



A FRAMEWORK ON CLOUD TECHNOLOGY IN FACILITATING DESIGN LEARNING

Nur Aziemah Mohamad¹, Khairul Anwar Mohamed Khaidzir² and Roliana Ibrahim¹

¹Department of Information System, Faculty of Computing, Universiti Teknologi Malaysia, Johor, Malaysia

²Department of Architecture, Faculty of Built Environment, Universiti Teknologi Malaysia, Johor, Malaysia

E-Mail: naziemah4@live.utm.my

ABSTRACT

Nowadays, the technology has evolved and its advancement has affected the learning field. People opted to use the cloud technology as it can cater the communication between the instructor and students. In this study, the focused learning field is architectural design learning. Design has a vast disciplines and it is often related to the architecture domain. It comes with three distinct features which are propose, critique and iterate. Hence, communication between instructor and students is crucial in order to get the best design. Most of the types of communication occurred during the critique session. Currently, the instructor found out that it is hard to intervene with the students design during the personal critique session. Thus, cloud technologies can act as a scaffolding tool during the design process. To achieve this study, a proposal on cloud-based design studio to facilitate the communication between instructor and students is done. An in-class observation has been done to see how the cloud technology can fit in facilitating the design process. By adapting the cloud technology in design learning, it gives opportunity for the instructor and students to communicate among each other while improving the design virtually in real-time.

Keywords: design learning, communication, cloud technology.

INTRODUCTION

In this modern day, the advancement of technology has affected the method of communication used in the learning field. Design is often used as a fundamental pillar in architecture, engineering, product design, graphic design and software design. As we all know, architecture is the most written about when it comes to design [1]. From time to time, the architecture designs are constantly changing and they have their own patterns and complexity [2]. Eventually, the outcome of the designs will be different from the existing one.

There are a lot of definitions when it comes to the architectural design learning. When an architect creates a masterpiece, the design must have its own value and quality. Basically, it consists of three distinct features which are propose, critique and iterate [3]. In any learning pedagogy, communication is important to convey the information towards the student. Thus, most of the human-human communication in design learning occurs during the critique session. Currently, design learning uses the conventional method which follows the standard protocol consists of going through an understanding on the design procedure. Next, they will develop a design concept by hand-drawn sketches. The sketches will be drawn accurate to scale and the computational tools are used to visualize the design [4]. Hence, the current tools used do not support the dynamic communications between instructor and students in virtual environment.

Nowadays, the latest technology has been used directly or indirectly in a daily routine especially for communications. Eventually, it has been integrated in the learning pedagogies. To accommodate the dynamic communications environment, the usage of cloud technology has been proposed to scaffold in design learning. In this study, cloud is the chosen tool to cater the

communication in the design process. Recently, cloud is very popular among the technology savvy. It can be accessed anywhere around the globe as long as there are Internet provided. The technology that the developer offers is dynamic and can be synchronized across multiple devices. In addition, the design can be shared among the instructor and students synchronously. Thus, it promotes the scaffolding when the students are doing their design.

In this paper, it will start with an introduction regarding with the study. Then, the second section will discuss on the literature review on design learning and the communications occurred within it. The next section will discuss on the cloud technology as a scaffolding tool to cater the communication. Then, section four will describe the related work from previous studies regarding the cloud implementation in learning. Section five and six are about the methodology of the study and the discussion respectively. Finally, the last section will conclude the paper.

DESIGN LEARNING

Design consists of multiple disciplines and it is crucial for the designers to have a vast knowledge to express their skills and creativity in their design practices [5]. To start a design, one must have a little knowledge in everything. The information gathered is required in designing for mental integration and synthesis [6]. Design is refers to an end product or a process [1]. Lawson also said that, in the design process, it consists of various disciplines and the designers need a set of skills and creativity to create it [1]. Besides that, the designers also need to decide the effects that they want and the methods to achieve it.

Design is also a thinking model in which it will lead to the meaning of productive designing [6]. This is



similar to the sense of productive [7]. The productive thinking has made the design become more unique in its own way. Hence, the thinking model has created architecture designs that have evolved from time to time. Although the architects share the same profession, they may not have the same daily tasks [8]. Every architect has its own way to express their designs and patterns. Borchers proves that the design is an outcome from the recurring patterns and they may or may not start it from scratch [9]. They only have to make or made a few adjustments on the design.

In this new generation, a paradigm shift happens in most of the education systems around the world. The learning method has been slowly replacing the teaching system in education. Teaching is dynamic, well-planned and a systematic presentation of ideas, facts, skills and techniques where maximum learning experiences are needed [10]. On the other hand, learning is mostly describes and emphasizes one intellectual context which will lead towards the development of ideas and topics [11]. As this study focuses on the architecture disciplines, to learn it, one must know about the process of design learning. In other words, design learning is also known as studio-based learning. Design learning is defined as a workplace for students to create and present their designs [12].

From a general perspective, a student who is literate in design should be capable of creating collaborations and creatively able to design the solutions for complex, open-ended problems [13]. Therefore, the design-based learning is often involves in a series of problems which are related to design. The series may be either a sequence of progressively design problems or from a various part of a large design project [14]. The learning is defined as an inquiry, apprenticeship model that is adapted from problem-based learning but it is more towards pervasive person-centred approach [3]. It provides an environment which allows the design activities to gain experience, training and education based on the reflective dimension [15].

As there is a lot of definitions for design learning, it can be deduced that the learning itself contains three distinct features which are propose, critique and iterate [3]. These features are crucial during the process for the students to improve their designs. Eventually, their current design will be enhanced and evolved. Thus, if they want to refer back to their first issue or problem, the design itself will never look the same as the previous one. The students will propose their designs and the critique session will occur next. These two phases will iterate until the design is done. From the critiques, the students will evolve in proposing the solutions to their instructor. The learning often takes place during the critique activities.

Critique session makes the learning itself stand out from the other pedagogies. Most of the communications occur during this session. This is proven by Lawson as he stated that the design process is divided into four main phases which are assimilation, general study, development and communication [1].

Communication is essential during the design process as it is one of the highlighted phases in the Royal Institute of British Architects (RIBA) Architectural Practice and Management Handbook [1]. During the critique session occurred, the students will pitch their ideas while the instructor will give their undivided attention towards the design. The comments given may be positive or negative so that the students can improve their designs for the better. Both of these features, propose and critique, will iterate until the design is done or when they think the design is complete.

Previous Studies on Cloud Technology in Design Learning

Iorio and Snowden have discussed on the usage of cloud and high performance computing advances for the next-generation of architecture, urban design and construction projects [1]. The usage of CAD for general design application has been applied to large-scale projects. Thus, this has also increased the process optimization tool. With the usage of cloud-based interactive computing environment which was introduced by the communication network. They proposed a set of techniques such as fast design parameter-space exploration, large-scale high-accuracy simulation and integrated multi-disciplinary optimization for semi- or fully-automated designs which can accommodate the interactive design process while improving the outcomes and reducing the development cycle times.

Whiting and Varadarajan have discussed on their experience using the existing cloud technologies and services [16]. They focused on the perspective of design education as studio-based teaching and the design practice itself. During the design process, the students will be introduced to a lot of online technology and applications. They are encouraged to use RSS feeds to get alerts of the latest updates. In addition, the tools were introduced before as an exercise before using the cloud technology. The cloud approach has a way in communicating more widely and aggregate towards the relevant online data sources in a customized mass of stored information. Thus, the cloud has become the driving catalyst in initiate the work opportunities in design learning.

CLOUD TECHNOLOGY

In this generation, the technologies become more advance and the inventors have this idea of creating a new paradigm in which people are increasingly accessing their data through cloud. The cloud is very popular among organizations and individuals. This includes the social networks that integrate their platforms with cloud. It provides the users with ubiquitous and reliable data storage in which it can be automatically synchronized across many devices without the constraint of venues. Moreover, the users can share the data among a group of users [17], provided there is an internet connection.

A lot of applications nowadays use cloud to store their data. The data stored comes in different sizes and it is saved in a data centre hardware or software. Those



hardware and software data centre is called cloud. Cloud technology also refers as both applications delivered as services over the Internet and the hardware and system software in the data centres that provide those services [18]. In addition, cloud requires network access to a shared group that can be highly arranged with less usage of management workforce or service provider interference [19]. It is easily accessed by the users anywhere around the globe. There are three types of models on the cloud technology which are public, hybrid and private. Most of the users are using the public cloud to access their data.

In addition, there are three main service models of cloud technology which are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) [19]. These service models will indicate the layers in the cloud and each layer has its own functionality. The core service layer which is the IaaS is functioned to manage the processing, storage, networks and sets of computing resources and able to build a dynamic systems demanded by the clients. The second layer is PaaS in which it will utilise the consumer-created infrastructure given by the provider using the programming, languages, libraries, tools and others. SaaS is the focused layer of this study. It is to make use of the provider's applications running on the cloud infrastructure [19][20].

SaaS is the only model services that will make the users have a potential interest to use the cloud technology [20]. For examples of the SaaS are Google Application, Microsoft Office 365, Salesforce.com and more. As the application is not dependent by any devices, thus, it can be used in any mobile gadgets as long as there is an internet connections. Most of the cloud technology will be using web browser for their first time registration. Then, it can be synchronised using the application developed by the developer which can be supported into the mobile devices such as tablets, smartphones, laptop and more. In addition, as the end users are probably from various backgrounds, the user interface should be easy to understand.

Since the applications store their data in their remote cloud server, the users can access their information anywhere they go as long as the Internet services are available. Therefore, when the cloud is implemented in the education system, the students and instructors can easily share their design with each other. In addition, the design will be synchronized with the other devices [18]. Besides, they can access their design and other knowledge through mobile devices. Hence, the dynamic environment supported by cloud will allow the teaching and learning become easier.

RELATED WORKS ON CLOUD-BASED IN LEARNING

There are a lot of studies that implement cloud in learning. Most of the authors are suggesting that by using cloud, it can assist the teaching in a classroom efficiently. In addition, the information can be shared among the students or instructors or both from any mobile devices.

Generally, cloud technology has becoming very popular in every field. Since the applications stored their data in their remote cloud server, the users can access their information anywhere they go as long as the Internet services are available. Therefore, when the cloud is implemented in the education system, the instructor and students can share their data with each other synchronously. Besides, they can also access their data through their mobile devices. Hence, the dynamic technology from the cloud will allow the teaching and learning become easier.

Ozdamli has mentioned that learning using cloud is interesting and entertaining, hence the students' motivation [21]. The cloud technology has given the students an opportunity to communicate, cooperate, share and learn with their peers, teachers and family members at any time and places. The author designed an environment called Mobile Supported Seamless Learning Space (MSSLS). The learning uses EverNote cloud system to store their materials and the students can share it to the others via Facebook and Twitter. The study can be depicted in Figure-1 below.

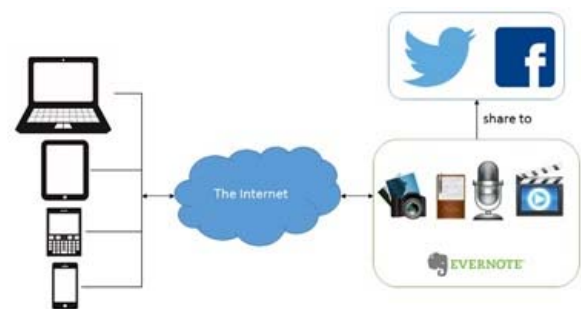


Figure-1. The MSSLS model.

Figure-1 shows the MSSLS model proposed by the author. The students are free to use any mobile devices to do their seamless learning. With the usage of EverNote cloud technology, students can carry out their task individually or in a group. They can take and edit their notes and materials, upload photographs, video and audio recordings. If they make an amendment on the materials, they can be aware of each other's work. Besides, these materials can be shared through social network such as Twitter and Facebook.

Simonova and Poulouva mentioned that, if the cloud is exploited and used in education for learning purposes, it will support the innovation in the usage of technologies with minimal cost of investment [22]. The authors proposed a model where the students use the cloud m-learning concept in their study as shown in Figure 2. A virtual classroom has been formed to enable the students to work from any time and at any place. A pre- and post-test have been done to see whether the students are ready for cloud m-learning concept.

Before the implementation of the cloud m-learning, a test has been done towards the students. The students have been divided into three experimental groups



which were the first one being offered by an automatically generated application in which provide the students type of materials appropriate to their learning style. Second group will have all access to all types of materials and they can choose their own learning style. The final group used the traditional methods according to the teacher's style of instruction.

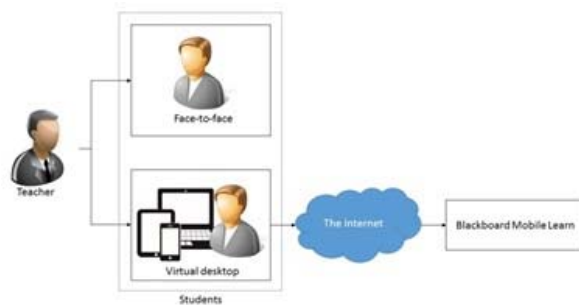


Figure-2. Cloud m-learning concept.

Figure-2 shows the cloud m-learning concept proposed by the authors by using the Blackboard Mobile Learn. The teacher gives lecture in a classroom and the students can either attend it face-to-face or watch it via online. For seminar, the students will be divided into several groups of 20 and they can either participate from any library in the Faculty of Informatics and Management (FIM) or use any virtual desktop services and participate at any place and time. In addition, the approach uses any mobile devices. The consultations with the teacher can be carried out personally through online/offline communications.

Lin et al has the cloud service implemented in the learning system [23]. Based on the framework he proposed in Figure-3, the communication between instructors and students can be done via cloud services during or after the class session. The author has been developed the web-based application with the embedded existing cloud which is the Google Application. The materials which are stored in the cloud databases can be accessed by the instructors and the students at any time and places. Therefore, it promotes independent learning to the students and eventually, reflections occurred over the time.

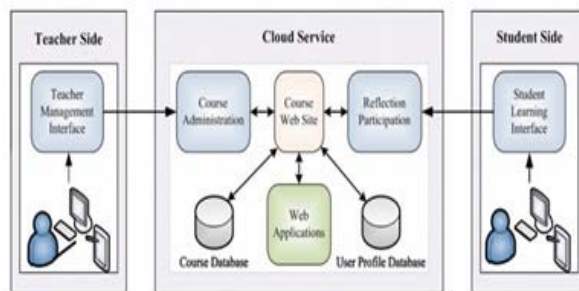


Figure-1. The framework of cloud-based reflective learning.

In Figure-3, from the teacher's side, the system will prompt the teacher management interface. In this side, the instructor will administer the course instruction and conduct the activities in assisting the students' reflection. All the materials and contents are stored in the cloud including the course website, web applications and the databases. The students have their own learning interface and can access the contents and materials during or after the class session. Besides, they can participate in various types of self-learning activities. Thus, this induces the reflective towards the students.

By studying the framework by Lin et al, communications did occur in synchronous and asynchronous ways [23]. In communicating with the users, synchronous communications occur when the instructor and students are having the reflective discussion in the class as it happens in a real-time. When the students access the contents after the class session, this is when the asynchronous communications happen. In addition, interactions also happen between the users. The interactions, such as human-human and human computer, do occur in the stated framework.

Lin et al study is suitable to be implemented in the architectural design learning environment. By using this framework, the students can enhance their learning through reflection [23]. The reflection ability is essential in the existing framework as it is going to be a strong foundations towards the new knowledge [24]. In addition, the framework will be adopted into the study because it is simple and easy to understand. In addition, this framework promotes self-reflection for the students.

METHODOLOGY

A qualitative method has been in this study to get an in-class observation regarding on the architectural design learning system. A studio session consists of 10 undergraduate students from the Department of Architecture in Faculty of Built Environment were observed to see how they communicate using the conventional method during the design process. In addition, a video and audio recording has been done to record the critique session. During the critique session, most of the communications took place and thus, the learning occurred at the same time.

In-Class Observation

For the preliminary study, an in-class observation has been done for a whole semester. The purpose of this observation is to get the insight of the learning culture. In addition, it is also done to see how the implementation of cloud can be used to scaffold design learning. Based on the related studies that have been done, a framework has been proposed to cater design learning environment. Thus, the communication can be seen from the extracted data through the observation. It focuses on the communications occurred in each phases.

In this study, the learning environment is focused on the design process. Design learning consists of three main features which are essentials in the study. They are



propose, critique and iterate. At first, the students will proposed their design. From the proposed design, the instructor will give criticism for further improvement. Both of these features will iterate until the design is complete. Therefore, the communications occur during the

design process especially during the critique session and the cloud is the proposed tool that will be used later in this study.

Table-1. The in-class observation during design learning.

Week	Details	Communication Occurred	Design Features
1-4	<ul style="list-style-type: none"> Project Initiation The students submitted their proposed project and report to their instructor. Most of the proposed designs were still in the preliminary phase of the design process such as coming out a concept and idea sketching. 	Human-Design Interaction	Proposal
4	<ul style="list-style-type: none"> The students are gathered in a group and presented their initial project proposal. During the proposal presentation, a brief critique session happened. The instructor did some critique on the proposal for future ideas and further improvement. The peers gave out their critiques on the presenter's project. 	Human-Human Interaction	Critique
5 – 14	<ul style="list-style-type: none"> For the recurring critique session, the student will meet their instructor personally. The progress from the proposal was shown to the instructor. 	Human-Design Interaction Human-Human Interaction	Proposal
	<ul style="list-style-type: none"> The progress should be visualised and simulated by using the computer applications for architecture design such as SketchUp, Revit or AutoCAD. The critique session occurs for further improvement on the design. 	Human-Human Interaction	Critique

Table-1 shows the in-class observation that had been done during design learning process. The in-class observation has been done to see whether the theory of the design learning applied in practice. For the first week, the project initiates and the students were required to go for a site visit. Then, they proposed their building design by doing some rough sketch and presented it during the proposal session. After they proposed, the instructor made some critique on their design. For the first critique session, it occurred in a group of students and the peers can also give their feedbacks regarding on the design.

For the next consecutive weeks, propose and critique features were repeated until the project was done and this phase is called iteration. In addition, the sketch was also being visualized by using the computer design software. Week by week, the students will consulted with their instructor on how to improve the design. The design will be progressively improved based on the critiques that have been given by the instructor. Besides, there are a few types of critique sessions that the students need to undergo such as desk critique, pin-up, interim and final crit [12].

DISCUSSIONS

The technology has become more advanced from time to time and has been enhancing the student engagement towards the sociological idea of the students [25]. Besides, the usage of technology among them has

effected the learning environment. As the technology being used in the daily life, the instructor must think of a method to attract the students to communicate with them. Hence, cloud is one of the existing technologies that can make instructor and students communicate in a synchronous method regarding the learning in virtual.

There is a lot of existing technologies which can act as a scaffolding tool in supporting the communications in design learning. Based on the related works on cloud-based in the learning field, it is possible to implement cloud technology into the design learning culture. As all the related works stated in the previous section are using cloud as a tool in learning, there are similarities and differences in the studies. The similarity of all the studies in related works is that they used cloud to facilitate the communication between the instructor and students. While, the difference of the studies is how they used the cloud technology in the learning itself.

In the in-class observation, it is found out that communications is very crucial in order to improve the students' designs. With the usage of the latest design software, the students will be having a face-to-face conversation with their instructor while showing their own designs. However, it is hard for the instructor to interact and intervene with the student's design in a virtual environment as this can be seen in the analysis in Table 2.



The intervention from the instructor is crucial to scaffold and improve the students' design.

Table-2. The table on communication interactions in design learning.

Communications	Propose	Critique	Iterate
Human-Design Interaction	/		/
Human-Human Interaction		/	/
Human-Computer Interaction	/	?	

From the analysis in Table-2, it can be seen that the students are accustomed to use the technology in their

everyday life. It can be assumed that there will be no problem in introducing the cloud technology in design learning to facilitate the communications between instructor and students. Subtly, the cloud technology that will be used can also promote the human-computer interaction. During the critique session, the human-human and human-design interactions occur simultaneously as the instructor wanted to scaffold the students' design by interacting with their design. Thus, a framework on the cloud technology implemented in design learning has been proposed such as seen in Figure-4.

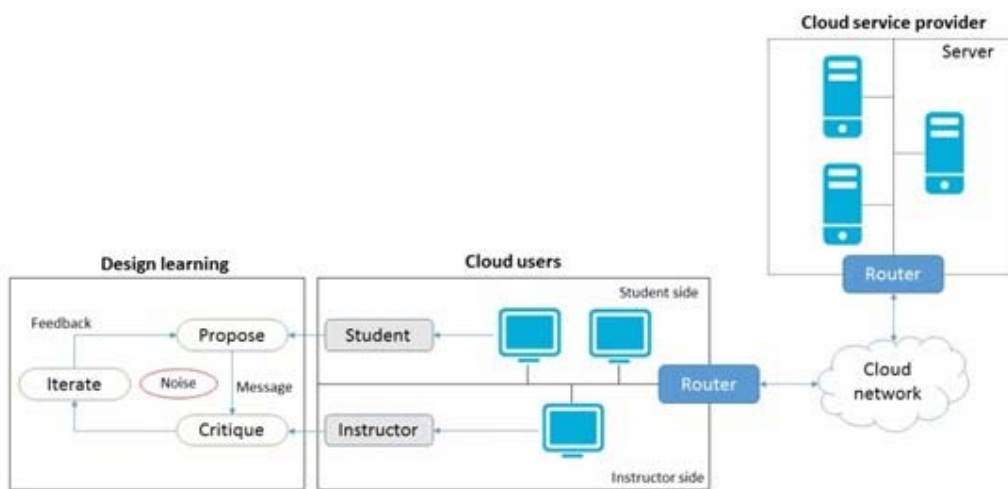


Figure-4. The propose framework of the cloud-based design learning environment.

Figure-4 shows the proposed framework of the cloud-based design learning environment. As we all know, there are three main features in design which are propose, critique and iterate. The cloud-based design learning environment framework is proposed because all the design process can occur in a virtual place. With the allocated cloud storage given by the developer, the students can save their designs in a cloud. In addition, the instructor can review the student's designs later. And this is the asynchronous communication with the design. Besides, by using the cloud technology, the students can simply use the saved design to improve and propose it again to the instructor. The instructor will critique the design by using the cloud technology in real-time.

By implementing the cloud in design learning, it will be easier for the instructor to communicate with the students by intervening towards their design. The user-friendly features of the existing cloud technology make it easier for both parties to understand how to use it. Hence, by altering the design in virtual using the cloud, it will improve the design and the learning will occur at the same time.

CONCLUSIONS

This study investigates a way to support the communication between the instructor and students in a synchronous virtual environment. The definitions of design learning in architectural field have been clearly discussed so that we can get the idea of how the learning actually works. Cloud technology has been studied to see its compatibility to be implemented in the learning environment. This is proven by the discussion on related studies regarding the usage of cloud in learning environment. Before designing the framework for this research, an in-class investigation has been conducted to see the whether the cloud can be used as a scaffolding tool in design learning.

A framework model on cloud-based design learning environment is developed in which it is capable of facilitating the communication between the instructor and students while participating the design process. This paper focuses on how the existing cloud technologies can be used in the architecture studio for its dynamic environment. The features in the cloud can cater the synchronous communication between the instructor and students when designing a building.

To conclude the paper, cloud technology is one of a scaffolding tool in facilitating the real-time communication design process. From the in-class



observation that had been done, the tool is suitable to be used during the continuous critique session between the instructor and students. For further investigation, the cloud as a facilitating tool will be implemented and tested in the study. Eventually, it will promote the design collaboration among them.

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REFERENCES

- [1] Lawson, B. 2005. How designers think. Oxford: Elsevier.
- [2] Iorio, F., & Snowdon, J. L. 2011. Leveraging Cloud Computing and High Performance Computing Advances for Next-generation Architecture, Urban Design and Construction Projects. Proceedings of the 2011 Symposium on Simulation for Architecture and Urban Design. San Diego, CA: ACM, 118-125.
- [3] Brocato, K. 2009. Studio Based Learning: Proposing, Critiquing, Iterating Our Way to Person-Centeredness for Better Classroom Management. *Theory into Practice*. 48(2), 138-146.
- [4] Rahimian, F. P. 2011. Impacts of VR 3D Sketching on Novice Designers' Spatial Cognition in Collaborative Conceptual Architectural Design. *Design Studies*. 32, 255-291.
- [5] Lim, Y., Lee, S., & Kim, D. 2011. Interactive Attributes for Expression-oriented Interaction Design. *International Journal of Design*. 5(3), 113-128.
- [6] Goldschmidt, G. 1995. The Designer as a Team of One. *Design Studies*. 16(2), 189-209.
- [7] Wertheimer, M. 1945. Productive thinking. New York: Harper Torchbooks.
- [8] Lawson, B. 2004. What designers know. Oxford: Elsevier.
- [9] Borchers, J. O. 2001. A Pattern Approach to Interaction Design. *AI & Society*. 15, 359-376.
- [10] Hussain, S., Anwar, S., & Majoka, MI. 2011. Effect of Peer Group Activity-based Learning on Students' Academic Achievement in Physics at Secondary Level. *International Journal of Academic Research*. 3(1), 940-944.
- [11] Bouton, M. E. 2007. Learning and behavior: A contemporary synthesis. Sunderland, MA: Sinauer Associates.
- [12] Lackney, J. A. 1999. A History of the Studio-based Learning Model.
- [13] Mathews, J. M. 2010. Using a Studio-based Pedagogy to Engage Students in the Design of Mobile-based Media. *English Teaching: Practice and Critique*, 9(1).
- [14] Myneni, L., Ross, M., Hendrix, D. and Narayanan, N. H. 2008. Studio-based Learning in CS2: An Experience Report. Proceedings of the 46th Annual Southeast Regional Conference on XX. 28th-29th March. New York, USA: ACM, 253-255.
- [15] Khaidzir, K. A. M. & Lawson, B. 2013. The Cognitive Construct of Design Conversation. *Research in Engineering Design*. 24(4), 331-347.
- [16] Whiting, M., & Varadarajan, S. 2009. Early Exploration of Cloud Computing for Design Practice and Education. *Internat. Assoc. Societies Design Res Coex*, Seoul Korea.
- [17] Li Z., Wilson, C., Jiang Z., Liu Y., Zhao, B. Y., Jin, C., Zhang, Z., and Dai, Y. 2013. Efficient Batched Synchronization in Dropbox-like Cloud Storage Services. Eyers, D. and Schwan, K. (Eds.) *Middleware 2013* (pp. 307-327). Berlin: Springer.
- [18] Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., Zaharia, M. 2010. A View on Cloud Computing. *Communications of the ACM*. 2010. 53(4), 50-58.
- [19] National Institute of Standards Technology (2011). SP800-145. Gaithersburg: National Institute of Standards Technology.
- [20] Wu, J., Ping, L., Ge, X., Wang, Y., Fu, J. Cloud Storage as the Infrastructure of Cloud Computing. (2010). *International Conference on Intelligent Computing and Cognitive Informatics*. 22nd-23rd June 2010. Los Alamitos, California: IEEE. 380-383.
- [21] Ozdamli, F. 2013. Effectiveness of Cloud Systems and Social Networks in Improving Self-directed Learning Abilities and Developing Positive Seamless Learning Perceptions. *Journal of Universal Computer Science*. 19(5), 602-618.
- [22] Simonova, I. & Poulouva, P. 2015. Cloud and m-Learning: Longitudinal Case Study of Faculty of Informatics and Management, University of Hradec Kralove. Proceedings of the 7th Asian Conference, ACIIDS 2015, Part II. 23-25 March. Bali, Indonesia: Springer, 411-420.



- [23] Lin, Y.-T., Wen, M.-L., Jou, M., and Wu, D.-W. 2014. A Cloud-based Learning Environment for Developing Student Reflection Abilities. *Computers in Human Behavior*, 32, 244-252.
- [24] Boyd, E., & Fales, A. 1983. Reflective learning: The key to learning from experience. *Journal of Humanistic Psychology*, 23(2), 99-117.
- [25] Persell, H. C. 2004. Using Focused Web-based Discussion to Enhance Student Engagement and Deep Understanding. *Teaching Sociology*, 32: 61-78.