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A Review on Cloud Computing Adaptation in Design Collaboration and Interaction

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ABSTRACT

In this new era, the technology has evolved and transformed to adapt the needs by human being. This advancement has also affects the design field from time to time. Human being has used design approaches throughout the history to get their desired needs. Most of the time, the design process has its own complexity and richness and the designers often faced this situation. Therefore, to reduce the complexity, the designs need to be done in a team. In order to do that, the designers need to collaborate and interact among the team members. The evolution of technology has given opportunities towards them to utilize the technology in the design learning. When applying the current technology, it will be easier for them to interact by using the features provided by the developer. Thus, throughout this paper, a review on the collaboration and interactivity in design learning using cloud computing will be discussed accordingly.

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INTRODUCTION

Throughout the history, mankind has done a lot of designing to acquire the needs and desire for their survivals. There are a lot of disciplines and fields when it comes to design such as architecture, engineering, product design, graphic design, fashion design, software design and more. Every design has its own pattern, complexity and richness. As stated by Borchers (2001), a proven solution to a recurring design problem is its pattern. The pattern has its own context to balance the positive and negative consequences of its usage. As there are a lot of disciplines using design as one of their idea, thus, a pattern language has been created to make it more understandable by all the designers. An architect in 1970s, Alexander (1979) explains that, to make the future buildings and urban environment more inhabits by human, a hierarchical collection of architectural patterns is used.

Besides having some patterns in designing an artefact, it also consists of complexity and richness. As mentioned by Stolterman (2008), practicing design is mainly about handling its complexity and its "messy" reality. The "messy" reality often relates to a scenario where there are demands and stress in design tasks with a limited technology, knowledge and tools to get it done within duration of time. Sometimes, the designers will used an approach by thinking and acting in a *designerly way* to handle this situations (Cross, 2001; Buxton, 2007; Moggridge, 2007). In designing, it is not only the designers who contributed the ideas. In order to get the best design, collaboration between the design managers, clients, users and other stakeholders must be taken into consideration. As the design complexity increased into another level and goes globally, collaboration needed to be done so that the artefact can be finished within a period of time (Nam and Sakong, 2009).

Nowadays, the collaboration methodology evolved with the advancement of technology. Traditionally, people opted for face-to-face communications. This method is still being used in the current days. However, as the globalization inspired the designers, it is possible for the design collaboration process took place non-collocated (Delavari *et al*., 2011). Hence, by using the current technology that being offered by the developer, they can communicate with each other despite of the difference geographic. In additional, Borchers (2001) stated that, collaboration between the experts in Human- Computer Interaction (HCI) is needed to achieve the high expectation of the design. Although the communications are becoming easier these days, the designers are still finding for a method to interact with the designs in the repository.

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Background Study:

Design consists of multiple disciplines and the designer needs to have a vast knowledge to express their skills in the design practices (Lim *et al*, 2011). In this research, the focused design domain is architecture. Architecture designs are constantly changing and it has its own patterns and complexity which will often improved the efficiency, sustainability, building energy performance and cost-effectiveness (Iorio and Snowdown, 2011). Thus, this will make the outcome of the design looks richer, sophisticated and desired by the users.

The architecture design of the buildings has evolved from time to time. Every architect has its own way to express their designs and pattern. Borchers (2000), stated that patterns is proven a recurring design problem and the designers may or may be not start their designs from scratch. The designers have to make or made a few adjustments on the design. Eventually, they will review the design collaboratively and it can be done in a short period of time. To learn about architecture, one must born with a creative thinking or simply learnt it from the bottom based. The formal architect learning is taught in the tertiary level of education. It applies in a pedagogy called studio-based learning.

Collaboration and interaction are also applied in studio-based learning. As the architects have their own patterns in designing their building, the academicians will teach their students regarding on the existing designs. There are a few interactions that are applied in studio-based learning and the most common two are human-computer and human-human interaction. However, Rahimian *et al*. (2008) stated that, significant changes must be done towards the architectural communication culture in order to cater the collaboration and interaction in the design process.

Studio-Based Learning:

There are a lot of pedagogies when it comes to learning. Pedagogy is defined as the method of teaching or learning such as project work, scientific investigations, media production, task-based activities, online courses and expository lessons. In this paper, a focused on studio-based learning which is one of the pedagogy that often use in fine arts and architectural education (Zollars *et al*, 2012). In addition to that, studio-based learning has been founded in the late 1800s by Superintendent Francis W. Parker. This approach has become the pioneer of a system known as the Quincy System (Lackney, 1999). Studio-based method is also defined as a workplace for students to create and presented their designs. As stated by Brocato (2009), studio-based learning is also an inquiry, apprenticeship model that follows a problem-based learning but allows a more towards the person-centred approach.

From a broad perspective, Mathews mentioned that, students who are literate in design should be capable of creating collaborations and creatively able to design the solutions for complex, open-ended problems. Thus, the studio-based pedagogy is often involves in a series of problems which are related to design and fine art. The series may be either a sequence of progressively more challenging design problems or various components of a large design project (Myneni *et al*, 2008). In addition, the crucial aspect of this pedagogy is the design critiques. There are at least four distinct and formal phases of critiques which are the desk critique, the pin- up, midterm critique, and final critique (Lackney, 1999). As the students present their project progress, both the instructor and students will give critiques and discussion towards the progress presentation.

From the critiques, the students will evolve in proposing the solutions to their instructor. The critique activities are where the learning took place. It is rarely happened in the formal education system and thus, encourages the students to become more active in the class. Eventually, it helps them to evaluate the materials and did some reflections based on the critiques session. The studio which is happened to be using the problems-based pedagogy is important because the instructors must give an undivided attention towards the students for a term. Besides that, the students need to include these design solutions in their portfolios as they will later presented it to the prospective employers (Lackney, 1999). Hence, studio-based learning is a valuable pedagogy because it might offers an alternative, person-centred approach to both instructors and the students about the classroom management (Brocato, 2009).

Studio-based learning has increasing the problems-solving skills from time to time. This pedagogy passes four steps in each term. Firstly, the students are given a complex problem which they need to solve by proposing a construct solution. Then, the student will present their proposed solutions in a class for discussion. Next, the critique session by the students' peer took place. Lastly, opportunity is given to the students to respond and modify their solutions appropriately (Zollars *et al*, 2012).

Traditional Vs. Modern Collaborative Design Process:

There is a slight difference between modern and traditional design process. As for the conventional design method, the design follows a standard protocol which consists of going through an understanding on the design brief and tasks. Then, the design concept are developed by drawing some sketches. Eventually, the design will be drawn using free-hand architectural with the accurate scale. Finally, tools are used to develop it (Rahimian *et al*, 2011). As the project started, the architect will gathers all the information from the clients

(Rahimian *et al*., 2008). Besides that, using the conventional collaboration method will cost some time because all the team members need to be involved together in the designs.

Although there is still no existing technology on creative thinking, the mind of a human being is still the best tool to express the design. A study shows that, doing a project in group can produce more creative designs than doing it all alone (Lugt, 2002; Paulus & Yang, 2000; Taggar, 2001). Thus, collaboration and interaction between the team members are needed in designing. Participations with standalone design can be developed during the mutual interactions (Rahimian *et al*., 2008). As the design process needs to be done in a group to get the best result, the members may or may not be at the same place while designing the artefacts. The technology existed in cloud may probably cater the collaboration and interaction process even though the team members were working in a different geographical area.

Cloud Computing:

Nowadays, the technologies become more advance and the inventors has this idea of creating a new paradigm in which people are increasingly accessing their data through cloud services. This service is very popular among the technology savvy. It provides the users with ubiquitous and reliable data storage in which it can be automatically synchronized across many devices. Moreover, the users can share the data among a group of users (Li *et al*., 2013), provided there is an Internet connection.

Cloud computing has its own user- centred design. According to HP Cloud Design Service, the principles design are consists of seven which are design for the best customer experience; simplicity; leverage the existing work wherever possible; modularity and flexibility; optimal for service integration; right level of service availability; and trusted for delivery (Comhaire, 2013). For a conventional cloud services, the main function is to synchronize the data in the local computer to the cloud. For more advanced cloud computing, there will be a lot of tools embedded in the services in which it probably to cater the research. In addition, Li *et al*. (2013) stated that, the cloud technology consists of both the service and the user end. The cloud is made up of many servers which are configured so that it can work in unison. Therefore, with the high popularity of cloud storage among the users, there are a lot of providers created the services just to dedicate the demand.

Features:

The cloud is made up of many servers which are configured so that it can work in unison. There are a lot of cloud storages existed in the market such as Dropbox, Google Drive, Microsoft OneDrive, Evernote, Apple iCloud and more. Most of the applications are given free by the providers. As the technology advanced, the providers have created a mobile version for the cloud. The users can download the mobile version in their devices such as smartphones or tablets, and they can access it anywhere they go. Most of the cloud services only offer the storages to the users. The data is stored online via multiple third-party servers.

The critique sessions in architectural designs often take place in a studio. Usually, the session often took place in face-to-face situation. However, the reflection abilities can be an important component in the acquisition, processing and applied the new information (Chen *et al*., 2010; Chen *et al*., 2008). The reflection abilities using cloud-based services may assist in the interaction activities as it will shows the engagement between the students and the lecturers. Furthermore, Lin *et al*. (2014) stated that, face-to-face student engagement interaction in classroom is not possible for the lecturer during the remote learning or after class sessions. Hence, the cloud computing may provide a solution to cater the collaborations and interactions in studio-based learning.

Cloud services user interfaces has its' own functionalities features. After observing the features of the cloud, it's noted that it is possible to be implemented in the studio- based learning. The features of cloud services to adapt the collaboration and interaction in learning can be seen in Table 1.

Table 1: Features of Cloud Services in Adapting the Learning Collaboration and Interaction.

Features	Adaptations in Learning
Storage	Designs and data can be uploaded here and synchronized in their personal computer to their cloud account.
	The lecturer can score the project and shared among the students by using provided tools.
	If the document is set to public, any students within the domain can follow it.
Embedded Social Network	The students and lecturers within the domain can interact with one another through Newsfeed.
Blogging Site	To publish the students' portfolio and projects to the public.
Electronic Mail	Notifications e-mail will be sent to the students if there are any modifications of file sharing on their documents.

Discussion:

As the time goes by, Persell (2004) has stated that the technology has become more advanced and has been enhancing the student engagement towards the sociological idea of other students. Thus, implementing cloud computing in studio-based learning, it might be crucial to cater the designs big data. Currently, databases are needed to store the complex design. Most of the tools existed nowadays

are relatively easy to migrate to the cloud environment. Hence, this will probably make it easier for the users to store their designs via cloud computing. Accessing this data needs a large amount of computing power and eventually will evaluate variation of designs and their effects towards the overall projects (Iorio and Snowdon, 2011).

Cloud computing is a very powerful tool. There are many layers in cloud which are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Armbrust *et al*., 2010). In this paper, the focus is on the user's end, which is the SaaS. SaaS indicates the interface which will interacts with the users. Besides that, all the user interfaces has its' own functionalities features (Ozdamli, 2012). The features offered in SaaS are probably capable in catering the human-computer interaction for designing. It is also considered that IT- supported technology can be a possible tool to enhance the communication in the design process (Delavari *et al*., 2011).

As the technology evolved, end users gained a lot of benefits especially in education. Nowadays, almost everything is at the tip of the finger. During designing, the designers can draw or uploaded their synchronized designs in the cloud with their local personal computer. When adapting the usage of cloud in the studio-based learning, the designs are automatically saved in the cloud repository. Moreover, in studio-based learning, criticism is a crucial event. The designs stored in the repository will be critique so that improvement can be made. By doing so, this will be an interaction between human-human and human-computer too. Hence, by having an interaction with the students, it can help in inducing their reflection and facilitate them via the cloud services (Lin *et al*., 2014).

Conclusion:

The paper concentrates on the collaboration and interaction of the design by using the existing technology which is the cloud computing. The features of the cloud have a possibility to cater the collaboration in the studio-based learning. To conclude this paper, by using the current technology, collaboration can be done even though the team members are in non-collocated places. As the technology evolved, the tools can be easily adapted by mankind thus, making it easier for them to interact with the design in real-time. Through mobility, collaboration with the team members can be done across the globe. Thus, for further investigation, the cloud computing may be fully utilized in collaboration especially in the design learning. Eventually, it might be the next step in design learning.

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