THE EFFECT OF FC COMBINED WITH CBL ON PROBLEM-SOLVING ABILITY

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ABSTRACT

The flipped classroom (FC) and case-based learning (CBL) are recognized as effective instructional models that emphasize the development of problem-solving ability. However, the implementation of FC combined with CBL has not been well explored. This study aims to investigate the effect of FC combined with CBL on students' problem solving by comparing it with the FC model and the traditional method. Three groups in a private university in Indonesia participated in an experimental study involving 94 students. Across 8 weeks, one experimental group received the FC model and a second experimental group received FC combined with the CBL model. The control group received regular learning activities. A measure of problem-solving ability was administered to all groups before and after the 8-week intervention. In the FC combined with CBL model, problem-solving ability increased significantly compared to students in the control group. The findings need to be replicated with an extended, after-class session that involves larger groups of participants over a longer time period.

Keywords: *flipped classroom, case-based learning, problem-solving ability, higher education*

INTRODUCTION

Enhancing students' higher order thinking skills, such as problem solving, is a critical task for higher education institutions in the rapidly changing digital world. However, this goal seems optimistic; despite the expansion of technology applications and capabilities in recent decades, traditional lecture-based teaching continues to prevail (McLaughlin et al., 2014). Traditional lecture-based teaching seems to fail to promote meaningful learning that prepares students to meet the demands of the 21st century skills. This can be problematic for higher education due to the main critiques that this method focuses on a teacher-centered approach and is ineffective in promoting higher order thinking skills (Alaagib et al., 2019). In response, many scholars assert that appropriate design interventions can have a positive effect in increasing higher order thinking skills.

One of the instructional approaches within the blended modality that has gained relevance in this context has been the flipped classroom (FC). The FC is defined as a pedagogical model in which direct instruction is delivered outside of the classroom through videos and class time is then available for deeper discussion of the topic, peer collaboration, and personalized instructor guidance as well as problem-solving activities (Diningrat et al., 2023). The FC model seems to have the ability to improve student learning by enabling active participation and interaction (Cui & Yu, 2019). In line with that, the appropriate design intervention of the flipped classroom model not only helps develop learning strategies for deep learning (Al-Samarraie et al., 2020), but also allows for more class time to be devoted to higher order thinking skills (DeRuisseau, 2016).

However, a flipped classroom model has traditionally placed more emphasis on watching videos and participating in activities, with less attention paid to the knowledge construction process or to the development of higher order thinking skills (Cui & Yu, 2019; O'Flaherty & Phillips, 2015). Cui & Yu (2019) also stated that students' learning in a flipped classroom is focused on active behavior rather than deep cognitive engagement. Other studies indicated that the lack of an appropriate and coherent design between preclass and in-class sessions lead to an ineffective instructional model of flipped classroom to improve student learning (Diningrat et al., 2020; Strayer, 2017). Although the FC seems to be gaining traction in higher education, there are still few studies that focus on examining such an instructional approach (Chen et al., 2014; Stöhr et al., 2020) and, therefore, it needs more research to fully explore its potential and challenges.

Case-based learning (CBL) seems to be an effective and efficient strategy to facilitate and improve student problem-solving performance as this strategy can provide a context from various dimensions to solve contextual problems and even facilitate knowledge construction (Choi & Lee, 2009). In line with this, the CBL strategy can encourage students to devise their own knowledge and develop solutions without constriction and this is believed to develop students' problem-solving abilities (Jonassen & Hernandez-Serrano, 2002). This paper aims to bridge this gap in the literature by investigating the effect of the flipped classroom model combined with case-based learning on students' problem-solving ability. The following research questions guided this research: Do differences exist in the problem-solving ability depending on whether students learn with the flipped classroom model combined with CBL, the flipped classroom model alone, or the traditional method?

FLIPPED CLASSROOM MODEL

The flipped classroom model is based on the idea that traditional teaching is inverted by delivering the course concepts before the class and allowing teachers to use class time for active learning through practice and the application of the course concepts (Bergman & Sams, 2012; Nouri, 2016). Researchers defined the FC model as an instructional model that consists of two parts of learning activity, namely preclass and in-class (Diningrat et al., 2023; Strayer, 2017). While the preclass learning activity is designed for students to work individually at home, the in-class learning activity is designed for active and collaborative learning to solve problems arising from practice.

The number of studies implementing the FC model in different educational fields has grown notably over the past few years (Al-Samarraie et al., 2020). The findings from the review by Al-Samarraie et al. (2020) revealed that the utilization of this instructional model in a university context and in various disciplines can promote students' performance, engagement, and attitude. Recently, Birgili et al. (2021) conducted a study to reveal trends and outcomes of the FC model and showed that this instructional model increases students' performance and has a positive influence on soft skills and attitudes. Moreover, in the field of English language teaching, Turan & Akdag-Cimen (2020) found in their systematic review that the FC model is a more effective instructional model than the traditional model. They also indicated the advantages of this instructional model, such as enhancing engagement, learning achievement, and the higher order thinking skills of students.

The effectiveness of the FC model in improving higher order thinking skills such as problem-solving has been widely studied in various fields of learning. Research conducted by DeRuisseau (2016) tried to determine the effect of the FC model on higher order thinking skills compared to traditional methods. The results of this study indicated that the FC model appears to provide more opportunities for students to carry out activities to apply learning materials that have an impact on carrying out higher order thinking activities, such as critical thinking, compared to traditional methods. Another study in the context of learning English was conducted by Etemadfar et al. (2020), the aim of which was to observe differences in students' critical thinking skills between the experimental group, which was taught by the FC model, and the control group, which was taught by traditional methods. The results of this study indicated that the experimental group, taught using the FC model, seems to have more critical thinking activities compared to the control group, taught by the traditional method. In other words, students'

critical thinking skills in the experimental group outperformed those in the control group.

Research related to the effectiveness of the FC model in the context of learning mathematics, where most of the learning objectives are to solve problems, has also been carried out. Yorganci (2020) looked at students' mathematical problem-solving abilities by comparing the FC model with elearning and blended learning models. The results showed that the FC model outperformed the elearning and blended learning models relative to mathematical problem-solving abilities. In line with these results, case study research conducted by Long et al., (2017) looked at the lecturer's perspective. The results of the study show that the FC model can provide students with opportunities to practice higher order thinking skills and problem-solving skills. In other words, the FC model can facilitate and improve students' problem-solving abilities.

CASE-BASED LEARNING

CBL is an interactive, student-centered exploration strategy that draws on real-life situations to initiate and promote authentic learning (Williams, 2005). Brandon and All (2010) defined CBL as a constructive learning paradigm in which students select and transform information, construct ideas, and make decisions based on their current or past knowledge.

CBL seems to be an effective and efficient strategy to facilitate and improve problem-solving performance because this strategy can provide context from various dimensions to solve contextual problems and facilitate knowledge construction (Choi & Lee, 2009). In line with this, the CBL strategy can encourage students to create their own knowledge and develop solutions freely, and this is believed to be able to develop students' problem-solving abilities (Jonassen & Hernandez-Serrano, 2002).

CBL is a learning strategy based on student learning activities (student-centered learning) and a constructivist learning paradigm in which students choose, build, and make decisions based on newly acquired knowledge and old knowledge (Brandon & All, 2010). Thus, CBL is the right strategy to develop the ability to solve contextual Indonesian educational problems. Previous research related to the effectiveness of CBL in improving problem-solving abilities has been carried out a number of times and the results of these studies show positive outcomes. The results of a systematic literature review of 70 articles found that CBL has been practiced in various learning contexts and that CBL strategies can facilitate deeper learning where learning activities take place beyond identifying wrong answers but in line with critical thinking and problem-solving activities (McLean, 2016). These results are supported by Koehler et al. (2020), whose study aimed to test the effectiveness of CBL strategies on problem-solving skills. The results showed that the CBL strategy was effective in developing students' solving skills. In line with the results of the research above, an experimental study conducted by Bi et al. (2019) compared an experimental group that was taught with the CBL strategy with a control group that was taught with the traditional method. The results of the study showed that the CBL strategy is more effective in improving students' problem-solving skills when compared to the traditional method.

FC COMBINED WITH CBL

In an attempt to build a teaching framework to help students improve their problem-solving ability, this study adopts the conceptual framework design by Diningrat et al. (2023) for FC model and the CBL model designed by Choi and Lee (2009). While the FC model consists of preclass and in-class sessions, the CBL stages can be broken down into reviewing the problem, analyzing the problem, creating a solution, making a decision, and reflecting on the results. Moreover, the aforementioned CBL procedures fit very well with the FC session, which has two phases of learning activities, namely preclass and in-class, as seen in Figure 1.

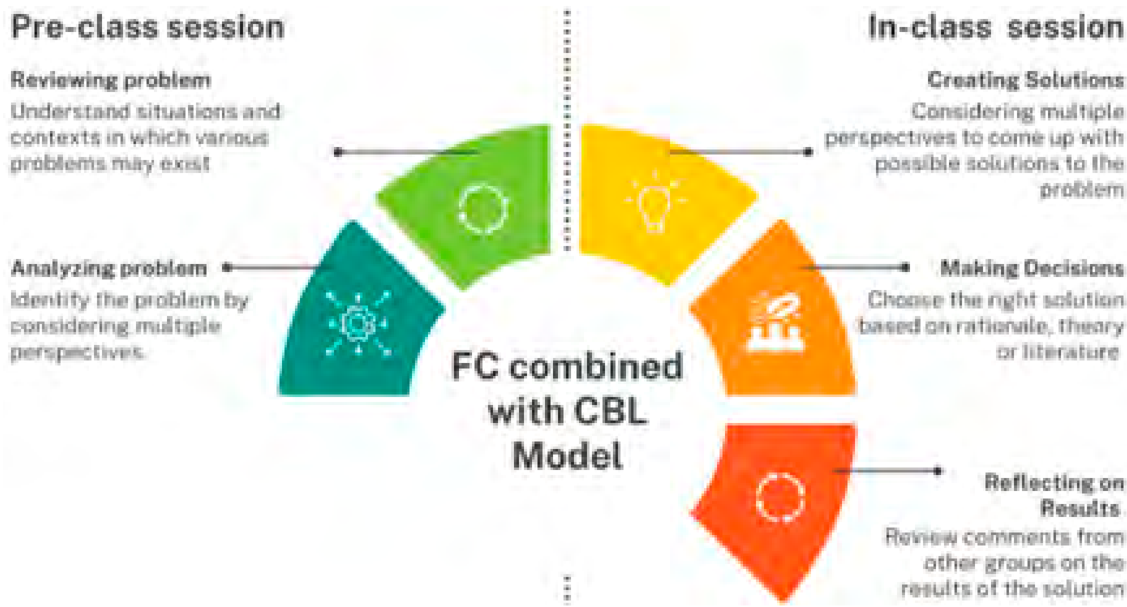
METHOD

In this section we explain the research design, including an overview of the research design, participants, and instruments, as well as the data collection process and data analysis.

Research Design

The aim of this study was to understand the influence on students' problem-solving ability when using the flipped classroom model combined with CBL. We employed a quasi-experimental study with nonequivalent control group design together with a pretest and posttest to achieve this aim (Tuckman & Harper, 2012). In addition, this

Figure 1.
Teaching Model of FC Combined with CBL



study followed a quasi-experimental design with three conditions as control and experiment groups. In the control condition, the students received their regular classroom activities. In one experimental condition, the students received the FC model. In the other experimental condition, the students received the FC model combined with CBL activities (see Table 1).

Participants

The study involved 94 students from three civic education course classes at the Universitas 17 Agustus 1945 Banyuwangi in Indonesia. The students assigned to one experimental group were taught using the FC model and students in the other experimental group were taught using the FC model combined with CBL, while those serving as the control group received the traditional method. To fulfil the research validity requirements, all groups were taught the same courses during the same time period. We informed every participant that this study was being conducted, and that research data was being collected before and after the implementation of interventions in which they could freely choose to take part or not.

Instruments

One of the most appropriate forms for assessing problem-solving skill was assessing students' ability to construct arguments in support of their solution to problems (Jonassen, 2010). In this study, essays were used as the pretest and posttest instrument to assess the participants' problem-solving skills. In the pretest, students were asked to write an argumentative essay on the topic of child sexual abuse. In the posttest, students were asked to write an argumentative essay on the topic of suicide attributed to bullying. To score the argumentative essays, the writing rubric by Jonassen (2010) was used. It included the quality of conclusions (4 marks), premises are sound (4 marks), adequacy of premises (4 marks), assumptions related (4 marks), credibility of premises (4 marks), counterarguments accommodated (4 marks), and organization of arguments (4 marks). Furthermore, both the pretest and posttest were scored by two raters and interrater reliability was computed. The interrater reliability coefficients of the pretest were .71 .for the quality of conclusions, .93 for .premises were sound, 82 for the adequacy of premises, 83 for assumptions related, .87 for credibility of premises, .91 for counterarguments accommodated, and .82 for organization of arguments. the interrater reliability coefficients of the posttest were .84 for the quality of conclusions, .85 for premises were sound, .87 for adequacy of premises, .91 for assumptions related, .82 for credibility of premises,

Table 1.
Learning Procedures

Conditions	Instructional Model	Learning Activities		
		Preclass Session	In-class session	After-class session
		Conducted online through the Learning Management System	Conducted in class through the face-to-face setting	
One experimental group	Flipped Classroom combined with CBL	• Stage 1. Reviewing the Problem: A teacher posted a case and the students were acquired to understand the situations and contexts in which various problems may exist. The students were also asked to complete the assignment of reviewing the problem. • Stage 2. Analyzing the Problem: A teacher asked students to identify the problem by considering multiple perspectives. The students were also asked to complete the assignment of analyzing the problem.	• Stage 3. Creating the Solution: The students were asked to create solutions through small group discussion that were scaffolded by the teacher. • Stage 4. Making Decisions: The students were asked to choose the right solution based on rational theory or literature that was scaffolded by the teacher. • Stage 5. Reflecting on the Results: Each group were asked to present their solution in front of class guided by the teacher. The group was also required to reflect on and revise the solution based on comments from other groups.	None
Other experimental group	Flipped Classroom Model	• Stage 1. A teacher posted videos and textbooks that related to the courses. The students were required to learn independently basic knowledge from the videos or textbooks posted by the teacher. • Stage 2. The students completed a quiz (e.g., summarizing).	• Stage 3. The students clarified any misunderstandings concerning the videos and textbooks through a discussion with peers that was guided by the teacher.	None
Control group	Regular Classroom	None	• Stage 1. The teacher gave a lecture that related to the course. • Stage 2. students practiced course activities.	• Stage 3. The students were asked to complete the homework.

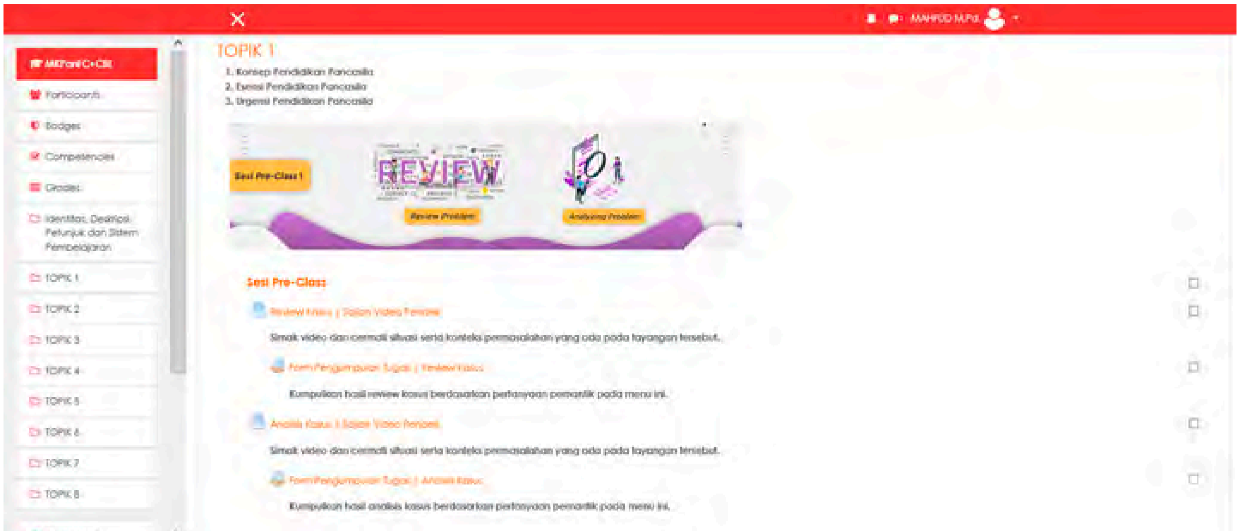
.78 for counterarguments accommodated, and .88 for organization of arguments.

Data Collection and Analysis

This study involved three existing classes with a quasi-experimental design: one control group and two experimental groups writing pretest and posttest essays. This intervention study comprised of a pretest (Week 1), implementation (Week 2–8), and posttest (Week 9). In the pretest, all groups were assessed their problem-solving ability prior to implementation. During the implementation phase, the traditional method was utilized in the control group. In one experimental group, the FC model was adopted and in the other experimental group, the FC model combined with CBL was used. In the course of the implementation phase, an argumentative writing course was delivered to the participants from all groups for seven weeks. Then in the last week, a posttest meant to assess the problem-solving ability of the students was administrated to all groups, similar to what had been done during the pretest phase.

A total of 94 students participated in the intervention study and were used in the final analyses. The distribution of scores in the pretest and posttest met the requirements concerning normality ($p > .05$) and variance homogeneity ($p > .05$). We reported the finding by means of a parametric test: Analysis of variance (ANOVA). The descriptive statistics were calculated with means and standard deviation, and the calculation of the effect size (Eta

Figure 2.
Screenshot of the Preclass Learning Activity



square, h2) permitted us to measure the magnitude of the difference when a significant one appeared (Cohen, 1988). The data were analyzed using SPSS 26 (IMB).

RESULTS

The descriptive statistics of the pretest results were evaluated to verify the potential differences in the problem-solving ability of students depending on whether they belonged to the FC model, the FC combined with CBL, or the traditional group. These statistical results showed that no significant differences existed in terms of problem-solving ability between the control group and experimental groups prior to carrying out the experiment F (2,91) = .487, p = .61 (see Table 2).

Table 2.
ANOVA Results of Pretest Scores

	Groups (n)	***Mean***	***SD***	***F***	***Sig***	***Partial Eta Squared***
Pretest of Problem-Solving Ability	*Traditional Method (28)*	*2.89*	*0.31*	*0.487*	*0.61*	*0.01*
	FC Model (33)	*2.95*	*0.31*			
	FC combined with CBL (33)	*2.96*	*0.32*			

In contrast, after seven weeks of implementation, the results revealed a statistically significant difference in problem-solving ability across the FC model, FC combined with CBL, and traditional method, F (2,88) = 74.23, p = .000. The results also showed a large effect size, h^2 = .61. Furthermore, the FC combined with the CBL group members had higher problem-solving ability (M = 4.42, SD = 0.44) than the participants belonging to the FC model (M = 3.60, SD = 0.31) and the traditional method (M = 3.36, SD = 0.34; see Table 3).

Table 3.
ANOVA Results of Posttest Scores

	Groups (n)	***Mean***	***SD***	***F***	***Sig***	***Partial Eta Squared***
Posttest of Problem-Solving Ability	Traditional Method (28)	3.36	0.34	69.360	0.00	0.60
	FC Model (33)	3.60	0.31			
	FC combined with CBL (33)	4.42	0.44			

DISCUSSION

The increased attention to the learning activity that unfolds in blended learning environments and the student-centered learning approach have been accompanied by the emergence of the flipped classroom model. This study investigated the design and effectiveness of combining the FC model with CBL to achieve the goal of teaching problem-solving. The combination of the FC model with CBL was systematically structured by adopting the FC model proposed by Diningrat et al. (2023) and CBL

proposed by Choi and Lee (2009). The administration of pretest scored proved that there were no differences in students' problem-solving ability before the implementation of our experiment.

The FC model combined with CBL had a significant effect on students' problem-solving ability. Whereas the students in the control group showed little improvement across the intervention period, both experimental groups achieved a remarkability high aptitude in problem-solving ability. The findings suggest that the FC combined with CBL is more effective in enhancing students' problem-solving ability than just the FC model. The results corroborate those obtained in previous studies, showing that participants from the FC combined with CBL group performed better in the scores of the case analysis-related questions than those from lecture-based teaching (Yang et al., 2021). A study by Cai et al. (2022) assessed the efficacy of FC combined with CBL in undergraduates in comparison with a lecture-based classroom. The findings indicated that the students in the FC combined with CBL group earned significantly higher scores in the clinical case analysis than those in the lecture-based classroom.

The advantages of FC combined with CBL may contribute to several aspects of the preparation and implementation of the course. In the preclass session, the FC combined with CBL model provides a self-paced preclass learning activity with specific guidance, such as reviewing and analyzing problems, and thus students can use their time more efficiently. In the in-class session, FC combined with CBL emphasizes the high level of cognitive abilities by encouraging students to utilize what they have to solve problems through creating solutions, making decisions, and reflecting on results. Thus, FC combined with CBL offers a sequential and gradual learning process that bridges the gap between the preclass learning of foundation knowledge and in-class session of application and problem-solving abilities (Strayer, 2017; Tawfik & Lilly, 2015).

Finally, although the present study's findings imply that FC combined with CBL is beneficial to the students' problem-solving ability, and this should not be taken to mean that other factors should not be used in such an environment. There are two limitations in this study. One is that it was relatively short in duration (seven weeks), thus we urge future researchers to investigate the utilization of FC combined with CBL over a longer time period, such as one semester, to verify our results. Another limitation is that this study was conducted for a relatively small cohort of participants. Studies with more participants enrolled may help to further verify the effectiveness and advantage of FC combined with CBL. Lastly, this study only focused on preclass and in-class sessions and did not extend the study to after-class activities. We recommend that future research include FC combined with CBL together with after-class learning activities.

CONCLUSION

This study presented insights into how students' problem-solving ability improves after implementing an FC model that had integrated a CBL strategy. The findings showed that FC combined with CBL is a promising instructional model for enhancing problem-solving ability in students.

RECOMMENDATIONS

The study has implications for research and practice. In the case of research, the study contributes to the literature devoted to the research of FC combined with CBL effects, which is still scarce. Furthermore, the key implication of this study is for practice in terms of instructor' support, including asking students to take more notes during the preclass session, helping students accurately monitor their schedule studying time, and encouraging students to use higher order thinking skills during the in-class session. These may benefit researchers and practitioners who seek to design FC combined with CBL to develop students' problem-solving ability in other contexts.

In the case of practice, setting up an FC combined with CBL model has the potential to replace or complement the FC model or traditional method, insofar as it can prove to be more effective in improving students' problem-solving ability than just the FC model or lecture-based learning.

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