serious time management problems. Although conflicts are seen as a disadvantage for teams (Klein & Lu, 1989), the interviewed teams converted them into their advantages. One of the Team A and B members expressed that "…actually we did not avoid conflicts among us. To achieve a better product it is better to contradict. Even when there were conflicting ideas, we easily agreed because we were flexible. We all shared the same aim of developing ourselves and acquiring experience."

Technological barriers (Fischer, 2004) has obstructed designers' idea developments. The designers complained about their lack of knowledge and expertise in computer programs that they needed to use to represent their design ideas. One member of Team C expressed that "our skills of computer programs was inadequate, this had directed us to imagine only that which we could draw in these programs…we did not have enough time to learn them because competitions mostly give limited time to prepare and represent a design idea…"

Experience enhances fluency in creativity (Guilford, 1959). In the interviewed teams team members often shared their experiences willingly converting them into shared experiences. The atmosphere of the work made it possible to spontaneously share information and idea. In Team A two members who had already been to the competition site described the site to the others with the help of 'Google Earth'. One of them mentioned that "I like the process of creating a design idea…brain storming... I knew the design place very well; it was an advantage for the team. Billur [another team member] and I were the teller of the place. We made a presentation and described the area on Google Earth". One of the members of Team A, who had not been to the site before mentioned that "…after they described the site, I felt like I was there. They used Google Earth and we went on a sightseeing tour in the virtual environment". In this way, previous-experiences largely shaped the teams' design ideas. Previously acquired skills and expertise about design also helped the groups in ensuring fluency (Guilford, 1950). Each member undertook a role that they were already experienced in.

Convergent and divergent thinking in the design teams

The design teams tried hard to be critical of their own ideas emphasising divergence. However, when the team liked one particular idea, they were drawn to fixate on the idea too quickly. One of the members of Teams A and B expressed this as follows: "…when we found a solution for the design problem, we were too excited. We quickly fell in love with the idea; maybe we abstained from making any changes afterwards."

However, in Team B the alternating phases of convergence and divergence helped the designers. The team used a shared board that was kept until the end of the process (figure 3). The board externalised the design ideas and kept them recorded, which helped the team produce diverse ideas and find challenging solutions. The board was used as a discussion forum for analysis and programming.

In Team C, the members decided to work individually in the beginning to increase divergence. Yet, the members created almost similar design ideas because of adapting a 'grid base plate' (figure 4 and figure 5). If we compare the teams' fluencies (Guilford, 1973) to understand their creativity and the ability to produce ideas in a short time, Team C decided to work individually, but they were unsuccessful because of fixating on an inflexible design tool. Teams A and B worked together the whole time and devised a shared environment that supported the sharing and recording of a variety of ideas.

As mentioned by Cropley (2006) too little and exaggerated convergent thinking could have negative effect on creativity. Team B complained that they spent a long time with concept generation. When the team found an idea, they were already bored with spending too much

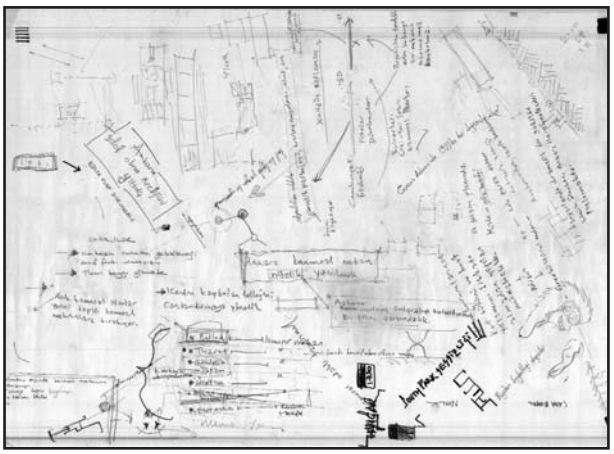

Figure 3. Shared white board
Source: Team B. (2011)

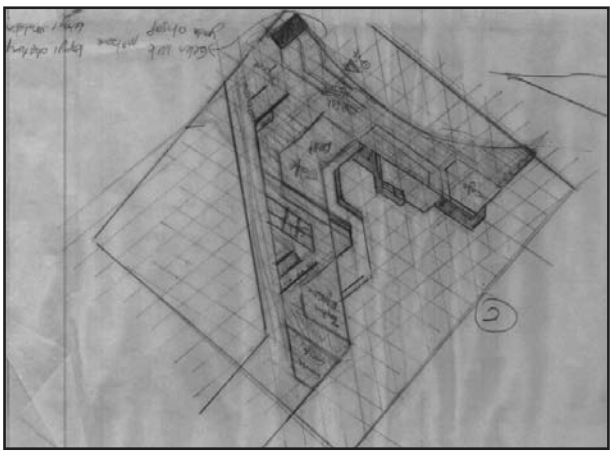

Figure 4. Grid base plate and one of the member's design. Source: Team C. (2011)

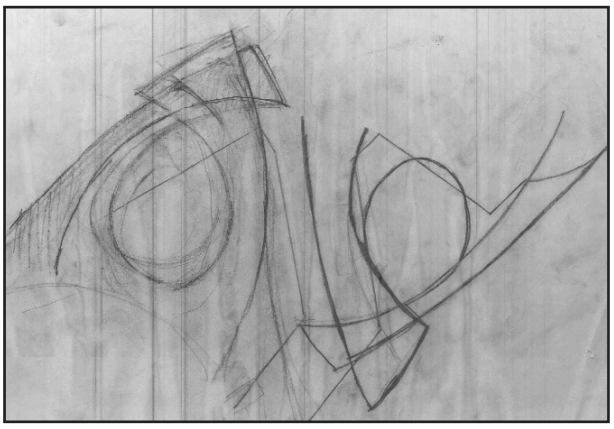

Figure 5. Final design of the team after the grid base plate removed. Source: Team C. (2011)

time on idea generation and they were not willing to develop it. However, the team members were aware of their problem and one of them explained that "…we somehow could not passed the preliminary step of literature search, reading articles etc…the design came out in a trick and we loved it, but, we could not elaborate the idea and go further…"

Curiosity (Guilford, 1973) is necessary to achieve variety in idea generation and generate novelty. One of the members highlighted specifically the importance of having a partner who was especially curious. Talking about his partner he mentioned that "He [the partner] always found interesting web pages, films, articles, pictures that we had never seen before. I don't know how he found them but I am sure his sophistication and his inquisitiveness had urged us all to start thinking differently…"

To generate a concept and adopt it (see Cross & Cross, 1995; Klein & Lu, 1989), the team members used different methods. Any of the members could take a persuasive leader role. In these situations the other members were either convinced or resistant to the idea. In some instances the teams assigned one of their members to be the "bad guy" in the group urging the others to convince him or her. Acting the 'bad guy' role might be used as a trigger for divergent idea generation process and the attempt to convince 'bad guy' might have directed the members to converge. However, one of the members of Team A stated that "actually, if I summarise the process, four of us found different problems and we solved them together."

The interviews also show that some members become dominating in the process by either constantly questioning ideas, or asking for perfectionism till the end, or imposing a personal idea on others. Questioning the design ideas often led the teams to rationalise their design ideas. All the three teams discussed each other's ideas as if they were in a jury format, which they were familiar with through their design studios. Some members were looking for ways of improving and perfecting the project till the end of the design process. In Team C, one of the members had already personally decided on a design idea, which she advocated till the end and managed to convince the others. The final design for this team became almost identical with her personal idea.

Conclusion

It is reasonable to say that creativity occurs in the iterative processes of convergence and divergence. The following conclusions from this study could be drawn:

RESEARCH

- The shared work environment increases the teams' idea generation. Two of the teams lived in the same place until the submission of the projects. Team C decided to live in the same place towards the end of the design process.
- Being student and looking for originality improved the teams' willingness' to generate ideas divergently. This willingness urged them to be inquisitive.
- The members' positive attitude helped them to achieve consensus, but this was not meant they did not questioned and elaborated ideas. The teams looked for reasonable explanations for consensus building.
- Collaborative designing improved the members' knowledge and skills such as analytical and critical thinking, and computer skills.
- The teams' communication styles were informal because of the members' close relationships which helped them easily express their ideas in the design process.

This study investigated how design teams maximise the number of alternative ideas while keeping an eye on consensus building. The results show two different situations. First Team C' strategy of using a grid base plan fixated the members too quickly. Second, although Teams A and B were not formally aware of divergent idea generation, they tried to increase diversity in problem identification and solution generation.

The teams used both convergent and divergent thinking throughout the design process. The teams were successful in generating a 'common' design idea. Teams A and B overcome spatial barriers by working in the same places. Team C, in the first days, worked in different places, later they worked in the same place. Temporal barriers could not be overcome without working in the same place. Teams A and B used shared large boards to support asynchronous, indirect, and long-term communication. Team C used a logbook to record all stages and concepts. All the teams were from the same architecture school so they had a common background and understanding about architectural design. Even though the teams had the same education, they had conceptual disagreements. Teams A and C solved conceptual disagreements with persuasion. Team B did not have conceptual problem because when the team developed a design concept, the members already liked it and did not need to discuss it any further. The teams shared the work according to each member's knowledge about technological tools.

Spatial and temporal barriers were overcome easily. Conceptual and technological barriers were harder to resolve. Conceptual disagreements usually enhanced divergent concept generation, while technological barriers might have limited the range of ideas.

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