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Peer assessment for knowledge improvement: Do the type and the affective nature matter?

Jesmine S. H. TAN, Wenli CHEN
jesmine.tan@nie.edu.sg, wenli.chen@nie.edu.sg
National Institute of Education, Nanyang Technological University, Singapore

Abstract: Peer assessment is an important component in collaborative learning. Its effects have been substantially evidenced to vary with the types of feedback. This mixed-method study was conducted in a pre-service teachers' TEL design learning context. It aimed to examine the different types of feedback and their affective nature on knowledge improvement. Specifically, the types of peer comments and their affective nature on pre-service teachers' TPACK knowledge improvement were examined. The results showed that feedback that raised questions and concerns about the work and suggestive feedback gained the highest response rate leading to further improvement. Both positive and negative comments had the same impact on supporting the improvement of their work. The emoticon at the technology platform did not influence the participants with the affective state of the peer comments. The implications of future peer assessment implementations and the design of technology platforms to promote effective peer feedback are discussed.

Introduction

Peer assessment is a form of collaborative learning between two peers with two roles, an assessor and an assessee (Kollar & Fischer, 2010; Er, Dimitriadis, Gašević, 2021). This approach has positive effects on learning. It can help identify flaws, clarify misconceptions, and provide suggestions for further improvements (Topping, 2009). Given the multiple terminologies in this research area, the terms peer assessment, peer critique and peer feedback will be used interchangeably in this paper.

While there are many benefits associated with peer assessment, students may face obstacles during the peer assessment process (Er et al., 2021). Even with a systematic guidance or structured process, superficial peer comments without constructive purpose may lead to unproductive learning. Furthermore, non-constructive and judgmental feedback may not identify students' learning gaps and do not improve learning (Fong et al., 2021). While better-performing students are more receptive to receiving feedback because of their confidence in receiving positive comments, weaker students may feel otherwise (Carless, 2006). Moreover, feedback provision, reception, and revision do not automatically mean that learning takes place (Kollar & Fischer, 2010). There must be evidence of outcome performance that occurs after the peer assessment process. Therefore, what types of feedback could lead to knowledge improvement is one area worth examination.

Moreover, the uptake of feedback is also likely to be positively related to learning when the feedback is relevant and of good quality such that the recipient of the feedback finds it worthwhile adopting (Kollar & Fischer, 2010). Topping (2009) purported that "peer feedback can be confirmatory, suggestive, or corrective" (p. 22). At the same time, Lu & Law (2012) states that affective comments influence performance. Affective feedback encompasses the use of affective language to express assessors' positive or negative feelings toward their peers' performance. (Lin, 2018). In fact, providing positive feedback is reckoned as an effective strategy to help sustain deep discourse (Chen et al., 2018), be it written or spoken. Not only does it help with cognitive development, but it also motivates learning, invokes positive emotions in learners, which could lead to a favourable outlook on the comments and better performance outcomes (Chen et al., 2018; Lu & Law, 2012). Therefore, how best to design peer assessment in educational contexts is an area that needs further exploration (Kollar & Fischer, 2010). In addition, the emotional aspect of feedback is also worth further investigation (Carless, 2006). Premised upon these areas, this paper examined how the different types of feedback and the affective nature of the comments affect peers in moving forward by improving their work. By understanding the types of feedback that could lead to better performance outcomes, we could better inform future peer feedback implementations by equipping students to provide certain feedback types that promote knowledge improvement. Moreover, suppose affective comments could motivate learning and has positive effect on knowledge improvement. In that case, it should be encouraged during the peer feedback process too. The following research questions were crafted for this study:

1. What are the types of feedback that affects knowledge improvement?
2. What effect do the affective comments have on knowledge improvement?

Literature Review

Peer assessment is reckoned as a form of formative assessment, is commonly seen from the cognitive and affective aspects (Nelson & Schunn, 2009). Cognitive feedback involves the content of the work, and the feedback comment could include summarising, specifying, and explaining aspects of the work under review (Lu & Law, 2012). Specific feedback is more effective than generalised feedback (Fong et al., 2021). General feedback without constructive comments has no value for knowledge and work improvement.

Affective feedback uses affective language to support and bestow praise or criticism by showing negative feelings about the work (Cheng, Liang & Tsai, 2015). Affective feedback can be divided into two types: positive affective feedback and negative affective feedback. Positive affective feedback is usually recommended and is deemed as one of the most common features presented in the area of formative peer feedback (Cho, Schunn, & Charney, 2006). In a computer-supported environment, emoticons are commonly used to convey emotions instead of text comments (Lu & Law, 2012). Regardless on the avenues of giving feedback, there are mixed results on the effect of positive affective feedback on students' learning improvement. Hence, more research studies are recommended to explore the different types of feedback to understand better how they affect subsequent improvement (Fong et al., 2021). Moreover, peer feedback helps students develop metacognition and understanding of the subject matter involved (Pantiwati & Husamah, 2017), which promotes knowledge improvement (Cheng, Liang & Tsai, 2015). In the pre-service teacher education, developing the competency to design a Technology-enhanced Learning (TEL) lesson is important. However, this is a challenging task (Kafyulilo, Fisser & Voogt, 2015). To guide them in the TEL design, the Technological Pedagogical Content Knowledge (TPACK) (Koehler, & Mishra, 2009) is reckoned as a reliable framework that could help determine the effectiveness of a TEL lesson design. The knowledge of TPACK requires understanding and negotiating the relationships between technology, pedagogy, and content (Wong, Chai, Zhang & King, 2014). Chen, Tan & Pi (2021) posited that such complex knowledge could be improved via a collaborative learning environment.

In a collaborative learning environment that is supported by computers, the wide learning spectrum can be extended effortlessly. Chen, Tan & Pi (2021) reckoned that peer feedback at the class-wide level benefits collaborative groups in knowledge improvement more than learning at the group level. In this study, the class-wide peer feedback is situated between two group-level phases in a computer-supported collaborative learning (CSCL) environment. By examining the feedback generated at the class-wide feedback phase, we could understand the impact of the types of peer feedback and their affective state had on the knowledge of TPACK.

Methodology

Participants and learning context

Twelve pre-service teachers from the author's institute participated in this study. An invitation was sent via a group chat to the course students, and twelve responded. The participants signed the consent form to express their voluntary participation. At the time of the study, the lecturer had more than ten years of teaching experience.

Before the collaborative lesson design session, the twelve participants were randomly grouped into six dyads using an online randomisation tool (https://www.randomlists.com/team-generator). The task for all dyads was TEL design on a reading comprehension segment based on the assigned Grade four Chinese language reading texts. The TEL design should exhibit the interactions of the three knowledge components: content, pedagogy, and technology knowledge. Two sets of materials were disseminated to the participants before the collaborative lesson design session to support the participants with the TEL design task. The materials are the Five-step Reading comprehension guide taken from the Chinese Language Syllabus and Teaching Guide for Primary Schools© (2015) and the definitions of the TPACK dimensions (Koehler & Mishra, 2009; Koehler, Mishra & Cain, 2013).

The research procedure

The entire collaborative lesson design session was conducted entirely online on Zoom. Both the lecturer and the participants are familiar with the Zoom platform. During the collaborative lesson design session, the lecturer started with a 15-minute briefing, followed by a Zoom break-out session for the discussion among the group members before peer feedback phase. After the first 20 minutes discussion, the lecturer admit all participants to the main room for the class-wide peer feedback. Thereafter, they were assigned back to their group breakout rooms for group refinement. Figure 1 shows the process of the collaborative lesson design procedure.

The CSCL platform for this study is the AppleTree system (Chen et al., 2013). The participants were instructed to construct the TEL design using the three types of bubbles on the AppleTree workspace (Figure 2) to form a tree structure, with the lesson objective as the root node (dark blue oval) and the lesson procedures (yellow rectangles) branching out from it. The technology platform associated with the lesson procedure will be populated

using the cloud bubbles (light blue clouds). The participants were familiar with the AppleTree system's functionalities. The tree-structured lesson design is employed rather than the traditional text-based representation. This graphical structure enables explicit representations of the inter-relationships between content, pedagogy, and technology components, which is helpful during the peer feedback process. The visual representation enabled the holistic understanding of complex knowledge in which words alone may be limited to convey (Plotnick, 1997).

Figure 1

The procedure of the study

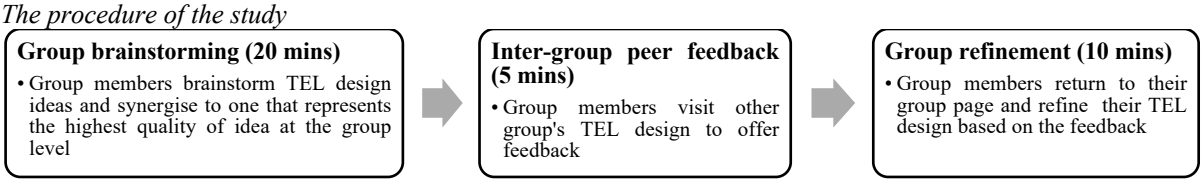


Figure 2

*The AppleTree system Graph-based workspace (Group one) (*Names shown are pseudonyms)

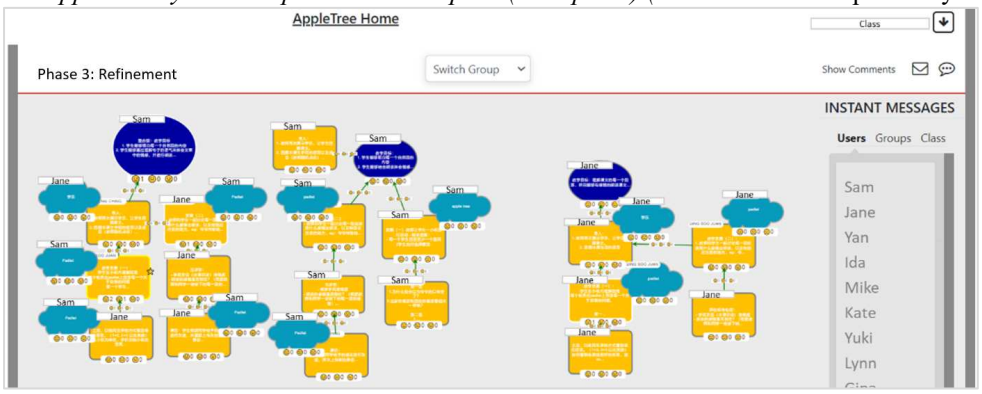


Figure 3 shows the Peer Critique window for the participants to enter their peer comments during the inter-group peer feedback phase. There are three opinions buttons represented by three emoticons. The participants could choose to illustrate their emotions of the peer comments. The emoticons are "Smiling face", which represents an Agreement, "Neutral face", which represents a neutral opinion and "Sad face", which represents a Disagreement. After selecting the opinion (emoticons), the "Explain why" text box with mandatory text entry prompts the participants to elaborate the reason for their opinion. This comment box with the text "Explain why" at the top helps elicit constructive and elaborated feedback. There is no limit to the number of comments each bubble can receive. Within the given time for the peer critique phase, the participants could access any groups to contribute their feedback. The next phase following this phase is the Refinement phase. During the refinement phase, the participants would be routed back to their group page to view the peer comments given by the other groups' members. One feature of the AppleTree system is anonymous feedback. With this feature, the names of the critic were hidden from peers but not the teacher. The participants knew of this feature. Figure 4 shows the refinement phase where each bubble indicates the number of comments under each emoticon.

Figure 3

The AppleTree system Peer comment box

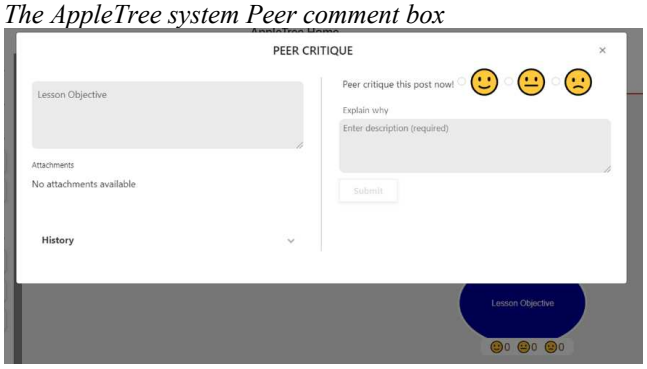
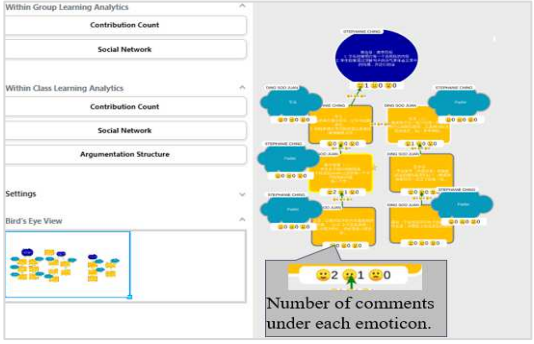


Figure 4

The AppleTree system Graph-based workspace for Refinement (Group one)



Data collection

The participants' generated artifacts were collected and examined to answer the two research questions. The data source was from the AppleTree system. The TEL design artifacts were collected by downloading the AppleTree system Report A, which contained the TEL design content and process during the collaborative learning phases. The data from this report were coded using the TPACK coding scheme. The second data set was the peer feedback data, collected by downloading the AppleTree Report B. Each row in Report B was one peer comment contributed by one participant. This data was coded using the Peer feedback coding scheme. Both reports are in Microsoft Excel format. Each data row had the participant's name and the timestamp of the online behaviour.

Research instruments

The TPACK coding scheme

The coding scheme for the TEL design was derived from the TPACK framework (Koehler & Mishra, 2009). TPACK is a well-acknowledged and dependable guide to evaluate the quality of TEL design (Koh et al., 2015). The unit of analysis of the TEL design was a complete TEL lesson design. The score for each TEL lesson design was derived from the content analysis of the TEL lesson procedures based on the interactions among content, pedagogy, and technology dimensions. The quality of each TEL lesson design for the TPACK dimension was measured by a ten-point scale ranging from one to ten, with one being the lowest quality and ten being the highest quality. Two trained coders coded the data. The inter-coder reliability was high (Cronbach's alpha = 0.75).

Table 1

The TPACK coding scheme

TPACK Definition	**Scale**				
The quality of the TEL design based on the interactions among content(C), pedagogy(P), and technology(T) dimensions.	1-2	3-4	5-6	7-8	9-10
	Very weak interactions among C,P,T.	Moderately weak interactions among C,P,T.	Relatively good interactions among C,P,T.	Good interactions among C,P,T.	Very good interactions among C,P,T.

The peer feedback coding scheme

The coding scheme for the feedback took reference from the works of Perkins (2003) 's ladder of feedback and De Sixte et al. (2020) 's findings on the effectiveness of positive (warm) elaborated feedback on post-feedback behaviour. The unit of analysis is one peer comment. Each peer comments were segregated based on the four types of feedback for coding. The affective state was coded by the emoticons on the AppleTree system and through judgement on the comment affective state. Positive affections are warm and motivational (e.g. "good" or a smiley emoticon). Negative affections are demeaning, and comments without positive affirmative words are neutral.

Table 2

The Peer feedback coding scheme

Rung	**Type**	**Definition**	**Type of emoticon**	**Affective state**
1	Clarity (C)	Ask questions to clarify about the work being reviewed	Smiley face (Po), Sad face (Ng) or Neutral face (Nu)	Positive (Po), Negative (Ng) or Neutral (Nu)
2	Value (Va)	Comments on the strength or on what they value about		
3	Questions and Concerns (Q&C)	Comment on your concerns about the work		
4	Suggestions (S)	Make suggestions for improving the work		

Data Analysis

Content analysis was conducted on the TEL design artifacts using the TPACK coding scheme to show the quality of the TEL design to examine the improvement of the knowledge of TPACK. This analysis is needed to examine the improvement of TEL design before and after peer feedback to address research question one. To answer the second research question, two analyses were conducted. The first analysis was based on the emoticons from the AppleTree system, followed by a content analysis on the peer comments using the peer feedback coding scheme. The coding of the affective state of the comments is independent of the emoticon of the AppleTree system.

Results

The types of feedback that affects knowledge improvement

Figure 5 shows an improvement in the TEL design quality after the peer feedback phase. This result illustrates that the peer feedback supported the pre-service teachers in improving their knowledge of TPACK, leading to an improvement in TEL design quality. The Mean difference shows the extent of improvement before and after peer feedback. Figure 6 shows the types of peer feedback and those that were responded to. The type of feedback that had the highest response rate was the Questions and Concerns comments, followed by suggestions. This result suggested that these two types of feedback should be encouraged since they promote knowledge improvement.

Figure 5

Quality of TEL Design before and after peer feedback

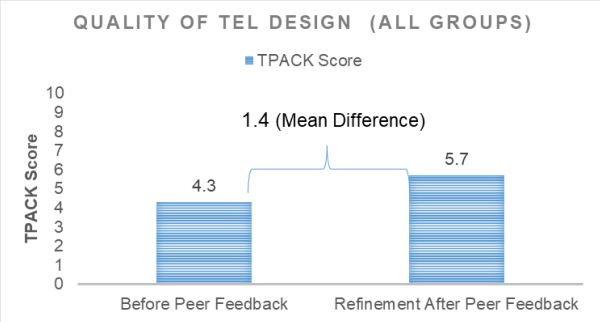
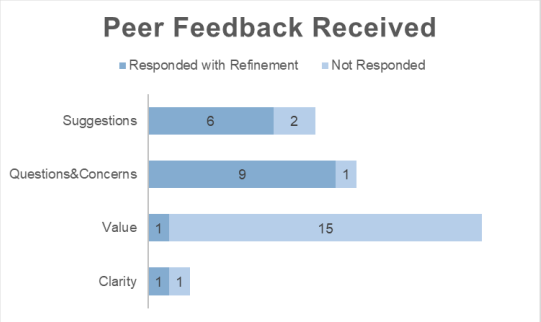


Figure 6

Peer feedback Received



The effects of affective comments on knowledge improvement

Figure 7 shows the affective feedback response based on the emoticon selected by the participants on the AppleTree system. The disagree emoticon was not selected at all. Figure 8 shows the affective nature of the comments based on the coded comments. Although there was no disagree emoticon selected, the results in Figure 8 shows the presence of negative comments based on the coded content. These results suggested that the affective state of the emoticons may not equate to the affective nature of the comments.

Figure 7

Affective feedback based on AppleTree emoticon

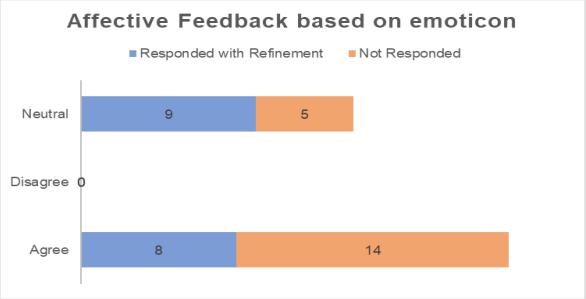
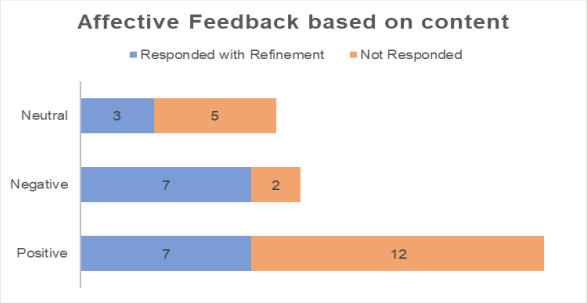


Figure 8

Affective feedback based on content



Further analysis was conducted to match the emoticons and the affective state comments. Table 3, the keywords and tones to decide the affective nature of the peer comments were highlighted with red text. Out of the 17 comments, five had the same affective state between the emoticon and the coded comments (grey shade), which are the positive comments with the Agree emoticon. This comparison suggests that emoticon and the affective state of the comments do not necessarily match. Hence, semantic tracing on the comments was conducted to examine what peer comments led to improvement in the TEL design. In Table 3, the blue text shows the keywords in feedback comments that match the improvements made to the TEL design, indicating the uptake trace, implying that the affective state of the comments does not influence the uptake for refinement. The important keywords and key phrases leading to the improved TEL design were mostly questions and concerns types that surfaced misconceptions, gaps, or suggestions for improvement, leading to improvement in the TEL Design improvement measured by the TPACK score. The highest improvement were Group 1 (M=5→7) and 4 (M=4→6), followed by Group 2 and 3 ((M=5→6), Group 5 ((M=3→4), Group 6 (M=4→6).

Table 3

The affective nature, the keywords and phrases of the responded peer comments and the improvements made

S/N	Emoticon	Affective nature	Type	Peer comment (Chinese words were translated to English)	Improvements made	Group To Group
1	Nu	Po	Va QC	I like the main activity of the lesson plan but using Quizlet to learn the	Deleted "Teacher to allow students to access Quizlet to	G1→G2

				words is more like the initial reading comprehension on vocabulary understanding, instead of the requirement in the third step of reading comprehension, that is, to understand each paragraph of the passage. It is also lacking in the **reading with intonation**.	complete learning the vocabulary list"	
2	Nu	Po	Va QC	I like how you include ICT to check for passage understanding. But it seems to miss out on the **reading with intonation required in the third reading comprehension step**.	Included "Finally, students read aloud in unison with intonations" (Group 3)	G1→G3
3	Nu	Ng	QC	this is more of initial reading comprehension on vocabulary understanding, not the requirement in the **third step of reading comprehension**.	Deleted the lesson procedures related to first reading comprehension on vocabulary understanding	
4	Nu	Ng	QC	This is already the **third step of reading comprehension**; the students have already completed the first step of the reading comprehension; shouldn't they proceed quickly to understand the passage, but not need to share and introduce the "Where" already?	Deleted the lesson procedure related to locating the words related to "where"	G1→G4
5	Nu	Ng	QC	But this part is more suitable for the first step of reading comprehension. For third reading comprehension, this learning task could be too simple, looks boring.	Refined "show some pictures" to "show a picture on sports day, allow students to relate their personal experience (interesting events)"	G6→G4
6	Nu	Ng	QC S	It is already the **third step of reading comprehension, should omit the initial part of removing vocabulary obstacles**	Deleted the lesson procedures related to vocabulary understanding	G1→G5
7	Nu	Ng	S	go direct to **understanding each paragraph**. In this way, you can allocate more time for students to fully understand the content of the text.	Deleted the procedures on vocabulary understanding. Retain "Teacher to allow students to use Nearpod to understand the text"	
8	Nu	Ng	QC	This **listening to the sound part** is more suitable for first reading. At this point, students already initially understand the passage already.	Deleted the lesson procedure on "listening to the sound part"	G6→G5
9	Nu	Ng	C	**"responsible for one animal"** for what purpose?	Elaborated on this procedure "Group activity: Each group three members. Each one is responsible for one animal (individual component)"	G1→G6
10	Po	Nu	S	Perhaps during reading comprehension at the group level, you could give them **some instructions** to prevent anyone not doing anything during this segment.	Include new procedure "Each student to answer at least one question"	G4→G1
11	Po	Nu	Va QC	Did achieve the learning objective. Just by using the **post-it notes method**, the teacher may find it difficult to concentrate on what words to teach.	Deleted "Finally, each group to submit all the unfamiliar words on post-it notes to the teacher"	G2→G5
12	Po	Nu	S	Perhaps **using the pencil to circle** could be better. Use highlighter to highlight cannot erase. Instead of writing on paper, the teacher can directly use Nearpod to display the paragraphs; the groups can circle the vocabulary they still do not understand during the third	Deleted "use highlighter to highlight the words that they do not understand"	G3→G5

				reading comprehension. This way can probably save time.		
13	Po	Po	Va S	Quite good, But a small suggestion, you can allow students to **use Padlet to record followed by peer critique**. This way, the teacher can listen and involve also.	Include new procedure "Each group member to answer questions related to each paragraph on Padlet"	G5→G1
14	Po	Po	S	Maybe can indicate using the tone of the sentences to **read out the intonation** :)	Include additional keywords (underlined) "Students to understand the sentences and the tone to grasp the emotion of the passage before reading aloud"	G5→G1
15	Po	Po	Va	I feel that this segment is very good "Student must answer one question, **then peer critique the answers of group members** within-group" segment include individual and group.	Included "Student to return home and record passage reading aloud and upload to SLS platform. Other students peer critique after listening to their peers' reading aloud audio."	G4→G2
16	Po	Po	Va QC	Interesting, but students **may not have participated in sports day**.	Included "If students did not participate in sports days before, teacher to provide a short video of sports day for students to relate the events in the video	G6→G3
17	Po	Po	Va S	Interesting can **provide video also**		

Discussion and conclusion

This study examined the different types of peer feedback and their affective nature on knowledge improvement. Results from the first research question showed that questions and concerns and suggestion feedback supported pre-service teachers in improving their TEL design resulting through the improved TPACK scores. Studies that examined the impact of different types of peer feedback on knowledge improvement is rare. Guasch, Espasa and Martinez-Melo (2019) found that suggestive feedback significantly increased metacognitive activities. In contrast, this study found that feedback that raises questions and concerns were more highly responded to as compared to suggestion feedback in supporting pre-service teachers with knowledge improvement. Findings from the second research question show that both positive and negative affective comments have an equal impact in supporting knowledge improvement. Apart from that, affective comments could also support the improvement of TEL design, although its uptake rate was less than half of the positive and negative comments. This observation suggested that affective comments have no significant impact on participants' uptake for improvement. This finding corroborated with De Sixte et al. (2020)'s study showing that positive messages do not necessarily influence post-feedback behaviour. Generally, the students were prone to consider comments that let them know what they would do rather than encouraging messages on what they had already done (De Sixte et al., 2020).

This study has theoretical significance. While students generally prefer receiving positive comments, they often interpret negative feedback as unconstructive (Fong et al., 2021). Furthermore, Kwon et al. (2019) found that positive affective feedback was ineffective for improving students' learning when the task is cognitively demanding. Interestingly, results from this study suggest that cognitive feedback (such as questions and concerns and suggestions) supported peers' improvement and is more effective than the affective nature of the feedback comments (Cheng, Liang & Tsai, 2015). Therefore, this study contributes to more empirical studies examining the impact of different cognitive feedback and their affective state had on post peer feedback behaviour. Secondly, the mismatch between the AppleTree emoticons and the affective state of the feedback comments have important implications on educational technology design. The results showing an absence of Disagree emoticon selection suggested that the participants were reluctant to indicate a negative emotion even though it was anonymous feedback. Therefore, including the affective emoticons in the technology platform to promote affective comments could probably only add value to user experience rather than for cognitive development purposes.

Practically, future implementation of peer feedback should consider developing students' ability to provide constructive feedback that could feedforward. For feedback to enhance learning, it must be acted upon (Boud, 2015). However, without specifying the areas for improvement in the comments, no action can be taken at the receiving end. This study has limitations. Besides examining the improvement of TEL design based on the given comments, further analysis on knowledge gain when the participants examined the TEL design of the other groups could also shed new insights to this research area. Given the small sample size and the authentic context, more future studies, including experimental designs, would be necessary to explore further findings in other educational contexts.

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