



# *Enhancing students' choreography and reflection in university dance courses: A mobile technology-assisted peer assessment approach*

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## **Abstract**

Choreography is an important and challenging educational objective in dance courses. However, most previous technology-enhanced learning studies for dance education mainly focused on students' dance skills, while the issue concerning the approaches to promoting students' choreographic performance has generally been ignored. To address this issue, the present study developed a mobile technology-assisted peer assessment approach based on social constructivism for use in a university general education dance routine choreography class. A total of 266 university students were divided into an experimental group and a control group. The experiment lasted for 15 weeks and involved two rounds of peer assessment. The results showed that mobile peer assessment could significantly enhance the innovative competence of dance routines and dance skills. In addition, according to the students' feedback, the dance routine choreography class was conducive to improving social skills, innovative competence, and intrinsic motivation, while mobile peer assessment could assist students in understanding accurate evaluation criteria, reflecting on their own in a more objective way, and broadening the aspects of appreciating the work.

## **Background and motivation**

In dance courses, students not only need to practice dance skills, but also need to learn to create the sequence of steps and movements in dance (Sööt, & Leijen, 2012; Springborg, 2017; Yams, 2018). Southcott and Joseph (2019) pointed out that choreography is a process to add new ideas to dance sequences to increase the effects of the performing based on dancers' experience and innovative thinking. However, most previous technology-enhanced learning studies for dance education focused on students' dance skills. A few studies related to choreography mainly reported the learners' conceptions in developing the dance sequences, while the issue concerning the approaches to promoting students' choreographic performance has generally been ignored (Yams, 2018). Several scholars have further indicated that choreography is an important and challenging educational objective to both teachers and students in dance courses (Antal & Strauß, 2013;

### Practitioner Notes

What is already known about this topic

- Researchers have pointed out that choreography is an important and challenging educational objective to both teachers and students in dance courses.
- Choreography is a process to add new ideas to dance sequences to increase the effects of the performing based on dancers' experience and innovative thinking.
- Previous technology-enhanced learning studies for dance education mainly focused on students' dance skills.

What this paper adds

- A mobile technology-assisted peer assessment approach is proposed for use in a university general education dance routine choreography class.
- The proposed approach significantly enhanced the innovative competence of dance routines and dance skills.
- The students' feedback also showed that the dance routine choreography class was conducive to improving social skills, innovative competence, and intrinsic motivation.

Implications for practice and/or policy

- Mobile peer assessment has great potential in helping students in understand accurate evaluation criteria, reflecting on their own in a more objective way, and broadening the aspects of appreciating the work as well as facilitating their innovative thinking.
- The proposed approach can be applied to other types of dance courses or other subject domains that aim to engage students in innovative thinking and performing.

Frichtel, 2017; Rowe & Zeitner-Smith, 2011). This implies the need to develop effective strategies or tools to facilitate choreographic quality in dance courses.

Dyer, Gregersen, and Christensen (2011) stated that questioning, observation, practice, interacting with others, and peer feedback are important competences influencing individual innovative competence. Bozic and Olsson (2013) further suggested that personal engagement, diverse communication and reflection are important factors affecting individuals' innovative thinking. Among various learning strategies, peer assessment has been recognized as an effective learning strategy for guiding students to evaluate peers' work through observation, thus promoting their reflection (Filius *et al.*, 2018; Martineau, Mamede, St-Onge, & Bergeron, 2016). Several previous studies have reported the effectiveness of applying peer assessment to promote innovative competence in science or computer courses (Formanek, Wenger, Buxner, Impey, & Sonam, 2017; Hwang, Tu, & Wang, 2018; Lai, 2016). However, in conventional technology-assisted dance learning, researchers have mainly focused on the use of videos to deliver dance knowledge and skills and to engage students in making reflections, while the issue related to choreography has generally been ignored, not to mention the influence of peer assessment on choreography performances (Leijen, Lam, Wildschut, Robert-Jan Simons, & Admiraal, 2009; Li, Zhou, & Teo, 2018). On the other hand, several studies have reported the advantages of reviewing peers' work and providing feedback in the face-to-face mode; for example, in the face-to-face mode, reviewers can examine the work or performance from more angles; moreover, the feedback as well as the reflection can be performed instantly (Kevin & Rick, 2019; Parrish, 2008). Therefore, the integration of technology should be positioned to assist with out-of-class reflection in face-to-face dance teaching rather than to replace traditional face-to-face courses.

The advancement of mobile and wireless network technologies has provided an opportunity to enable students and teachers to practice out of the class in a face-to-face mode with the support of technology. The use of mobile technology not only enables students to record peers' performance for reference or review, but also allows them to provide comments or ratings without interrupting the performance or disturbing other audience members (Hsia, Huang, & Hwang, 2016). Previous studies have also indicated the need to use an anonymity mechanism for peer feedback in the face-to-face learning mode; the use of mobile technology is a good choice (Leijen *et al.*, 2009). In an effort to improve peer feedback efficiency, and considering the need for students to receive feedback in a face-to-face mode, it seems appropriate to adopt mobile technology-assisted peer assessment (Lin, Hsia, Sung, & Hwang, 2018). As a result, the present study applied mobile technology-assisted peer assessment to a university general education dance course, and explored its effects on students' choreography as well as their dance skills performance and learning perceptions.

### Literature review

Peer assessment represents a strategy to promote learning improvement; peers evaluate other learners' learning performance and inform each other about the evaluation results during the learning process. It is a reciprocal process; students can evaluate others' work and receive feedback on their own working performances from peers (Nicol, Thomson, & Breslin, 2014; Topping, 1998). When providing feedback to peers, students will think, compare, and adopt different perspectives to interact with the topic and the content. Through higher order thinking, students address their own evaluation results, and then generate benefits for learning (Noroozi, Biemans, & Mulder, 2016; Van Popta, Kral, Camp, Martens, & Simons, 2017). Students can also understand the audience's opinions and experts' evaluation criteria, and then reflect on their performances and effectively enhance their learning effectiveness (Hsia *et al.*, 2016). Besides, when receiving peers' feedback, students must consider the accuracy of the message, and integrate it into their own original experience and knowledge when they choose to reject or accept peers' suggestions (Martineau *et al.*, 2016; Topping, 1998). Even though some students claimed that people of the same age do not have the qualifications or ability to conduct peer assessment (Ashenafi, 2017; Meek, Blakemore, & Marks, 2017), Filius *et al.* (2018) further indicated that it helps students to engage in in-depth thinking and learning when they question the content of peers' feedback. The aforementioned studies are also in line with Piaget's cognitive conflict theory. When learners obtain the results of peer assessment, they may experience cognitive conflict, and then revise their work to make improvements. Aside from this, the results are also consistent with social constructivism proposed by Vygotsky. Learners receive feedback from their interaction with the society, and then reflect on their performances to improve (Piaget, 1964; Vygotsky, 1978).

On the other hand, researchers also point out the challenges of peer assessment. For instance, Liu and Carless (2006) specified that the process of peer assessment might involve potential risks such as embarrassment, humiliation, losing privacy or face, to name just a few. As a result, the anonymity mechanism of online interaction could provide students with a more secure feedback environment; however, when compared to face-to-face discussion, online feedback is less effective (Leijen *et al.*, 2009). However, with the prevalence of mobile technology, this problem now seems to have been solved. For instance, Kuo, Chen, Chu, Yang, and Chen (2017) adopted peer-assessment by using mobile phones in a Kung Fu Tai-Chi physical education course. Their findings revealed that it could effectively increase students' affective perceptions, including learning motivation, self-efficacy, and attention level. Also, in their survey on perceived usefulness, the majority of students recognized that this way could enhance the learning benefits. As a consequence,

creating an in-class immediate peer assessment learning environment to support dance courses is a strategy worth practicing.

In view of the numerous features and learning benefits of peer feedback, relevant teaching application and research continue to receive attention from and be investigated by researchers in different fields. It has been applied in skill courses; for example, Hwang, Chen, and Sung (2019) applied online peer assessment in musical instrument learning, delaying peers' feedback and interaction until after class. Martineau *et al.* (2016) required medical students to conduct peer feedback and observe peers respectively when they learned the skills of performing physical examinations. After comparing the two groups, students with peer feedback outperformed those with no peer feedback. Hsia, Huang, and Hwang (2016) applied peer assessment in drama learning in a junior high school. The results indicated that the teaching experiment could effectively facilitate students' drama performance skills and satisfaction. From the past studies, it can be seen that peer feedback is a teaching strategy with great potential. It can effectively increase skills and affect performance, but its advantages definitely go far beyond those. Hwang *et al.* (2019) further reported that peer assessment had great potential to facilitate students' innovative thinking based on their findings in an e-book design activity in an elementary school science course. Dyer *et al.* (2011) pointed out the skills influencing innovative competence, including hands-on practice, observation, interaction with others to obtain feedback, questioning, and so forth. These skills tracked with the peer assessment; peer assessment enabled students to produce their work, instruct them to propose the evaluation results and interact with peers through observation, and guide them to question or accept advice when receiving peer feedback. As a result, applying peer assessment to choreography courses to develop students' innovative thinking in dance performance is a method that is worth attempting.

## Method

### *Research questions*

The research questions were as follows:

1. Did students with mobile technology-assisted peer assessment perform better in terms of innovative competence compared to those with traditional feedback?
2. Did students with mobile technology-assisted peer assessment perform better in terms of dance skills compared to those with traditional feedback?
3. What were the learning advantages when incorporating dance routine choreography teaching into a university dance course?
4. In what ways did mobile peer assessment influence students' learning in a university dance course?
5. What were the challenges when incorporating dance routine choreography teaching into a university dance course?

Based on the literature, it was expected that engaging the students in peer-assessment activities in a face-to-face mode using mobile technology would enable them to engage in in-depth thinking and reflections, and thus improve their innovation in the choreography outcomes. In addition, it was expected that, by providing comments to peers and receiving their comments, the students' dance skills as well as their learning engagement could be promoted.

### *The dance learning context of mobile technology-assisted peer assessment*

The present study adopted Zuvio IRS to construct rubrics and items for students to express their evaluation results of peers' group performances when using mobile phones or tablet computers



Figure 1: The interface for peer assessment

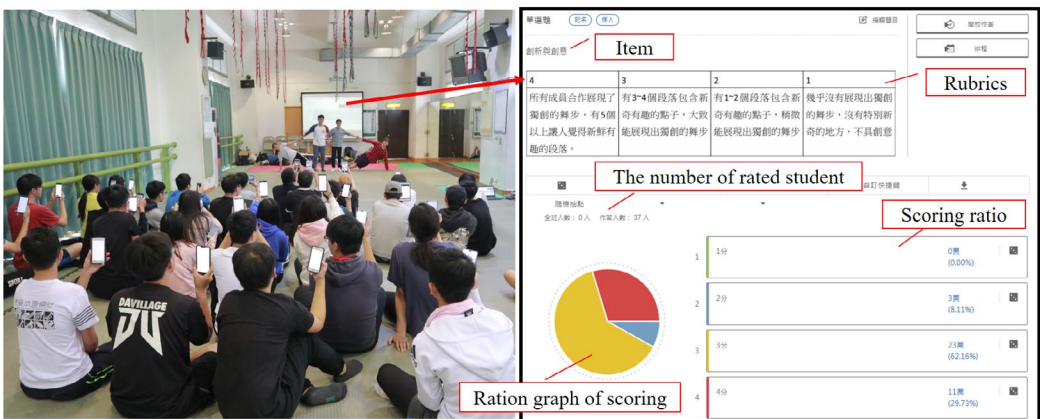


Figure 2: The peer assessment context and scoring interface

to conduct peer assessment (Figure 1). The statistical results were presented anonymously on the big screen through the immediate online response function (Figure 2). In addition, the teacher was also on site to instantly examine students' choreography, and to compare the peer assessment results. The teacher was able to instantly understand students' dance appreciation ability and provide essential additional remarks to assist in clarifying the misconceptions in innovation.



### *Subjects*

The participants were recruited from six classes of a general education dance course from a university, with a total of 266 people. The participants were all novice learners and it was their first time to take dance courses. They were either freshmen or sophomores, and they were aged 19 to 20. To avoid different instructors generating different results, all the participants were taught by the same instructor who had taught creative dance courses for more than 10 years and who was also the winner of the “creative dance” item in a national dance competition.

Also, corresponding to the real teaching contexts at school, all the groupings were conducted based on the original classes. Three classes with 135 students were randomly chosen to be the experimental group with mobile peer assessment in the classroom activities, while the other three classes with 131 students were the control group with verbal peer feedback. The in-class teaching activities were conducted in groups of four to five students, randomly assigned by the instructor. The group members were able to decide their role positioning or tasks during the choreography and practice process.

### *Course design*

The course content of choreography teaching referred to Vygotsky's (1978) social constructivism and the lesson plans designed by Ludevig (2015). The course was not designed for students who aimed to become dancers or choreographers; instead, it was for beginners who were interested in dance as a leisure activity. Students were instructed so as to provoke their higher order innovative thinking and to focus on peer feedback and interaction through “interaction, perception, and presence theater.” The design of the teaching activities is described as follows:

1. Choreography teaching: the instructor instructed students to perceive such change as music, space, time, emotions, interaction, etc., to understand the key concepts of the choreography course, and to undergo preliminary dance routine innovation and practice.
2. Group-interactive revision: based on group choreography performances, students discussed in groups, revised, and re-performed in class; the instructor joined the groups randomly, giving suggestions regarding students' innovation, errors, and misconceptions.
3. Feedback in theater: students performed their choreography in groups; peers off the stage observed, appreciated, and provided suggestions or evaluation feedback.
4. Revision and Performance: after receiving peers' scoring or suggestions, students would make final revisions and practice to complete the group choreography task.

### *Experiment process*

In an effort to investigate the effects of mobile technology-assisted peer assessment on students' innovative competence and dance skills, the students were divided into two groups, each adopting a different peer feedback approach. The experimental group adopted mobile peer assessment while the control group adopted verbal peer feedback. The experiment lasted for 15 weeks of the university general education dance course. The class was held once a week, for 100 minutes each time. The experiment procedure is shown in Figure 3.

The type of dance taught in the dance course was “creative dance.” The teaching plan was designed based on the suggestions of Frichtel (2017). In the previous 6 weeks, both groups of students had learned the fundamental dance knowledge and skills via the traditional teaching approach. The learning content for each week consisted of five sessions, that is, movement ritual, warmup, inquiry and innovation, rehearsal, and reflection. During the learning process, the students had opportunities to contribute ideas, develop previous knowledge, explore new concepts, and refine their practice.

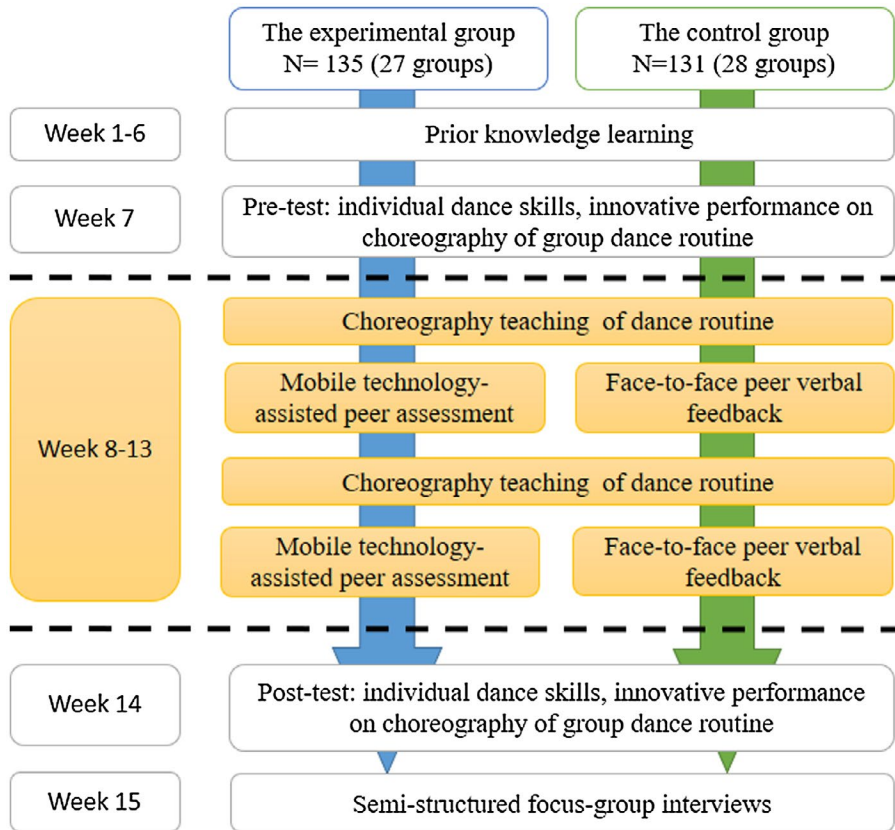


Figure 3: The experiment process

After that, a 1-week pre-test was administered to understand the students' prior knowledge and dance skills to exclude the preliminary differences of the two groups before the experiment. The content of the skills subject included the innovative competence of dance routine choreography, and the individual performance of dance skills. Afterwards, 6 weeks of choreography teaching was conducted for the two groups of students; the teaching content was developed and designed based on Vygotsky's (1978) social constructivism and the choreography teaching activities proposed by Ludevig (2015). Each group consisted of four to five students, and through interaction and communication, team members mutually innovated and practiced the dance routine using their creativity and team spirit. In addition, both groups of students had two rounds of group performance in the aforementioned instructional period so as to obtain peers' and the teacher's feedback and suggestions. After the group demonstrations, 50 minutes of class time was freed up for the students to revise and practice according to the feedback.

The difference between the two groups of students was the way in which the peer feedback was conducted. The experimental group conducted peer assessment in class and received the scoring results immediately using mobile phones or tablet computers.

On the other hand, the control group conducted face-to-face verbal peer feedback in the class using the same rubrics. The teacher first explained the scoring criteria for each dimension of the

rubrics to the students, and then projected the rubrics on a big screen for their reference during the peer-assessment process. The students took notes when reviewing peers' dance performance, and were allowed to provide verbal comments right after each dance performance.

After the teaching experiment, a 1-week post-test was administered to the two groups of students, including the group innovative performance of their dance routine and individual dance skills. Finally, to probe into the students' learning perceptions, focus-group semi-structured interviews were conducted in the 15th week (10 minutes per interview).

*Instruments*

The instruments employed in the present study included the rubrics for the innovative performance of the dance routine, the rubrics for the dance skills, and the interview guidance for investigating students' perceptions.

The rubrics for the innovative performance of the dance routine were adapted from the Dance routine rubrics proposed by Rcampus (2018b). Three experts who had more than 12 years' experience of teaching creative dance courses as well as serving as judges for international dance competitions were recruited to evaluate the rubrics to ensure their validity. The original criteria consisted of Dance 8 Counts, Knowledge of Choreography, Rhythm & Tempo, and Originality & Creativity. After deleting Knowledge of Choreography, Rhythm & Tempo, and similar aspects in the rubrics of dance skills, the study categorized performance into four levels: Perfect (4), Fair (3), Incomplete (2), and Extremely incomplete (1). The grading rubrics are shown in Table 1.

Three instructors with more than 5 years of teaching experience conducted the scoring. The Kendall coefficient of concordance test was performed; the Kendall's  $\omega$  of the pre-test was 0.71, and that of the post-test was 0.78 ( $p < .00$ ), indicating that there was a high consistency among the three experts' evaluations. Thus, the average of the three experts' evaluation was used as the score for innovative performance of the dance routine.

The dance skills examination referred to the dance performance evaluation rubric proposed by Rcampus (2018a), including Knowledge of Choreography, Technical skills, Performance Skills, and Rhythm & Tempo. The instructor examined and ensured the rubrics were appropriate for the teaching content in this course. All the evaluation aspects were classified into four levels: Perfect (4), Fair (3), Incomplete (2), and Extremely incomplete (1). The rubrics of dance skills are presented in Table 2. The ratings were conducted by the instructors and two other teachers, each

Table 1: The rubrics of innovative performance of the dance routine

Criteria	4	3	2	1
Dance 8 counts	The dance includes the required (8 out of 8) number of eight counts and group transitions from the last eight count to the beginning	The dance includes most of the required (7 out of 8) number of eight counts and group transitions from the last eight count to the beginning	The dance includes some of the required (6 out of 8) number of eight counts and group transitions from the last eight count to the beginning	The dance includes a few of the required (5 or less) number of eight counts and group transitions from the last eight count to the beginning
Originality/creativity	All group members (100%) collaborate and create original dance steps	All group members mostly collaborate and create original dance step	All group members slightly collaborate and create original dance steps	All group members hardly collaborate and create original dance steps



Table 2: The dance skills rubrics

Criteria	4	3	2	1
Knowledge of choreography	A few errors, however they do not interfere with the performance	Some errors (3-5 errors) causing brief pauses in the performance	Unsure of some movements, Sometimes hesitates/watches others and makes several errors	Remembers a few of the steps/movements and tries, but looks lost and out of sync with others
Technical skills	Dance performed with attention to details of technique; has attained proficiency in dance style	Dance performed with attention to most details of technique	Only some understanding of technical elements demonstrated in the performance	Little attention paid to how movements are done or other details of dance
Performance skills	The dancer draws the judge in to want to watch them and is able to engage the audience completely through their performance	The dancer communicates with the audience/judges through eye contact and facial and body expression. Occasionally loses focus	The dancer is generally focused, but only some attempt made to grab attention of the judges with eye contact and good facial expression	The dancer is not very focused on making eye contact, concentrated or committed to the performance
Rhythm & tempo	Accurate in beat, tempo, rhythms of dance sequences throughout the dance	Generally accurate in beat, tempo, rhythms of dance sequences most of the time	Falls behind and/or speeds up in places or makes errors in rhythm	Gets off beat and speeds up or falls behind often

with more than 5 years of teaching experience. After the Kendall coefficient of concordance test, the Kendall's  $\omega$  of the pre- and post-test were the same, 0.82 ( $p < .00$ ), showing that there was significant correlation among the three experts' scores. Thus, the average of the three experts' evaluation was adopted as the dance skills score.

The interview questions referred to the questions about information technology-integrated teaching by Hwang, Yang, Tsai, and Yang (2009), with a total of seven questions. Then, some words were slightly revised based on the learning strategy integrated into the experiment. For example, one of the questions was "What did you gain most by using this strategy to learn dance? What did you learn most? Please give an example."

The interviews were recorded and transcribed first, and then were coded and analyzed based on the grounded theory proposed by Glaser and Strauss (1967). In the first stage, the students' statements were transcribed as text one by one following the format "Class, group number, time: statement." For example, "F07347: The feedback from peers helped me improve my dance skills although I do not know who they are" represents that the statement from the 7th group of Class F was recorded at 3 minutes 47 seconds. In the second stage, two researchers who had experience coding interview data were asked to categorize the statements using the open coding approach. In the third stage, the coding results from the two researchers were compared. For those inconsistent coding results, they were asked to discuss until they reached agreement.

**Results**

To exclude students' different starting points, which might have an influence on the results, all the quantitative data were analyzed using ANCOVA (Analysis of Covariance). The qualitative method was analyzed by the researcher of the present study and another researcher. The similar content from the interviews was integrated and categorized into the same category, and then analyzed and discussed by the researchers.

*Analysis of innovative competence of the dance routine*

To answer research question (1), the scores for innovative competence of the dance routine were analyzed by the homogeneity of regression test; the  $F$  value did not reach its significance level ( $F = 2.22, p = .14 > .05$ ), indicating that the scores of the two groups did not violate the assumption of homogeneity of variance. ANCOVA could therefore be conducted.

As shown in Table 3, after excluding the influences of the pre-test scores, there was a significant difference in students' innovative competence of dance choreography between the two groups with different peer feedback methods ( $F = 6.21, p = .02 < .05$ ). The adjusted mean of the experimental group was 4.59, while that of the control group was 3.97. Additionally,  $\eta^2 = 0.11$ , showing a moderate effect size (Cohen, 1988). This showed that integrating mobile technology-assisted peer assessment into choreography teaching could better enhance the innovative competence when compared to the traditional face-to-face feedback. The results also corresponded to the interview data reported by students.

Table 3: ANCOVA results of scores for innovative competence of the dance routine

Groups	N	Mean	SD	Adjusted mean	SE	F	$\eta^2$
EG	27	4.59	0.98	4.59	0.18	6.21*	0.11
CG	28	3.97	0.89	3.97	0.18		

\* $p < .05$ .

### *Analysis of dance skills*

To answer research question (2), the scores for individual dance skills were analyzed by the homogeneity of regression test; the  $F$  value did not reach its significance level ( $F = 1.26, p = .26 > .05$ ), revealing that the scores from the two groups did not violate the assumption of homogeneity of variance, and that ANCOVA could be adopted for analysis.

As demonstrated in Table 4, after excluding the effects of the pre-test scores, significant difference in the students' individual dance skills according to the two different peer feedback methods was shown ( $F = 7.88, p = .005 < .01$ ). The adjusted mean of the experimental group was 11.38 while that of the control group was 10.99. In addition,  $\eta^2 = 0.03$  showed a moderate effect size (Cohen, 1988). It was obvious that mobile technology-assisted peer assessment benefited students' learning of dance skills more than the traditional face-to-face feedback.

### *Learning advantages brought by the group dance routine choreography teaching*

Regarding research question (3), the top three benefits that were mentioned most by the students were "strengthening the ability of team collaboration and communication," "promoting brainstorming and creativity," and "including some of the factors that enhance intrinsic learning motivation" such as challenge and a sense of achievement. These findings are consistent with those of several previous studies, such as Frichtel (2017) and Southcott and Joseph (2019).

The detailed descriptions and examples of each dimension are summarized in Appendix A. Regarding "strengthening the ability of team collaboration and communication," it was found that, in addition to the verbal communication to integrate everyone's ideas and opinions, students also had to take everyone's physical ability into consideration, and coordinate their dance skills. In other words, the dance routine choreography allowed the team members to connect more closely, including verbally communicating their innovative thinking, respecting each other's physical ability, coordinating their dance skills, and so forth. It increased the opportunities and level of teamwork, and produced much more emotional interaction. Regarding "promoting brainstorming and creativity," it could be seen that students made endeavors to brainstorm and make use of their imagination during the choreography in the hope of breaking the old framework and showcasing their innovative energy. Regarding "including some of the factors that enhance intrinsic learning motivation," the choreography of the dance routine could provoke challenges to students, including innovative thinking and the breakthrough of the dance skills.

### *Effects of mobile peer assessment on students' learning*

Regarding research question (4), the top three benefits of applying mobile technology-assisted peer assessment addressed by the students were "understanding the accurate evaluation criteria," "reflection from an objective perspective," and "broadening the aspects of appreciating the performance," as shown in Figure 4.

The detailed descriptions and examples of each dimension are summarized in Appendix B. All in all, students held positive attitudes toward the peer assessment. Through the learning in this

Table 4: ANCOVA of the scores for individual dance skills

Groups	N	Mean	SD	Adjusted mean	SE	F	$\eta^2$
EG	135	11.29	1.92	11.38	0.10	7.88**	0.03
CG	131	11.08	2.06	10.99	0.10		

\*\* $p < .01$ .

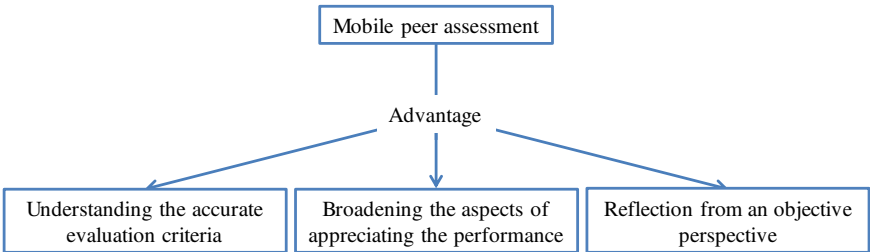


Figure 4: Graphical presentation of the advantages of mobile peer assessment

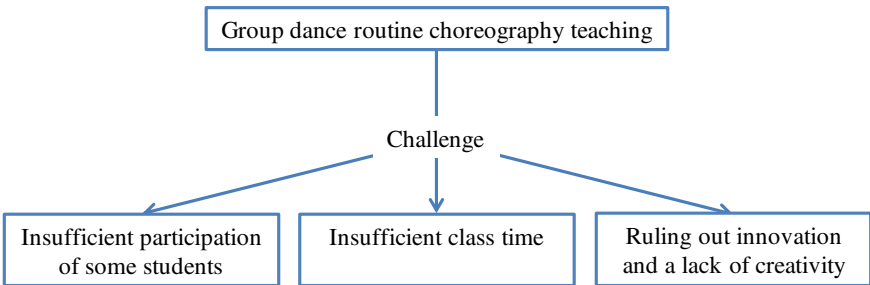


Figure 5: Challenges in group dance routine choreography teaching

class, they realized the key points step by step. With regard to other negative feedback, the same problems occurred in both groups. Since dance is a performance skill, performing on stage is inevitable. Only by practicing on stage many times could students ease their mental pressure. This was the reason why such processes as rehearsal, formal performance and playback were included in the previous dance class.

*Challenges in group dance routine choreography teaching*

Regarding research question (5), the top three complaints addressed by the students in the choreography teaching of the dance routine were the “insufficient participation of some students,” which influenced the teamwork, “insufficient class time” because innovation requires abundant time, and “ruling out innovation and a lack of creativity,” as shown in Figure 5.

The detailed descriptions and examples of each dimension are summarized in Appendix C. It was found that not only how to innovate the choreography but also how to connect their innovative thinking and physical capabilities to put them into practice bothered the students, and were also obstacles during the innovation.

**Discussion**

The present study employed the choreography teaching of dance routine and mobile technology-assisted peer assessment incorporated into a university general education dance course. It investigated the effects of students’ innovative competence and dance skills. Students’ learning perceptions expressed in the interviews were also analyzed.

The researcher firstly made efforts to verify Vygotsky's (1978) social constructivism in the dance routine choreography with higher order thinking. The study employed two rounds of peer assessment to increase learners' social interactions and to promote their higher order thinking. The findings revealed that the students' choreography performance in the group dance routine did improve significantly; that is, the peer assessment could increase students' innovative competence (Hwang *et al.*, 2018). Furthermore, in the past, researchers have integrated peer assessment into learning dance skills many times. No matter whether using recordings on an online platform (Hsia, Huang, & Hwang, 2016) or using mobile technology in the classroom (Lin *et al.*, 2018), the results all showed that learners' dance skills proficiency level had significant improvement, which was in line with the present study.

On the other hand, from the students' feedback it was found that the choreography teaching of group dance routines could facilitate such capabilities as teamwork, communication and coordination, promote brainstorming and innovative thinking, and provoke students' sense of achievement and challenge compared with the general dance class. As indicated by several scholars, dance could serve as a medium to develop social skills and strengthen interpersonal relationships (Athanasiadou & Karkou, 2017; Panagiotopoulou, 2018; Pentz & Schroeder, 2017). Dancing together promoted close communication among participants no matter whether verbal or non-verbal, such as eye contact, breathing and physical interaction (Pereira & Marques-Pinto, 2018). Based on the findings of the present study, when dance only emphasized skills, the students did not feel any improvement in their social ability. When dance required choreography, the students would devote themselves to the communication and coordination of team members' innovative thinking and dance skills proficiency level. Secondly, students made endeavors to break the traditional framework and develop innovative ability during their dance routine choreography. Such a growth in innovative thinking could further increase the learners' innovative energy in daily life in the future, as indicated by several researchers (Antal & Strauß, 2013; Ludevig, 2015; Yams, 2018). Lastly, students felt a sense of achievement and challenge because of the dance routine choreography. When the learning activity could satisfy students' innate mental needs or make participants like or be brave in facing challenges, it was an activity to enhance intrinsic motivation (Tseng & Tsai, 2010). This complies with the suggestions of several researchers that engaging students in creative tasks and performing is likely to promote their intrinsic motivation owing to the sense of accomplishment they experience (Talmi, Hazzan, & Katz, 2018). This was an interesting finding, indicating that the dance routine choreography could stimulate students' intrinsic motivation.

Regarding the use of mobile technology in the face-to-face peer-assessment mode, the students did not mention the deficiency of mobile peer assessment in the present study. They only reported that they were not familiar with it and did not know how to evaluate their peers in the beginning. Other feedback showed that this mechanism was beneficial to dance learning, including understanding accurate evaluation criteria, reflecting in an objective way, and broadening the aspects of appreciating the work. When learning with the peer-assessment approach in the face-to-face mode using mobile technology, the students' privacy was protected and they did not need to worry about interrupting the performance or disturbing other audience members, which encouraged them to freely provide comments based on the rubrics and interact with peers to share ideas as indicated by Lin *et al.* (2018) and Kuo *et al.* (2017). This could be the reason why the students in the experimental group indicated that they were able to understand accurate evaluation criteria, make reflections, and have a broader view under the mobile peer-assessment approach. Since the evaluation rubrics included diverse and complete scoring aspects, they could serve as the indicators for raters (Cheng, Liang, & Tsai, 2015). Thus, when students acquired the knowledge



of appreciating and evaluating dance routines through the rubrics provided by the teacher, they could realize the way to improve their own performance, and learn to focus on different performance details when scoring. What's more, they reflected on and revised their own and the team's performance according to peers' evaluation, which conforms to Piaget's (1964) cognitive conflict theory and Vygotsky's (1978) social constructivism. On the contrary, without the mobile technology, the students in the control group might have been afraid of expressing their opinions, and hence had fewer opportunities to exchange ideas with peers. As indicated by one student "It is great to see peers' dance performance in the face-to-face mode, as it allows me to see the details; however, I dare not show my opinions in front of others" (A07822).

Furthermore, the current study also collected data about the challenges faced in the choreography teaching of group dance routines, including insufficient participation by some students that influenced the choreography task, little time for innovative thinking and discussion that made students feel pressured and nervous, and lack of imagination and creativity. Thus, it is suggested that the flipped classroom be integrated into future dance choreography classes. The teacher can record the choreography teaching as a video first for students to learn prior to class; then, students bring their innovative thinking to class for further discussion and practice. In this way, more class time can be freed up for hands-on practice and peer discussion (Pierce & Fox, 2012). Meanwhile, students can save their individual learning time to develop mutual higher order thinking (Danker, 2015). Also, it would solve the problem that everyone needs different amounts of time for innovative thinking, which resulted in wasting the majority of the class time to wait for each other's ideas. Besides, future studies should further explore the way to help students organize their thinking to solve the problem of insufficient ideas during the choreography process, for instance, adopting mindtool-based collaborative learning to enhance students' innovative performance (Wu, Hwang, Kuo, & Huang, 2013). This approach was applied to a university management course and had significant effects; future investigation can be conducted to see whether it is appropriate for dance choreography.

## Conclusions

This study demonstrates that the use of a mobile technology-based peer-assessment approach is able to improve students' innovative competence and dance skills in the face-to-face learning mode. The experimental results revealed that the approach significantly enhanced students' innovative competence of dance routines and dance skills. In addition, the students indicated that the dance routine choreography class was conducive to improving social skills, innovative competence, and intrinsic motivation, while mobile peer assessment helped them understand accurate evaluation criteria, reflect on their own in a more objective way, and broaden their appreciation of dance performance.

In addition to proposing an effective approach, another contribution of the present study is to use quantitative evaluation to evaluate the students' innovation competences in choreography rather than using a self-reported questionnaire. This is quite different from most previous studies. Moreover, through the analysis of student interviews, the advantages and challenges of group choreography were analyzed. The advantage could be a good reference for educators in related fields for developing teaching plans to engage students in effective learning and innovative thinking. In terms of challenge, several suggestions are proposed regarding researchers' possible directions for designing new learning strategies to help students achieve better learning outcomes and experiences.

On the other hand, there are limitations in the present study that should be noted. First, the focus of this study was solely on students' point of view, while the teacher's perspective was not

included. Second, although most students had experience of using mobile devices, this could be the first time that they had used mobile devices for peer assessment; that is, the novelty of the technology might have affected the results of the study. Third, the “anonymous” feature of using the mobile app might be a factor affecting the students’ learning, although the students in both groups generally stated in the interview that their anxiety was mainly from performing in front of the audience rather than from reviewing peers’ performances.

Therefore, it is suggested that follow-up research can be conducted to investigate how the approach affects teachers’ choreographic process and their ability to teach. Second, the type of dance considered in the study was “creative dance”; further studies could investigate the impacts of the proposed approach on other types of dance. Third, it is also important to compare the feedback quality of the students learning with different peer-assessment approaches.

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### Statements on open data, ethics and conflict of interest

The participants were protected by hiding their personal information during the research process. The researchers obtained informed consent from all participants who knew that their participation was voluntary and that they could withdraw from the study at any time.

There is no potential conflict of interest in this study. The data can be obtained by sending a request e-mail to the corresponding author.

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Appendix A. Learning benefits brought by the group dance routine choreography teaching

Types	Description	Examples
Strengthening the ability of team collaboration and communication	<p>Choreography required much closer teamwork than pure learning of dance skills</p> <p>Students would make efforts to communicate and coordinate each other's ideas to ensure better team performance during the innovation process of the dance routine</p> <p>The dance routine choreography allowed the team members to connect more closely, including verbally communicating their innovative thinking, respecting each other's physical ability, coordinating the dance skills, and so forth</p>	<p>"Choreographing together makes everyone more united" (F09033)</p> <p>"It increased the team collaboration. Because we need to practice dancing and choreography together, it needs everyone's cooperation to finish" (C07152)</p> <p>"I learned how to communicate and coordinate. Everyone has his/her own ideas about dance steps, so we need to discuss and decide whose method to adopt" (B01228)</p> <p>"The class put more emphasis on solo work before, but now everyone needs to perform well to have a good performance. Therefore, I have more opportunities to communicate with my team members" (C06144)</p> <p>"Everyone needs to think about how to finish this action together. In particular, the action at the end of our performance needs everyone's participation" (C03204)</p> <p>"When choreographing, we need to consider others' proficiency levels and need more ideas" (F06311)</p> <p>"I needed to dance alone before, but it needs everyone to help with the choreography this time, including some actions for everyone to do" (D08235)</p>
Promoting brainstorming and creativity	<p>For choreography, students no longer relied on the teacher or passively waited for the knowledge. Rather, they actively thought, and discovered their physical capabilities</p> <p>When compared to the teacher directly teaching the knowledge, students were more likely to actively explore</p>	<p>"In the previous class, the teacher taught one action, and then we learned. We did not need to use our brains" (C08246)</p> <p>"Now, we need to think reversely about what we can learn. Usually, we just learned what the teacher taught us before" (C06047)</p> <p>"Traditionally, the class focused on the teacher's teaching; however, in this class, we need to think how to choreograph. This is what I gained the most from" (D03212)</p> <p>"In the past, we just did what the teacher said; yet, this time, we had to use our brains to think and be creative. In this way, I think I learned more" (D06109)</p> <p>"I need to think about what I want to do rather than [relying on] the teacher. It seems that I am learning and gaining knowledge, and I do not need to follow others' ideas. It is much more tiring because I have to think all the time" (D06144)</p>

(Continues)



Appendix A. (Continued)

Types	Description	Examples
Including some of the factors that enhance intrinsic learning motivation	In the past, when practicing the dance skills, students might not open their senses to perceive the emotions of the music, the interaction between other dancers	“I did not know the feeling of dance before because I had to practice all the dance steps until it became a reflex action. However, if I have to choreograph, I need to use my brain” (D01228)
	This learning strategy could promote innovative competence	“It increased the physical interaction in the team, which is the context among people. Now, people seldom interact with others” (F07347)
	Students realized the meaning of hands-on learning during the choreography; they gained a sense of achievement and expected to have better performance	“Teaching more about choreography is helpful to the future because we may be stubborn sometimes. After thinking again and again, maybe one day we are enlightened” (B09958)
		“I can use my imagination to seek new actions, and dance what I want to dance” (B05035)
		“I feel a sense of achievement when I use my experience, catch the beat, and practice the dance steps I make” (B04237)
		“I feel that I successfully finished something. It is not easy to choreograph, and then I teach everyone and practice together. We reached the objective and finished a performance together” (B07346)
The choreography of the dance routine could provoke challenges to students, including innovative thinking and the breakthrough of the dance skills	“I think choreography is a very meaningful and crucial part. I can brainstorm; a test without a test paper is a healthy kind of competition” (A08624)	
	“I think it is enriching but challenging. It is really troublesome, but I still gained a lot” (A04129)	
		“I did not have to choreograph in the previous dance classes. I just danced based on what the teacher taught, so it is much more challenging” (A02045). “It requires creativity, some changes and some challenges of our physical abilities. It is also a challenge to our imagination” (F10032)

Appendix B. Effects of mobile peer assessment on students' learning

Types	Description	Examples
Understanding the accurate evaluation criteria	Through the rubric provided by the instructor, students acquired knowledge of how to appreciate and evaluate other dance routines and how to improve their performance from it	"The scoring criteria are listed out clearly. We can compare our team with others. What part are we missing or what part do we have? Each team has its own features" (B10550) "We know better regarding the dance criteria. We can also adopt others' advantages into our own performance. It is like the performance walkthrough; we are able to realize how to perform better" (D01439)
Reflection from an objective perspective	Students were able to reflect on their own work through the rubrics provided by the instructor  They could evaluate their own and others' performance through the peers' evaluation	"We are able to evaluate the dance routine from the instructor's perspective. Then, we can tell that our performance does not have clear expression" (B10510) "I can know where I did not perform well through the evaluation. I can improve on my own, and see where we can revise together" (E02231)
Broadening the aspects of appreciating the performance	In the past, they just focused on their favorite part; now, they observed different details in the performance and learned to appreciate the whole dance performance from a broader viewpoint	"In the past, I just thought whether I liked those actions or not; yet, when doing the evaluation, I will look at more details" (B07434) "I've never rated before so my perspective may be different. Originally, I looked at the creative point of the performance, but now I will also look at the beat" (B09622) "I did not know where to start my evaluation" (D02255)
Only one student reported With regard to other negative feedback, the same problems occurred in both groups	Students lacked the experience of evaluating dance  Performing on stage would place a little mental pressure on students  Only by practicing on stage many times could students ease their mental pressure	"I am happy to watch others' performance, but I don't want to dance on stage. I am so nervous" (E05132) "I feel depressed and pressured when I need to perform on stage" (C08448) "This can make me not so nervous on stage. I can face the audience in advance" (F10247) "I will not feel so nervous when facing people in the future. It can train my composure" (F08433)

Appendix C. Challenges in group dance routine choreography teaching

<i>Types</i>	<i>Description</i>	<i>Examples</i>
Insufficient participation of some students	The engagement of team members would influence team performance, which is also the obstacle faced by some of the groups	<p>“Some people just don’t interact and discuss with others, but it is hard for choreography. Choreography requires everyone’s engagement. If we just dance according to what the teacher asked, it is okay if we lose one person. On the other hand, if it is choreography and one person doesn’t engage in it, other people will be very tired” (A06140)</p> <p>“It is risky for choreography. If someone doesn’t want to engage, we won’t have a good performance” (A06505)</p> <p>“Because of the choreography, if your team members change, you need to start over again” (C07121)</p> <p>“There was usually someone missing for the practice. Like today, we have one person missing, so it is not good to add more new things” (E04339)</p>
Insufficient class time	<p>Since the dance routine innovation could not be finished in a single week, it would face the problem that university students might be absent when the time of the innovation activity was conducted after class</p> <p>Students’ ideal discussion time seemed to be longer than that provided by the instructor</p> <p>The problem was not only insufficient discussion time but also students’ high expectations and lack of confidence in their dance routine choreography</p> <p>If students could preview the dance routine choreography task before class, the team members could discuss it in the online community first, which would improve their thinking in class and solve the problem of insufficient time</p>	<p>“It was a little bit too hurried to have a complete conclusion. We could have detailed results only if we created a chat group for discussion” (E03620)</p> <p>“We didn’t have time. Maybe because we just finished the discussion, the teacher just went to the next stage of the class without letting us practice” (E03638)</p> <p>“At first, we finished our discussion. At the time when we were about to go on stage, our team decided to change back. Because the action was not complete, we thought we could not perform well. But when we changed back to the original version, we thought we did not prepare well” (D08109)</p> <p>“I hope that the teacher can announce the choreography task of the dance routine for the next class in advance so we can have more time to discuss in the chat group, and address our own ideas first” (C03421)</p> <p>“I think the teacher can inform us about the choreography task beforehand. Then, we can think about it first, or I feel pressured” (D08437)</p>

(Continues)

Appendix C. (Continued)

Types	Description	Examples
Ruling out innovation and a lack of creativity	Some students still preferred other learning activities that did not require brainstorming, group discussion and teamwork even though they knew they could obtain more from this approach	"The class can have more training on muscle strength and stretching because I don't have to use my brain" (C08729)
	Some of the students rejected the approach because of its difficulty	"I gained a lot from choreography, but I don't like it. It's troublesome" (D06537)
	Not only how to innovate the choreography but also how to connect their innovative thinking and physical capabilities to put it into practice bothered the students, and were also obstacles during the innovation	"This class is more bothersome. We have to discuss and think; also, we cannot be absent" (C08113)
		"Choreography causes us inconvenience because we don't have any ideas. It is really hard to design the dance steps" (D02558)
		"It is really too difficult for us who have no experience to start from scratch, especially for me as I have no basic dance skills. We think we did not perform well and lacked creativity in our choreography" (E07309)
		"Actually, I have a few ideas for some actions, but it may not be possible to act out" (C06736)
		"Sometimes the actions we think about are too difficult. We have the idea, but cannot put it into action" (B06558)