Effects of a peer-assessment-based mobile physical education learning approach on students' affective perspectives on a university Tai Chi course

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Abstract: The advancement of mobile technologies has encouraged an increasing demand for the support of mobile learning. Researchers have emphasized the need for well-designed peer involvement in order to improve students' abilities in the cognitive, affective and psychomotor domains. Peer assessment has been considered to be an effective learning strategy to improve students' learning performance in past decades. However, few studies have focused on the effects of the peer assessment strategy on students' performance from the affective perspective, especially in Physical Education courses. Therefore, in this study, a peer-assessment-based mobile physical education approach is proposed for developing a mobile learning system for a Tai Chi physical education course in a university. To evaluate the effectiveness of the proposed approach, an experiment was conducted by assigning 42 college students to participate in this learning activity. The students in the experimental group adopted the peer-assessment-based mobile physical education approach, while those in the control group learned with the conventional mobile physical education system. The experimental results show that the proposed approach not only promoted the students' learning interest and motivations, but also improved their learning self-efficacy and socialization.

Keywords: peer assessment, mobile learning, physical education, Tai-Chi, affective perspective

1. Introduction

In Taiwan, physical education is offered as part of the twelve-year national fundamental education as well as at university. The purposes of physical education are not only to train learners in proper exercise habits, but also to enhance their interest in learning, and understanding the individual's physical condition. Teachers have emphasized that a well-designed curriculum plays an important role in physical education, influencing the effectiveness of the teaching/learning process. In particular, motion-based physical education teachers not only instruct learners on sports expertise, but also provide basic operation demonstrations, such that learners will clearly understand the process and knowledge they need to follow in the pre-defined guidelines.

Previous studies have shown that teachers use technology and multimedia as tools in physical education to facilitate learners' learning motivation and enhance their achievement (Leijen, Lam, Wildschut, Simons, & Admiraal, 2009; Papastergiou, Gerodimos, & Antoniou, 2011). Furthermore, multimedia-based teaching models are being widely adopted in ballet lessons to enhance learners' reflective ability. Papastergiou et al. (2011) described multimedia materials presented in the form of blogs that apply to basketball skills to guide the teaching and learning environment. These multimedia materials provided a learner guide (photos) and depiction of the skills, which helped to enhance the learners' self-efficacy. However, the effect of using multimedia in physical education depends on the students' self-discipline ability. Therefore, it has become an important issue to develop effective learning guidance approaches for physical education learning.

The advancement of personal computing technologies such as smartphones, tablet PCs, and wearable devices, has provided an opportunity that enables students to interact with learning systems and their peers in the real world (Kearney, Schuck, Burden, & Aubusson, 2012). This kind of learning approach which allows students to use mobile devices with a wireless network to provide learning materials and perform learning tasks as part of real-world activities has been called "mobile learning" (Lai & Hwang, 2015; Furió, Juan, Seguí, & Vivó, 2015) or "ubiquitous learning (u-learning)" (Chu, Hwang, & Tsai, 2010; Hwang, Tsai & Yang, 2008). Ozcelik and Acarturk (2011) employed the mobile learning approach in a computer course field trip, further showing that mobile learning assists learners in terms of effectively incorporating information into their own practice paradigm. Moreover, Liu and Chu (2010) conducted a mobile English learning activity, also reporting the advantages of the mobile learning approach. Researchers have indicated that mobile learning has great potential for improving students' learning motivation and interest (Chen, Chang, & Wang, 2008; Chu, Hwang, & Tsai, 2010). Researchers have also indicated that proper mobile learning strategies or tools need to be considered to help students acquire the expected learning achievements in real-world environments. This study seeks to explore the difference between traditional and non-traditional mobile-learning strategies regarding physical activity promotion.

To assist students in enhancing their learning outcomes in a mobile learning scenario, peer assessment provides learners with opportunities to develop their own understandings of content, learn from each other, and share their skills and strengths. Moreover, the approach can be used as an aid to learning activities of various courses, such as natural sciences, social sciences, and the humanities (Orsmond, Merrya, & Reilinga, 1996; Falchikov & Magin, 1997; Topping, 1998; Gay, Sturgill, Martin, & Huttenlocher, 1999). Many studies have demonstrated the benefits of peer assessment, which promotes critical thinking, learning achievements and motivation (Chu, Hwang, & Tsai, 2010; van Zundert, Sluijsmans, & van Merriënboer, 2010; Hwang, Kuo, Yin, & Chuang, 2010).

However, despite the value of peer assessment, learners still need to take an active role in the learning process (Tsai, Liu, Lin, & Yuan, 2001). Also, supporting and guiding learners with proper learning strategies and guidance has become an important and challenging issue in developing effective learning guidance models for mobile physical education. To cope with this problem, this study proposes a peer assessment-based approach for mobile learning. Moreover, learning motivation, perceived ease of use and usefulness, and students' self-efficacy are measured to investigate the effects of the proposed approach on the in-field performance of the students from different aspects.

2. Peer-assessment-based mobile Physical education approach

This section further explains how peer assessment is used to engage a student's progress in the cognitive and psychomotor domains. The peer-assessment-based mobile physical education system is developed for conducting physical education activities. Figure 1 illustrates the proposed system architecture, which consists of three modules as follows.

1. Mobile physical education module: students can use their mobile phones to log into the system via a wireless network, and read learning materials and record their learning films. Students can upload their films to the server according to the instructions. The functions of this module contain viewing learning materials, film recording and film uploading.
2. Peer assessment system module: learners can connect the system either on their smartphones or computers to give scores and comments. Learners can also view the scores and comments given by their peers in the system, adjust their movements accordingly, and re-upload their learning videos. The functions of the module include filling in, modifying and viewing the assessment sheets. By discriminating between various learning records, students can learn by considering the motions selected by others, or by rethinking the subject again if they found some ideas or motions to be unfamiliar. It is useful to note that this method of using peer assessment to help students understand the meaning of a subject works for both individual and group settings.
3. Back-end databases module: teachers can observe the students' learning status in the system and check with every learner's personal learning videos and peer assessment results. The module contains databases of the learner's personal information, learning materials, learning videos, learning portfolios and peer assessment sheets.

First, students use mobile phones in a real learning environment, and follow the learning activities provided by the system to learn. During the learning process, the system will provide suitable learning guidance for the students and help them to complete each learning objective. The system also records students' learning films by using the embedded recording function of the mobile phones, and all the films will be uploaded to the server. After all of the films have been uploaded, a peer assessment activity then starts.

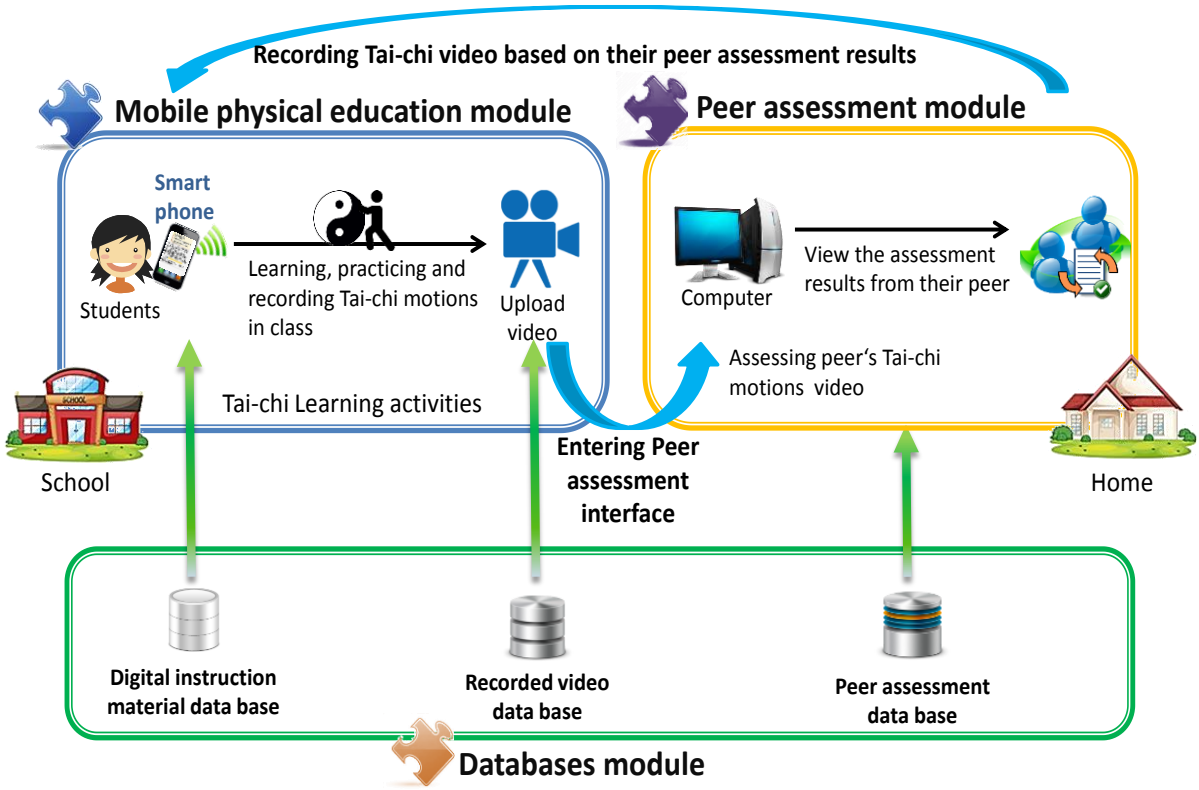

Figure 1. System architecture.

During the peer assessment process, students can use their mobile phones to complete the peer assessment. Moreover, the system will automatically assign two students' films for anonymous assessment. Furthermore, the system uses a five-point Likert rating scheme as the peer assessment sheet, and it will show related information near each assessment item to help students understand the meaning of each item. For example, if students choose 5 points, it means all the movements in the film are correct and good enough. The detailed assessment standard is shown in Figure 2.

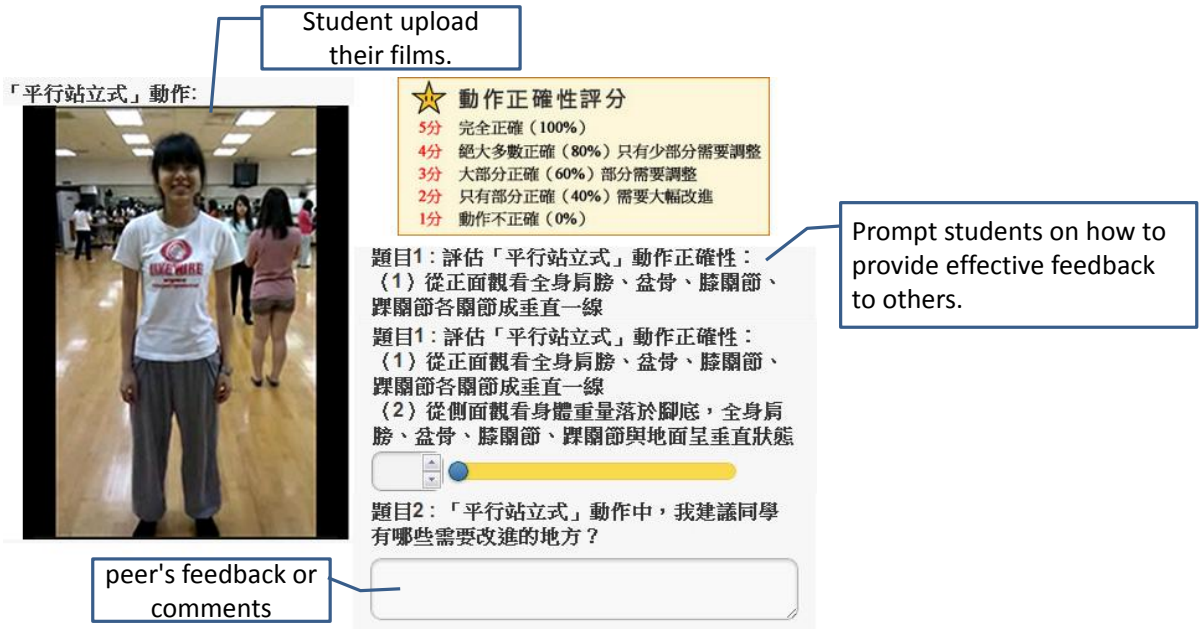

Figure 2. System Interface for peer assessment.

After the peer assessment stage, students can then view the scores and advice from their peers, and can record a new film according to the advice. Students can re-upload their films to the system, and the teacher can then log into the system to see all students' films and scores to understand the learning progress of each student.

3. Experiment Design

To evaluate the efficacy of the peer-assessment-based mobile physical education system, an experiment was conducted on the Tai-Chi physical education course in a university in Taipei, Taiwan. A total of 42 undergraduate students (15 male students and 27 female students) participated in this study. The average age of the students was 21 years old. After learning the five basic Tai-Chi motions in the Tai-Chi physical education course, one class was assigned to be the experimental group (n=20) and the other was assigned to be the control group (n=22).

The students in the experimental group were guided by the Tai-Chi peer-assessment-based mobile physical education system, while those in the control group learnt with the conventional mobile physical education system. Both groups of students were taught by the same instructor who has over 25 years of Tai-Chi teaching experience.

Figure 3 shows the procedure of the experiment. It took 6 weeks to conduct the learning activity. In the first two weeks, after learning the five basic Tai-Chi motions in the Tai-Chi course, the two classes were assigned to be the experimental group and the control group. The students were also asked to take the pre-questionnaire including sport learning motivation and sport learning motivation. After the experiment, a post-test was used to test their basic sport knowledge. The students were also asked to finish the pre-questionnaire including sport learning motivation, sport learning motivation, and perceived ease of use and usefulness.

The measuring tools in this study include a self-efficacy measure, a learning motivation measure, and tai-chi skill evaluation. The self-efficacy measure was developed by Pintrich, Smith, Garcia, and McKeachie (1991). The questionnaire for the learning motivation measure was developed by Hwang, Yang, and Wang (2013). The tai-chi skill evaluation was adopted to assess the differences between the two groups after the learning period. The evaluation consists of five basic motions worth twenty points each.

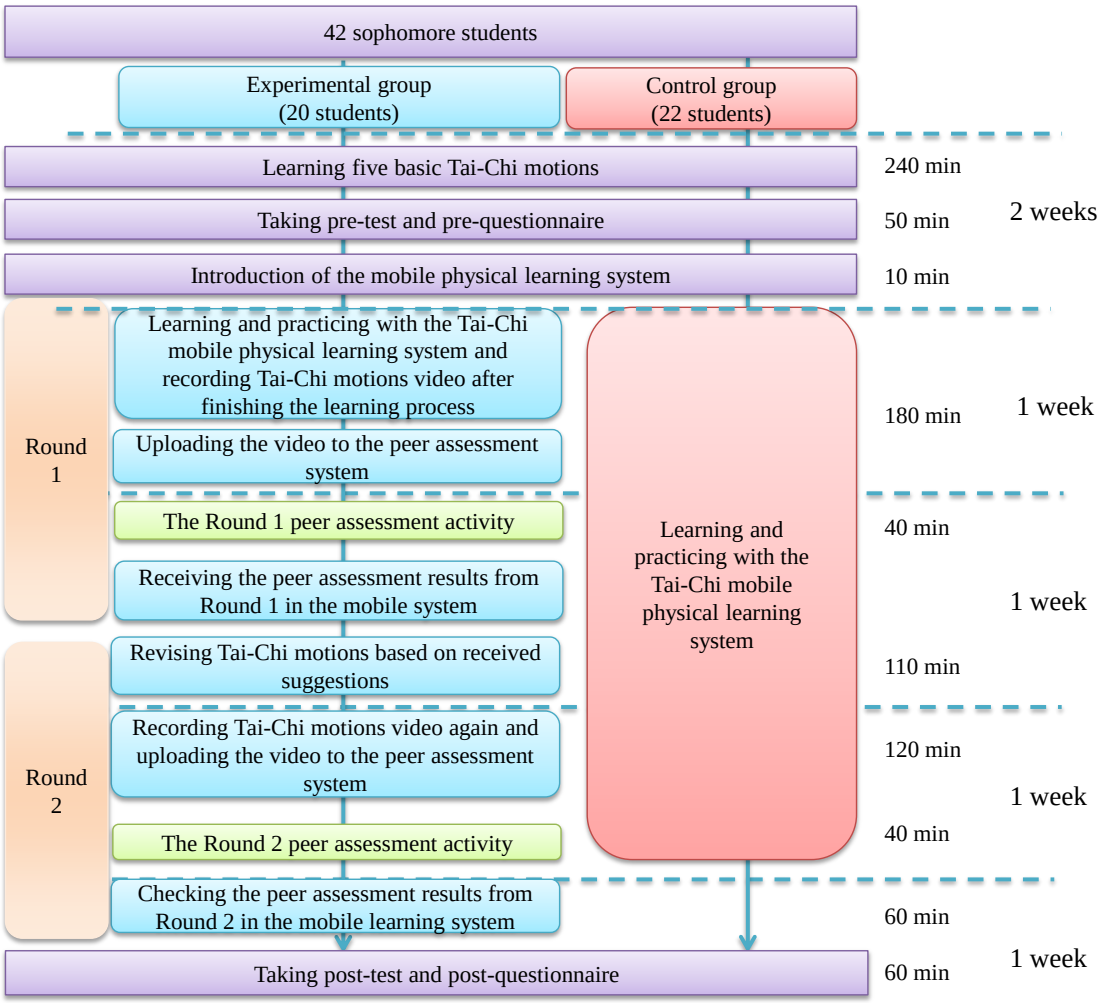

Figure 3. Experiment procedure.

4. Experimental Results

In this experiment, we analyzed the peer assessment mobile learning effect on learning motivations, self-efficacy, and user satisfaction. The major findings are described below.

4.1 Analysis of learning motivations

The questionnaire is presented with a 5-point Likert scale where '5' means strong agreement or positive feedback and '1' represents high disagreement or negative feedback. The results show that the learning motivation of the experimental group students improved after the learning activity. In the learning motivation questionnaire, the experimental group has a significant difference (t=-3.39, p=0.003<0.01) between the pre- and post-questionnaires. In contrast, the t-test results of the control group (t=0.76, p<0.01) showed no significant difference, as shown in Table 1. The results indicate that the learning motivation of the students from the experimental group increased after the learning activity. Further questionnaire analyses showed that the students felt the importance of learning tai-chi (Q1) and they were fond of the content of the class (Q2), as shown in Table 2. The results revealed that the new learning tool effectively stimulated the students and interested them in learning tai-chi based on the comparison of the results of the pre-test and post-test.

Table 1: The paired *t*-test result of the pre- and post-questionnaires of learning motivation.

Groups		N	Mean	S.D.	*t*
Peer-assessment-based mobile physical education group	Pre-questionnaire	20	3.54	0.36	-3.39**
	Post-questionnaire	20	3.91	0.35	
Conventional mobile physical education group	Pre-questionnaire	22	3.61	0.41	0.76
	Post-questionnaire	22	3.54	0.44	

Table 2: The paired *t*-test result of the pre- and post-questionnaires of sports learning motivation for the peer-assessment-based mobile physical education group.

Question		N	Mean	S.D.	*t*
(Q1) I find the content of the Tai-Chi lessons important	Pre-questionnaire	20	3.45	0.60	-2.99**
	Post-questionnaire	20	3.85	0.59	
(Q2) I like the learning content of the Tai-Chi lessons	Pre-questionnaire	20	3.40	0.68	-2.99**
	Post-questionnaire	20	3.80	0.62	

**$p<0.01$

4.2 Analysis of learning self-efficacy

A seven-point Likert scheme was applied in the pre-test of physical self-efficacy. The three sets of values in the one-way ANOVA (Analysis of Variance) test result are provided as follows: the mean value of the test was 4.00 for the peer-assessment-based mobile physical education group and 4.02 for the Tai-Chi mobile learning group (E2). According to the results, there was no significant difference in the physical self-efficacy of the two groups ($F=1.70$, $p=0.19>0.05$).

Based on the analysis above, this research further compared the three sets of values of physical self-efficacy before and after learning, as shown in Table 3. The results found that the experimental group (E1) had a significant difference between the pre- and post-tests of physical self-efficacy (t=-2.64, $p<0.05$). On the contrary, there was no significant difference between the pre- and post-tests of physical self-efficacy in E2 (t=-0.71, p=0.48>0.05). This indicated that perceived self-efficacy significantly improved after learning with the peer assessment-based mobile learning system.

Table 3: The paired *t*-test result of exercise self-efficacy of physical education.

Groups		N	Mean	S.D.	*t*
Peer-assessment-based mobile physical education group	Pre-questionnaire	20	4.17	0.78	-2.64*
	Post-questionnaire	20	4.59	0.72	
Conventional mobile physical education group	Pre-questionnaire	22	4.15	0.78	-0.71
	Post-questionnaire	22	4.24	0.72	

*$p<0.05$

4.3 Analysis of Perceived Ease of Use and Usefulness

To better understand the students' perceptions of the use of the mobile learning system, this study collected the students' feedback on the "perceived usefulness" and "perceived ease of use" of the system. The results indicated that most students gave positive feedback concerning the two dimensions of the mobile learning system. The average ratings for "perceived usefulness" are 3.56 and 2.93 for the experimental group and the control group, respectively; moreover, their average ratings for "perceived ease of use" are 3.81 and 3.59. In comparison with the ratings given by the control group, it should be noted that the students in the experimental group gave higher ratings for "perceived usefulness" and "perceived ease of use", implying that the students who learned with the peer assessment mobile system

revealed higher degrees of technology acceptance than those who learned with the mobile learning system.

In terms of perceived usefulness, the *t*-test result (t=3.81, P<0.001) shows a significant difference between the experimental group and the control group. This depicts that the peer assessment mobile learning approach is more effective than the mobile learning approach. The students of the experimental group considered the intelligent mobile system easier to use than a desktop computer. Also, they could learn better by using the intelligent mobile system and the mobile learning system. This implies that most students in the experimental group agreed with the usefulness of the peer assessment learning system approach in terms of improving their learning achievements.

5. Conclusion and future work

This paper explores the impact of using the peer assessment of mobile learning to enhance the positive impact of physical learning. A peer assessment-based mobile learning approach was developed that can provide a richer understanding of how users can more efficiently employ peer assessment to enhance the learning experience. The experimental results showed that the students of the experimental group had significantly improved in their learning motivation. We also surveyed the learners' perceptions of peer assessment-based mobile learning, which were on the whole positive. These results also point to suggestions and references for the design of efficient mobile-supported collaborative learning activities in the future. Further research will be needed to investigate this methodological concern and its practical applications.

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References

Chen, G. D., Chang, C. K., & Wang, C. Y. (2008). Ubiquitous learning website: Scaffold learners by mobile devices with information-aware techniques. *Computers & Education, 50*, 77-90.

Chu, H. C., Hwang, G. J., & Tsai, C. C. (2010). A knowledge engineering approach to developing mindtools for context-aware ubiquitous learning. *Computers & Education, 54*(1), 289-297.

Falchikov, N., & Magin, D. (1997). Detecting gender bias in peer marking of students' group process work. Assessment and Evaluation in Higher Education, 22(4), 393-404.

Furió, D., Juan, M.-C., Seguí, I., & Vivó, R. (2015). Mobile learning vs. traditional classroom lessons: a comparative study. *Journal of Computer Assisted Learning, 31*(3), 189-201.

Gay, G., Sturgill, A., Martin, W., & Huttenlocher, D. (1999). Document-centered Peer Collaborations: An Exploration of the Educational Uses of Networked Communication Technologies. *Journal of Computer-Mediated Communication, 4*(3), 0.

Hwang, G. J., Kuo, F. R., Yin, P. Y., & Chuang, K. H. (2010). A Heuristic Algorithm for planning personalized learning paths for context-aware ubiquitous learning. *Computers & Education, 54*(2), 404-415.

Hwang, G. J., Yang, L. H., & Wang, S. Y. (2013), A concept map-embedded educational computer game for improving students' learning performance in natural science courses, *Computers & Education, 69*, 121-130.

Hwang, G.-J., Tsai, C.-C., & Yang, S. J.-H. (2008). Criteria, strategies and research issues of context-aware ubiquitous learning. *Educational Technology & Society*, *11*, 2, 81–91.

Kearney, M., Schuck, S., Burden, K. & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Educational Technology*, *20*, 1, 1–17.

Lai, C. L., & Hwang, G. J. (2015). A Spreadsheet-based visualized Mindtool for improving students' learning performance in identifying relationships between numerical variables. *Interactive Learning Environments*. doi:10.1007/s10209-014-0390-z

Leijen, Ä., Lam, I., Wildschut, L., Simons, P. R. J., & Admiraal, Wilfried. (2009). Streaming video to enhance students' reflection in dance education. *Computers & Education, 52*(1), 169–176.

Liu, T. Y., & Chu, Y. L. (2010). Using ubiquitous games in an English listening and speaking course: Impact on learning outcomes and motivation. *Computers & Education, 55*(2), 630-643.

Orsmonda, P., Merrya, S., & Reilinga, K. (1996). The Importance of Marking Criteria in the Use of Peer Assessment. *Assessment & Evaluation in Higher Education, 21*(3), 239-250.

Ozcelik, E., & Acarturk, C. (2011). Reducing the spatial distance between printed and online information sources by means of mobile technology enhances learning: Using 2D barcodes. *Computers & Education, 57*(3), 2077-2085.

Papastergiou, M., Gerodimos, V., & Antoniou, P. (2011). Multimedia blogging in physical education: Effects on student knowledge and ICT self-efficacy. *Computers & Education, 57*(3), 1998-2010.

Pintrich, P.R., Smith, D.A.F., Garcia, T., & McKeachie, W.J. (1991). A manual for the use of the motivated strategies for learning questionnaire (MSLQ). MI: National Center for Research to Improve Postsecondary Teaching and Learning. (ERIC Document Reproduction Service No. ED 338122).

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research, 68*, 249-276.

Tsai, C. C., Liu, E. Z. F., Lin, S. S. J., & Yuan, S. M. (2001). A networked peer assessment system based on a Vee heuristic. *Innovations in Education and Teaching International, 38*(3), 220-230.

van Zundert, M., Sluijsmans, D. M. A., & van Merrie¨nboer, J. J. G. (2010). Effective peer assessment processes: research findings and future directions. *Learning and Instruction, 20*(4), 270-279.