# THE EFFECTIVENESS OF PEER ASSESSMENT IN THE FLIPPED CLASSROOM

Wing Shui Ng and Ka Luen Cheung
The Education University of Hong Kong
Hong Kong

## Abstract

The flipped classroom pedagogy has been promoted to encourage students to learn at their own pace outside the classroom and with the absence of teachers. Valuable in-class time can thus be freed up for students to deepen their understanding of the content. However, learning at home can promote a lackadaisical learning environment. Student learning relies heavily on learning motivation. To address this motivational challenge, a peer assessment component was deliberately integrated into the flipped classroom pedagogy in this study. Preliminary results suggest that the students demonstrated a good attitude in the pre-lesson peer assessment process, and they were satisfied with the peer assessment activity.

*Keywords*: Peer Assessment, Flipped Classroom, Assessment for Learning, Peer Feedback, Interaction

## Introduction

In recent years, higher education standards have emphasized the shift from an instructor-centered educational model to student-centered learning. Teachers, instead of being the "sage on the stage", function as a "guide on the side" to facilitate students' collaborative active engagement with the learning resources in their knowledge construction endeavor (King, 1993). The advance in digital technologies provides many opportunities for students to learn in a more dynamic and innovative way. Therefore, there is a growing need to rethink and redesign the traditional lecture-based course model for the 21st-century classroom. One such pedagogy is the flipped classroom, which consists of a combination of pre-class and in-class learning activities. While there are advantages in using the flipped classroom pedagogy, it is not without challenges in its implementation. One of the major challenges comes from the attitudes of students learning outside the classroom. Learning effectiveness will decline if the student has a low level of self-regulated ability (Akcayir & Akcayir, 2018). In order to address the challenge, a peer assessment component, with the aim to promote students' interaction and learning satisfaction, was deliberately integrated into the design of the flipped classroom pedagogy in this study. This paper aims to report the pedagogical design of integrating a peer assessment component in the flipped classroom pedagogy and its effectiveness in improving student attitudes towards learning.

# Literature Review

This section gives an introduction to the flipped classroom pedagogy and highlights the challenge of unsatisfactory student attitudes in pre-lesson learning. It is followed by a discussion of peer assessment in promoting student attitude. The research question is stated at the end of this section.

## Advantages and Challenges of Flipped Classroom Pedagogy

The flipped classroom pedagogy is often referred to as "reverse instruction", "blended learning", "inverted classroom" or "24/7 classroom" (Bergmann & Sams, 2012). While a widely agreed model has not existed (Tucker, 2012), the essence of the flipped classroom approach is for instruction that used to occur in class to be accessed at home in advance of class. The valuable in-class time can then be freed up for students to participate in higher-order problem solving and collaborative learning tasks under the guidance of a teacher to enhance the effectiveness of learning (Kim, Kim, Khera, & Getman, 2014; Lage, Platt, & Treglia, 2000; Tucker, 2012).

The flipped classroom pedagogy has been widely adopted across various disciplines in higher education. Examples of applying this pedagogy can be found in software engineering (Gannod, Burge, & Helmick, 2008), nursing (Missildine, Fountain, Summers, & Gosselin, 2013), nutrition (Gilboy, Heinerichs, & Pazzaglia, 2014), history (Gaughan, 2014), biology (Stone, 2012), and language education (Hung, 2015). There are many benefits of utilizing the flipped model of teaching and learning. First, this approach offers a flexible mode of learning. Since the learning materials can be accessed online, students have the autonomy to take control of their learning in their own space, and at their own pace. In flipped classrooms, students are generally required to watch assigned online videos before coming to classes, where they participate in group activities and discuss problems or misconceptions. After the class, they are encouraged to review the online learning materials provided by the teacher and other resources on demand in order to reinforce their understanding of the acquired knowledge. It also fosters students' self-regulation competence (Lai & Hwang, 2016), digital literacy skills and lifelong learning skills required in the 21st century (Ng, 2015). Second, by having students coming to class prepared, instructors can use class time more effectively and creatively to provide multiple opportunities for students to collaborate and apply what they have learned. Third, a number of studies have shown the improvement in student learning outcomes, assignment performance, motivation, levels of student engagement, and satisfaction with the learning in the classroom by the application of the flipped classroom pedagogy (Mason, Shuman, & Cook, 2013; McLaughlin et al., 2013; Stone, 2012). Fourth, the flipped classroom model provides more capacity in class to develop students' generic skills such as critical thinking skills, problem-solving skills (Mason et al., 2013), creative thinking skills (Al-Zahrani, 2015), and collaborative learning skills (Strayer, 2012).

The flipped classroom can take many forms. One common strategy is termed 'just-in-time teaching' (Novak, Patterson, Gavrin, & Christian, 1999). It is a web-based pre-class warm-up activity where students complete an electronic assignment (e.g., reading, watching lecture videos, doing worksheets or exercises) and then submit their responses online before the class. By doing so, teachers are given just enough time to evaluate students' learning progress and to incorporate insight gained from the responses into the upcoming lesson (Novak et al., 1999). Therefore, in-class activities are tailored to address specific problems and cater to individual learning needs.

Although the flipped classroom pedagogy brings many benefits to student learning, it is not without challenges in its implementation. A comprehensive review of the challenges related to the flipped classroom pedagogy can be found in the studies by Lo and Hew (2017), and Akcayir and Akcayir (2018). Among the related challenges, students' unsatisfactory attitudes, such as paying less efforts, in the pre-lesson activity is consistently highlighted. Learning is an active, generative, and effortful process, and good learning requires students to adopt a mindful approach. However, students may not always behave in this ideal way. The learning outside the classroom driven by students themselves promotes a lackadaisical learning environment. This mode of learning relies heavily on students' self-motivation. Students with a low level of motivation may get less done (Du, Fu, & Wang, 2014). Chen (2016) reported that some students in his study did not complete pre-lesson activities and instead go to the class unprepared, which negatively affected subsequent in-class collaborative activities. Students' attitudes towards pre-lesson learning is, therefore, considered a critical factor for the success of the flipped classroom pedagogy.

## Peer Assessment Promotes Positive Attitude

Assessment for learning has been advocated in the last few decades, especially after the extensive literature review conducted by Black and Wiliam (1998) to confirm its beneficial impacts on learning. Assessment has been identified as a powerful aid to engage students into a more in-depth learning process and transform them into reflective practitioners (Ng, 2016). Among the various methods for implementing assessment for learning, peer assessment has been particularly encouraged in the design of teaching and learning in higher education (Ng, Xie, & Wang, 2018; Ng, 2013; Ng, 2012). Peer assessment is able to improve students' learning to learn skills, social skills, promote reflection and self-assessment, and enhance meta-cognition of self-awareness (Topping, 2009; Topping, 1998). In the affective aspect, peer assessment that involves students in an active learning process enables students to develop a greater sense of ownership and responsibility in their learning and evoke a higher level of learning motivation (Topping, 1998).

Interaction is an important element of peer assessment. As suggested by Moore and Kearsley (2005), learner-learner interaction can be achieved in groups which includes both within-group and between-group interactions. It can also be done

on an individual basis, where a student interacts with others in the learning community. With the advancement of communication technologies, it is now possible for students to interact in online environments. Students usually find peer interactions stimulating and motivating. Inter-learner discussions are also considered to be highly valuable in helping students to evaluate learning content (Moore & Kearsley, 2005). In the literature, the importance of interaction in teaching and learning has been suggested (Swan, 2002). Interactions have been recognized as one of the most important components of learning experiences in education (Vygotsky, 1978). Purposeful interaction in specific and predetermined ways can enhance students' knowledge and skills (Ritchie & Hoffman, 1997). Research has demonstrated that active discussion among course participants significantly influences students' satisfaction and perceived learning in a positive way (Swan, 2001). Similarly, Rust (2007) stressed that dialogues between students are valuable to the learning process. Jung, Choi, Lim, and Leem (2002) also suggested that collaborative interactions with peers are important in enhancing learning and active participation in online discussions.

Given that peer assessment is known to enhance students' positive attitude, a peer assessment component was deliberately inserted into this study during the implementation of the flipped classroom pedagogy. This study aimed to explore the question "What is the effectiveness of integrating a peer assessment component to improve students' learning attitude in the flipped classroom pedagogy?" The following section elaborates the method of this study.

# Methods

This section describes the procedure of the study and how data were collected and analyzed.

## Procedure

In this study, the researchers' intention was to understand the phenomenon of the learning process in its natural setting. The case study approach to qualitative research was applied to explore the research question (Punch, 2011). The researchers were teacher-trainers in a teacher-training institute in Hong Kong. This study was conducted in a Master of Arts in Mathematics and Pedagogy Programme. The participants were selected using a convenience sampling approach. A total of 20 students taking the course entitled Instructional Design in Mathematics were invited to participate in this study. Three of them obtained their bachelor's degree from universities in Hong Kong while the rest from universities in Mainland China. Seven groups with two to three students per group were formed randomly at the beginning of the course for a subsequent peer assessment activity in the flipped classroom.

Before the lesson, each group was assigned to watch an online video of secondary school mathematics. The topics of the video include Pythagoras' Theorem, Remainder Theorem, solving quadratic formula, the graph of exponential

function, the angle of elevation and depression, and usage of Pythagorean trigonometric identity. Each student in a group was required to review the assigned video and design five to six short questions about the video that show understanding of the key concepts introduced in the video. They were informed that the quality of their questions would be assessed by their peers. During the subsequent lesson, the members in each group discussed all suggested questions and agreed upon five to six questions that demonstrated understanding of the key concepts in the video.

In the week before the second lesson, a video link, together with the agreed upon questions of each group, was sent to students of two other groups. Each student was required to assess the quality of the questions designed by their peers with regard to content and presentation. They were asked to provide constructive feedback. In this design, each group received five to six sets of individual responses from the members of two other groups. The researchers collected all the feedback and sent it back to the original group for further in-class discussions. During the second lesson, each group discussed the collected feedback and finalized a set of questions for the video assigned to their group. In the next lesson, each group was then required to embed the finalized questions into the video using the edpuzzle platform. At the end of the lesson, the students were invited to express their opinions on the peer assessment component using a questionnaire adapted from the study conducted by Chu, Hwang, Tsai, and Judy (2010).

## Data Analysis

In this study, data were collected in the peer assessment process and at the end of the pedagogical intervention, analyzed to make sense of students' learning attitude. During the process, an individual student was required to provide feedback to the peers. As suggested by Garrison and Innes (2005), it is the quality of the feedback provided by students in the peer assessment process that can more reliably reflect students' attitudes in the process of inquiry. It is reasonable to believe that students who adopt a serious attitude in the peer assessment process will produce more high-quality feedback. An important criterion of high-quality feedback is whether it is specific or not (Gielen, Peeters, Dochy, Onghena, & Struyven, 2010; Nelson & Schunn, 2009). It includes providing the location of and identifying the problem as well as offering a solution. Feedback in this format can be categorized as "Specific Feedback". On some occasions, the contents of a draft assignment may be incomplete but not incorrect. Advisory feedback, which is more indirect, is considered appropriate as a kind of scaffolding for learning (Tseng & Tsai, 2007). This type of feedback is categorized as "Suggestive Feedback". Another two categories of feedback advocated by researchers are "Summarizing Feedback" and "Reinforcing Feedback". Summarizing feedback refers to summary statements which condense portions of an essay or the whole essay (Nelson & Schunn, 2009). Reinforcing feedback is given as a kind of praise when the student does it properly or correctly (Tseng & Tsai, 2007). However, since feedback is valuable only if it promotes

subsequent improvement, reinforcing feedback or summarizing feedback can only be considered useful if it is followed by specific feedback or suggestive feedback which lets students know how to improve. This kind of feedback can be regarded as "Mitigative Feedback" which makes the criticisms less abrasive. Therefore, the researchers analyzed the feedback provided by the students to determine the extent to which it could be categorized as high-quality Specific Feedback, Suggestive Feedback, and Mitigative Feedback, therefore identifying the students' attitudes in their pre-lesson learning process. Apart from analyzing students' feedback, the data collected by the questionnaire at the end of the pedagogical intervention were analyzed using descriptive statistical methods to review students' overall satisfaction on the peer assessment component in the flipped classroom pedagogy.

## Results

In the process of peer assessment of the design questions, a total of 217 comments were provided. The number of comments in the categories of specific feedback, suggestive feedback, and mitigative feedback were 83 (38%), 18 (8%), and 41 (19%), respectively. In other words, 65% of comments given by the participants during the pre-lesson peer assessment activity were regarded as high-quality. Apart from that, there were 63 (29%) comments in the form of low-quality reinforcing feedback. Another 12 (6%) comments were found to be vague in the meaning. Examples of different categories of feedback are listed in Table 1.

Table 1
*Examples of feedback provided by the students in peer assessment*

| Feedback Category | Topic of Video | Designed Question of the Assigned Video | Peer Comment |
|---|---|---|---|
| Specific Feedback | Pythagoras' Theorem | Please guess the condition for Pythagoras' Theorem. | Do not use "guess". I cannot guess the condition before I recognize this theorem. |
| Suggestive Feedback | Graph of Exponential Function | How many points are appropriate to sketch the graph? | I think we should review the steps of drawing a general graph of a function, then consider how many points are appropriate to sketch the graph |
| Mitigative Feedback | Solving Quadratic Formula | State the general form of method of taking square roots. | Good question to make sure that students know the form of the quadratic equations when using the method of taking square roots.<br>You can also review the two steps when using the method of taking square roots before you set another example for students to practice. |
| Reinforcing Feedback | Pythagoras Theorem | How to use Pythagoras' Theorem to get out of the cave? | This question is good because it has the calculation. |

At the end of the last lesson, the students were invited to express their comments on the peer assessment component using a questionnaire with a Likert 5-point

response scale in which 5 indicates Strongly Agree and 1 indicates Strongly Disagree. The results are listed in Table 2.

Table 2
*Students' opinions on the peer assessment component in the flipped classroom pedagogy*

| Question | Mean |
|---|---|
| 1. The mission of this learning activity makes me better understand how to identify and classify the features of the target learning objects. | 4.8 |
| 2. Although the mission of this learning activity might not easy to complete, it was easy to understand the way of learning. | 4.8 |
| 3. Learning with this peer assessment approach is more challenging and interesting than learning with the traditional direct teaching approach. | 5 |
| 4. I had new findings or knowledge about the target learning objects owing to the use of this peer assessment approach to learn. | 4.9 |
| 5. I have tried new ways of thinking styles to learn owing to the use of this peer assessment approach. | 4.7 |
| 6. The guidance provided by the peer assessment approach is helpful to me in learning how to identify the features of the target learning objects. | 5 |
| 7. The guidance provided by this peer assessment approach is helpful to me in observing the differences within the target learning objects. | 5 |
| 8. When using this peer assessment approach, I learned how to observe the target learning objects from new perspectives. | 4.9 |

## Discussion and Conclusions

The flipped classroom pedagogy is becoming more prevalent in teaching and learning, especially in higher education. A core component of this pedagogy is that students are asked to carry out self-study outside the classroom before the lesson. Research highlights that students' unsatisfactory attitude in self-study outside the classroom is a critical challenge (Akcayir & Akcayir, 2018; Lo & Hew, 2017). Self-learning without the guidance of a teacher promotes a lackadaisical learning attitude (Du et al., 2014). The effectiveness of learning to a great extent hinge on students' self-motivation. A student with low motivation may not follow the instructions from the teacher to work on the pre-lesson activity and it may adversely affect the effectiveness of the flipped classroom pedagogy (Chen, 2016). This study attempted to integrate a peer assessment component in the process of flipped classroom pedagogy to enhance students' positive learning attitude. Quite positive results were obtained from this study. A total of 65% of peer feedback given by the students in the pre-lesson activity was in the categories of high-quality specific feedback, suggestive feedback, and mitigative feedback. It reflects that the students completed the pre-lesson activity with a good attitude since research has confirmed that students who adopt a serious attitude in the peer assessment process will produce more high-quality feedback (Garrison & Innes, 2005). In order to provide triangulation of results, a questionnaire was used to explore the students' overall satisfaction on the peer assessment component of the teaching method. As shown in Table 2, the mean scores ranged from 4.7 to 5. This suggests that the students were very satisfied

with the integration of a peer assessment component in the flipped classroom pedagogy. In particular, they considered learning with this peer assessment approach as more challenging and interesting than learning with the traditional direct-teaching approach. The guidance provided by the peer assessment approach was helpful in learning how to identify the features of the target learning objectives. This result further strengthens that peer interaction promotes active learning and overall satisfaction (Moore & Kearsley, 2005; Swan, 2001; Jung et al., 2002). However, we remain cautious about the results due to the limitation of this study: there was no control group included for comparison and the sample size was relatively small.

Even though research has confirmed the beneficial effects of the flipped classroom pedagogy in student learning, it is important to address the challenges in its implementation. To secure the effectiveness of the flipped classroom pedagogy, educational practitioners are recommended to include a peer assessment component, such as the design in this study, to promote students' positive attitude during their self-study outside the classroom. This study contributed to the field by suggesting the method of using assessment for learning to enhance learning effectiveness for future reference.

## References

Akcayir, G., & Akcayir, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education, 126*, 334-345.

Al-Zahrani, A. M. (2015). From passive to active: The impact of the flipped classroom through social learning platforms on higher education students' creative thinking. *British Journal of Educational Technology, 46*(6), 1133-1148.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day.* Eugene, Oregon, Washington: ISTE.

Black, P., & Wiliam, D. (1998a). *Assessment and classroom learning*. Assessment in Education: Principles, Policy & Practice, 5(1), pp. 7-74.

Chen, L. L. (2016). Impacts of flipped classroom in high school health education. *Journal of Educational Technology Systems*, 44(4), 411–420.

Chu, H. C., Hwang, G. J., Tsai, C. C., & Tseng, Judy C. R. (2010). A two-tier test approach to developing location-aware mobile learning systems for natural science courses. *Computers & Education, 55*(4), 1618-1627.

Du, S.-C., Fu, Z.-T., & Wang, Y. (2014). The Flipped Classroom–Advantages and Challenges. *Proceedings of the International Conference on Economic Management and Trade Cooperation* (17-20). Xian, China: Atlantis Press.

Gannod, G. C., Burge, J. E., & Helmick, M. T. (2008). *Using the inverted classroom to teach software engineering. Leipzig, Germany*.

Garrison, D. R., & Innes, M. C. (2005). facilitating cognitive presence in online learning: interaction is not enough. *The American Journal of Distance Education, 19*(3), 133-148.

Gaughan, J. E. (2014). The flipped classroom in world history. *The History Teacher. 47*(2), 221-244.

Gielen, S., Peeters, E., Dochy, F., Onghena, P., & Struyven, K. (2010). Improving the effectiveness of peer feedback for learning. *Learning and Instruction, 20(4)*, 304-315.

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutrition Education and Behavior, 47*(1), 109-114.

Hung, H. T. (2015). Flipping the classroom for English language learners to foster active learning. *Computer Assisted Language Learning, 28*(1), 81-96.

Jung, I., Choi, S., Lim, C., & Leem, J. (2002). Effects of different types of interaction on learning achievement, satisfaction and participation in web-based instruction. *Innovations in Education and Teaching International, 39*(2), 153-162.

Kim, M. K., Kim, S. M., Khera, O., & Getman, J. (2014). The experience of three flipped classrooms in an urban university: An exploration of design principles. *Internet and Higher Education, 22*, 37-50.

King, A. (1993). From sage on the stage to guide on the side. *College teaching 41*(1): 30-35.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1), 30-43.

Lai, C. L., & Hwang, G. J. (2016). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. *Computers & Education, 100*, 126-140.

Lo, C., & Hew, K. (2017). A critical review of flipped classroom challenges in K-12 education: possible solutions and recommendations for future research. *Research and Practice in Technology Enhanced Learning, 12*(4), 1-22.

Mason, G. S., Shuman, T. R., & Cook, K. E. (2013). Comparing the effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course. *IEEE Transactions on Education, 56*(4), 430-435.

McLaughlin, J. E., Griffin, L. M., Esserman, D. A., Davidson, C. A., Glatt, D. M., Roth, M. T., & Mumper, R. J. (2013). Pharmacy student engagement, performance, and perception in a flipped satellite classroom. *American Journal of Pharmaceutical Education, 77*(9), 1-8.

Missildine, K., Fountain, R. Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. *Journal of Nursing Education, 52*(10), 597-599.

Moore, M., & Kearsley, G. (2005). *Distance education: a system view.* Toronto: Thomson Wadsworth.

Nelson, M. M., & Schunn, C. D. (2009). The nature of feedback: how different types of peer feedback affect writing performance. *Instructional Science, 37*(4), 375-401.

Ng, W. (2015). Technology integration and the flipped classroom. In: *New digital technology in education* (149-169). New York: Springer International Publishing.

Ng, W. S. (2012). The Impact of Peer Assessment and Feedback Strategy in Learning Computer Programming in Higher Education. *Issues in Informing Science and Information Technology*, 9, 17-27.

Ng, W. S. (2013). Students' Perspectives on the Process and Effectiveness of a Self- and Peer-Assessment Strategy in Learning Web Design Within a Wiki Environment. International Conference on Information, Communication Technologies in Education, *ICICTE 2013 Proceedings* (257-266). Crete, Greece: ICICTE.

Ng, W. S. (2016). Enhancing the Quality of Educational Website Design through Assessment for Learning Strategies. In G. Sreedhar, *Design Solutions for Improving Website Quality and Effectiveness* (24-51). USA: Information Science Reference.

Ng, W. S., Xie, H., & Wang, F. L. (2018). Enhancing Teacher Assessment Literacy Using a Blended Deep Learning Approach. In K. S. Cheung, L.-f. Kwok, K. Kubota, L.-k. Lee, & J. Tokito, *Blended Learning. Enhancing Learning Success* (Vol. 10949, 203-214). Springer International Publishing.

Novak, G. M., Patterson, E. T., Gavrin, A. D., & Christian, W. (1999). *Just-in-time teaching blending active learning with Web technology*. Upper Saddle River, NJ: Prentice-Hall.

Punch, K. F. (2011). *Introduction to research methods in education.* London: SAGE Publications Ltd.

Ritchie, D. C., & Hoffman, B. (1997). Incorporating instructional design principles with the world wide web. In B. H. Khan, *Web-Based Instruction* (135-138). Englewood Cliffs, NJ: Educational Technology Publications.

Rust, C. (2007). Towards a scholarship of assessment. *Assessment & Evaluation in Higher Education, 32*(2), 229-237.

Stone, B. B. (2012). Flip your classroom to increase active learning and student engagement. In: *Proceedings from 28th annual conference on distance teaching and learning*, Madison, WI.

Strayer, J. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research, 15*, 171-193.

Swan, K. (2001). Virtual interaction: design factors affecting student satisfaction and perceived learning in asychronous online courses. *Distance Education, 22*(2), 306-331.

Swan, K. (2002). Build learning communities in online courses: the important of interaction. *Education, Communication & Information, 2*(1), 23-49.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research, 68*(3), 249-276.

Topping, K. J. (2009). Peer assessment. *Theory Into Practice, 48*(1), 20-27.

Tseng, S.-C., & Tsai, C.-C. (2007). On-line peer assessment and the role of the peer feedback: a study of high school computer course. *Computer & Education, 49(4)*, 1161-1174.

Tucker, B. (2012). The flipped classroom. *Education Next, 12*(1), 82-83.

Vygotsky, L. S. (1978). *Mind in society: the development of higher psychological processes.* Cambridge: Harvard University Press.

# Author Details

Wing Shui Ng
ngws@eduhk.hk

Ka Luen Cheung
kaluen@eduhk.hk