Metacognitive Scaffolding to Support Students in Learning Authoring System Subject

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***Abstract*—Authoring System is one of the computer-based subjects that expose students with creative activities using an authoring tool such as *Adobe Flash* software to produce multimedia applications. The demonstrations and hands-on activities among students while learning this subject are fundamental. Therefore, the guidance from the instructors through the use of metacognitive scaffolding may ease their difficulties, as this type of guidance supports students in understanding the best possible strategy to accomplish difficult tasks and thus, develop their thinking. In this study, students were scaffolded by the instructor through the use of mechanisms of metacognitive scaffolding. This guidance was delivered through the discussion on the Facebook group page, in which each prompted mechanism of metacognitive scaffolding from the instructor was coded accordingly. In addition, to demonstrate the effectiveness, students were given a pre and post test assessment. This study was carried out for seven weeks. The sample of the study was composed of twenty master students from the Educational Technology program. The quantitative analysis reveals that students' performance in learning Authoring System subject increase after receiving metacognitive scaffolding from their instructor.**

Keywords—metacognition; metacognitive scaffolding; metacognitive strategies; learning performance.

I. INTRODUCTION

Authoring System is one of the computer-based subjects that expose students with creative activities, ranging from simple typing content to designing and developing of complex multimedia courseware by using an authoring tool to produce computer-based instructional applications [1]. Sidhu and Ramesh [2] stated that the use of multimedia authoring tools requires one to have knowledge and skills to operate such tools. For example, some challenges that concern learners include their lack of knowledge [3] and also their technical skills [4]. On the other hand, the demonstration and hands-on activities in learning this subject are critical [5]. Thus, support or scaffolding from knowledgeable others in learning this subject is crucial [6], [7].

In education, scaffolding refers to the process in which teachers or skillful peers assist a learner, solve problems and help the learners to complete a complex task that is beyond his or her current knowledge [8]. There are four types of scaffolding that support learners, especially in an online learning environment. This includes: procedural, conceptual, strategic and metacognitive scaffolding [9]. Among those four types of scaffolding, metacognitive scaffolding seems to be the appropriate way to assist students in learning Authoring System subjects as it guides students with both theoretical and technical knowledge [10]. Besides that, Jumaat & Tasir [11] found that researchers mostly prefer the use of metacognitive scaffolding especially in assisting students in an online learning environment.

II. LITERATURE REVIEW

A. Authoring System

Authoring System subject requires students to have familiarity and knowledge of technical skills such as operating software tools and understanding its functions for the purpose of drawing, creating animations or developing multimedia applications. For students who are first being introduced to this subject, operating such tools can be quite troublesome. Thus, the guidance from the instructors through the use of metacognitive scaffolding may ease their difficulties, as this type of guidance supports students in understanding the best possible strategy to accomplish difficult tasks and thus, developing their thinking.

B. Metacognitive Scaffolding

According to [9], scaffolding students' during learning can motivate them to learn challenging tasks, particularly in a computer-based learning environment. Furthermore, Reingold, Rimor and Kalay [12] have stated that metacognitive scaffolding supports the learning process by framing the problem, guiding students, and giving ways for them to solve problems under possible strategies. This type of scaffolding suggests the students to plan ahead, evaluate learning progress and determine their needs. Moreover, metacognitive scaffolding may also remind the students to reflect on the learning goals in order to manipulate the problem at hand.

By using metacognitive scaffolding in a learning process, novice students can be assisted in learning in a better environment, particularly through good guidance from experts. There is a growing body of scholarly works on integrating metacognitive scaffolding through software-based activities [13], [14], in computer-supported learning

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environment [15], [16], and the impact of metacognitive scaffolding on learning [17].

According to Azevedo et al. [18], scaffolding students' metacognition during learning in a computer-based learning environment can motivate students to learn the challenging tasks because students who are first being introduced to develop multimedia applications with Flash may find it difficult for them to accomplish tasks as this software requires both knowledge and technical skills.

In fact, metacognitive scaffolding has also provided opportunities for the students to explicitly reflect on the quality of their planning and how well they executed their plans [19], [20]. According to Bannert, Hildebrand, and Mengelkamp [21], metacognitive scaffolding intends to increase students learning abilities by means of systematic approach in assisting students on how to think about the problem under study. With the assistance of metacognitive prompts by the instructors, it certainly requires students to carry out certain tasks or activities when the learning takes place. From here, learners could highly simulate to activate their own heuristic learning [22]. Besides that metacognitive support focuses students' awareness of their own thinking and on understanding the activities they are engaged during learning. Meanwhile, Reingold, Rimor, and Kalay [12] have introduced seven instructor metacognitive scaffolding mechanisms that can be used in an online learning medium.

The primary research questions that involved in this study were as follows:

i) What are the dominant mechanisms of metacognitive scaffolding used by the instructor to assist students in learning Authoring System subject?
ii) How does the metacognitive scaffolding could enhance students' performance in learning Authoring System subject?

III. METHODOLOGY

A. Research Design

A pre-experimental research, a one-group pre-test and post-test design was used throughout this study. This "single group study" does not include the control groups due to the researcher's concern on the threats of an internal validity. This includes any form of communication that exists between participants in control and experimental group that may influence the final results.

B. Participants

A total of twenty master students who were enrolled in an Authoring System subject, from the Educational Technology program were involved in this study.

C. Procedure

The study was conducted for seven weeks. Just before the class started, students were given a pre - test assessment to determine their prior knowledge in learning this subject. Later on, to trigger their learning process, four mobile learning applications or *apps* were developed and then distributed to the students. There are four topics involved in the subject: i) Introduction to *Adobe Flash*, ii) Drawing in *Adobe Flash*, iii) Creating Animation with *Adobe Flash* and finally, iv) Applications of Interactivity.

At the end of each lesson, students were then being given a learning activity. This learning activity consists of a set of questions that are related to the learning topic represented in the mobile apps. The students were also required to discuss with their instructor and their peers within the *Facebook* group page, a page that has been created and monitored by the instructor. This is where the instructor scaffold the students using the seven mechanisms of metacognitive scaffolding introduced by Reingold, Rimor and Kalay [12]. Finally, students were given post-test assessment as a result to determine the effectiveness of metacognitive scaffolding that possibly has helped students in learning Authoring System subject.

D. Instruments

Two research instruments were used in this study, which are observation on the *Facebook* group page and also performance test.

1) Observation on Facebook group page

Students are encouraged to discuss with their instructor and peers throughout the seven weeks of study. The researcher played her role; monitored and observed instructor and the student's participation in the discussion. Each prompted mechanisms by the instructor were coded accordingly using content analysis technique as shown in Table 1.

TABLE I. MECHANISMS OF METACOGNITIVE SCAFFOLDING PROMPTED BY THE INSTRUCTOR

Code	Description
MS 1	Presenting rationale for task and activities (Giving direct rationale or asking students the rationale of the task)
MS 2	Presenting the relationship between reading items, course objectives and tasks (Comparing two concepts, identifying the differences or similarities)
MS 3	Supporting reflective writing (Giving feedback – positive or negative feedback to encourage reflection)
MS 4	Focusing on the process of learning (Monitoring learning process/asking questions to trigger learning at low level not yet require students to reflect)
MS 5	Encourage relationships among participants (Asking questions to encourage students to interact with peers and give compliments to the group performance)
MS 6	Discriminating between conclusion/fact/opinion/ hypothesis
MS 7	Supervising text comprehension (Instructor refers to previous statements that posted by students and then make comments or asking more about their posts)

This research used 'meaning' as the unit of analysis. The inter-rater reliability was calculated. The percentage of agreement on each item of metacognitive scaffolding was 81 percent, in which 46 of 57 items agreed between two raters. The Cohen's Kappa value of 0.794 was determined, in which value from 0.80 onwards is considered 'almost perfect' [23].

2) Performance test

Performance test consists of pre-test and post-test. Both were designed with the same structured questions. Pre-test

were given before the class started and post-test was given to the students on the seventh week, which is on seventh week-right before the class has ended. The correlation coefficient value for test-retest in this study is 0.738. The pre and post-test questions was validated earlier by two experts. Table 2 shows examples of questions in the performance test.

TABLE II. EXAMPLE OF QUESTIONS IN THE PERFORMANCE TEST

No.	Question
1	Provide two examples of applications that can be developed with Adobe Flash CS3.
2	To draw an image of a house, what is an appropriate tool to be used?
3	What is the difference between Brush tool and Pen Tool? And does the size of the pen head and brush head can change?
4	Discuss a step by step procedures to create Text Entry Question in Flash as per below example. When the user keyed in his name "Ahmad", His name will appear whenever he clicked on the submit button.

IV. RESULTS AND DISCUSSIONS

Table 3 shows that there were a total of 628 posts of metacognitive scaffolding prompted by the instructor throughout the discussion. The findings revealed that across twenty students who were involved in the study, MS4 is the dominant mechanism of metacognitive scaffolding prompted by the instructor, followed by MS3 and MS5.

TABLE III. DISTRIBUTIONS OF INSTRUCTORS' METACOGNITIVE SCAFFOLDING

Student	Mechanisms of Metacognitive Scaffolding							
	MS1	**MS2**	**MS3**	**MS4**	**MS5**	**MS6**	**MS7**	**Total**
S1	1	0	7	10	5	1	5	29
S2	3	0	5	11	4	2	1	26
S3	8	0	11	13	8	2	2	44
S4	2	1	8	12	3	2	1	29
S5	2	0	4	11	2	0	1	20
S6	6	0	7	5	1	3	0	22
S7	7	0	4	2	1	0	2	16
S8	6	0	10	12	5	3	2	38
S9	6	0	9	17	5	0	2	39
S10	6	0	8	14	9	3	3	43
S11	10	1	6	10	4	1	2	34
S12	13	2	12	23	16	1	2	69
S13	7	0	4	7	3	1	5	27
S14	2	0	13	7	5	0	2	29
S15	3	0	12	17	7	2	1	42
S16	2	1	6	10	6	1	3	29
S17	11	0	3	12	3	0	2	31
S18	2	0	3	5	2	0	0	12
S19	0	0	5	10	2	3	0	20
S20	0	0	6	12	9	1	1	29
Total	**97**	**5**	***143**	***220**	***100**	**26**	**37**	**628**

Instructors often encouraged the students to focus on the process of learning (MS4). It was suspected that instructor keen to provide this kind of support, which have appropriately facilitated the students with strategies that have kept them on track and let them focus on their tasks. Mazzolini and Maddison [24] also agreed that one of the key roles of an online instructor is to facilitate and encourage students to participate and focus on the learning process. The example of MS4 posted by the instructors is as follows:

Instructor comment: *"What is the function of Shape Tool actually? Can it be used to create a star? And what kind of shape you can create with the tool?"*

Besides encouraging and trigger students learning process, instructors regularly providing feedbacks to the students (MS3) – be it positive or negative feedbacks; both are valuable in pertaining students engagement in the discussion. Finally, instructors' effort to encourage relationships among students (MS5) in the discussion should not be overlooked. The objective is to increase students' motivation and thus increase their participation and involvement in the discussion. Indeed, Garrison and Anderson [25] agreed that students who are involved in discussions regularly by interacting with their peers can actually improve their learning outcome.

Table 4 provides the details on the distributions of metacognitive scaffolding received by each student, as well as their pre and post-test scores.

TABLE IV. DISTRIBUTIONS OF INSTRUCTORS' METACOGNITIVE SCAFFOLDING AND STUDENTS' PRE AND POST-TEST SCORES

Student	Total of metacognitive scaffolding received	Pre-Test Score	Post-Test Score
S1	29	40	80
S2	26	23	86
S3	44	23	71
S4	29	40	100
S5	20	3	66
S6	22	34	71
S7	16	23	66
S8	38	34	100
S9	39	29	100
S10	43	34	77
S11	34	34	91
***S12**	69	29	100
S13	27	40	80
S14	29	29	74
S15	42	46	94
S16	29	46	77
S17	31	29	97
S18	12	34	66
S19	20	29	77
S20	29	29	69

Findings revealed that S12 as the student who received a high number of metacognitive scaffolding from the instructor with a total of 69 posts. Interestingly, result also shows that there is a large difference between pre and post test scores for S12.

TABLE V. PEARSON CORRELATION MATRIX

	Post-test Score
MS	0.592**

**. Correlation is significant at the 0.01 level (2-tailed)

Result from Table 5 indicates that there is a positive, moderate significant correlation between the metacognitive scaffolding with the student's performance in learning the subject. This might be due to the students' benefiting from the structured guidelines of the seven mechanisms of metacognitive scaffolding prepared by the instructor prior to the discussion sessions; this action has contributed to the students' learning performance. This finding supports the discoveries from previous studies which have linked instructor metacognitive scaffolding with students' performances [26], [27]. This suggests that metacognitive scaffolding can enhance students' performances as it supports students in their learning process through proper strategies that stimulate their thinking. Besides that, this finding reveals that the use of *Facebook* can actually promotes students' interests and become engage in an academic related discussion.

V. Conclusions

This study concluded that the metacognitive scaffolding from the instructor through the discussion on the *Facebook* group page increases students' performance in learning Authoring System subject. Moreover, instructor's involvement in guiding the students somehow emphasizes students' participation and engagement in the discussion, and thus contributing to their academic success.

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