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Integrating PBI in the flipped classroom: A framework for effective instruction

Syaiputra Wahyuda Meisa Diningrat *, Negeri Malang University, Department of Educational Technology, Faculty of Science Education, Jl. Semarang No. 5, Malang, East Java 65145, Indonesia, https://orcid.org/0000-0003-4529-9168

Punaji Setyosari, Negeri Malang University, Department of Educational Technology, Faculty of Science Education, Jl. Semarang No. 5, Malang, East Java 65145, Indonesia https://orcid.org/0000-0003-0187-9785

Saida Ulfa, Negeri Malang University, Department of Educational Technology, Faculty of Science Education, Jl. Semarang No. 5, Malang, East Java 65145, Indonesia, https://orcid.org/0000-0002-2302-7172

Utami Widiati, Negeri Malang University, Department of English, Faculty of Letters, Jl. Semarang No. 5, Malang, East Java 65145, Indonesia, https://orcid.org/0000-0002-8603-4556

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Abstract

The existence of the flipped classroom has gained attention among scholars and teachers, particularly in higher education. This instructional model appeals much concern due to its capability not only to shift the instructional process from teacher-centered to student-centered but also to transform university classrooms into an active learning environment where students have the opportunity to apply concepts to solve the problems. However, the current pieces of evidence showed that teachers implementing the flipped classroom instructional model still encounter issues that raise additional concerns, such as technical difficulty, design gaps between pre-class and in-class learning activity, and little study on robust frameworks have been developed for this instructional. Consequently, teachers generate an inadequate learning activity design in the flipped classroom. Therefore, this study aims to develop a vigorous framework for the flipped classroom model by integrating problem-based instructional strategy. After reviewing relevant theories and empirical findings, the result of the study provides a foundation framework for the flipped classroom design. This framework consists of two circles of learning activity design that coherence between pre-class and in-class. The theoretical framework provided in this study is considered as initial study, thus, further researches are highly suggested for future scholars to explore its effectiveness.

Keywords: flipped classroom, instructional framework, effective instruction;

* ADDRESS FOR CORRESPONDENCE: Syaiputra Wahyuda Meisa Diningrat, Universitas Negeri Malang, Department of Educational Technology, Faculty of Science Education, Jl. Semarang No 5, Malang, East Java 65145, Indonesia. *E-mail address*: syaiputra2015@gmail.com

1. Introduction

Lambert (2012), states that lecturing, as the most popular instructional strategy used in higher education, is a teaching approach where the teachers mainly focus on directly communicate the learning content to the students. The main critiques for this method are focus on teacher-centered in the instructional process and ineffective to cultivate higher-order thinking skills (Alaagib, Musa, & Saeed, 2019). Currently, higher education institutions have been forced to switch towards more flexible, effective, active, and focus on student-cantered that can reduce the limitations of teaching approaches employed by the lecture (Nouri, 2016). Consequently, different active learning strategies have been introduced, such as the flipped classroom (Nouri, 2016; O'Flaherty & Phillips, 2015) and problem-based instruction (Savery, 2019). O'Flaherty & Phillips (2015) showed that teachers have a great opportunity to encourage students' learning ownership and students' thinking skills in the flipped classroom learning environment, to achieve long life learning, and to prepare the students meet with the new demands of future skills. Hence, learning to solve a problem is one of the pivotal skills in the future demands and any setting (Jonassen, 2004).

The initial idea to flip the classroom is that traditional teaching in which normally conduct in-class is flipped to be conducted out of class by the students. Thus, instead of lecturing the students, they have opportunity to understand content through video lecture at home and in-class learning activity focuses on problem-solving with teacher-guide. Most currently, a number of literature reviews discussing the flipped classroom model in the higher education context showed that it is highly potential to use this instructional model in promoting learning outcomes such as engagement, attitude, and performance (Al, Aizat, Ahmed, & Alzahrani, 2019; Strelan, Osborn, & Palmer, 2020). In line with the result of the study, most of the students had a positive perspective experienced toward the instructional model of flipped classroom, so that, students' motivational, engagement, and learning lead to increased, even for low achievers (Nouri, 2016) and in various disciplines (Al et al., 2019). Kurt (2017) showed that the flipped classroom model can improve self-efficacy beliefs, academic achievement, and favourable perceptions about the model. Therefore, the flipped classroom has promise to encourage students to interact with the important content in advance of attending class, while opportunities for higher-order thinking are afforded during class time.

Whereas several studies highlighted some potential challenges faced by teachers. For example, the main of flipped classroom challenges are related to the pre-class learning activity, such as inadequate student preparation prior to the class and students' need for guidance at home (Akçayır & Akçayır, 2018). The Similarity to the study, the time spent, and technical difficulties, lack of resources, lack of skill and design gaps, as well as evaluated issues were considered as the main challenges encountered by teachers in designing and applying the flipped classroom model (Al et al., 2019; Karabulut-Ilgu, Jaramillo Cherrez, & Jahren, 2018; Shnai, 2017). Consequently, students also faced challenges in the implementation the flipped classroom model, such as lack of preparation before they start the class and not all students enjoyed active learning during in-class as well as students might not collaborate well (Long, Cummins, & Waugh, 2017). Since there is no robust framework developed for implementing the flipped classroom design, (Lo, 2018), a literature review suggests that flipped classroom learning course and activity design need to be based on a theoretical framework (Karabulut-Ilgu et al., 2018).

However, when teachers' do not arrange and manage classroom activities appropriately, the flipped classroom implementation does not guarantee to enhance students' achievement in their learning (Shi, Ma, MacLeod, & Yang, 2019; van Alten, Phielix, Janssen, & Kester, 2019). Thus, a well-organized instruction is necessary to design the flipped classroom model successfully, pre-class learning and in-class learning activities should be managed carefully in order to achieve a successful flipped classroom

implementation. In response to that, this study attempts to develop a vigorous theoretical framework for the flipped classroom model. Especially, by integrating an active learning strategy of problem-based instructional in the flipped classroom.

2. Method

This study in an attempt to present a foundation framework for the flipped classroom model by integrating problem-based instructional strategy. This study also provides an in-depth understanding through conducted a comprehensive search of the relevant theories and empirical findings related to the flipped classroom. This includes identifying and classifying appropriate design of learning activities between pre-class and in-class by using the search condition ("pre-class for flipped classroom" and in-class for the flipped classroom") empirical findings were found. The coding of each dimension is given as follows:

- Pre-class learning activity: several dimensions were considered, including learning theories, the form of learning material, instructional strategy and principles as well as approaches to evaluating learning outcomes.
- In-class learning activity: several dimensions were considered, including learning theories, the form of learning material, instructional strategy and principles as well as approaches to evaluating learning outcomes.

3. Result and Discussion

3.1. Defining the flipped classroom

Basically, the flipped classroom can be seen as an instructional model in which the usual instructional activity conducted in-class will be conducted at home, and that what is usually conducted as assignments will be done in the in-class time (Bergmann & Sams, 2012). (Bishop & Verleger, 2013) defined the flipped classroom model as an instructional strategy that consists of two stages such as interactive group learning activities in-class time and direct computer-based individual instruction pre-class time. Therefore, the current study defines the flipped classroom model as an instructional model consists of two parts of learning activities, namely pre-class and in-class. On one hand, pre-class learning activities are designed for individual instruction. On the other hand, in-class learning activities are designed for active and collaborative learning. In details, (McLaughlin et al., 2014) proposed two parts of learning activities design such as teachers prerecord lectures and post them online for students to watch outside the classroom (individual learning). By doing so, classroom times can be allocated to student-centered learning such a problem-solving activity, active and collaborative learning. Additionally, pre-class learning activities should be focused on basic knowledge content and in-class learning activities should be focused on higher-order thinking, such as practicing, applying, and demonstrate knowledge content learned from pre-class requirements (Harris, Harris, Reed, & Zelihic, 2016).

In the flipped classroom, students are required to engage in and complete some form of pre-class learning in preparation for a structurally aligned learning activity in-class with their teachers and peers. This structural alignment between these two learning activities is an important distinction for those who might practice that simply uploading their lecturer recording will be adequate. Additionally, pre-class learning engagement affect students' preparedness for in-class learning activities in the flipped classroom model. Thus, the current study aims to propose theoretical framework to achieve

the alignment between pre-class and in-class learning activities. Especially, in integrating problem-based instructional strategy in the flipped classroom model.

3.2. Studies on pre-class learning activities

In the flipped classroom, pre-class learning activity, students must obtain basic knowledge outside the class as preparation for in-class learning activities. Due to the major goal of the pre-class learning activity is "transmitted information", the potential learning theory that relates to this learning activity is cognitivism. Cognitivist learning theory sees learning as acquiring knowledge (Duffy & Cunningham, 1996). Thus, the main goal of the following discussion is how to organize a pre-class learning strategy to support communicating knowledge that easily and effectively acquired by students. Researchers propose that in the pre-class preparation teacher should provide an opportunity for students to manage their cognitive load (Abeysekera & Dawson, 2015) and their motivation (Zainuddin, 2018). Consequently, there are three important concerns to design pre-class learning activities. Teachers should think of several design criteria such as videos should be kept short with a steady flow, high quality content is important, both physically (e.g. sound) and pedagogically. Teacher also need to consider the integration of assessment, and the context in which the learning activity sits (Lee, Lim, & Kim, 2017).

The physical features of online lectures discussed in this current study are related to length, speed, and auditory quality of lecturing videos. Several previous studies have conducted to show the effectiveness of video lectures to support pre-class learning activity. For example, (Jensen, Holt, Sowards, Heath Ogden, & West, 2018) have investigated instructional material among the interactive tutorial, lecturing videos, and also the textbook-reading. The findings revealed that the lecturing video strategy is significantly better in the final assessment. In line with Lee & Choi (2019), students demonstrated higher performance with lecturing videos than reading materials. Moreover, research about lecturing videos showed that they do not only could provide a sense of teachers' presence in online courses, but also positive perception as well as positive experiences (Scagnoli, Choo, & Tian, 2019).

Lecturing videos are beneficial since they have flexibility to stop and play for reviewing as well as to watch the video at the most convenient time for learners (Xiu, Moore, Thompson, & French, 2019), and to increase students' satisfaction of studying and enhances perceived teaching effectiveness, as well as student's reading motivation (Tse, Choi, & Tang, 2019). Additionally, lecturing video increases students' engagement with content, enhance student's perception of better learning experiences through content interaction, and meet different students' preference. (Scagnoli et al., 2019).

The cognitive theory of multimedia is an effective way to design effective lecturing videos that increase students' engagement. Several practical implications to guide teachers include: first, minimize the extraneous by lecturing video materials for students. Hence, learning objects should be covered being less than 10 minutes. Second, strategies should be implemented to encourage students truly gain knowledge. For example, teachers should ensure that all students have completed the worksheets, monitor how well students have comprehended the content during pre-class learning activity and should be seriously considered the quiz scores on the pre-class final evaluation. Finally, teachers must assist students who have low self-directedness (Lee & Choi, 2019; Mayer, 2009; Persky & McLaughlin, 2018). These principles, however, show that the teachers' role to design and to conduct pre-class activity should consider not only the principles of multimedia learning but their presence during pre-class learning activity is also essential to assist the students that need teacher's help. To bring the teachers' presence, asynchronous ways such as direct messages, forum discussions or synchronous ways, such live sessions can be used.

Since pre-class learning activity allows students to take control and ownership of their learning, self-regulation of getting to know is a crucial aspect for improving students' outcomes during online learning activities (Broadbent & Poon, 2015). For example, (Jovanovic, Mirriahi, Gašević, Dawson, & Pardo, 2019) show that the more often students have interaction during the pre-class activities throughout the course, the better their final exam performance tends to be. Whereas, students who

did not have a solid pattern of engagement with the pre-class activities over the week they have low score in the final exam. Self-regulated learning strategies of time management and metacognition have been found to have widespread wonderful correlations with academic success in an online learning activity (Broadbent & Poon, 2015). A study showed that metacognitive strategies (planning, monitoring, evaluation) have pivotal role as a predictor of learning performance in the pre-class learning activities (Yilmaz & Baydas, 2017). Additionally, the kinds of self-regulated strategies such as self-efficacy and help-seeking strategy have significant impacts on students' achievement in pre-class activity. A study showed that the more self-efficacious in pre-class learning activity leads to achieve higher learning outcomes. Meanwhile, the use of helping-seeking strategies between student-teachers and student-student also enhance students' achievement in the pre-class learning activity (Sun, Xie, & Anderman, 2018).

Therefore, clear instructions in using the strategies should be well-prepared and presented for students in order to adapt the strategies more easily. (Ng, 2018) proposed three self-regulated learning principles, they are: first, presenting the vivid instructional goals. Second, delivering high-quality guidance to the students and encouraging interaction between teacher-students and peer dialogue among students. Third, providing the opportunity to close the gap through watching the videos in students' ownership learning and students are given the chance to interactively engage during pre-class learning activity. Online interaction may include presenting a question either synchronous such as in discussion forum and email or asynchronous such as real-time conference.

In addition, self-directed learning skills where individuals evaluate their learning needs, select and apply an accurate approach should be considered by giving students responsibility and preparation skills during pre-class learning activities. Previous studies showed that self-directed learning readiness could be among the factors that supporting successfully pre-class learning activity (Ceylaner & Karakuş, 2018; Lee & Choi, 2019). Thus, self-regulated learning strategies of time management, metacognitive, self-efficacy, and help-seeking as well as self-directed learning are essential learning strategies during pre-class learning activity.

3.3. Studies on in-class learning activity

Once students have a foundation knowledge of the key concept, in-class learning activity is devoted for student-centered and active-learning activity. Due to the major goal of in-class learning activity is "construct knowledge in active-learning ways", the potential learning theory that relates to this learning activity is the constructivism. Constructivist learning theory sees learning as an active process of constructing instead of acquiring knowledge (Duffy & Cunningham, 1996). Therefore, the main goal of the following discussion is how to design an in-class learning strategy that facilitates individual knowledge construction by helping students engage in a meaningful way.

The main idea to flipping the classroom is that they give the students opportunity to actively engage in-class time through active learning activity. Thus, teachers should have more times to give a direct feedback during the active learning activities. When the students actively construct and organize the knowledge into their meaningful and active learning activities, the active learning will possibly happen. (Roehling, 2018) argued that active learning experience typically involves one or more of the following features: Discussion and application the content, practice to solving the problems, reflection about what has been learned, and consolidation activity through collaboration activity as well as presenting the solution, and ownership the learning.

Active learning comes in various forms and the researchers mainly prefer the active-learning activities such as problem-solving, and collaborative group work (Akçayır & Akçayır, 2018). Regarding in-class learning activities, a previous study revealed that active learning are the key contributions of the flipped classroom model and it might be the most influential elements for positive learning outcome (Jensen, Kummer, & Godoy, 2015). There are some empirical supports for the effectiveness of active learning. For examples, several studies revealed that active learning techniques are not only effective and superior to lecture, but also effective in developing thinking and problem-solving skill,

engaging student in learning activities as well as for teaching, social and cognitive presence. (Kay, MacDonald, & DiGiuseppe, 2019; Minifie & Davis, 2013).

Due to the learning activity, active-learning, in-class stage has the central role in the successful learning in the flipped classroom, the current study employs a problem-based instruction. Based on students' experience, the previous study showed that students found positive attitudes by integrating problem-based instructional and not only being motivated to solve the ill-structured problem, but also having high self-efficacy (Tawfik & Lilly, 2015). In line with the empirical study, combined flipped class with PBI is effective in helping students whose performance is low to improve their skills and knowledge (Chis, Moldovan, Murphy, Pathak, & Muntean, 2018).

Therefore, the empirical evidence suggested that teachers should integrate problem-solving learning activity in-class time to motivate students engage in solving the real problem. Engagement in-class problem solving could improve the students' achievement (Wang, 2019). In addition, the problem-based activities in flipped classroom could provide positive contributions to the students' self-regulated skills (Çakiroğlu & Öztürk, 2017).

Constructivist learning theory has inspired further development of several instructional models such as problem-based instruction (PBI) and collaborative learning. PBI is an instructional strategy in which students learn to solve ill-problems as the major feature of problem-solving activities. However, Schmidt, van der Molen, te Winkel, & Wijnen (2009), showed that the main roles of problems in PBI are such as encouraging student's curiosity in domains of study; experiencing appropriate learning activity with the real problem that fits with the future demand. Thus, designing high-quality problems is a key success factor for PBI as the problem is the starting point and the driving force for learning.

Barrett, Cashman, & Moore (2011) proposed three illuminate concepts for understanding problem design such as the problem as a provoker of liminal space, the problem as a trigger for tackling threshold concepts, and the problem as a stimulus for hard fun. In detail, to foster flexible thinking, problems need to ill-structured and open-ended to support intrinsic motivation, and they must be realistic and resonate with the students' experiences (Cindy E. Hmelo-Silver1, 2004). Hence, these features of the problems will be proposed in the current study.

The general features for instruction within PBI proceed are included: a small group of students is given a problem that is aligned with the instructional goals; ill-structured problem that does not have a single correct answer as a trigger to solve the problem; a collaborative group is set for student to identify what is required to be learned for solving the problems; a self-directed skill is used to find out the answer to the problems; encourage students to explain to the group on what they have found and consolidate their optional solutions; the students present their possible solution, and reflect on their solution and strategy they used (Savery, 2019).

Moreover, researchers proposed four primary principles of the PBI that teachers must consider (Dolmans, De Grave, Wolfhagen, & Van Der Vleuten, 2005; Savery, 2009), they are: first, problem as a stimulus for learning, PBI poses authentic, meaningful, and ill-structured problems as well as contemporary and fit within the curriculum for the discipline. These issues should encompass a description of a few phenomenon that need to be explained. Thus, the problem is the focus of acquiring knowledge and fostering flexible thinking. Additionally, (Korin & Wilkerson, 2011)suggest that posing a problem to the instructional process could use video or video-based problems.

Second, tutor as the facilitator, during PBI, students work as a team in a small group to solve problems, the teachers' role is to scaffold the students' learning process. Their challenges are to hold the process of gaining knowledge going, to probe the students' knowledge deeply, to ensure that each of students are concerned within the manner, and to monitor the instructional progress of each student in the group as well as to modulate the challenge of the issues. Thus, the teacher's ability to make learning in PBI a self-directed process by helping students' metacognition and self-regulation of learning are crucial to the success of problem-based instructional.

Third, during PBI, teachers should consider utilizing authentic test that fits with the learning objective such as project-based or problem-solving. Thus, the teachers should be aware of the appropriateness of learning goals with the problem posing to the students. Fourth, during PBI, the teachers should consistently and thoroughly help students by asking them to encourage key concepts

learned from the experience. Is short, the key to the successful implementation of this instructional strategy lies in designing a learning environment that stimulates and encourages students toward constructive, self-directed, collaborative, and contextual learning.

3.4. Framework for integrating PBI in the flipped classroom

The alignment between all components of PBI in the flipped classroom environment such as pre-class and in-class learning activities is a vital part of designing the instructional model. For students to experience coherent instruction, pre-class and in-class portions of instruction should follow the same approach. However, to achieve a successful implementation in integrating PBI in the flipped classroom, (Strayer, 2017) proposed four situational principles for integrating a problem-based instructional strategy in the flipped classroom as follows:

- Pre-class learning activities design should pose the problems and provide initial instructional materials, content materials, and resources to students as well as provide initial guidance and modeling for students. Hence, as stated in the principles of PBI, the video-based problem will be employed. This video could create by teachers using Apps of a screencast or utilized existing video as long as the video fits with the intended problem in instructional goals.
- In-class learning activities design should create space for students to find solutions and present their findings to the class for authentic, holistic, and ill-structured problems. As students work in a small group on a problem in class teachers must scaffold student understanding and serve as a metacognitive coach for students by helping the students to determine what useful information they already know and what important information they still need to determine in solving the problems. Besides, design in small group in-class learning activity yielded better test scores compared to the individual in-class activity. (Rawas, Bano, & Alaidarous, 2019).

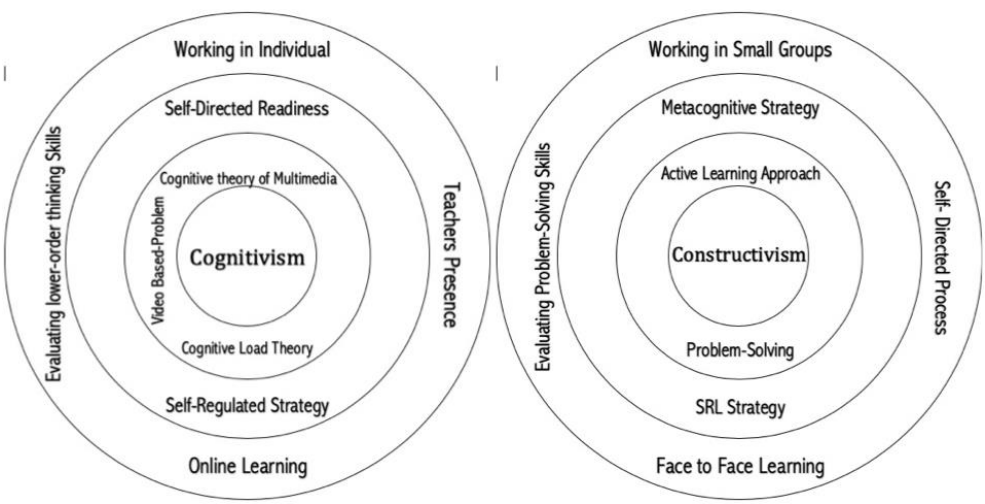

Figure 1. Framework for effective integrating PBI in The Flipped Classroom

For the more coherent instruction, pre-class learning activity and in-class learning activity design sections should follow the above framework. Especially, when teachers intend to design and implement PBI instructional strategy in the flipped classroom instructional model. As describe above, the framework employs different methods for different purposes during activities in the pre-class and

in-class learning tasks. Apart from that, those methods used during an instructional circle have fit in term a coherent instructional that support the students to enhance their experience.

The framework proposes two circle learning activities designs. First, organizing pre-class learning activities to support communication knowledge effectively acquired by students is the major goal of this part. Thus, for completing pre-class learning tasks, teachers must consider cognitivist learning theory (first circle) as a foundation to design a whole instructional activity. The second circle suggests that before creating video based-problems, cognitive theory of multimedia and cognitive load theory become fundamental considerations to produce a video based-problem that appropriate with the students' needs. The thirds circle suggests encouraging the students to use their self-directed readiness to regulate their time management, self-efficacy, and metacognitive as well as help seeking strategy. Finally, the last circle suggests that when a student works individually at home, the teachers' presence in online learning activity is a necessary. For example, teachers not only can scaffold students who need their help, but they also can evaluate the students' lower order thinking skills.

Second, organizing in-class learning activities to facilitate individual knowledge construction and create meaningful experiences to engage the students is the major goal of this part. Thus, for completing in-class learning tasks, teachers must consider constructivist learning theory (first circle) as a foundation to design the whole instructional activities. The second circle suggests devoting active-learning approach during in-class time such a problem-solving activity. The third circle suggests encouraging the students to use their self-regulated learning strategy such as planning, monitoring, evaluation the problem-solving activities (metacognitive skills). Finally, the last circle suggests that despite the students work in a small group in face to face interaction, the instructional must accommodate the self-directed process. It means that, every student should engage in self-directed learning activities to propose their point of view to the problems. Additionally, the teachers should evaluate students' higher order thinking skills such a problem-solving skill.

4. Conclusion and Recommendations

The instructional model of flipped classroom has potential to shift from teacher-cantered to student-cantered. Although several previous studies have confirmed the effectiveness of the flipped classroom, few of them have not taken the instructional framework into account. Thus, many teachers were lacking in designing instructional that coherence between two stages of flipped classroom learning activities. In sum, the findings of the current study provide a robust framework for designing effective flipped instruction by integrating problem-based instructional. This framework offers instructional learning activities that support one another between pre-class and in-class learning tasks.

Based on the review results, several recommendations are provided as follows:

- First, for completing pre-class learning tasks, teachers must be aware of cognitivist learning theory, cognitive theory of multimedia, and cognitive load theory to become fundamental considerations to produce a video-based problem that appropriate with the students' needs. Encourage students to use their self-directed readiness to regulate their time management and self-efficacy. When a student works individually at home, the teachers' presence in the online learning activity is necessary to evaluate the students' lower order thinking skills.
- Second, for completing in-class learning tasks, teachers must consider constructivist learning theory as a foundation to design a whole instructional activity. devoting an active-learning approach during an in-class time such a problem-solving activity. Encouraging the students to use their self-regulated learning strategy such as planning, monitoring, evaluating the problem-solving activities (metacognitive skills). Despite the students collaborate as a group in a face to face interaction, the instructional must be a self-directed process. It means that every student in the group should be encouraged to use their self-directed skills to propose their point of view

to the problems. the teachers should evaluate students' higher order thinking skills such a problem-solving skill.

In term of practical implications, the current framework provides specific guidance as to how teachers and instructional designers who intend to implement the flipped classroom using the problem-based instructional approach. The framework also serves as a model for how teachers might produce well-designed of the instructional model of the flipped classroom as the framework is simple, useable, and flexible in the higher education context. All in all, the conceptual framework proposed in this study is considered preliminary, thus, it is highly suggested for future researchers to conduct further studies on the investigation of its effectiveness.

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