# A Study on Transforming the Knowledge in Design Learning Environment

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## ABSTRACT

Design learning is a paradigm where it is often being cultivated in the architectural domain. The paradigm itself is quite different from the other pedagogies. In design learning, the students need to undergo a design process to create their artefact in a certain period of time. The process itself consists of three distinct phases, which are ideation proposal, critique and iterate. The teaching and learning session in architectural design learning environment often focuses on the interactions and thus, producing communications in the studio class. During the design process, the interactions occurred can be categorised as human-artefact and human-human. While in the design process, there is a lot of knowledge in which can be expressed and applied towards the design artefact. The expression is so tacit that sometimes it is difficult for the students to transform and capture it into explicit knowledge. The knowledge transferred from the instructor to the students can act as a scaffold in creating the design artefact. Therefore, a virtual learning tool is proposed to investigate how efficient the technology can assist the transformation of tacit knowledge into explicit in design learning environment.

**Keywords**: Design learning, transform, tacit knowledge, explicit knowledge.

## I   INTRODUCTION

Mankind has done a lot of designing throughout the history. The design is often expressed together with the innovation created by the human being. Design is vast and applied in almost all of the domains that have existed in the world. It consists of multiple disciplines and the designers themselves need to have a lot of knowledge in expressing their skills while doing the design practice (Lim et al, 2011). However, architectural and fine arts are the most popular domains when it comes to design (Lawson 2005).

To learn on how to create a design formally, the information and knowledge can be gathered in a studio class. In the studio class session, the students need to undergo a process in creating their design artefact. The design process has three distinct phases, which are ideation proposal, critique and iteration (Brocato, 2009). Both of these phases, propose and

critique, will iterate throughout the design process until their design artefact can be considered as done. Thus, as the students go through the design process, there will be a lot of interactions going on between the students themselves and their instructor.

The interactions between instructor and students are essential during the design process and can be categorised into human-artefact and human-human interactions (Goldschmidt, 1995; Lawson, 2005). Most of the interactions occur during the critique phase in a design process. Every pedagogy existed is known for its implicitness. This is also applicable to design learning. The interaction between the instructor and students show that the knowledge from the instructor is being transferred to the students regarding on the ideation proposal. As the knowledge is transferred to the students, the transformation from the tacit knowledge of design to explicit must be captured by them.

In this paper, the sections will start with the introduction regarding the study. Secondly, a brief description on design learning environment. Followed by design as tacit knowledge and its knowledge transformation occurred during the process. The next section consists of a discussion regarding on the topic. Finally, a conclusion is done to deduce this paper.

## II   DESIGN LEARNING ENVIRONMENT

Design can be implemented in different domain but served as the same purposes. It consists of multiple disciplines and the designer needs to have a vast knowledge to express their skills in the design practice (Lim et al, 2011). In addition, design itself is a thinking model in which it will lead to the meaning of productive design and sense of productivity (Goldschmidt, 1995; Wertheimer, 1945).

Learning emphasizes on individual intellectual that leads to the development of ideas (Bouton, 2007). Design learning is an environment where it is adopted for the architectural students in a studio class session. Each author has their own terms and definitions in describing the design learning. Generally, it consists of a process where it has a distinct value and quality. The design process contained several phases such as propose, critique and iterate (Brocato, 2009).

Design may contain a recurring pattern from past experience or knowledge that the designers may not

have started it from scratch (Borchers, 2001). Thus, in a design process, the first phase would be the ideation proposal. This is the phase where the students need to propose their ideas to their instructor. Then, the instructor will criticise the proposed idea by the students. The criticism made is constructive and will be a scaffold towards the student's design. Both of these phases will iterate until the design artefact can be considered as done.

The critique phase in the design cycle makes it stand out from the other pedagogies. To transfer the knowledge of design from the instructor to students, this scenario can be found in the critique phase. In the critique phase, most of the interactions occur to get the best design. Interactions are essential in order to pass the knowledge from the instructor to students and this is proven by Lawson (2005) as he defined and divided the design process into assimilation, general study, development and communication.

### A. Interactions in Design Learning

An interaction is defined as a reciprocal action, effect or influence in which it is often occurred in the communication (Berge, 1999). Hence, it can be deduced that interactions are essential in the design process. In design learning environment, there is a few interactions occurred either to influence the artefact or the human being itself. The interactions can be categorised as human-artefact and human-human interactions. Both of these interactions are important to get the best artefact while doing it in the design process.

As the interactions occurred, one must know the current insight of design learning environment apart from the process cycle itself which is propose, critique and iterate. The current design learning environment follows a standard protocol. Firstly, it will go through a session where an understanding on the design brief and task takes place. After that, the design concepts are developed by drawing some free-hand sketches. Eventually, the design will be developed to the accurate scale. Lastly, some architectural tools are used to develop and visualised the idea (Rahimian et al, 2008).

Currently, there is still no existing tools which can beat the human mind. The complexity of human mind is the central for logic and creativity. Therefore, in the earliest stage of design process, it is essential to come out with an idea or a concept before proceeding to the next phase. Most of the time, the designers express their ideas by using free-hand sketching. Based on experience and knowledge that most probably will have a great influence in creating a design artefact, it is very rare to see exactly the same building designs happened concurrently.

Based on the knowledge and experience that possessed by the instructor, the concept of the design depends heavily on the used ideas (Lawson, 2001; Goldschmidt, 1998). Interactions also exist when the student is creating the design all alone (Schön, 1983). During the interaction between the student (human) and design artefact, he or she needs to argue and rely on themselves to create it. Usually, an individual student must put him/herself in a lot of shoes and act as a whole team that might consist of architect, engineer, quantity surveyor, and more. As there is still neither technology nor tools existed in creative thinking, the human mind is still the best tool to express the design idea and concepts.

A study shows that, contributions and interactions of ideas from different perspective can produce more creative artefacts, as compared to doing it all alone (Lugt, 2002; Paulus & Yang, 2000; Taggar, 2001). Thus, it depicts that interactions between human-human is crucial to improve the current design artefact. At the same time, this will be an added value and skills towards the students. During the conceptual and ideation proposal of the design artefact that has been created by the students, a criticism must be made towards the proposed idea and eventually will become a successful design interaction (Goldschmidt, 1995; Lawson, 2004).

The interaction between the instructor and students shows that collaboration of idea occurs during critique phase (Lawson, 2004). In order to get the most successful architectural design creation, Goldschmidt (1995) claimed that, most of the design idea creativities rely and adopt from the evaluations during the interactive or interdependent process. Most of the time, the criticism made between human-human interaction is needed for the students to view their design artefact from another angle or perspective. Thus, the interactions between the instructor and students are crucial as the conceptual idea of the artefact is analysed for further improvement (Lawson, 2005).

### B. Studies on Human-human Interaction in Design Learning

To get the best design artefact, the students need to undergo a design process where interactions occur throughout the environment. A lot of studies has been conducted to show that interactions between humans are important to improve the design. Table 1 shows the existing studies on human-human interaction which is focusing in design domain.

**Table 1. Existing studies on human-human interaction in design practice.**

| Authors | Details on how human-human interactions occurred |
|---------|--------------------------------------------------|
| Nam & Sakong (2009) | Developed a prototype where the users could interact and collaborate in real-time. |
| Stolterman (2008) | Used a prepare-for-action which acted on the situation while improving the interaction in design practice. |
| Rahimian et al (2008) | A dialogue session took place in regard to the design problem and provided alternatives towards the arouse issues. |
| Hailpern et al (2007) | The designers could collaborate and create their design artefact in a synchronous collocated environment. |

Table 1 shows the existing studies on human-human interaction in design practice. The design domain from the studies in Table 1 may not concentrate on architectural domain. As stated before, design consists of multi disciplines that can be implemented in real life. Studies show that the interaction between humans are important in improving their current idea on their design artefact. The authors stated that, even though collaboration of ideas and critical criticism has been made during the design process, a medium is needed to interact among each other.

The medium for interaction is also important in design learning. Most of the time, the medium is created to convey the knowledge sharing between two designers. In addition, a medium is also used to improve the design artefact as the interactions most of the times occur in synchronous and simultaneous manner. Hence, as the interactions occur, it increases the efficiency in collaboration (Nam & Sakong, 2009).

## III  DESIGN AS TACIT KNOWLEDGE AND ITS TRANSFORMATION

Design is used in various disciplines and occasions. It becomes one of the fundamental concepts when it comes to creating an innovation. To design, one must have the creativity to create it. Most of the time, the designers are born with creativity. However, to enhance the skills and creativity, the designers can learn it from the experts in most Architecture schools.

The design process shows its complexity during the critique phase. The idea of creating an artefact can be designed through one's experience, themes or interests. The evolution of idea by facing each critique session has transformed the design artefact from time to time. Meanwhile, the students need to shape their developed artefact based on their primary idea. At the end of the day, the students will come out with different architectural design from each other. Thus, the complex of the design learning environment contains the tacit knowledge only can be showed or gained by both of the instructor and students.

Design learning, like most pedagogies, contains tacit knowledge. Sanchez (2004) defined tacit knowledge as a personal nature and hard to extract from one's brain. Meanwhile, he also explained that explicit is a knowledge where it can be easily explained by someone with any type of assistance. Tacit knowledge does not stop at the individual skill, experience and own knowledge, it can also be observed in the form of interactions and collaborations between them (Puusa & Eerikäinen, 2010). Therefore, through the intervention from the instructor while the students prepare their artefact, it is essential to process the tacit knowledge into explicit.

There are a few tools that can transfer and transform the knowledge. Although there is a few methods to get the knowledge, it must undergo a process of transformation from tacit to explicit. Hence, the explicitly readable design process can be used or revised for future references by undergoing a particular process. Most of the previous studies found that it is difficult to capture and transform the tacit knowledge into explicit. However, Nonaka & Takeuchi (1996) proposed a method in SECI model which can be seen in Figure 1 below.



Figure 5. SECI model proposed by Nonaka & Takeuchi (1996)

Figure 1 depicts the SECI model proposed by Nonaka & Takeuchi (1996). They stated that, each knowledge can be converted or transformed and seen as continuous learning. There are four processes in this model which are socialization, externalization, combination and internalization. Based on SECI model in Figure 1, to transform from tacit to explicit knowledge, a process called externalization will be focused on. There is a few cases that has been involved in externalization process which are articulating an individual tacit knowledge that

involves idea or visualization in words, metaphor and analogy.

From the externalization process in the SECI model, a protocol has existed while the knowledge exchange occurs. It structures the information exchange in such a way that the provider of information or a recipient of information can capture the information in a mannerly method. It clarifies and interprets an individual's knowledge into an understandable format for the others. In addition, a storyline in a narrative is also one of the best methods to share the knowledge and mostly occurs during interactions (Khalid & Mahmud, 2008). Hence, this can be shown during the design learning process where the knowledge sharing often occurs. Eventually, a transformation from tacit to explicit can be done.

In design learning, the instructor will share their knowledge and experiences to the students while practicing design in the learning environment itself. Then, the students will exchange the knowledge that they gain from their instructor explicitly during the critique session. The notes that they have taken will be in a readable format for them and it will be used for future improvements of their design artefacts.

## IV DISCUSSION

### A. Design Interactions in Knowledge Transformation Process

Interactions are essential in a design learning process. To get the best design artefact, a collaboration of ideas between human beings are needed in order to get the feedbacks. In the critique phase, this is where the interaction between instructor and students occurs. Through design learning environment, it promotes the knowledge sharing as it passes the knowledge from the instructor to students which often occurs in the studio session. Based on the studies, we have learned that design learning is filled with knowledge. Most of the knowledge are gained from the theory, feel and

experience. Then, this knowledge will be passed to the students from the instructor in the critique phase. However, the criticisms that have been made by the instructor are solely based on the ideation proposal from the students. Furthermore, every word said by the instructor should be taken into consideration for further improvement on the design artefact. Thus, it shows that tacit knowledge plays an important role in a design learning environment.

In the current environment, the students will propose their ideas and concepts through one-to-one communication. As they propose, they should get a feedback on the artefact in order for them to improve and make some changes on it accordingly. So, this is where the instructor will intervene by giving some constructive criticisms towards the ideation proposed by the students. Most of the time, the students will jot down what they can capture or gain from their instructor during the critique session. Based on the current method, the students will forget on how to implement some of the main points regarding on the criticisms made in the iterative phase.

Through SECI model, it is found that the tacit knowledge in design learning can be transformed into explicit through a process called externalization which can be seen in Figure 1. The transformation process is essential so that it is easier to archive the readable knowledge. The stored knowledge can be used in different ways such as to refer to the comments made by the instructor, for future references in learning and to get some inspirations for the others. To be in line with the technology era, the usage of current tool is needed to transform the knowledge in an easier way compare to the current method.

To transform the knowledge in a design process, a tool from the current technology is needed to assist and eventually, act as a scaffolding tool in the learning environment. A framework on the knowledge transformation in design learning is depicted in Figure 2.
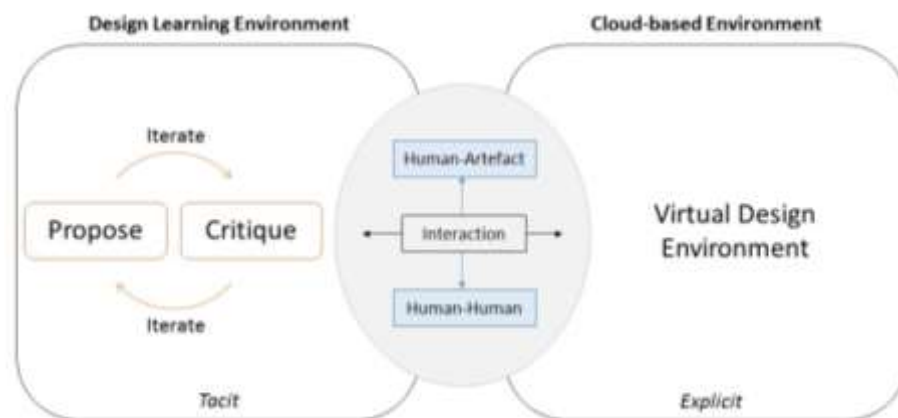


**Figure 6. Virtual design environment for knowledge transformation (Lin et al, 2014; Brocato, 2009; Mohamad, Khaidzir & Ibrahim, 2015).**

Figure 2 shows a framework to accommodate the knowledge transformation of design learning in a virtual environment. It involves a method to capture the tacit knowledge within the design learning processes. In addition, it should transform and represent these knowledges into explicit knowledge in order to facilitate human-computer interaction in a new scaffolding model of virtual studio class. To transform the knowledge, the usage of current technology as a scaffolding tool is needed to visualise the explicit knowledge that has been transferred through interactions between the instructor and students during the design process.

Nowadays, the technology is evolving from time to time. With the latest technology offered in the market, many can be used in facilitating the interactions between human beings. Through the technology tool, the instructor can intervene with the students' design artefact and at the same time, act as a scaffolding tool to facilitate the interactions. Therefore, the technology can be easily used as a transformation tool to support the design learning process.

## B. Cloud Technology as a Virtual Scaffolding Tool

Nowadays, the technology has evolved from time to time and has been implemented into the learning system. Most of the technologies created in today's world are engineered to cater and connect the people even in a non-collocated venue. When people are connected with each other, this is where the interactions take place. Thus, the most suitable tool to interact among each other is none other than the cloud technology.

Cloud technology has its own specialty where people can interact and collaborate with each other. The users store their data in a remote cloud server and eventually, they can access their files anywhere they go as long as there is an Internet connection provided. Besides having it ease on accessing the documents, the cloud technology also provides a dynamic front-end environment, which is often described as Software as a Servive (SaaS), to cater the learning process.

Based on previous studies, it is found that cloud technology is most of the time being used in the learning activities (Mohamad, Khaidzir & Ibrahim, 2015). With the implementation of cloud technology in design learning process, it can act as a scaffolding tool where it exists in a virtual environment. From Figure 2, it shows that the usage of cloud technology is supporting the design learning knowledge transformation process. This occurs when the students use the virtual environment to visualise their architecture artefact and its evolvement towards the instructor.

The visualization on the improvement and evolvement of design artefact via the usage of the cloud technology will depict that it is the explicit version of the complexity and tacit that took place during the critique session. Therefore, a cloud technology is proposed to become a virtual scaffolding tool in viewing its efficiency to assist the transformation of tacit knowledge into explicit in design learning environment.

## V CONCLUSION

Design learning is known for its design process where most of the interactions occurred during the critique session. As it promotes the interactions between the instructor and students, thus the transfer of knowledge also happened in the process. As the learning environment itself contains a lot of tacit knowledge, hence this study investigates a method to transform the tacit knowledge in design learning to explicit.

The interaction is among the many things that are important in design learning process. Via interaction, it can transfer the knowledge or information from an instructor to a student in a short duration of time. The teaching and learning session in an architectural design environment often envision the interactions as a scaffolding tool to improve one's artefact design. The knowledge that has been learnt and gained in the critique phase will not be the same for each student because it depends on their ideas and creativity while producing the artefact.

A framework model on knowledge transformation in a virtual design environment has been developed to cater the interactions in design process. It should be capable of capturing the interactions in learning while participating the design process. This paper focuses on the importance of interactions between instructor and students which often contains the tacit knowledge. A process is needed to be used to transform the knowledge from tacit to explicit. In order to do that, the usage of existing technology is essential in acting as a scaffolding model of a virtual environment.

To conclude this paper, current technology is needed to transform the tacit knowledge of design learning into explicit easily. In addition, the technology used should also act as a scaffolding tool for the learning process to take place. For further investigation, the cloud technology will be as a proposed tool to transform the tacit knowledge gained through the learning and archive it into something readable for future references.

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