Integration of Peer Instruction in Online Social Network to Enhance Higher Order Thinking Skills

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Abstract—Higher Order Thinking skills (HOTs) are important thinking skills for lifelong learners, active social responsibility and proactive employees in the 21st century. The rapid development of technology in education has made learning anywhere and anytime possible. This study was conducted to investigate the effect of the integration of peer instruction in online social network could on students ability to answer HOTs questions. Peer instruction is one of the learning techniques that promote HOTs in a cooperative learning setting. It promotes students' participation in class and increases their learning engagement. This study applied repeated measures one group pre-post test design which was carried out among 20 students (purposive sampling technique) in higher education institution. It was carried out in 3 different sessions. Students have to answer HOTs questions in the form of multiple choices using an online quiz system, while peer instruction activities were carried out using and online social network app. Findings show that there is significant effect of peer instruction activities on students quiz scores and no significant difference of students peer instruction activities among the 3 learning sessions.

Keywords—Peer instruction, Higher order thinking skills, Online Social Learning

1 Introduction

Higher order thinking skills are vital for learning processes for a whole life, contribution for social responsibility and producing proactive employees in the 21st century [1,2]. Building the skills among the learners could be challenging, but there are ways to help acquire and enhance them, one of which being peer instruction. Interactions made among the learners would trigger active learning systems, one of the main aspects to crop higher order thinking skills among the learners. According to [3], active involvement from the learners, expected to be achieved via active learning systems could encourage the learners to have a higher level of understanding of things, thus providing them the opportunities to be able to integrate and synthesize the knowledge gained

from the learning process. Learners who are actively involved in learning processes by implementing peer instruction, for example, could improve their conceptualization ability systems, enabling them to have a higher level of knowledge retention, compared to the passive learners [3]. Higher order thinking skills that can be enhanced from the active learning system are always described as the ability of a learner to synthesize, make judgement from a problem and solve it using a higher level of thinking. These skills are very important for students or learners to acquire them, since in this modern era of globalization, those skills are needed for them to be competent as in the context of working areas, where they need to apply the theories they learned in real life situations. Higher level order of thinking also could help the learners to learn better and increase their ability to gauge their own weaknesses [4].

Online network environment is one of the components of modern teaching and learning processes, where the students can access instructional processes via online mode, thus enabling these learning processes to take place anywhere and anytime, as long as the internet connection is available [5]. It is being widely used nowadays, as it is more interactive to attract students' attention better, compared to conventional classroom teaching. The teachers or instructors are also encouraged to use it more often as it could help in the students' learning process. Integrating it with peer instruction is another way for the students to acquire higher order thinking skills even faster. Peer instruction is described as an approach for students to construct their own understanding of knowledge, where students share and discuss their findings together with their peers, brainstorming together in solving problems [6]. This paper examined the way integrating these two approaches, namely, peer instructions and online social network could enhance higher order thinking skills among the learners.

2 Literature Review

While active learning is fast becoming one of the main learning approaches preferred by the lecturers when teaching groups of adult learners, the approach implementation can vary, depending on the expected outcome of the study stated in the learning objectives of each lecture or subject. For example, in online social network environment, participants are involved in the discussion that requires them to demonstrate their skills involving analysis, evaluation and synthesis (creation of new knowledge). On top of that, participants are actually involved in the process of learning of complex judgmental skills, such as critical thinking and problem solving which fall under higher order thinking skills (HOTS). Discussion between participants can be aggressive and can also be linear at times, in which case, motivation and support are needed to sustain the discussion and remain relevant within the defined scope. Therefore, peer instruction is seen as a trigger to enhance Higher Order Thinking Skills in Online Social Network.

2.1 Peer Instruction

Peer instruction (PI) can be described as student's engagement in build up their understanding of the learning concepts through individually answer a question, discuss

with their friends, and answer to the same question [7]. The PI encourages critical thinking, problem solving, and decision-making skills [3]. Thus, the challenges encountered in higher education today, are to provide opportunities or medium for students to capitalize on the power of social media technology while simultaneously inspiring the students with authentic scenarios for them to practice techniques in solving problems and to develop thinking skills all to be done as a team [8]. While the students develop their skills, particularly thinking skills, they also could develop their leadership and team working skills, as well as working in a team, regardless of the number of people in a group. Besides that, PI is one of the examples of student-centered approaches that involve cooperative and active learning and it lets the students to have the freedom in constructing their own learning period and process [6].

2.2 Active Learning

Active learning has become one of the main learning approaches being used by lectures when teaching adult learners. The approach of active learning varies and it depends on the expected outcome of the study stated in the learning objectives of each lecture or subject. For example, in the environment of online social network, participants are involved in the discussion that requires them to demonstrate analysis, evaluation and synthesis skills (new knowledge creation) [9, 10, 11]. On top of that, the participants are also involved in the process of learning complex judgment skills, such as critical thinking and problem solving, which fall under higher order thinking skills (HOTS). Discussions between participants can become heated or sometimes, linear that needs motivation and support to sustain and maintain it within the scope of the particular discussion [9,11]. Therefore, peer instruction is considered as a trigger to develop Higher Order Thinking Skills in Online Social Network. Thus, the input from individual communication and skills influence will be analyzed to design the framework of peer instruction in online social network to enhance HOTS.

Active learning approach provides the students with the opportunity to see theory in practice. Students will have their own time to discuss on a particular topic, while attempting to reach consensus on the correct answer or the creation of a new knowledge. By having discussion sessions, students will be more engaged, interested, and involved in the learning process. The process that happens during the discussion among peers could trigger their higher level of thinking which enables them (as well as the instructor) to assess their understanding of the concepts.

In online social network, there are many ways to encourage students' participants in a discussion or a forum [5, 12], one of which being peer instruction, seen as a main contributor to trigger an active online discussion which becomes the cause of students' involvement [13]. Students' behaviour in class can be different, compared to that while a discussion is held online. As teachers or instructors, they play a main cast in motivating students to cooperate by encouraging them to be involved in the discussion. In addition, the teachers and instructors can also give tips or guide the discussion into the right direction. However, students' behaviour will react differently when they are discussing a topic in online social network, as they feel more open and confident to throw

ideas or share their understanding, or even post any questions, compared to while in a formal lecture.

In an online discussion, social skills are seen to be an important attribute among participants to fulfil the objectives to be able to bring the discussion into an active learning. However, not all students possess these social skills attribute, thus causing the initiatives to bring an online discussion into a successful student-centered learning approach a challenge. [14] defined social skills as the ability to communicate effectively, the ability to work well in a team and the ability to influence and inspire others. Social skills is also defined as the ability to induce cooperation among each other [15]. In other words, social skills refer to the ability to find common ground and build rapport. This can also refer to the proficiency in managing relationships and building networks between peers which interaction is based on an integration of such knowledge and skills.

2.3 Higher Order Thinking Skills (HOTS)

Creative thinking can promote an individual's growth to become more innovative, better creativity, ideal and imaginative [4]. The definitive value of a tool used to detect cognitive presence depends on which model of critical thinking is being used (i.e., practical inquiry) as well as its capability to reflect educational practices. Recognizing the aforementioned cognitive presence focuses on higher order thinking processes is detrimental in contrast to learning outcomes of specific individuals [16]. Higher order thinking skills are a crucial aspect in teaching and learning. Thinking skills are cardinal in educational process. The thought of a person can affect learning's ability, speed and effectiveness. Hence, thinking skills correspond with learning processes. Students who are shaped to use thinking skills exhibit positive outcome in their education development [4].

Higher order thinking skills include majority of cognitive elements: critical, logical, reflective, meta-cognitive, and creative thinking. They are stimulated by brain when individuals encounter unsolved problems, uncertainties, confusions or dilemmas. Meanwhile, [17] assessed critical thinking skills in 5 different levels: Interpretations, Evaluation of Arguments, Inference, Recognition, and Deductions. Besides, HOTs also can be categorized into 6 levels, namely, remember, understand, apply, Analyze, evaluate and create, as mentioned by [18].

A previous study about students' attitudes towards the usage of technology showed positive relationships and a direct influence on the higher-order thinking of the students [19]. In addition, [20] reported that, students positively believed in using social media as a learning tool in higher education. They also suggested future research on the effectiveness of using social media for education for different types of courses and teaching methods [20]. Thus, in this study, students' level of higher order thinking skills will be explored in online social network learning environment.

3 Research Methodology

This research was carried out using one group repeated measures design. The activities were done through online social network using WhatApp application for peer instruction and Kahoot quiz system for learning assessment. The class comprised a total of 20 students (purposive sampling technique) in their 5th semester education programme. They are part-time students who are currently pursuing their studies in Bachelor Degree Programme. The subject course was designed to consist of 5-time face-to-face teaching and learning sessions, where each session is carried out for 6 hours, comprising 2.5 hours of lectures, 2 hours of activities and 1.5 hours of break.

3.1 Research Design

Creative thinking can promote an individual's growth to become more innovative, better creativity, ideal and imaginative [4]. The definitive value of a tool used to detect cognitive presence depends on which model of critical thinking is being used (i.e., practical inquiry) as well as its capability to reflect educational practices. Recognizing the aforementioned cognitive presence focuses on higher order thinking processes is detrimental in contrast to learning outcomes of specific individuals [16]. Higher order thinking skills are a crucial aspect in teaching and learning. Thinking skills are cardinal in educational process. The thought of a person can affect learning's ability, speed and effectiveness. Hence, thinking skills correspond with learning processes. Students who are shaped to use thinking skills exhibit positive outcome in their education development [4].

The peer instruction technique was applied in three different sessions of a class. In each session, students were given 2 questions, developed as multiple-choice quizzes on the subject taught. An online quiz system was used to record the students' answers. All the questions were asked twice, allowing the students to have 2 attempts to answer the questions. During the 1st attempt, students had to think for the answers all by themselves while, during the 2nd attempt, students can discuss the answers with their peers before giving the final answers as shown in Figure 1.

Step 1 : The quiz system shows a question (question number 1) with possible answers to the students.

Step 2 : Students are allowed to think for the correct answer by themselves within 60 seconds.

Step 3 : Each student responds to the quiz system by selecting only one correct symbol that represents his or her chosen answer for the 1st attempt. In the quiz system, all possible answers are displayed in the form of symbols.

Step 4 : The quiz system shows the percentage of chosen answers selected by students during the 1st attempt, without showing the correct answer. **

Step 5 : Students are allowed to discuss the correct answer for the same question (question number 1) with their peers within 90 seconds.

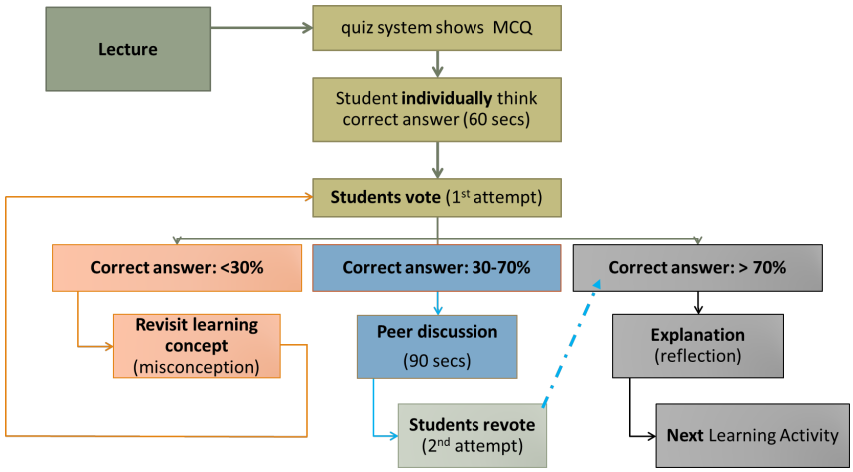

Fig. 1. The process of peer instruction

Step 6 : After the discussion, each student responds to the quiz system by selecting only one correct symbol that represents his or her chosen answer for the 2nd attempt. Students are permitted to vote their previously chosen answer (1st attempt) or change their answer if needed.

Step 7 : The quiz system shows the percentage of chosen answers that selected by the students during the 2nd attempt. Teacher highlights the correct answer.

**If the total of students who correctly answered the questions was below 30%, the teacher will be required to revisit the learning content and explain to the students regarding their misconception of the learning content. Meanwhile, if the total of students who correctly answered the questions was below 70%, the teacher will ask students to be engaged in the Step 5 (peer discussion) and to rethink for the correct answer before selecting for the 2nd attempt. If the student who answers correctly is more than 70%, the teacher will have to explain the answer to the whole class before moving on to the next questions. If they are still struggling understanding, the teacher will need to repeat the process in mini lectures.

3.2 Instrumentation

The main instrument used in this study is the set of HOTS questions. For every session, there were two multiple choice questions of single-best response type developed according to HOTS level based on Bloom's taxonomy of cognitive domain. Bloom classified the cognitive domain into two major groups: 1) Low order thinking skills and 2) Higher order thinking skills. Bloom labelled the lower domain as remembering, understanding, and applying, while the higher order was classified into three levels, namely, analyzing, evaluating, and creating skills. In this study, questions in all the sessions were formulated at the level of analysis and evaluation cognitive level. The questions formulated for all the sessions and the respective cognitive levels are shown in Table 1.

Table 1. Formulated questions for all the sessions

Session	Question #	Question	Cognitive level
1	*1*	*Effective navigation can answer all these questions except ..*	Analyze
	2	*How can we ensure that the developed visual design is consistent?*	Evaluate
2	3	*Which of the followings are not used for visual sketching?*	Analyze
	4	*Three main of the following parts that have to be considered when designing website except …*	Evaluate
3	5	*Which of the followings have to be considered when designing information?*	Analyze
	6	*The developed website has to consider the followings except..*	Evaluate

4 Results and Findings

To answer the aim of this study, descriptive statistics was used to provide the percentage of answers received, based on all three sessions in the 1st and the 2nd attempts as shown in Table 2. Generally, all mean values for students' scores during second attempt increases. For all the questions, percentage of students getting correct answer after the second attempt is higher for all the questions.

Table 2. Descriptive statistics for students' 1st and 2nd attempt for all three sessions

Question (Q)	Attempt	Answer A	Answer B	Answer C	Answer D	Mean	Standard Deviation
1	1st	2 (10%)	5 (25%)	11 (55%) ☑	2 (10%)	0.55	0.51
	2nd	0	0	18 (90%) ☑	2 (10%)	0.90	0.31
2	1st	0	3 (15%)	10 (50%) ☑	7 (35%)	0.50	0.51
	2nd	0	1 (5%)	15 (75%) ☑	4 (20%)	0.70	0.47
3	1st	0	0	5 (25%)	15 (75%) ☑	0.75	0.44
	2nd	0	1 (5%)	0	19 (95%) ☑	0.95	0.22
4	1st	15 (75%) ☑	3 (15%)	2 (10%)	0	0.40	0.50
	2nd	20 (100%)☑	0	0	0	0.45	0.51
5	1st	10 (50%) ☑	4 (20%)	5 (25%)	1 (5%)	0.50	0.51
	2nd	15 (75%) ☑	0	5 (25%)	0	0.75	0.44
6	1st	4 (20%)	5 (25%)	4 (20%)	7 (35%) ☑	0.30	0.47
	2nd	0	4 (20%)	3 (15%)	13 (65%) ☑	0.65	0.49

☑ = correct answer

To identify the effect of peer instruction on students' scores in HOTS questions after every first attempt of answering the questions, paired sample t-tests were carried out to the following question pairs as shown in Table 3. Pairs were formed based on students' first and second attempt in answering every question. Findings show that peer instruction has significant effect on students' attempt in answering HOTS questions for

Question 1, Question 5 and Question 6 and no significant effect on students' attempt in answering HOTS question for Question 2, Question 3 and Question 4.

Table 3. Paired-samples *t*-test results

	Paired Differences					*t*	*df*	Sig.(2-tailed)
	Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference*				
				Lower	*Upper*			
Q1 1st Attempt - Q1 2nd Attempt	-0.35	0.587	0.131	-0.625	-0.075	-2.67	19	0.015**
Q2 1st Attempt – Q2 2nd Attempt	-0.20	0.616	0.138	-0.488	0.088	-1.45	19	0.163
Q3 1st Attempt – Q3 2nd Attempt	-0.20	0.523	0.117	-0.445	0.045	-1.71	19	0.104
Q4 1st Attempt – Q4 2nd Attempt	-0.05	0.510	0.114	-0.289	0.189	-0.44	19	0.666
Q5 1st Attempt – Q5 2nd Attempt	-0.25	0.550	0.123	-0.507	0.007	-2.03	19	0.056*
Q6 1st Attempt – Q6 2nd Attempt	-0.35	0.489	0.109	-0.579	-0.121	-3.20	19	0.005*

**p< 0.01, *p< 0.05

To further identify if there is any significant difference between students' scores upon peer instruction intervention after three different sessions, repeated measures one-way ANOVA test was carried out. It was found that there is no significant difference between three different sessions ($F(2, 38) = 0.884$, $p = 0.422$, ($p > 0.05$) indicating that all the effects of peer instruction intervention over three sessions were the same.

5 Discussions

In this study, students' knowledge-based or conceptual mastery in HOTs was examined to see the effects caused by incorporating peer instruction in class teaching. This pedagogical method that promotes active learning during class and increases students' engagement with peers was also found to contribute to students' performance in quiz. The main research finding, which focuses on students' performance on making decision after peer instruction activities, revealed that, the increased percentages of correct answers for HOTs questions that include analyzing and evaluating levels.

During peer instruction activities, active learning activities further promote students' learning performance. The questions formulated in this study were mostly related to the conceptual knowledge about website design and peer instruction activities before students' second attempt had assist students' understanding. This is similar to findings by [21] who found that peer instruction can improve students' conceptual knowledge and

boost learning motivation particularly self-efficacy. This study shows that students' learning performance did not significantly increase for questions that are closely related to students' ability to memorize facts in the learning domain. For example, peer instruction has no significant effect on students' score in Question 4, where students have to first, remember the types of design for website development. It clearly shows the role of peer instruction in improving conceptual understanding [22].

During peer instruction activities, students have to discuss via an online social network app. After series of intervention, students' ability to carry out peer instruction activities is consistent during all the sessions in this study. Students familiarity towards online social network app might contribute to this factor which allow peer instruction activities to occur in a less demanding learning environment. Students' readiness for online social network is very important as it will affect the way they socially interact online [23]. Using online social network app allows the students to communicate efficiently, collaborate and co-create learning, as well as provide variety of ways to learn [24].

6 Conclusion

Students' ability to analyze and evaluate in the decision making process is enhanced by having discussions [10]. [25] claimed that, there is a greater opportunity to change the opinions of someone who is wrong or who has a misunderstanding, compared to changing the opinions of someone who has already obtained the correct answers or who has a clear understanding on the subject matter or a question. Peer instruction activities were found to effect students' conceptual understanding in this study particularly for questions of high order thinking skills. However, the role of medium of interaction for peer instruction is also important. Practitioners have to properly select the technological tool that is familiar to the students to reduce the demand of conducting peer instruction activities in every learning session.

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