Chapter 9
Facilitating Collaborative Learning Through Peer Assessment APP: A Case Study

Abstract It has become common practice to adopt collaborative learning in the field of education. Among different collaborative learning strategies, peer assessment is one of the most effective strategies to improve learning performance and higher order thinking skills. Self-efficacy and motivation are two important dimensions of psychology in peer assessment. This study aims to investigate peer assessment, self-efficacy, and motivation as well as the role of feedback. In total, 48 undergraduates participated in this study and they conducted two-round peer assessments via a developed APP (Application). The results indicated that students with higher intrinsic motivation tended to have higher self-efficacy in peer assessment. Cognitive feedback and concrete suggestions were the most effective for improving learning performance in peer assessment. The implications and limitations of this study can contribute to the implementation of peer assessment in future studies.

Keywords Collaborative learning · Peer assessment · Self-efficacy · Motivation · Feedback

9.1 Introduction

Peer assessment has been widely acknowledged as an effective strategy that helps students make reflections on their learning processes (Lin et al. 2011) and improves their learning achievements (Lai and Hwang 2015). There are many advantages in terms of conducting peer assessment activities. For example, peer assessment can foster student's critical thinking skills (Chao et al. 2014; Lynch et al. 2012). Liu and Li (2014) revealed that peer assessment was helpful in enhancing learners' meta-cognitive awareness. In addition, peer assessment can engage assessors in evaluating their peers' work and providing feedback (Nicol et al. 2014). Learners benefited from peer assessment activity because it provided good opportunities for explaining, summarizing, and reflecting upon the learning processes (Chang et al. 2014).

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In recent years, mobile technologies have developed rapidly and provided good potential for promoting learning. Instant facilities provided by mobile technologies can enable learners to interact with peers or teachers synchronously (Shih et al. 2010). Learners can obtain learning materials and share ideas anytime and anywhere via mobile technologies (Chao et al. 2014). Moreover, Cizek (2010) posited that technology enhanced assessment can provide real-time feedback and formative assessment so as to decrease teachers' workloads. Therefore, researchers have developed mobile peer assessment to submit products, evaluate peers' work, and provide feedback (Chao et al. 2014; Lai and Hwang 2015). However, previous studies paid less attention to the psychology traits and the role of feedback in peer assessment. Hence, this study attempts to investigate peer assessment self-efficacy and motivation as well as the role of feedback messages.

9.2 Literature Review

9.2.1 Peer Assessment

Peer assessment is an instructional method that aims to engage learners in evaluating their peers' work (Topping 2009). In addition, learners need to revise their own work based on peer feedback. Therefore, peer assessment includes two important activities: one is evaluation of peers' work, another is revision of self-work (Chen and Tsai 2009; Smith et al. 2002). Peer assessment provides learners with opportunities to make meaning, reflect on their own ideas, share their understanding, and revise misconceptions (Roscoe and Chi 2007).

Previous studies have reported that peer assessment can improve learning performance. For example, Tsai and Chuang (2013) found structured online peer assessment was helpful for improving learners' writing performance. A similar finding was also reported by Joordens et al. (2009) who found that learners' writing skills were improved after peer assessment. In addition, peer assessment can arouse the interest and motivation of learners. Shih (2011) found that learners' interest in English writing was aroused, and their motivation to write inspired, as a consequence of peer assessment. Furthermore, peer assessment can increase learners' engagement (Bloxham and West 2004) and enhance critical thinking skills (Sims 1989).

Furthermore, Cheng et al. (2015) addressed that what types of peer feedback learners receive was the most important issue in peer assessment. Previous studies also indicated that negative feedback may induce negative emotional responses in peer assessment (Cheng et al. 2014). Therefore, some learners cannot benefit from feedback messages via peer assessment. Thus, which types of feedback message are valuable for learners still needs to be explored (Nelson and Schunn 2009). Based on the previous studies, it was found that there were three types of feedback, namely cognitive, affective, and meta-cognitive feedback. Lu and Law (2012) reported that

cognitive feedback was the most common type of feedback. Some studies reported that cognitive feedback was more helpful for learners using peer assessment to improve learning performance (Cho and Cho 2010; Hattie and Timperley 2007). Some studies found that positive affective feedback was critical for improving learning outcomes (Tseng and Tsai 2007). While Chen and Tsai (2009) found that meta-cogntive feedback was significantly related to learning performance in peer assessment. Therefore, the results of previous studies varied from one study to another. Thus, this study further examines the role of feedback messages in peer assessment so as to gain more insights into the nature of feedback.

9.2.2 Self-efficacy

Self-efficacy was defined as the specific beliefs about what one can do (Bandura 1982). Bandura (1997) believed that self-efficacy had great influence on one's motivation, emotions, thought patterns, and behaviors. Researchers have addressed the idea that self-efficacy is a determining factor in learning performance (van Dinther et al. 2011). Students with high self-efficacy often fulfill their potential (Sööt and Leijen 2012).

Previous studies have demonstrated that self-efficacy was closely related to learning performance (Bell and Kozlowski 2002; Kagima and Hausafus 2000). This means that a higher self-efficacy can lead to better learning performance. Multon et al. (1991) found that self-efficacy was significantly related to learning performance in different contexts via the meta-analysis of 39 studies. Even in a web-based learning environment, self-efficacy still correlated to learning performance (Wang and Newlin 2002).

In addition, previous studies also revealed the relationships between self-efficacy and peer assessment. De Grez and Valcke (2013) found that self-efficacy was positively related to raters' scores. Tseng and Tsai (2010) also indicated that students with higher self-efficacy were more engaged in peer assessment. Hsia et al. (2015) revealed that self-efficacy was significantly related to dance skills in arts courses. To sum up, self-efficacy can affect the quality of peer assessment to some extent.

9.2.3 Motivation

Motivation refers to individuals' internal states that direct their goals and activate their behaviors (Franken 2006). Motivation was characterized as those achievement goals that closely relate to the reasons for performing academic-related tasks (Clayton et al. 2010). Ryan and Deci (2000) posited that intrinsic motivation and extrinsic motivation are two dimensions of motivation. Students will make greater effort when they are intrinsically motivated (Ames and Archer 1988). Tseng and Tsai (2010) revealed that learners with higher intrinsic motivation could perform

peer assessment activities better. Furthermore, Kane et al. (2013) posited that motivation can keep students involved in a high level of dance performance. Therefore, motivation was a very important factor encouraging students to learn better (Ryan and Deci 2000). Previous studies have indicated that peer assessment can significantly promote students' motivation in arts course (Hsia et al. 2015). Furthermore, intrinsic motivation was also closely related to self-efficacy and dance skill performance in peer assessment activities (Hsia et al. 2016).

The purpose of this study is twofold. First, it aims to investigate how self-efficacy and motivation correlate to each other in peer assessment activities. Second, it aims to explore the role of peer feedback. Thus, the research questions are formulated as follows:

1. What are the relationships between self-efficacy and motivation in peer assessment?
2. Which kind of feedback is more helpful for students?
3. Are there any differences in feedback messages between the first round of assessment and the second round of assessment?

9.3 Peer Assessment APP

In order to facilitate students to conduct peer assessment, an APP on peer assessment was developed. The main functionalities included:

- Uploading group products (see Fig. 9.1).
- Viewing the products of every group (see Fig. 9.2).
- Peer assessment based on the criterion for the first time (see Fig. 9.3).
- Viewing the results and providing feedback to peers (see Fig. 9.4).
- Revising group products and resubmitting.
- Peer assessing based on the criterion for the second time.

The system randomly assigned members of three groups to be assessors for the first round assessment. In the second round assessment, the system assigned the same members to conduct peer assessment.

9.4 Methodology

9.4.1 Participants

Participants enrolled on the multimedia technology and webpage making course worth 4 academic credits. In total, 48 volunteers participated in this study, with 15 % of them being male and 85 % of them female. The average age of the participants was 19 years, and they majored in Chinese literature or communication theory. All the participants were randomly assigned into 12 groups of 4 people.

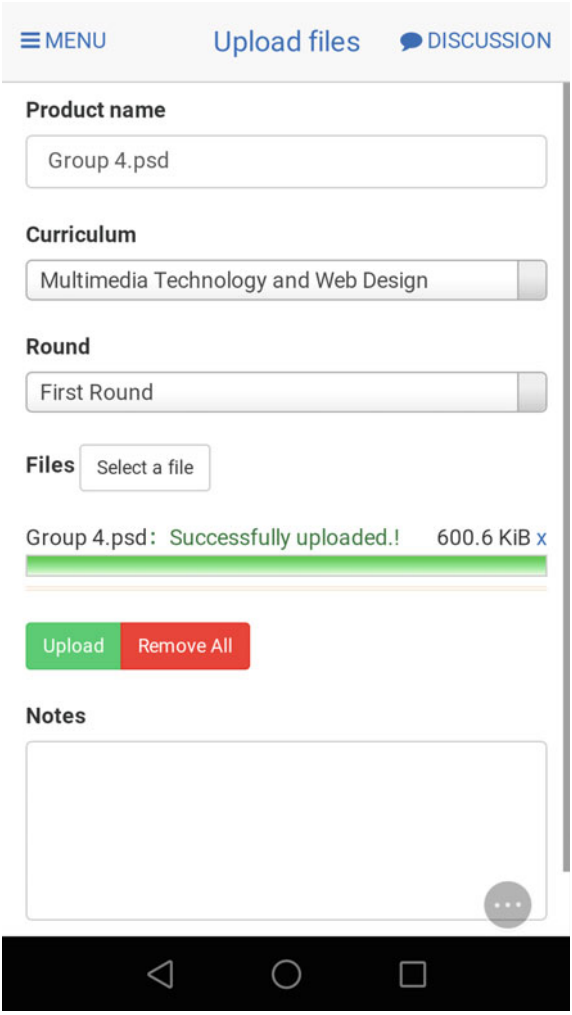

Fig. 9.1 Uploading the group product

They all had prior experience of collaborative learning. Therefore, no specific training was implemented before collaborative learning. Furthermore, group members in every group were not familiar with each other.

9.4.2 Collaborative Learning Task

The collaborative learning task was to make a poster using Photoshop CS5. Every group completed the same task over a period of three weeks. Participants could discuss online via a collaborative learning platform. They could also discuss

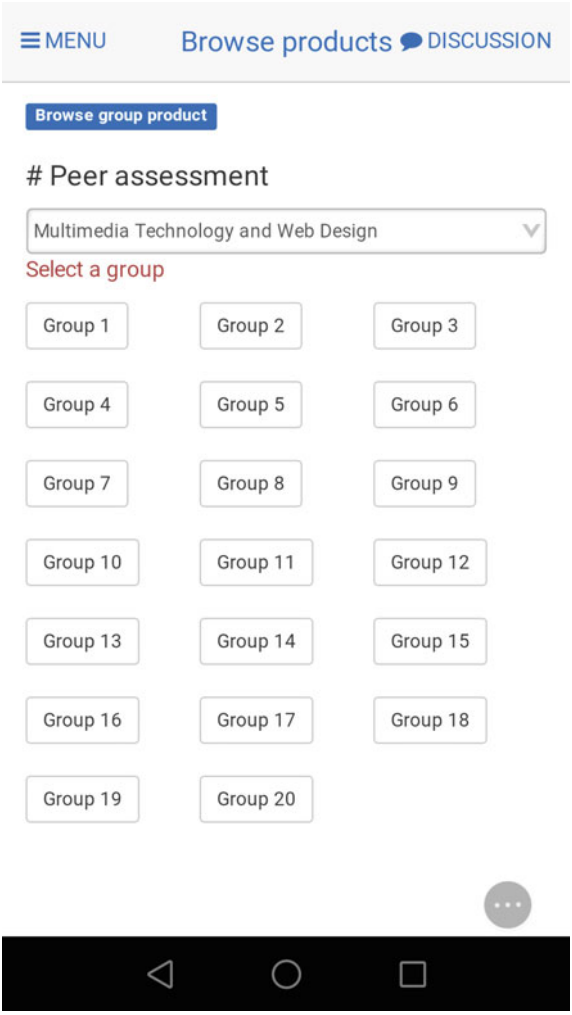

Fig. 9.2 Viewing the products of all groups

face-to-face with their group members. Initially, they were informed that the posters would be twice evaluated by their peers.

9.4.3 Measuring Tools

The peer assessment self-efficacy questionnaire was adapted from Tseng and Tsai (2010). It consisted of an evaluating scale, receiving scale, and reacting scale. There were 15 items with a 5-point Likert score ranging from "not at all confident" to "very confident". The evaluating scale, the receiving scale, and reacting scale consisted of

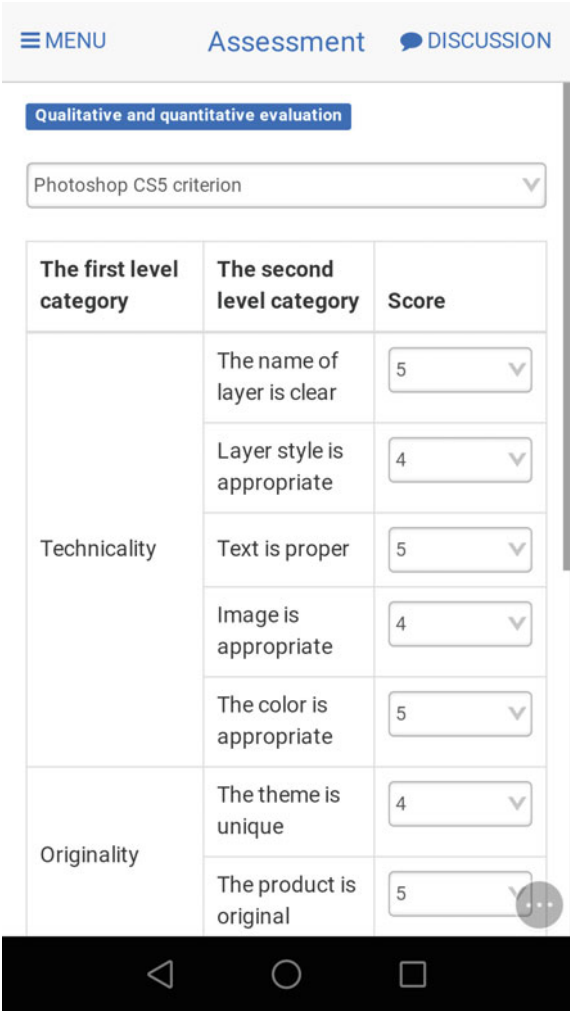

Fig. 9.3 Peer assessment

six items, four items, and five items, respectively. The evaluating scale measured learners' confidence in evaluating others' products. For example, "In the peer assessment activity, I can give helpful opinions or suggestions when I review peers' work." The receiving scale measured learners' confidence in receiving feedback from their peers and accepting their own disadvantages. For example, "In the peer assessment activity, I can examine the problem in my own work when I get comments from peers." The reacting scale measured learners' confidence in reacting to peer feedback. For example, "After reading comments in the peer assessment activity, I can improve my work with a good strategy." The overall Cronbach's alpha coefficient for the three scales was 0.90, indicating excellent reliability.

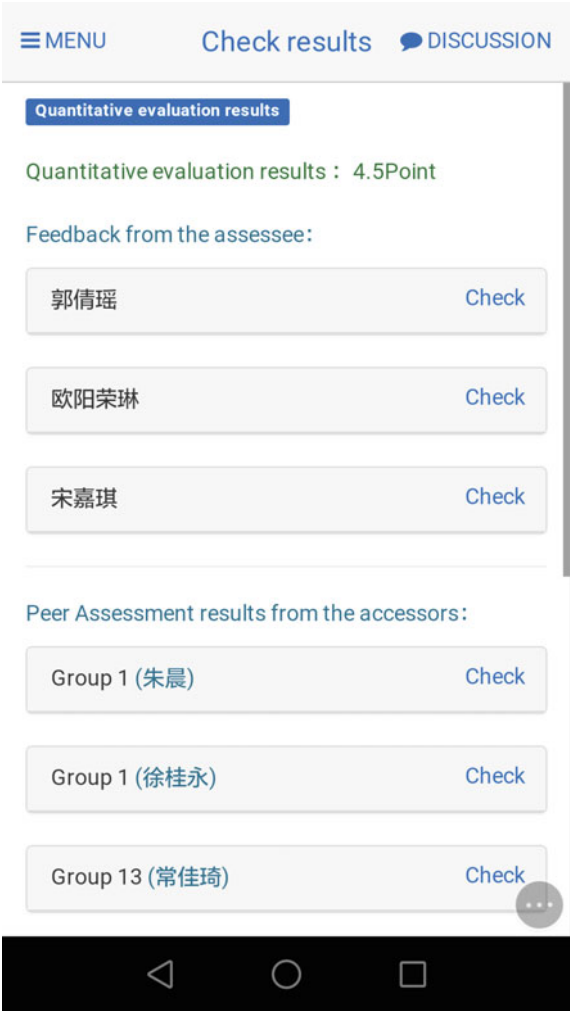

Fig. 9.4 Viewing the results

The peer assessment motivation questionnaire was also adapted from Tseng and Tsai (2010). It consisted of an intrinsic motivation scale and an extrinsic motivation scale. There were 12 items with a 7-point Likert score ranging from "strongly disagree" to "strongly agree". The intrinsic motivation scale measured the internal attribution for peer assessment. For example, "In peer assessment, I am triggered to learn more if I have the chance to review peers' work." The extrinsic motivation scale measured the external attribution for peer assessment. For example, "I turn in peer assessment just to meet the teachers' course requirements." The overall Cronbach's alpha coefficient for the two scales was 0.78, indicating good reliability. The role of feedback messages was investigated by four questions, as shown in the appendix to this chapter.

9.4.4 Procedure

The procedure for this study is as follows. First, all of the groups conducted collaborative learning and produced a poster using Photoshop CS5. Groups then uploaded group products to the peer assessment APP. Second, the system randomly assigned members of three groups. These members evaluated peer products based on the rubric, which included the dimension of text, color, layout, theme, and qualitative comments. Third, all of the groups revised their group products based on comments and suggestions. After that, each group resubmitted their revised products to the system. Fourth, the system assigned the same assessors to evaluate the group products. Therefore, the whole assessment included two rounds of peer assessment. Finally, all of the participants answered four questions (see the appendix at the end of this chapter) via the APP. Participants were then administered the peer assessment self-efficacy questionnaire and the peer assessment motivation questionnaire.

9.5 Results

9.5.1 The Relationships Between Peer Assessment Self-efficacy and Motivation

Table 9.1 shows the descriptive results of the peer assessment self-efficacy and motivation questionnaires. Table 9.2 shows the relationships between the evaluating scale, receiving scale, and reacting scale in the self-efficacy questionnaire. It was very clear that the evaluating scale was significantly related to the receiving scale ($r = 0.642$, $p < 0.01$) and reacting scale ($r = 0.697$, $p < 0.01$). The receiving scale was significantly related to the reacting scale ($r = 0.609$, $p < 0.01$). This result indicated that students with higher confidence in evaluating their peers' work tended to have greater confidence in receiving peer views and reacting to peer feedback. The learners with higher confidence in receiving peer views also tended to have higher confidence in making reactions to peer assessment.

Table 9.3 demonstrates the relationships between intrinsic motivation and extrinsic motivation. The results indicated that there was no significant relationships between intrinsic motivation and extrinsic motivation ($r = 0.127$, $p > 0.05$). This means learners that had higher intrinsic motivation did not tend to have higher extrinsic motivation in peer assessment.

Table 9.1 The descriptive statistics result of peer assessment

	Means	Standard deviation
Evaluating scale	5.39	0.89
Receiving scale	4.91	0.73
Reacting scale	5.33	1.12
Intrinsic motivation scale	5.50	0.83
Extrinsic motivation scale	4.48	1.08

Table 9.2 The relationships between evaluating scale, receiving scale, and reacting scale

	Evaluating scale	Receiving scale	Reacting scale
Evaluating scale	1	0.642**	0.697**
Receiving scale	0.642**	1	0.609**
Reacting scale	0.697**	0.609**	1

** $p < 0.01$

Table 9.3 The relationships between intrinsic motivation and extrinsic motivation

	Intrinsic motivation scale	Extrinsic motivation scale
Intrinsic motivation scale	1	0.127
Extrinsic motivation scale	0.127	1

Table 9.4 shows the relationships between peer assessment self-efficacy and motivation. The findings revealed that learners with higher intrinsic motivation were inclined to have higher confidence in receiving peer views ($r = 0.288$, $p < 0.05$) and reacting to peer feedback ($r = 0.347$, $p < 0.01$). However, there was no significant relationship among extrinsic motivation and self-efficacy scale.

9.5.2 *Clustering Analysis of Learners' Self-efficacy in Peer Assessment*

Table 9.5 shows the clustering results of learners' peer assessment self-efficacy. It was very clear that there were three clusters in terms of learners' peer assessment self-efficacy. Cluster 1 had low self-efficacy, Cluster 2 had medium self-efficacy, and Cluster 3 had high self-efficacy. In addition, there was significant difference in evaluating peer work, receiving peer comments, and reacting to peer assessment among these three clusters.

Table 9.4 The relationships between peer assessment self-efficacy and motivation

	Evaluating scale	Receiving scale	Reacting scale
Intrinsic motivation scale	0.144	0.288*	0.374**
Extrinsic motivation scale	0.264	0.272	0.153

* $p < 0.05$, ** $p < 0.01$

Table 9.5 The clustering results of learners' peer assessment self-efficacy

Scales	Total ($n = 48$) Mean (Standard deviation)	Cluster (1) ($n = 5$) Mean (Standard deviation)	Cluster (2) ($n = 31$) Mean (Standard deviation)	Cluster (3) ($n = 12$) Mean (Standard deviation)	F (ANOVA)
Evaluating	5.38 (0.88)	4.00 (1.24)	5.25 (0.52)	6.30 (0.47)	26.93**
Receiving	4.91 (0.72)	3.80 (0.73)	4.88 (0.59)	5.43 (0.46)	13.98**
Reacting	5.33 (1.12)	2.88 (1.03)	5.25 (0.39)	6.56 (0.37)	104.72**

9.5.3 The Role of the Feedback Message

Table 9.6 shows the results of the feedback message over two rounds of the peer assessment. Overall, most learners believed that peer comments were very useful for improving group products. In the first round of peer assessment, 57.81 % of learners posited that peer comments were very useful. In the second round of peer assessment, it sharply increased into 95.08 %. Furthermore, there was significant difference between the first round and the second round ($\chi^2 = 20.04$, $p < 0.01$). This finding indicated that learners acknowledged the usefulness of peer assessment.

As shown in Table 9.6, 67.19 and 62.3 % of learners believed that cognitive comments were the most effective and useful in the first round and second round, respectively. Furthermore, there was no significant difference between the first round and second round ($\chi^2 = 0.21$, $p > 0.05$). The finding implied that cognitive comments were the most effective and helpful for improving group products.

The findings also revealed that concrete suggestions were the most effective in the first round and second round of peer assessment, accounting for 31.33 and

Table 9.6 The feedback message over two rounds of peer assessment

Items		The first round (%)	The second round (%)	χ^2
What do you think of the peer assessment?	Very useful	57.81	95.08	20.04
	Useless	42.19	4.92	1.17
The effectiveness of comments	Cognitive comments	67.19	62.3	0.21
	Meta-cognitive comments	26.56	32.79	0.16
	Affective comments	06.25	4.92	0.005
The effectiveness of feedback message	General advice	4.82	4.61	0.0003
	Concrete suggestions	31.33	32.24	0.01
	Positive comments or praise	10.24	15.79	0.26
	Negative comments or criticism	14.46	10.53	0.13
	Comments on methods or strategies	23.49	19.74	0.14
	Comments on reflecting on the group products	15.66	17.11	0.02
What have you learned from peer comments?	Domain knowledge and skills	36.84	32.37	0.21
	Methods or strategies	30.08	33.81	0.13
	Positive feelings	21.05	19.42	0.02
	Be more interested in what I have learned	12.03	14.39	0.04

32.24 %, respectively. In addition, there was no significant difference between the first round and second round ($\chi^2 = 0.01$, $p > 0.05$).

As shown in Table 9.6, 36.84 and 32.37 % of learners believed that domain knowledge accounted for the greatest percentage in terms of benefitting from peer comments. Moreover, there was no significant difference between the first round and second round ($\chi^2 = 0.21$, $p > 0.05$).

9.6 Discussion

This study investigated the relationships between peer assessment self-efficacy and motivation as well as the role of feedback messages. The questionnaires of peer assessment were adopted to measure self-efficacy and motivation. The results indicated that learners who had high scores in evaluating peer work, receiving peer views, and reacting to peer feedback had high self-efficacy in peer assessment. This finding was consistent with Barbeite and Weiss (2004) who found that people who had more confidence felt less anxious when they engaged in computer-based activities. As Bandura (1997) stated, learners who had high self-efficacy tended to complete tasks that were beyond their abilities.

The findings also revealed that learners' intrinsic motivation was positively related to their self-efficacy in peer assessment. This result was in line with Tseng and Tsai (2010) who found that intrinsic motivation was more related to self-efficacy than extrinsic motivation. This result also corroborated that intrinsic motivation played a crucial role in fostering self-efficacy (Bandura and Schunk 1981; Harter 1981). This finding also implied that only when students learned with intrinsic motivation, will they have a better learning performance.

The results also found that peer assessment was very useful for improving group products. Among different kinds of feedback information, cognitive feedback and concrete suggestions were the most effective and useful in peer assessment. This finding was consistent with previous studies (Hattie and Timperley 2007), indicating that cognitive feedback led learners to better understand subject matter. The result were similar to the findings of Cheng et al. (2015) study which revealed that cognitive feedback was more useful for improving students' learning gains than affective and meta-cognitive feedback. With respect to the type of feedback message, similar to Cheng et al. (2015) as well as Strijbos et al.'s (2010) findings, it was found that concrete suggestions were more helpful with enhancing learning performance.

This study had several implications for practitioners. First, peer assessment is an effective and useful strategy to engage students in collaborative learning. Peer cognitive feedback was more useful for improving group products than affective feedback and meta-cognitive feedback. Therefore, teachers should design peer assessment activities and implement them in different subjects. In addition, although cognitive feedback is important, affective and meta-cognitive feedback are also essential during collaborative learning. Positive feedback can enhance learners'

confidence and self-efficacy. Second, learners' intrinsic motivation is the most important for improving self-efficacy and learning performance. Therefore, teachers should inspire students' intrinsic motivation by encouragement or other learning activities. Third, high self-efficacy can improve the quality of peer assessment. Therefore, self-efficacy is another important factor to improve learning performance. Students who have high self-efficacy tend to have a good learning performance, which in turn can improve self-efficacy further.

This study was constrained by several limitations. First, the sample size of the study was small. Future studies will expand the sample size to examine the effectiveness of peer assessment. Second, this study only selected one task to investigate the relationships between self-efficacy and motivation as well as the role of feedback. Future studies will design different kinds of tasks to generalize the results. Finally, the study lasted for three weeks. It was very interesting to conduct longitudinal study in order to track how self-efficacy and motivation evolve over time.

9.7 Conclusion

This study aimed to probe peer assessment self-efficacy and motivation as well as the role of feedback facilitated by peer assessment (APP). The main findings of this study indicated that learners' intrinsic motivation was positively related to their self-efficacy in peer assessment. In addition, peer assessment was very effective at improving students' learning performance. In contrast with affective feedback and meta-cognitive feedback, cognitive feedback played a crucial role in peer assessment. Learners preferred the specific suggestions that really helped them to improve the quality of their products. This study shed light on the psychological traits of peer assessment and highlighted real-time feedback in peer assessment.

Appendix

Questions about peer assessment

1. Overall, what do you think of the peer assessment?
   A. Very useful
   B. Useless
2. Which kind of comment is the most useful for improving group products?
   A. Cognitive comments
   B. Meta-cognitive comments
   C. Affective comments

3. Which kind of peer feedback messages are the most useful for improving group products?

   A. General advice
   B. Concrete suggestions
   C. Positive comments or praise
   D. Negative comments or criticism
   E. Comments on skills, methods, or strategies
   F. Comments on reflecting on the group products

4. What have you learned from peer comments?

   A. Domain knowledge or skills
   B. Methods or strategies
   C. Positive feelings
   D. Be more interested in what I have learned

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