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Behaviours in design collaborations: Insights from a team learning perspective

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Abstract: This paper proposes that designers can improve their collaboration effectiveness by foster team learning behaviours. Most of the design collaboration literature is on how to effectively transmit information between members. Team learning literature, however, covers how to effectively transmit, understand, refine and retransmit information between members. Despite the extant literature on design collaboration, there has been little to no research that examines the model and effects of team learning behaviours on delivering collaborative designs. This paper provides a literature overview of design collaboration, which has predominantly studied design activities through a social lens. It then provides the growing body of team learning literature from organisational science, which focuses on the learning processes of teams collaborating on a project. The paper then synthesises both strands of research, before proposing that team learning behaviours are more explicit in indicating effective design collaborations than our existing research on communicating practices.

Keywords: design collaboration; team learning; collaborative behaviours

1. Introduction

A popular stance in the design collaboration literature is the idea that communication is the key to effective collaboration. This common perspective has been widely observed and documented, evident from the large bodies of work that examines design collaboration through either a social lens or a communication theory lens (Bucciarelli, 2003; Carlile, 2004; Pikas et al., 2016). However, **how** the team members contribute to the group (communication) is as important as **what** they provide to the group (knowledge). In fact, **why** the team wants to contribute back to the team after listening to each other (team learning) is even more critical. So researching through a social or communication theory lens may not be sufficient in understanding how to foster effective design collaborations. While there is increasing attention on understanding how team learning behaviours foster effective collaboration in organisational learning discipline, this attention is absent in the design

collaboration discipline.

Is the designer learning from team members' experiences, and responding accordingly? Do arguments occur not only to bring attention to differences but to value-add to the project? Does the team co-construct a synthesised body of knowledge (transdisciplinary knowledge) for the collaboration? Or does the team simply place their siloed expertise together (multidisciplinary knowledge)? Here lies the distinction between the current social and communication perspectives used to examine design collaboration and team learning perspective used to discuss effective collaborations. The former seeks to strengthen communication between members occurs, and the latter seeks to ensure members receive and respond accordingly to the communication.

The motivation of this paper arose from the need for additional explicit mechanisms that will help foster effective design collaborations. Existing research focuses on increasing collaboration efficiency by discovering and promoting different forms of communication. However, this array of communication does not necessarily mean more effective collaborations. Therefore, the objective of this paper is to compare the research on effective collaborations in the design literature with research on team learning from organisational science, then identify the gaps in the literature on design collaboration. The purpose is to broaden the research focus on *how to facilitate communication between team members* to *how to ensure communication is received and acted upon accordingly*.

This paper contributes by: (1) charting the current research on fostering design collaborations using communication methods, (2) reporting the team learning behaviours of effective collaborations from organisational science literature, (3) cross-referencing both strands of research, and (4) identifying the gap in the design collaboration literature that require further research. Based on these conclusions, the author recommends designers working in teams to also focus on how they learn as a team, on top of how they communicate in the team behaviours.

2. Background

One of the ways a team of architects deliver a design proposal to clients is to interpret the clients' brief, come up with an idea, turn it into a concept and materialise the concept into a design. Apart from sketches and conversations, they also employ digital models, physical prototypes and technical drawings to communicate amongst themselves. However, it is very common, for architects to work with a range of experts outside their discipline during this process. Such experts may include paying stakeholders, end users, engineers, builders, construction managers, landscape architects and financial planners. Whether these experts are considered part of or external to the team of architects, there is no denying that they each bring their own disciplinary expertise to the project. The challenge architects face here is communicating with these experts effectively to incorporate their knowledge into the design project.

With digital technologies, architects can increase collaboration amongst themselves by

using virtual design studios (Achten, 2002) to organise asynchronous communication and information exchange effectively. Since the architects receive similar education and professional training, they can use industry-specific software to improve information flow between themselves (Svalestuen et al., 2017). To communicate with the experts outside their discipline, they can use basic software such as Wikis (websites for users to edit and contribute) for everyone to record ideas, design changes and decisions (Burry et al., 2005).

To further understand the role of communication in a multidisciplinary design team, three guiding questions were used to frame the following literature review:

- **What** does a designer communicate with the team in a design collaboration?
- **How** does a designer communicate with the team in a design collaboration?
- **Why** do designers communicate what they communicate in a design collaboration?

2.1 What does a designer communicate with the team in a design collaboration?

In a simple team arrangement involving only designers, an individual designer contributes to the team by describing ideas and designs to respond to the brief and the team's ongoing discussions. This arrangement is rare. Even in an all-designer team, each member has their perspective and their way of responding to the brief.

When team members come from different disciplines, collaboration becomes even more complicated and challenging. This complexity arises because each member gets to contribute their disciplinary expertise to the team. They will also bring to the table different opinions, even conflicting views, on the project. In such an arrangement, the designer takes on more responsibilities. From someone who produces a design, the designer now must mediate the different perspectives of the team to create a design. As such, what the designer communicates with the team will depend on the role the designer performs in the team. As the demand for multidisciplinary collaborations increases, the need to adopt different roles are becoming more common for the designer (Inns, 2010).

The designer's role may be of an inquirer (Johansson-Sköldberg et al., 2013), who asks critical questions to extract insights from different team members. Designers may also be of a problematiser, who re-present given problems as ill-defined problems (Cross, 2007). This action emphasises the importance of unpacking the problem, invites richer discussions of the problem and highlights the dangers of assuming a single perspective to solve the problem. Designers may also be a facilitator that steers the exchange of ideas between team members. Whether members discover ideas through team conversations (Johansson-Sköldberg & Woodilla, 2014) or toolkits (Liedtka, & Ogilvie, 2011), design facilitators help the team diverge in thinking to reveal more creative ideas (Minder & Heidemann Lassen, 2018). Designers can also be coaches, who bring team members of diverse backgrounds together and guide them through the process of exploring the problem and delivering solutions as a group. The impact of designers as coaches were studied in both education settings (Ledsome

& Dowlen, 2007; Powers & Summers, 2009) and professional settings (Reich et al., 2007; Styger & Ellis, 2013).

In multidisciplinary teams, the designer often oscillates between these roles. It is also unsurprising if a designer performs these roles simultaneously. These examples show a glimpse of the value a designer brings to the team. More importantly, it reveals that there are many ways to elicit the varying knowledge, perspectives and insights from the team members.

2.2 How does a designer communicate with the team in a design collaboration?

How designers communicate with their team is another area of considerable research interest. Over the last few decades, information communication technology has enabled designers to communicate digitally. This advancement has made communication more convenient for designers. They can initiate and continue conversations without the presence of the receiver – asynchronous communication. However, this technology has also introduced greater complexity on how designers communicate in collaborative design projects by giving us more modes of communication.

Today, designers have a diversity of ways to communicate with their team. Designers still have the traditional option of communicating verbally, through face-to-face discussions or phone calls. For information that cannot be thoroughly captured through verbal methods, designers use artefacts as a communication device. Artefacts may be two-dimensional drawings, aimed at turning intangible ideas into concrete yet evolving ideas (Henderson, 1998). The artefacts may also be a series of scaled models used to represent the design development process (Schmidt & Wagner, 2004) or even a simple and tangible mock-up, to trigger a discussion of ideas amongst the team (Brandt, 2007).

With information communication technology, designers can, to an extent, replicate the tradition methods digitally. For example, using video conferencing to meet with team members instead of gathering in a room to discuss. In fact, designers have the option of communicating synchronously (real-time, e.g. conference calls), asynchronously (delayed e.g. wiki discussion threads) or a mix of both. To transmit information that cannot be captured in words, designers can share analogue drawings online synchronously (Everitt et al., 2003). They can also broadcast and share their artefacts online synchronously (Gumienny et al., 2011) and even work together on a digital file simultaneously (Paavola & Miettinen, 2019). While online communication can increase idea generation in collaborative designs (Rahman et al., 2013) and indirectly increase the stimulation of creative ideas (Ocker, 2005), it still cannot match the performance of teams that collaborated in person (Andres, 2002; De Pillis & Furumo, 2006).

Again the designer oscillates between the different ways of communication with the team members and will employ a combination of communication modes as required by different situations or task. These modes attempt to elicit different forms of knowledge, perspective and insights from the team.

2.3 Why do designers communicate what they communicate in a design collaboration?

Despite the various ways to extract and transfer information, the need to communicate remains the same. In design, it is used mainly to negotiate ideas and manage conflicts (Cross & Cross, 1995) to arrive at decisions and progress towards a design outcome (Bucciarelli, 1994; Henderson, 1998).

A key indicator of successful communication is the presence of a shared understanding, which allows members to make important decisions that progresses the project together (Valkenburg, 1998). It is also this shared understanding that avoids unnecessary re-questioning of decisions that hamper progress (Valkenburg & Dorst, 1998). When teams cannot achieve a shared understanding of the project, collaboration becomes challenging, tricky (Cross, 2011; Maher et al., 1996) and may even become destructive to the project.

In practice, it is highly unlikely that all team members are present for every exchange of ideas or to even understand ideas exactly as intended. This is because everyone frames their understanding differently (Schön, 1983). However, sharedness in understanding can be achieved through dialogue (Møller & Tollestrup, 2013) so that team members learn how to frame their ideas similar to one another (Stumpf & McDonnell, 2002). Since it's impossible to guarantee the singularity of an overlapping understanding, Smart et al. (2009) proposed to define shared understanding as an ability to draw information from different members to complete tasks that help achieve a common goal. This suggests that shared understanding exists as a dynamic state (Bittner & Leimeister, 2013), which surfaces depending on how it needs to be used in its context.

Whether it's a state of shared understanding, or a sharedness in understanding, the goal of a designer when communicating with the team is to extract, exchange and amalgamate knowledge into a team body of knowledge, so as to then deliver a design outcome. In fact, some researchers even argue that collaborative design is about communicating and integrating knowledge from different members to attain shared understanding (Kleinsmann et al., 2007) and that shared understanding is the foundation of collaborative design (Gomes et al., 2016).

2.4 Author's critique: Is communication behaviour the only way to achieve shared understanding?

It is unarguable that there is extensive research on collaboration between designers and evidence that effective communication leads to successful design collaborations. However, does facilitating communication behaviours always achieve shared understanding and ultimately a successful collaboration? Shared understanding may be an outcome of successful communication, but effective communication does not guarantee shared understanding. It can only increase the likelihood of achieving shared understanding.

Some researchers even say that communication is not the answer to effective collaboration (Jowers et al., 2016). In other words, socialising processes, that is to say, how people

communicate, may not be a suitable lens to examine design collaboration effectiveness. So, are there other factors aside from communication behaviours that can be used to achieve shared understanding and ultimately, effective collaborations?

If communication in a design collaboration environment is to elicit and integrate knowledge into a team knowledge, shouldn't the team's ability to learn from and adapt to each other's knowledge also be a vital characteristic of shared understanding? Hence, an alternative lens, which this paper proposes, is to examine design collaborations from a team learning perspective. After all, one of the benefits of working in a team is access to a range of expertise from every team member. To not learn from these available experts is not to take advantage of the team's strength.

3. Team Learning

This section explains why the author chose to examine team learning behaviours from organisational science as alternative indicators of effective collaboration.

3.1 Design and learning

Every design process involves learning. What we have learnt from previous experience influences the way we design and what we design (and are designing) influences what we have learnt (Duffy, 1997). When we learn, we use past and current experiences to frame and change how we perceive our situations. When we design, we create artefacts to change our current and future conditions. Both these actions, learning and designing, share a similar objective - to change our experience of situations. The act of designing is filled with learning activities, which are visible and invisible (Lawson, 1997; Schön, 1983). Whether it is learning from the current design task to understand what we are designing, or using the experience to determine how we approach a design project, learning in design is inevitable.

The outcomes of design learning in the literature are described in terms of design cognition, rationale and knowing (Cross, 2007, 2011; Lawson, 1997; Schön, 1983). In comparison, the act of design learning has received less attention, both in design education (Eastman et al., 2001) and in professional practice (Dall'Alba & Sandberg, 2006). In this context, the presence of motivation differentiates design learning from design knowing. Design knowing is the process of becoming aware of the design and its situation whereas design learning is the process of intentionally trying to understand the design and its situation.

If shared understanding is necessary to create effective design collaborations, and that it is achieved after teams elicit, transfer and amalgamate each other's knowledge, design learning is a necessary action in the route to creating shared understanding.

3.2 Why not individual learning

While individual learning affects how shared understanding is nurtured within the team, the author does not elaborate on it because it does not capture the reciprocal interactions

between team members. Yes, the practice of design in professional setting activates learning in the individual (Schön, 1983), and that experiential learning is the foundation of creating meaningful understanding (Dewey, 1986; Kolb, 1984). However, there are many other factors within the individuals that influence how they perform in teams. Some factors include their character (Birdi et al., 2016), their cognitive style (Peeters et al., 2008; Sonalkar et al., 2017), how they interpret the task (Eisentraut, 1999), and even their adaptability to different approaches to the task (Kirton, 2003). To consider individual learning as a factor of fostering effective design collaboration will require the coupled examination of these additional factors. Since these issues apply to every individual of the team, the severity of how each member learns from and performs with each other through collaboration is compounded.

3.3 Cultural difference and its affordances

The author acknowledges that cultural differences between individuals influence team performance. However, cultural differences do not affect team performance directly. The presence of cultural differences increases the likelihood of interpersonal conflicts (Ayub & Jehn, 2010) and influences how each member addresses these conflicts (Paletz et al., 2014). As Stahl et al. (2010) pointed out, cultural differences can be a positive and negative asset to the team. Their study showed that when conflicts triggered by cultural differences end poorly, it can lead to further task conflicts and a decrease in social integration. When the team managed their conflicts appropriately, their differences increased the team's creativity. For example, Gray and Boling (2018) highlighted that translators were introduced into a co-creation workshop to mediate the conversations between Scandinavian and Chinese team members. Therefore, the author does not elaborate on the impact of cultural differences on team performance but examines the management of conflict as a team learning behaviour (Constructive conflict) in the section below.

3.4 Organisational science

In organisation science, where team learning literature emerged from, research is focused on how individual behaviours benefit or disadvantage the development of organisations. Early authors include Argyris and Schön (1978), who described how employees in organisations learn from their experience to either correct their mistakes (single-loop learning) or change policies to prevent future mistakes from occurring (double-loop learning). Since organisational learning aims to improve the performance of organisations, the discipline observes and describes effective teamwork methods based on how individuals and teams learning independently and interdependently.

In the organisational learning literature, research on team learning is focused on how team behaviours impact the way a team achieves a common goal by through shared understanding. The seminal work by Edmonson (1999) identified team learning as a behavioural and cyclical process that involves gathering information, discussing information and seeking feedback. Individuals gather information by asking their team members questions. They discuss the information to identify errors in understanding and seek

feedback to ascertain that information is accurate within the group.

Based on the previous section on design collaboration, team learning shares many similarities to what, how and why a designer communicates in a collaboration. The key difference is that team learning behaviours can indicate that teams are developing a collective knowledge (Ellis et al., 2003) whereas communication behaviours can only suggest that teams are using methods that help build collective knowledge.

4. Findings

There are four basic team learning behaviours from the team learning literature that may help examine the effectiveness of design collaboration more accurately. These four primary behaviours are 1) sharing, 2) co-construction, 3) constructive conflict and 4) error management. The following explains these concepts and evaluates them against concepts found in design collaboration literature.

4.1 Sharing and Co-construction

When individuals share meaning with the team, they share their understanding of the project with other members. The distinction between sharing meaning and co-constructing meaning is that the former involves aggregating meaning whereas the latter is amalgamating meaning that converges into an idea. Without the construction of meaning by team members, it is impossible for team learning to occur. That is because the individual needs first to contribute their knowledge to the team so that the team can then receive and learn (Van den Bossche et al., 2006). When individuals share meaning in the team, they are then able to co-construct meaning with the team.

When individuals co-construct meaning with the team, they listen to, add on and build upon each other's ideas. As mentioned previously, the difference here is that members are not merely 'piling on' but are 'mixing in' ideas to achieve a shared understanding of the project. This process helps teams unlock collective meanings that could not have been achieved purely through the construction of meaning (Van den Bossche et al., 2011). Some researchers argue that this co-construction process is repetitive (i.e. iterative and not a linear process) (Decuyper et al., 2010) to align team members' cognitive behaviour with each other (London et al., 2005). Ultimately, it is to achieve a shared knowledge amongst team members, which could not exist without collaboration (Van den Bossche et al., 2006).

Co-construction, in the team learning literature, is the joint effort of the team to create a shared body of knowledge by discussing with each other. Co-creation, from a design perspective, is the collective effort of turning ideas into creations (Sanders & Stappers, 2008). However, it originated from a business perspective and referred to the act of creating value together (Prahalad & Ramaswamy, 2004), especially with different stakeholders to capture their expertise within the outcome. When these two perspectives are combined, co-creation represents the creation of a design outcome through consultations with various stakeholders. While co-construction and co-creation may share similar qualities, their

objectives are different. The former focuses on creating a shared understanding with the team, whereas the latter focuses on delivering an outcome.

4.2 Constructive conflict

When team members debate over meanings, ideas or processes, they enter a conflict. When conflict is constructive, it reveals differences in opinions and can initiate greater elaboration of ideas. Through this elaboration, hidden meanings associated with the proposed ideas come to light (Van den Bossche et al., 2006). However, this conflict can be destructive to the project as well. Instead of using the conflict as an opportunity to investigate ideas further, these conflicts may end when an individual ignores the comment or rejects the opposing party (De Dreu & Weingart, 2003).

Surprisingly, there has been little research that looks at the impacts of constructive conflicts on creating a shared understanding in design collaborations. Only recently did design researchers looked at the positive influences of conflicts on the design outcome. McDonnell (2009, 2012) found that conflicts within conversations between team members help advance the design, and Paletz et al. (2017) discovered that micro-conflicts reduced the uncertainty of the design task. However, most of the existing research focused on the impacts of conflicts on team cohesion. For example, how different cognitive background can lead to conflicts (Kilker, 1999), how to resolve disputes in design collaborations (Lauche, 2007) and how to avoid conflicts (Hsu, 2017).

In the team learning literature, conflict is recognised as a potential driving force that can increase shared understanding. Here, the challenges are to differentiate constructive and destructive conflicts and to encourage constructive conflict. However, the design literature suggests that conflict is a negative influence on team cohesion and should be avoided.

4.3 Error management

How the team treats a reported error have direct consequences on how subsequent errors are identified. With proper error management, mistakes can be fruitful learning opportunities that initiate discussions (Frese & Keith, 2015) and even instigate problem-solving activities (Edmondson & Lei, 2014). Despite the considerable learning potential that comes with making a mistake (Tjosvold et al., 2004; Weinzimmer & Esken, 2017), research also shows that organisations still gravitate towards blaming and punishing employees when mistakes occur (Edmondson, 2004). Since admitting a mistake has almost become synonymous with taking the blame for failure (Edmondson, 2011), this faulting practice tends to obstruct individuals from sharing their mistakes. In more severe situations, the lack of proper error management may even lead individuals to deny or blame the mistake on others (van Dyck et al., 2005).

Despite the learning benefits an error management process brings to a collaboration, there is no research on the benefits of making errors in design collaborations. In fact, existing literature on error management in design shows errors as undesirable. For example, Love

et al. (2014) report that fixing errors in the late stages of design can cost up to a third of the valuation of the project. Lopez et al. (2010) attempted to classify errors to prevent them. Love et al (2011) proposed a framework to use digital communication tools to identify and reduce errors in the design process.

Like the perspective on conflict, team learning literature recognises the benefits and disadvantages of making errors in a collaborative environment. In contrast, design literature only recognises the negative implications making an error has on the project.

5. Discussions

From the review above, the significant difference between the two research disciplines is in the purpose of communication. The design literature focuses on understanding and improving communication methods to make collaboration more efficient. On the other hand, the team learning literature focuses on encouraging learning behaviours associated with the creation of a shared understanding. Even though learning behaviours (sharing, co-construction, constructive conflict and error management) require communication with the team, it also involves individual and team learning processes. This additional attribute makes team learning distinct from the existing design research scope on communication methods.

These team learning concepts, though mostly still in its early stages within the design context, already has some theoretical implications. These concepts, coupled with the growing research on team learning in the organisational learning literature, prompt researchers to step back and re-examine if communication methods between team members should be the key identifier of effective collaborations. Instead of describing how communication is executed in design collaborations, more attention could be paid on how the content of communications changes as it passes through different team members.

5.1 Measuring our current state

This model of team learning behaviour has been tested in a variety of context such as military teams (Veestraeten et al., 2014), teacher teams (Vangrieken et al., 2016), student teams (Van den Bossche et al., 2006) and engineering teams (Cauwelier et al., 2019). Now, empirical studies are needed to validate these concepts with design teams. The first step would be to use Savelsbergh's (2009) measurement instrument on team learning behaviours to examine if team learning behaviours do foster effective design collaborations.

Savelsbergh's measurement instrument is an empirically validated multidimensional questionnaire used to measure a team's reflection, feedback, and communication behaviours. These dimensions were built from previous questionnaires that measured co-construction (Van den Bossche et al., 2006), reflection (Schippers et al. 2003), error management (van Dyck, 2000) and feedback behaviour (Edmondson, 1999; van Offenbeek and Koopman 1996; Schippers et al. 2003). The objective of measuring these qualities is to identify the relationship between team learning behaviours and team performance. The questionnaire was tested with 19 customer service teams (approximately 180 individuals

holding various positions) in a Dutch banking organisation and yielded a positive relationship between team learning behaviours and team performance.

5.2 Implementing these conditions

These team learning behaviours offer a new way of examining design collaborations. The validated instrument also allows researchers to empirically measure the impact of these concepts. But the ultimate question is, how can designers put these concepts into practice and benefit from it?

Teams can adopt specific processes to cultivate team learning behaviours. These facilitating processes help teams transcend from simply a group of individuals to a team (Decuyper et al., 2010). One of these facilitating processes is *Team Activity* (Kinny et al., 1994). This involves team members of different expertise share the responsibility of producing the same outcome. For example, an architect and landscape architect working to design a zoo where the boundaries of building and landscape are blurred. A second process is *Boundary Crossing* (Kasl et al., 1997). This involves team members actively seeking information outside their team of expertise. In the same example, the architect asking advice from a zoologist, who is not in the design team but still able to contribute to the design. A third process is *Team Reflexivity* (West, 2000), which involves the team reflecting collectively on what was done and needs to be done to achieve their shared goals. This is more than a just a discussion of works to be done. In the same example, it is an opportunity for the architect to learn from the working experience of the landscape architect. These three processes have been found to cultivate team learning behaviours (Decuyper et al. 2010).

6. Conclusions

This paper has only introduced the four basic team learning behaviours into the design discipline. Yet organisational learning discipline contains an array of literature on other types of learning behaviours, methods to facilitate such behaviours effectively and research on conditions to support such behaviours. Since these research focus on explaining what makes collaboration effective, the concepts should also be tested with the design discipline to further understand how communication and learning impacts design collaborations.

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