THE EFFECTS OF SCAFFOLDING STRATEGY IN ONLINE SOCIAL-COLLABORATIVE LEARNING ENVIRONMENT ON ENGINEERING STUDENTS KNOWLEDGE CONSTRUCTION LEVEL: A LITERATURE REVIEW

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ABSTRACT

Engineering students show very little gains in high knowledge construction level that allow them to integrate and apply real world situations especially to develop the competence and expertise in the engineering field (Streveler *et al.*, 2008). In order to achieve the complex skills of the engineering students, scaffolding strategy needs to embark on the learning process. Scaffolding is a key strategy in cognitive apprenticeship, in which students can learn by taking increasing responsibility in complex problem solving with the guidance of more knowledgeable mentors or teachers (Collins, Brown, and Newman, 1986). This study will provide some useful insight for the scaffolding strategy used towards knowledge construction process in an online social-collaborative learning environment. The findings of this study will clarify the scaffolding types versus knowledge construction level in online social collaborative learning environment.. The knowledge construction processes as defined by the scaffolding strategy factors will assist curricula designers or lecturers to redefine the roles and metacognitive activities of the lectures and students in order to make the learning process in the online social-collaborative learning environment more efficient, meaningful, and can improve engineering students' knowledge construction process as well as innovative and creative thinking. The findings of this study could be used as a basis for further research in online social-collaborative learning environment.

Keywords:
Scaffolding strategy, knowledge construction, online social-collaborative learning, engineering students

1. INTRODUCTION

This paper relates scaffolding strategy to build upon on transformative learning environment in higher education (based Malaysia Education Blueprint, 2013) for engineering students' knowledge construction. In order to bring the improvement of learning environments, much more needs to be known about how lecturers or facilitators understand and conduct scaffolding strategy in an online social-collaborative learning environment (SCLE) on students' knowledge construction. This study will provide some useful insight into scaffolding strategy for knowledge construction in such situation. The findings of this study will contribute to clarify the scaffolding types versus knowledge construction level in online SCLE. The key issue is the engineering and technology students have gained very little in higher knowledge construction level that allow them to integrate and apply their learning process, especially to develop the competence and

expertise in the engineering field (Streveler *et al.,* 2008). Some researchers have reviewed that students have low prior knowledge with learning higher knowledge construction in interactive computer because they lack of adequate to guide them through the process of knowledge construction (Moreno and Valdez, 2005). Therefore, it is important to explore how to better facilitate or scaffold engineering students into higher knowledge construction.

This paper should benefit to curricula designers or lecturers or facilitators to redefine the roles and metacognitive activities in the engineering classroom in which scaffolding strategy factors effects on students' knowledge construction.

The remainder of the paper is structured as follows: First, explained the features of scaffolding. Second, described the scaffolds for collaborative learning and computer supported learning environments. Third, use of online learning environment for scaffolding, Next, the importance of scaffolding strategy in an online SCLE. The findings of the study are then presented. The paper concludes with a summary of the study's scaffolding research contribution and directions for future research.

2. FEATURES OF SCAFFOLDING

Scaffolded instruction is defined as to how individuals learn (Collins, Brown and Newman, 1986; Vygotsky, 1978; Wood, Bruner and Ross, 1976). Wood et al. claim scaffolding is provided to the adult for handling the task beyond the learner's capabilities. Also, they emphasized six types of support can supply to a person: "…*recruiting the person's interest, reducing the degrees of freedom by simplifying the task,maintaining direction, highlighting the critical task features, controlling frustration and demonstrating ideal solution paths...*"

Pearson (1985) cited that one of the characteristics of scaffolding is the transfer of responsibility in which scaffolding is needed for the students at the initial stage of learning, then gradually released it when student capability to perform well. Meanwhile, Guzdial (2006) claims this process as "fading."

Lecturer or facilitator supply support when engineering students cannot carry out the task independence, then assist them experience success to achieve their learning goal (Cooper, 1993). Puntambekar and Hubscher (2005) view that scaffolding as an interaction between lecturer or facilitator with student, peer to peer or and computer with students. Also, there is a variety of support such as software tools, curricula and other resources designed to assist students achieve their learning goal successfully in the engineering classroom.

The features of scaffolding is related to concept of Les Vygotsky's Zone of Proximal Development (ZPD) (1978). ZPD is defined as different between the student's actual and the potential development level. Therefore, various of scaffolding strategy is supply of the engineering students for minimizing this gap.

Greenfield (1999) identified five features of scaffolding in building construction:
- Provides a support
- Functions as a tool
- A range of types of support
- Permits worker to complete a task
- A worker uses it as selectively aid when needed

Belland, Kim and Hannafin (2013) define a scaffolding design framework to promote engineering students' knowledge construction during their learning process. The framework consists seventeen scaffolding strategies divided into six categories such as establish task value (ETV), promote mastery goals (PMG), promote belonging (PB), promote emotion regulation (PER), promote expectancy for success (PES) and promote autonomy (PA).

Thus, scaffolding concludes as a temporary support, release when no longer need, but reintroduced when necessary. Different needs of scaffolding strategy based on the needs of particular students. In order to derive benefits of engineering students' knowledge construction, scaffolding can be done collaborative and computer supported collaborative learning environments will be discussed in the next section.

3. SCAFFOLDS FOR COLLABORATIVE LEARNING AND COMPUTER SUPPORTED COLLABORATIVE LEARNING ENVIRONMENTS

Traditionally, teaching and learning (T&L) approach such as lecturer center learning did not see much more effective and efficiency in knowledge construction into a higher level for engineering students. Also, students are lack of learning engagement in such of learning environment.

Nowadays, transformative learning environment integrated with computer supported learning environment (CSLE) have brought a new circumstance for the students in the engineering classroom. Therefore, classroom settings may need to associate with scaffolding strategy through utilize of social media technology (Cisco, 2009), There are many benefits of engineering students work in collaborative learning. Likewise, lead them to seek new information, assist to clarify misconceptions in their own understanding, seeking new approaches to solve the problem or task given by lectures or facilitators and increase quality of feedback from the availability of peers (Vye et al., 1998, Slavin, 1987, Johnson and Johnson, 1975 and Barron, 1991).

Hence, Chen, Ruberg, and Martin (2008) claimed that social media technology can develop student potential into deeper or higher knowledge construction It is also provides opportunities for advance learning and teaching. Consequently, Tileston (2000) argues that social media technology as a tool to assist lecturers or facilitators for enriching collaborative learning and computer supported collaborative learning (CSCL) environments. Meanwhile, engineering students have a deep understanding and address high-level thinking through such of learning environments. Besides, they can construct knowledge in an online learning environment while scaffolding strategy provided to apply metacognitive activities in the learning process.

So, Dr Liam Boyle (2008) asserts that utilize of social media technology to support *"…(a) active learning: learn by doing (b) group learning: discussion, collaboration (c) metacognition: self-learning and reflection on learning..."* Having discussed the scaffolds for collaborative learning and computer supported collaborative learning environments, it is timely to explore the use of online learning environment for scaffolding.

4. USE OF ONLINE LEARNING ENVIRONMENT FOR SCAFFOLDING

The best of use scaffolding strategy in emerging complex learning environments for engineering students to optimal construct their knowledge. Tabak (2004) claimed that

integrate with social and material support in design, rich an online learning environment. Lecturers or facilitators use the different form of scaffolding strategy will bring out different learning outcome to the engineering students. For instance, facilitator or peer support for immediate feedback on interactions and elaboration. Meanwhile, software supports may guide students into step-by-step process of learning.

Recent research has shown that about scaffolding mechanisms in an online learning environment such as asynchronous online discussion (AOD). Guzdial and Turns (2000) emphasized students face hurdles on"… *(a) unmotivated by discussion topic, (b) not knowing what issues to discuss and (c) not knowing how to discuss…"*

Therefore, Hill and Hannafin (2001) stressed that four types of scaffolding to address the problems of "Not knowing what issues to discuss" and "Not knowing how to discuss". They had categorized scaffolding strategy to support engineering students learning as shown in table 1.

These scaffolding strategies are relevant to construct knowledge in an online learning environment (Teo and Chai, 2009). The next section explains the importance of scaffolding strategy can be used to support engineering students' knowledge construction through online SCLE.

5. THE IMPORTANT OF SCAFFOLDING STRATEGY IN AN ONLINE SOCIAL-COLLABORATIVE LEARNING ENVIRONMENT

Some studies have shown that facilitate increased scaffolding for engineering and technology students engaged peer interaction, either face-to-face, online or both. It would have more motivation and positive attitudes in their learning process (Johnson *et al.*, 1998a; Springer, Stanne and Donovan, 1998). Eventually, it is also engages engineering students to accelerate their knowledge construction (Van Der Styf, 2002).

In addition, scaffolding strategy can assist them to build on prior knowledge and construct new knowledge in the process of learning. Lecturers or facilitators may integrate scaffolding strategy to facilitate effective knowledge construction through an online learning environment. It helps students share knowledge with exchangeable information. Different types of scaffolding may adaptively different needs of engineering students. So, lecturers or facilitators should supply different type of scaffolding for all students at all levels. Therefore, it is important to design a flexibility and feasibility an online social-collaborative learning environment to assist engineering students continuous construct the knowledge in the learning process.

Lecturers or facilitators need to create a framework integrate with effective scaffolding through an online learning environment in which assist engineering students have multiple resources of information to develop more meaningful knowledge (Greene and Land, 2000). Meanwhile, allow social negotiation between peer to peer interaction in the processes of learning engineering contexts. Therefore, establish interactive social environment that can be constructed, negotiated and shared knowledge construction.

Table 1: Classifications of scaffolding strategy and knowledge construction development

Scaffolding type	Description (Way J. and Rowe L., n.d.)	Hierarchies of learning (Base on Bloom's taxonomy) (Bloom and Kathwohl, 1956) (in term of the observability of the responses to the scaffolding)	Types of Knowledge Construction Development (adapted from (Petenati et al., 2007))
Conceptual	Assists the engineering students in decision making what to consider or focusing thinking, to prioritize what is important, making connections between concepts or in simplifying complex concepts,	Mid-level (Thought-processes that guide to conceptual understanding)	Declarative/Conceptual knowledge – learning as acquisition (Remember and understanding)
Procedural	Assists with how to use the resource. Focuses on using specific functions, procedures or navigations.	Low-level (Specific physical / direct interaction)	Procedural knowledge – learning as acquisition and demonstration of abilities (Application)
Metacognitive	Assists the engineering students to reflect on what they have learnt (self-assess), or reflect on how they are learning (awareness of processes). Assists with what is known and how to think	High level (Higher-order thought processes and intent to engage the engineering students with ideas or abstractions)	Metacognitive / Self-regulatory knowledge – learning as the acquisition of competences and organizational structures (Integration)
Strategic	Assists by direct or indirect suggestion, approaches or strategies to achieve learning goals, offer alternative way to do a task.	Mid-level (Observable to an extent depending on the specific situations)	**Assumption By TML And Dr. JH** **Argumentative – learning as the acquisition of communication skill (analyzing)**

CONCLUSION

In this paper, the author argued that the effects of scaffolding strategy in an online social-collaborative learning environment brings learning engagement between engineering students for knowledge construction. In order to support the engineering students' development of knowledge construction into higher level is an important aspect of continued investigation, the transformative social learning environment may provide the

self–determination of students' knowledge construction (Deci *et al.*, 1991). Lecturers or facilitators can expend considerable effort in scaffolding strategy for their students' knowledge construction and structuring them in the engineering classroom (Doyle,1986). In assisting curricula designers or lecturers to redefine the roles and metacognitive activities in an online social-collaborative learning environment, scaffolding strategy factors need to be embedded in teaching and learning process. There is a limited investigation to address the development of scaffolding strategy in a social-collaborative learning environment towards engineering students' knowledge construction.

This paper suggests that shared features between scaffolding strategy processing within knowledge construction and online social-collaborative learning environment may positive integrates between students' competence and their learning performance. This paper also argues that adopting a common model in order to investigate those apparent similarities would be useful and further suggests that current knowledge construction models of learning engagement seem highly applicable. However, such models of knowledge construction may not translate completely into the online social-collaborative learning environment. Furthermore, research in scaffolding strategy development will most likely further inform our understanding of learning engagement. Clearly, many issues need to warrant further research.

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