Online Reciprocal Peer Tutoring Approach in Facebook: Measuring Students' Critical Thinking

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Abstract—Critical thinking skills are one of the essential employability skills for graduates when entering the workforce. The lack of critical thinking skills among Malaysian graduates is a concern, as these skills are vital for success in the 21st century. Therefore, this paper aims to study the effects of online reciprocal peer tutoring (RPT) through Facebook discussion on students' critical thinking. In this study, the instructor used the online RPT approach on Facebook to nurture students to think critically. In RPT, the tutor role is switched between participants in each task, giving equal opportunities to all learners to benefit from the tutor and tutee role. This approach was integrated into their learning for four weeks to increase students' critical thinking. They need to be involved in 4 critical thinking tasks based on Bloom's taxonomy during the learning process. Twenty-nine undergraduate students from the School of Education, Faculty of Social Sciences and Humanities at Universiti Teknologi Malaysia completed the validated instrument, Watson-Glaser Critical Thinking Appraisal test (inference, assumption, deduction, interpretation, evaluation arguments) before and after the treatment. The findings show that it is significantly different in making inference ($Z=-3.85$, $p=.000<*.05$) and deduction ($Z=-3.627$, $p=.000<*.05$) criterion in post-test. These revealed that students who engaged in the online RPT environment showed positive improvements in those criteria in critical thinking after the treatment. In conclusion, students' critical thinking can be nurtured using Facebook with active learning strategies such as online RPT.

Keywords—critical thinking, online reciprocal peer tutoring, Facebook, WGCTA

1 Introduction

Developing critical thinking (CT) has been the most crucial issue for improving education in Malaysia [1]. CT skills are essential for higher education students because

these skills are needed later for the workforce [2]. In the Malaysian context, based on Malaysia Education Blueprint 2015-2025 [1], graduates lack critical thinking skills that are essential for success in the 21st century. Thus, developing students' CT is crucial to be infused in higher education curriculum regardless of whether the learning happens in classroom discussions or online discussions. In this study, the development of students' CT can be achieved by implementing reciprocal peer tutoring (RPT) strategy through online discussions using the Facebook platform.

Further, online learning has been growing and used widely in higher education. The online learning environment supports active interaction between students and instructors via online forums, chat rooms, and emails. Since many youngsters are familiar and more proficient with social media platforms, educators need to implement these technologies in teaching and learning. Numerous studies reported positive findings regarding the application of social media tools for academic purposes [3]–[5]. Thus, this study uses Facebook as a discussion platform to enhance students' critical thinking.

2 Literature review

2.1 Online learning in higher education

The usage of computers and the Internet for academic purposes in higher education has increased in recent years [6], [7]. As Internet technology has become more readily available and accessible, most higher education courses worldwide have embedded online learning in teaching and learning formally and informally. Moreover, another reason for using online learning is the rise of Web 2.0 because of today's web technology evolution. Most of the usage of open educational resources in Web 2.0 offers the tools for instructors to create and share their work. Some examples of open educational sources include online social networking sites, Wikis, blogs, and e-books. With various online learning platforms nowadays, educators can choose from informal online learning platforms such as social networking sites to formal online learning platforms such as learning management systems to use for teaching and learning.

There is an ongoing argument between online learning scholars whether using a specific delivery technology or the teaching strategy improves learning [8]. Often the problem occurs not to be technological but pedagogical: seeing why and how to use technologies efficiently in practice is a complex issue. As stated in [9], they argue that choosing the right technology for education does not matter. Still, most importantly, students and instructors can achieve the learning goals if the teaching strategy is adopted appropriately in the virtual spaces. However, the features of the technology are necessary to bring real-life models and simulations to the learner; as a result, the technology does affect the learning. Many scholars reviewed these issues from various perspectives. Thus, instructors should consider the right delivery technology and the appropriate teaching strategy for an active online learning environment.

2.2   Using Facebook to support teaching and learning

Recently, many studies reported both positive and negative results about Facebook as a means for teaching and learning. [10] studied the effectiveness of Facebook in teaching and learning a computer science course in a university preparatory year setting in Saudi Arabia. The findings show that the students developed a positive attitude when using Facebook and Web 2.0 tools in their learning activities. In addition, Facebook also can be one of the best tools to increase communication for at-risk students at youth colleges in Hong Kong [11]. The study investigates the usage of Facebook to create a learning community that can help to motivate them to attend and to participate in different school activities. The positive interaction on Facebook kept all the students in class and encouraged them to attend more seriously to their tasks. Although the semester ended, they continued to interact on Facebook. Besides, a study [12] on the impact of collaborative learning on academic achievement using Facebook in Sunway University in Malaysia revealed that students intend to use Facebook for collaborative learning. But other factors influence collaborative learning, such as intention, interactivity, and engagement.

Despite positive results of using Facebook as a teaching and learning, a study by [13] shows negative findings. There were more passive observers, where 46 percent made no comments or likes and did not upload any documents and links. Only 26 percent of students actively participated in commenting and posting on the course's web page. They proposed other strategies that can help students be more interactive, such as active learning approaches. Therefore, designing the suitable teaching approaches implemented through the Facebook platform can result in the active participation of students in online discussions.

2.3   Critical thinking in higher education

CT is a crucial issue in higher education, and educators have continued to emphasize the nurturing of CT of students. Generating graduates who can think critically about content is the fundamental aim of the institution for higher education. The 21st-century generations face an increasingly technical and complex world that needs more education than in the past. Workers who can think critically to make decisions and solve problems are what most organizations want as their workforce. Thus, in today's world, a new type of worker called a "knowledge worker" is more demanding for organizations. These days to coherently respond to the higher demands for the workforce, higher education must generate graduates who can think critically. With an appropriate teaching method in crafted students' thinking to the higher levels, students can positively develop their thinking in no time. A previous study by [14] conducted two discussion forums in an engineering mathematics unit for two weeks of treatment. The participants of the study were 60 undergraduates from the Swinburne University of Technology, Sarawak Campus, enrolled in a mathematics course. The results showed that their CT skills developed from the first to the second forum. Thus, it is crucial to use the suitable method to develop students' CT thinking, although in a short period.

2.4 Reciprocal peer tutoring strategy using facebook to enhance students' critical thinking

King [15]–[19] investigated many studies on guided peer questioning strategies in reciprocal peer tutoring settings on guiding students to create low- and high-level questions for their peers. Instructors used this strategy to promote students' CT; students learned to generate thoughtful questions that they would take turns answering. Most people tend to ask "low level" simple recall questions rather than "high level" questions that require meaningful analysis of complex information. Therefore, asking thoughtful questions is a skill that needs to be an excellent critical thinker.

Tutors provide examples of questions that engage tutees in long and developed answers that help to clarify their understanding. King [19] suggested a series of generic question stems that can be used in guided peer questioning strategy. Students can use these generic questions in any context, including the transfer of critical thinking skills, which occurs when they know that the transfer is the aim of activities that can increase their thinking abilities. The generic question stems have two types of questions which are review and thinking types of questions. Review type of questions involves low-level questions that do not require critical thinking, consist of comprehension and factual questions. In comparison, the thinking type of questions comprises high-level questions that require critical thinking, such as how and why questions where students need to give sound reasoning of the subject discussions.

In this study, the instructor integrated RPT in Facebook Group discussion to foster students' critical thinking. Learning through Facebook may encourage active student communications through online discussions. Additionally, students can construct new knowledge and improve their thinking skills to a higher level [20]. Furthermore, elements such as personal profile spaces and social connectivity of Facebook that most current students are familiar with could be motivation factors that may involve students using Facebook for learning.

Thus, teaching strategies that involve peer learning, such as RPT, are appropriate for integrating through Facebook. RPT is a social constructivism learning that can produce significant academic success within a targeted course [21]. The switching role between tutor and tutee gives mutual benefits to them [22]. Besides, RPT strategies may develop CT among students using guided questions provided to them [23].

2.5 Measuring critical thinking skills

Several existing assessments are in multiple formats (multiple-choice test, essay, open-ended, etc.) to measure CT. Some of the most popular and widely used assessments of CT, including California Critical Thinking Skills Test (CCTST) [24], California Critical Thinking Disposition Inventory (CCTDI) [25], Cornell Critical Thinking Test (CCTT) [26], and Watson Glaser Critical Thinking Appraisal tool (WGCTA) [27]. In this study, the instructor distributed the WGCTA (Form A and B) to measure CT skills in higher education. The adapted WGCTA from [28] as an indicator to assess local students was used. The adapted WGCTA is in the Malaysian context, where the items and concepts in the original form are still the same and are only slightly changed

to suit Malaysian culture. The reliability and the validity of the adapted WGCTA were considered adequate in general and had a great validity in general. Thus, as the WGCTA is a well-established standardized test widely used to measure CT, this test was chosen to measure students' CT before (Form A) and after (Form B) intervention. Therefore, this study investigates the effects of online reciprocal peer tutoring (RPT) through Facebook discussion on students' critical thinking using the WGCTA test. This study only reported the findings of student' CT in general but, the results of students' CT for discipline-specific content was published in [29].

3   Methodology

This study investigated the effects of online reciprocal peer tutoring (RPT) through Facebook discussion on students' critical thinking. A one-group pre-and post-test design was employed in this study.

3.1   Respondents

A total of 29 students (S1-S29) participated in this study. The participants were second-year undergraduate students who enrolled in a Computer and Multimedia course from the School of Education, Faculty of Social Sciences and Humanities from Universiti Teknologi Malaysia.

3.2   Online RPT procedure

The intervention in this study was conducted in four weeks using online RPT through Facebook discussion. The instructor created 14 Facebook Group pages; students randomly formed 13 dyad groups and one triad group. Four CT tasks based on revised Bloom's taxonomy [30] were given to them each week to be discussed. The tasks include Web Design (Task 1), Interface Design (Task 2), Instructional Design Process (Task 3), and Motivation Component in Developing Software or Website (Task 4). Every task was designed to enhance them to think critically.

The tutor used a guided peer questioning strategy [19] consisting of three types of questions: integration, comprehension, and factual questions. Additionally, they all had opportunities to become tutors as the roles changed in every task's middle of the week. Therefore, during the intervention, the learning happened with guided questions for them to use to promote their thinking skills to higher levels. All the Facebook discussions, statuses, comments were collected and analyzed using content analysis, and the result was published in [29].

3.3   Instrumentation

The two versions of WGCTA, which are Form A (pre-test) and B (post-test), were given to measure their CT before and after the intervention (see Figure 1). This study used the adapted WGCTA test in the Malaysian context from [28]. The test comprises

the five subtests (80 items; 16 items per subtests) of the WGCTA, which are (1) inference, (2) recognition of assumptions, (3) deduction, (4) interpretation, and (5) evaluation of argument. The time duration for administering the test was 90 minutes. The maximum raw score for WGCTA is 80. Raw scores are obtained by adding the number of correct answers on each of the five subtests and then totaling the subtest scores. In summary, the raw score on this test is the total number of correct responses. 80 is the highest possible total comprehensive score, and 0 is the lowest. Then, the raw scores are converted into percentages.
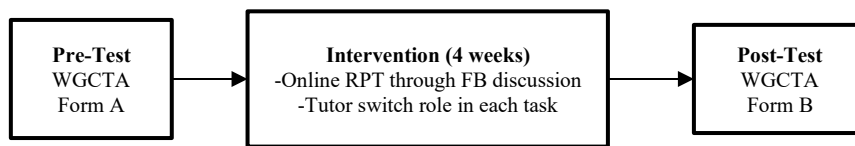

Fig. 1. The procedure of the study

3.4 Data analysis

The data were analyzed using SPSS. After answering the post WGCTA test, an interview was conducted with selected students who have been categorized as low, average, and high achievers. This interview was conducted to gather in-depth opinions from the students regarding critical thinking in general. The results from the interview were to support the data collected based on the WGCTA test.

4 Result and discussion

A Wilcoxon signed-rank test utilizing SPSS was administered at a 0.05 confidence level. In addition, the score of each criterion in WGCTA-A and WGCTA-B such as Making Inference, Recognition of Assumption, Making Deduction, Making Interpretations, and Evaluating Arguments were also analyzed using the same test. The overall students' improvements from pre-test to post-test also were examined. Table 1 reports the overall WGCTA Form A and Form B ranks, which indicated that 26 students had improved in the WGCTA test from pre- to post-test.

Table 1. Ranks of overall WGCTA Form A and B

		N	Mean Rank	Sum of Ranks
WGCTA_B - WGCTA_A	Negative Ranks	3a	14.50	43.50
	Positive Ranks	26b	15.06	391.50
	Ties	0c		
	Total	29		

a. WGCTA_B < WGCTA_A; b. WGCTA_B > WGCTA_A; c. WGCTA_B = WGCTA_A

Table 2 reports the mean for the results of the Wilcoxon signed-rank test for each criterion and the overall mean marks in WGCTA. From Table 2, the overall Wilcoxon

signed-rank test results indicated that the null hypothesis is rejected as the students' performance in WGCTA had improved ($Z = -3765$, $p = 0.000$). Therefore, the online RPT environment was found to influence the students' level of CT significantly. In addition, the data is analyzed deeper for each CT criterion.

The data reveal that the students were more capable overall in making inferences and deductions that were statistically significant ($Z=-3.850$, $p=.000$ and $Z=-3.627$, $p=0.000$) and achieved higher mean marks in the post-test (WGCTA-B) ($M= 7.931$ and $M=12.207$). These findings suggest that students who engaged in the online RPT environment showed positive improvements in CT's Making Inferences and Deduction criterion after the treatment. The possible reasons might be the treatment's CT tasks, which required students to make inferences and deductions compared to other CT skills. The majority of the students' scores had increased, therefore showing significant improvement in their CT skills. The students' CT skills had improved over four weeks of the study. The findings of this study mirror those of the previous studies [31]–[33] that have examined the effects of the usage of online peer learning on students' CT skills. Previous studies showed an improvement in the students' CT skills as measured by a standardized test such as the Ennis-Weir Test of Critical Thinking (EWTCT), the California Critical Thinking Skills Test (CCTST), or a non-standardized test.

Table 2. Summary of the mean marks and Wilcoxon sign rank test

Critical Thinking Criterion		Pre-test	Post-test	Paired Differences	
		WGCTA-A	WGCTA-B	Z	Sig (2 tailed)
Making Inference	Mean	5.034	7.931*	-3.850	.000*
	SD	2.212	2.359		
Recognition of Assumption	Mean	11.345	12.241	-1.187	.235
	SD	2.663	2.247		
Making Deduction	Mean	8.862	12.207*	-3.627	.000*
	SD	2.587	2.412		
Making Interpretations	Mean	11.241	11.862	-1.092	.275
	SD	1.976	2.117		
Evaluating Arguments	Mean	11.897	10.966	-1.420	.156
	SD	2.820	2.556		
Overall	Mean	47.931	54.655*	-3.765	.000*
	SD	5.175	5.887		

Note: *Statistically significant difference between pre-test (WGCTA-A) and post-test (WGCTA-B).

A possible explanation for this result might be the structured online discussions consisting of CT tasks and guided peer questioning strategies in the present study, which can stimulate students' thinking to higher levels. [32] found that structured online discussions employed Socratic questioning strategies, which, similar to guided peer questioning strategies, significantly improved the learner's CT skills and attitude, as compared to unstructured online discussions. Structured online discussions were also generally perceived to be more engaging by students in feedback, modeling, and empowerment.

Peer tutors were encouraged to ask thought-provoking questions to encourage tutees to think critically. Given below are examples of some thought-provoking questions taken from Task 1:

— S26: In your opinion, what causes this thing to happen? Why did they plagiarize our software? Why did they not build the software themselves?

Peer tutors used the guidelines on the types of questions as a reference to discuss with the tutees. As the online discussions are asynchronous, students have more time to prepare and formulate their answers. Prior studies [34] have noted the importance of well-made questions on how they lead to new ideas, the ability to make arguments, and how they were comprehensively exploring the subject matter. For example, student S16 mentioned in the interview that the guidelines on the types of questions helped give them ideas to generate new questions.

However, the WGCTA tests measure only general content and not discipline-specific content could also influence the results. Therefore, these tests do not precisely reflect the CT skills of undergraduate students. The WGCTA tests include content related to neutral topics such as weather conditions, scientific facts or experiments, and other subject matters that people generally do not have strong feelings for or prejudices against. The test items do not ask specifically about the subject matter involved in this study: Multimedia Application and Web Design. Two theories similar to the literature review [35] can be explored based on student interviews. The first theory is that CT skills are applicable across any domain. Secondly, different CT skills needed in a specific field are highly dependent on the knowledge of the subject at hand and the relevancy of other CT skills. Following are the views of two of the students interviewed:

— S3: CT in general and specific are different because in general and specific have other objectives and purposes. For example, in particular subjects like Multimedia subjects, we need the correct facts to argue. Still, in general, we can use a logical mind.
— S29: In my opinion, CT skills used in general and specific are the same. CT skills are needed in any situation regardless of any subject or in daily life.

Even though a set of CT skills are relevant and existent across various domains, students can still think critically on a particular task depending on how much knowledge they have. It was found out that a few students exhibited good CT capabilities. Thus, the CT skills' relevancy depends on the students' understanding of the specific subject. The CT criteria that showed a significant improvement was making inference and deduction. This result indicates that students are better at reasoning and in giving judgments. Their study skill factor may explain this result. For instance, when students evaluate arguments, they ensure that they are well informed about the content. Before they make any deductions, they think of ways to draw a better conclusion. It also seems possible that this result is due to the types of questions used in the Facebook discussion by the tutors. Factual, comprehension, and integration questions might trigger students to draw conclusions and make judgments. Recalling prior knowledge and understanding the subject matter are excellent ways to gain the necessary information

to conclude reasonably. Hence, by asking the right questions, students might be encouraged to think, make judgments, and draw conclusions [36].

5   Conclusion and recommendations

To conclude, the student's WGCTA scores were mainly increased and statistically significant, which shows improvements in WGCTA scores. The students were found to be better at making inferences and deductions. Factors such a general and specific content used to assess CT skills might have influenced the current findings. Additionally, students' study skills might affect their ability to make inferences and deductions. It was also discovered that the ability of the students to make judgments and draw better conclusions depended on the types of questions used.

Suggested future studies could cater around research in different settings and subject courses to determine whether similar findings and results are obtained in other educational contexts. The online RPT method can be implemented for different subjects such as language learning, mathematics, science, etc. While the intervention of online RPT lasted for only four weeks in this study, it is suggested that the intervention be implemented for at least an entire semester in future studies.

Different types of peer tutoring could be implemented in the future study such as cross-age, for example, third-year students as a tutor and first-year students as a tutee. This study involved only the second-year undergraduate students as participants. Different settings and cohorts might produce different results and have a more valid comprehensive conclusion regarding peer tutoring. Furthermore, research collaboration with other universities could be carried out by considering geographical factors which could lead to different interactions.

6   Acknowledgment

7   References

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