

## Scaffolding Students' Metacognition for Effective Online Learning

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### ABSTRACT

Assisting students' metacognition especially in online learning environment is a vital concern among researchers and educators. This study explores the effectiveness of scaffolding students' metacognition and investigates its impact on students' performance in online learning environment. This study used a framework of metacognitive scaffolding that focused on two mechanisms which are supporting students' reflective writing and guiding students to focus in the process of learning. These mechanisms will be given through a set of questions prompted by instructors in Facebook discussions. This study used one group pre-experimental research design. A total of 23 undergraduate students were involved in the study. Students were asked to be engaged in purposeful critical discourse in order to solve questions about topics related to Telecommunication and Networking. Results showed that there is a significant difference on students' performance before and after the instillation of instructors' metacognitive scaffolding in online learning where  $p < 0.05$ . Thus, this study suggests that the framework of metacognitive scaffolding is imperative with regards to foster students' metacognition and student's performance in online learning environment.

### Keywords

Metacognitive scaffolding; online learning; students' performance

### Introduction

One of the instructional strategies that are widely used within an online learning environment is metacognitive scaffolding. Metacognitive is derived from the concept of metacognition. As being mentioned by Hacker et. al. (1998), metacognition is thinking about one own's thinking. It refers to the mechanism of arrangement, monitoring and managing performance and understanding. Meanwhile, scaffolding is a form of support delivered from knowledgeable person to other person. Thus, metacognitive scaffolding can be defined as assisting students to understand their own thinking process. For example, assisting students to construct problem, provide guidance and help them to find ways of possible solutions (Rimor et al., 2008).

Metacognitive scaffolding provides strategy and assists students throughout their learning process. It enables them to plan what they will learn, monitor their learning and reflect upon what they have learned about a particular task. Hence, students' metacognition can be nurtured from the assistance of instructor or teachers. Metacognitive scaffolding is one of the guidelines that could help teachers to assist students' metacognition. Therefore, the objective of this study is to test the effectiveness of a framework of metacognitive scaffolding developed earlier by Jumaat & Tasir (2015) to assist students' metacognition in online learning. This framework suggests two of the most dominant mechanisms of metacognitive scaffolding which are: (i) guiding the students to focus on the process of learning (MS3) and (ii) supporting student's reflective writing (MS4). Besides that, this study also investigates the effectiveness of this framework towards students' learning performances.

### Literature Review

According to Pea, R. D. (2004), instructional scaffolding refers to temporary support form given by instructors to assist students to new understandings which they cannot achieve by themselves. This kind of support may be as cognitive or social. Example of social support is proper management of group assignment while cognitive is such build up students understanding incrementally through the assignment given.

Scaffolding in education is the process of learner will be guided by instructors to solve and complete the complicated task higher than current knowledge that he or she have (Azevedo & Hadwin, 2005). Ling & Harun (2014) note that employment of scaffolding is to encourage students involved in tasks that beyond their comprehension and capabilities. Interestingly, scaffolding can be used in assisting students to create conceptual frameworks (Dawn et al., 2011). In addition, scaffolding in education as it can be embedded as a tool that equips learners with adaptable learning approach and changing needs (Jackson et al., 1998). Generally, there are four types of scaffolding which are conceptual, procedural, strategic and metacognitive scaffolding (Hill & Hannafin, 2001). As explained earlier with all the evidence, researcher feel that metacognitive scaffolding was appropriate technique to be used in this study as it is could improve quality and quantity of works by students (Davis, 1996).

Metacognitive Scaffolding is the combination of metacognition and scaffolding concepts. Metacognition is the rule of regulation of one’s cognitive activities. While scaffolding is the way or method of instructor assist their students to solve a task beyond their knowledge. According to Molenaar et al. (2011), metacognitive scaffolding can improve cognitive development process of an individuals and also stresses the viewpoint in scaffolding studies, which is improve learning outcomes is the purpose of metacognitive scaffolding.

Until recently, there has been little interest in metacognitive scaffolding research. Molenaar & Järvelä (2014) revealed, metacognitive scaffolding as an instructional design method can build student’s metacognitive knowledge through peers’ interactions. Support by Choi et al. (2005) findings, metacognitive scaffolds able to increase interactions which can be seen that it increased questioning behaviour among students in online discussions. Thus, as mentioned earlier, interactions are crucial towards successful learning.

As mentioned earlier, metacognitive scaffolding gives benefits to students’ learning such as stated by Choi et al. (2005), metacognitive scaffolds able to increase interactions which can expand students’ knowledge. Thus, it is crucial to have framework for instructor to monitor students’ learning process especially in online learning environment such as Facebook platform. Luckily, Jumaat & Tasir (2015) was developed a framework of metacognitive scaffolding in Facebook learning environment. This framework purposed to serve as a rules to instructors to guide students in learning. As discussed before, this framework also associated instructor’s metacognitive scaffolding and preferred type of online discussion by students in the online discussion. This framework includes seven mechanisms of metacognitive scaffolding (MS1, MS2, MS3, MS4, MS5, MS6, MS7) and also types of online interactions prompted by students (A, Q, CM, CN, EV, CLE, I2E, E21, CE and OT).

But, according to Jumaat & Tasir (2015) the most frequent used mechanisms are MS3 and MS4 which is supporting students’ reflective writing and guiding students to focus on the process of learning as stated in Figure 1 below. Later on, in this study, only 2 dominant mechanisms of MS were implemented which are MS3 and MS4.

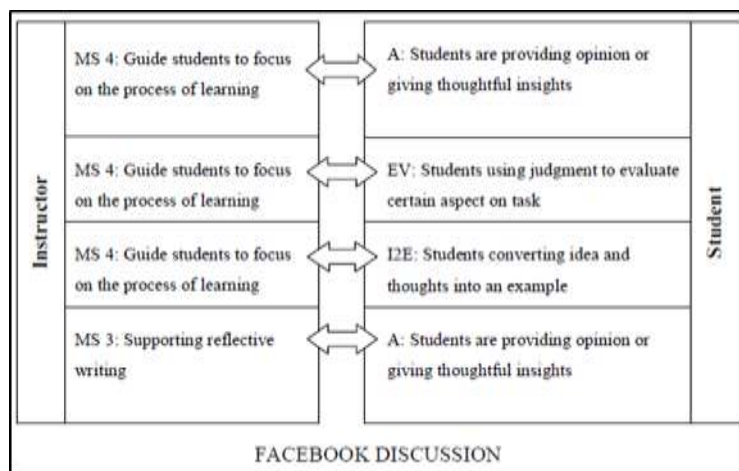


Figure 1. Framework of metacognitive scaffolding

This framework also pointed out that, students may have triggered different types of online interactions when MS3 and MS4 is used. As mentioned on Figure 1, instructor that used mechanism of supporting reflective writing (MS3) may encouraged students to give interactions such as acknowledgement of opinion (A). While instructor that guide student to focus on the process of learning (MS4) may prone students to reflect interactions of acknowledgement of opinion (A), evaluation of learning task (EV), and giving the of ideas to examples (I2E).

## Methodology

Respondents involved in this research are 23 undergraduate students who were enrolled in Telecommunication and Networking subject. A quantitative research using pre-experimental research design, a one group pre-test and post-test were adopted in this study. A pre-experimental one group pre and post-test design was chosen

A pre-test is conducted in the first week of class. A set of question is distributed to the respondents. After the questions were returned, the researcher started to create a Facebook group. The group is set as private and all students in that class are invited to join the group. Researcher started the discussions by asking questions in the group. The questions covered from chapter 1 until chapter 5 of the syllabus which is introduction to telecommunication, data communication, computer networking, connecting a network 1 and connecting a network 2 which is include wireless technology. Researcher will integrate framework of metacognitive scaffolding throughout the discussion along seventh week of experiment. Lastly, in week seven, a post-test was conducted and data were collected, analysed and evaluated.

In this study, as the sample size is quite small which is only 23, a normality test was conducted to test the distribution of the sample. Result of normality test was shown in the table below.

Table 1. Test of Normality

	<b>Shapiro-Wilk</b>		
	Statistics	df	Sig
Pre-test marks	0.929	22	0.102
Post-test marks	0.959	22	0.436

As indicated in the table above, the significance value for both pre-test and post-test marks are above 0.05 which are 0.102 and 0.436. The data is approximately normally distributed. Therefore, as the entire requirement met in this study, paired t test appropriate to be used in this study.

## Results and Discussions

The effectiveness framework of Metacognitive Scaffolding injected in learning through Facebook in enhancing students' performance is based on students' achievement in Pre Test and Post Test. As proven, there is an increment of students' marks in Post Test. From the data obtained and analyzed, researcher found that the injection of Metacognitive Scaffolding in discussion through Facebook has affected students' performance in learning. There is significant difference existed before and after the implement of metacognitive scaffolding in Facebook discussion.

To see whether there is difference on students' performance in learning in depth, paired sample T Test has been used. Answers given by students are marked based on marking scheme and marks are summed to the total of 100 for each test. Overall distribution of students' scores in Pre Test and Post Test indicated in Table 2.

Table 2: Marks obtained by Students in Pre Test and Post Test

Student	Pre Test (100%)	Post Test (100%)	Score Differences (Post Test – Pre Test)
1	16	58	42
2	12	64	52
3	16	32	16
4	32	46	14
5	24	44	20
6	22	40	22
7	32	58	26
8	16	51	35
9	26	58	32
10	36	71	35
11	16	52	36
12	22	46	24
13	18	28	10
14	22	46	24
15	34	86	52
16	22	59	37
17	22	77	55
18	26	44	18
19	16	51	35
20	12	36	24
21	24	57	33
22	12	36	24
23	22	82	60

Based on the data from Table 2, there is an increment of all students' marks in Post Test. For example, student 1 obtained 16 marks in Pre Test, increase up to 58 marks in Post Test. Surprisingly, student 23 showed excellence achievement in which the score differences is quite high, that is 60 marks. But eventually, marks of the student increase by 60 to 82 marks in Post Test. However, only one student which is student 13 gets only 10 increments of marks in the Post Test. Analysis results of the Pre Test and Post Test are shown in table 3.

Table 3: Mean Analysis for Pre Test and Post Test Marks

Test	Mean	N	SD
Pre Test	21.74	23	6.99
Post Test	53.13	23	15.39

Mean for marks in Pre Test is 21.74 while mean for marks in Post Test is 53.13. Based on these two mean obtained in the analysis, it clearly indicates that mean marks in Post Test is higher than mean marks in Pre Test. The mean difference is significance at  $p=0.05$ .

With the proven that the data was normally distributed, the researcher continued in conducting paired-sample t-test analysis. Table 4 shows the results of paired-samples t-test for pre and post-test assessment. The results revealed that the Sig.(p-value) is .000, which is less than 0.05. This shows that there was a statistically significant difference between the mean of students' pre-test and post-test scores. This result concludes that the treatment, which is the metacognitive scaffolding from the instructor does helps students in learning the subject.

Table 4: Paired Differences of Pre Test and Post Test Mark

Paired Differences					t	df	Sig. (2-tailed)
Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference				
			Lower	Upper			
-31.39	13.76	2.87	-37.34	-25.44	-10.94	22	.000

Results from this study is also consistent with the findings reported by Molenaar et al. (2011). In her study, she revealed that metacognitive scaffolding could improve cognitive development process of an individuals and indirectly, it improves students' learning outcomes. An active engagement and critical discourse that exist between instructor and students in this study might also contributes to significant results. For example, in the topic of Telecommunication and Networking, the instructor posted a question as below:

Instructor: Assalamualaikum and hi guys! Our discussion today is about software system. By hearing those words, what' s on your mind, guys? Feel free to share.”

The above question posted is actually MS4 which is guiding students to focus on the process of learning and given by the instructor. It is aim to make the respondents to think and share their point of view regarding the question asked. Not only that, in the discussions of the topic, instructor injected MS3 in the comments for the purpose to encouraged students to give more feedback. As per mentioned by Swan & Ice (2010), interactions are essential in online learning environment. In turn, students who do not receive any external feedback or responses about their learning progress will possess low learning achievements. Thus, feedback from instructor in this study also contribute towards students learning performance. For instance, below is another interaction that exist during critical discourse between student and instructor:

Student 1: Waalaikumsalam. Hmmm, let me try on the definition of software system. Is it a software that run a system?

Instructor: Once again, first person to response! Congratulations dear. Good try Sarah. Can you give an example Sarah?

Student 1 (respondent): That's because I'm always with my phone! That's why. Software system, for example, operating system? Like Windows, Android, iOS, Ubuntu and Linux.

Instructor: Oh good , that's the advantage of having a smartphone. Yesssss! absolutely correct!! Thank you Sarah.

Based on the comments above, student 1 shows a type of interaction in which she acknowledged and provide her opinion on the question asked. Meanwhile, the instructor continues providing MS3 which is supporting student reflective writing in order to encouraged students and to expand their understanding. For example, the instructor continues to ask the students to provide significant examples of given answer. Interestingly from the mechanism applied, student started to ask instructor back and the discussion continue in a meaningful way. Indeed, metacognitive scaffolds able to increase interactions including increasing questioning behaviour among students in online discussions (Choi et al., 2005).

## Conclusions

It is interesting to note that the results from association rule mining were also able to detect the interdependencies between the instructor's MS and interdependencies between the types of student online interactions. For example, the interdependencies occurred between MS4 => MS3. This suggests that whenever the instructor guided the students to focus in the process of learning (MS4), she also had the tendency to support the students' reflective writing (MS3). This suggests that these two pairs of MS were inter-correlated, and both were needed in order to support the students in learning at best. The result obtained from association rule mining also identified the inter-correlation between the

types of student online interactions. For example, those students who transmitted opinion also preferred to evaluate their learning.

This also implies continuity in terms of interactions professed by the students to expel their thoughts in learning. At first, the students might have provided opinions based on their own understanding. However, they then projected some sorts of evaluation over their own judgment of the learning task. The inter-correlation between student's interactions may suggest that without the instructor intervention, such interactions might have possibly triggered the students' learning process. These results may contribute to the idea of future recommendations especially for educators and researchers who aim to investigate the nature of interactions among students in an online learning environment, and how it can possibly influence students' engagement in the learning process. Such a finding is consistent with the previous studies, which concluded that interactions among students may also influence learning through knowledge exchange (Liu & Tsai, 2008); this leads to cognitive development, problem solving and higher order thinking (Wilkinson & Fung, 2012), and it also improves a student's performance in learning (Tsuei, 2012). Therefore, the existence of the framework has provided a shortcut for the instructor to produce meaningful learning through the use of metacognitive scaffolding, particularly by looking into the preferred types of online interactions among the students. This has actually reflected the students' learning process.

### **Limitation and Future Studies**

In this research, the effectiveness of framework metacognitive scaffolding in learning through Facebook is being tested. Since the framework is being implemented via Facebook, future research should investigate the effectiveness of this framework in group feature of other social media or applications. It would be interesting to compare the effectiveness of framework metacognitive scaffolding in other social media.

The participation among students in the discussion is satisfactory, however, to increase participation among students, instructor can give extra marks for active participations to encourage students to give feedback on the post. This study only focused on undergraduate students in one section of the Telecommunication and Networking. Future study need to increase variety of participants such as from different university to increase the quality of the study. It also would be interesting to conduct this study by involving participants from other country to examine whether differences in sociocultural contexts give effect on framework of metacognitive scaffolding used in Facebook.

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