



Investigating the Impact of a Fully Online Flipped Classroom on Students' Performance: A Mixed-Method Study*

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ABSTRACT

This article examines the challenges and possibilities of implementing a flipped classroom in fully online settings. It provides insights into the dynamics of interaction and collaboration in a fully online flipped classroom and offers recommendations for its implementation and further research. In addition, the impact of a fully online flipped classroom approach on students' performance was compared to that of online learning. A mixed-method design was used in the research, with 59 students participating. Quantitative and qualitative data were collected during the 14-week study regarding the fully online flipped classroom approach. The study's findings indicate that a fully online flipped classroom approach significantly impacts student success and enhances learning outcomes compared to traditional online learning.

Keywords: Fully online flipped classroom, flipped classroom, achievement

Article Type: Research Article

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1. INTRODUCTION

The flipped classroom model has gained popularity in educational institutes worldwide. It is a pedagogical approach involving students engaging with course materials, such as online lectures and readings, before class. A flipped classroom allows students to learn independently and participate in group activities during class, increasing self-sufficiency and optimizing learning time (Suhartono et al., 2021). It also provides opportunities for personalized learning, as students can review and revisit materials as needed.

In the flipped classroom, class time is used for collaborative and interactive activities, such as case scenarios and small group discussions (Critz & Knight, 2013). The goal is to promote active learning and problem-solving skills. Research has shown that the flipped classroom model positively impacts student achievement compared to traditional lecture-based classrooms (Saira et al., 2020). It promotes deeper understanding and critical thinking skills (Karagol & Esen, 2018). However, implementing the flipped classroom model also comes with challenges. Student-related challenges include self-discipline and motivation to engage with pre-class materials. Faculty challenges include creating high-quality online resources and adapting teaching strategies to facilitate active learning. Operational challenges include technological infrastructure and support (Lo & Hew, 2017).

Research has shown that the flipped classroom model can be effective in various educational contexts. It has been successfully implemented in graduate nursing education (Critz & Knight, 2013), K-12 education (Lo & Hew, 2017), and teaching English (Ayçiçek & Yelken, 2018). The flipped classroom model has also been recognized as a potential approach to teaching mathematics, with the ability to transform the teaching of the subject (Cevikbas & Kaiser, 2020).

The flipped classroom model has been popular and used in different educational settings. However, with the onset of the pandemic, many educators have had to modify this model to adapt it to the new reality of remote learning. These modifications have included using new technologies and tools to facilitate virtual collaboration and engagement and adjustments to the content and structure of lessons to ensure that students can learn effectively in a digital environment.

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Fully Online Flipped Classroom is an innovative approach to education that combines flipped learning principles with online instruction. In a fully online flipped classroom, students are encouraged to complete pre-class work online, just like in a conventional flipped classroom. However, instead of meeting face-to-face in physical classrooms, students engage in online discussions and activities. This approach has gained popularity, especially during the COVID-19 pandemic, as it allows for flexible and remote learning (Nerantzi, 2020).

The use of fully online flipped learning has also been explored in specific subject areas. For example, a study focused on fully online flipped learning in teaching grammar to language learners. The study found that fully online flipped learning effectively improved student achievement and perceptions (Ahmad, 2021). One study found that fully online flipped classrooms positively affected student learning performance in two stages (Hew et al., 2020). Another study investigated the effect of an extended flipped classroom model on students' reading comprehension for fully online learning. The study found that the extended flipped classroom model and students' working memory capacity significantly affected reading comprehension (Diningrat et al., 2023). Another study compared the engagement of nursing students in an online course using flipped virtual classrooms. The study found that flipped classes offered students more opportunities to develop higher-order thinking skills and engage more deeply in learning (Phillips & O'Flaherty, 2019). While there are benefits to fully online flipped learning, it is important to consider students' perceptions and experiences. A study on EFL students' perceptions of online flipped classrooms found that while students believed they could learn materials better with flipped classroom instruction, they had concerns about the effectiveness of online platforms and interaction in flipped instruction (Hung, 2022). Another study explored the experiences of teacher candidates related to online flipped learning and found that it provided active, flexible, and interactive instruction, creating a fun learning environment (Ozudogru, 2021).

The existing literature provides valuable insights into the effectiveness of fully online flipped classrooms across various educational contexts, demonstrating their potential to enhance student learning and engagement. However, it also highlights specific gaps that necessitate further investigation. While previous studies have examined the impact of fully online flipped learning in specific subject areas, such as language instruction and nursing education, there is a need for a comprehensive, mixed-method study that encompasses a broader spectrum of disciplines. Additionally, considering the concerns raised by students regarding the effectiveness of online platforms and interaction in flipped instruction, it is imperative to address these apprehensions in the study design. Furthermore, the experiences of teacher candidates in online flipped learning suggests the importance of active, flexible, and interactive instruction, emphasizing the need for a pedagogical approach that maximizes these elements in the fully online flipped classroom model. By addressing these gaps, this study aims to provide a more holistic understanding of the impact of a fully online flipped classroom on students' performance and experiences in the digital learning environment.

Based on the chosen mixed-method approach and the study's focus on investigating the impact of a fully online flipped classroom, the research questions addressed are as follows:

1. How does the fully online flipped classroom approach impact students' academic performance compared to a traditional online class format?
2. What are the perceived advantages and disadvantages of the fully online flipped classroom approach according to the participants?

These research questions guide the study in comprehensively examining the effectiveness and experiences of implementing a fully online flipped classroom model. They encompass quantitative measures of academic performance and qualitative exploration of participants' perspectives to provide a well-rounded evaluation of the educational intervention.

2. METHODS

The mixed-method approach was chosen for this study to provide a comprehensive and balanced evaluation of the impact of a fully online flipped classroom on students' performance. By incorporating quantitative and qualitative components, we aimed to capture a more nuanced understanding of the phenomenon under investigation. The quantitative component allowed us to quantify the effects of the new approach on student performance through rigorous pretest and posttest measurements. This aspect of the study provides empirical evidence of any significant improvements or differences between the experimental and control groups. The quantitative component of the study consisted of experimental research where we examined the impact of a new approach on student performance. We conducted a pretest and posttest at the beginning and end of the 14-week application. The experimental group utilized a fully online flipped classroom approach during the implementation, while the control group relied on online classes.

Complementing the quantitative component, the qualitative aspect of the study allowed us to delve deeper into the participants' experiences and perspectives. By inviting the experimental group to share their feedback on the fully online flipped classroom approach, we gained valuable insights into the method's advantages and disadvantages from the students' vantage points. This qualitative data contextualizes the quantitative findings, providing a richer narrative around how the participants experienced and perceived the fully online flipped classroom. The mixed-method approach ensures a more holistic and robust examination of the research question. It quantifies the impact on student performance and provides

qualitative insights that help elucidate the underlying mechanisms, potential challenges, and overall effectiveness of the fully online flipped classroom approach. This combined approach strengthens the validity and reliability of the study's findings, offering a more comprehensive view of the educational intervention being investigated.

2.1. Participants

During the spring semester of the 2022-2023 academic year, a study was conducted among 59 students who enrolled in an Information Security course at a state university. The course is designed to teach the principles and details of information security and is taken during the second semester. Participants were randomly assigned to either the experimental or control group, with 29 students in the experimental group and 30 in the control group. The study also revealed that 18 participants (30.5%) were female, while 41 (69.5%) were male.

2.2. Instruments

The pretest-posttest achievement test was applied at the beginning and end of the program. Semi-structured interviews were conducted to obtain student feedback.

2.2.1. Digital Data Security Awareness Scale

Yılmaz, Şahin, and Akbulut (2015) have devised a scale consisting of 32 questions, with factor loadings of the scale items ranging from 0.506 to 0.689, signifying good internal consistency. The scale is a 5-point Likert scale with response options ranging from 1 = Strongly Agree to 5 = Strongly Disagree. Moreover, the scale has a high Cronbach's Alpha coefficient of 0.945, indicating its reliability.

2.2.2. Semi-structured interview form

A survey was designed to collect student perspectives on a fully online flipped classroom. We were asked about the benefits and challenges of implementing a fully online flipped classroom. An online platform was used to administer the survey, and all students participated voluntarily.

As part of the survey, participants were requested to provide their own responses to the subsequent questions:

1. What are the benefits of a fully online flipped classroom?
2. What challenges have you faced while engaging in a fully online flipped classroom?

2.3. Implementation Process

The design of the fully online flipped classroom process has been prepared by considering the following principles.

1. **Students should be guided towards a fully online flipped classroom in the first week:** Students new to this approach should note the following notifications. Course materials are available online before class, and students should prepare accordingly, completing tasks beforehand. Additionally, small group discussions will occur in breakout rooms during live online classes, followed by short exams using the Quizizz student response system.
2. **Students should be given sufficient time for weekly pre-online and online classes activities. That's why course materials should be available online before the course:** The study materials for the upcoming weeks have already been distributed, ensuring that students are informed about the content they will encounter. This is comparable to the approach taken by online educational platforms such as Udemy. Moreover, the course syllabus has also been made available.
3. **Formative assessment should be used for activities in pre-online and online classes. Technology tools such as online discussion forums should also be used in pre-online classes learning:** To improve the level of participation, motivation, and engagement of students in pre-online and online classes, a comprehensive formative assessment was conducted. The assessment involved gathering and analyzing student feedback regarding their learning experiences and identifying areas that require improvement. Based on the results, appropriate measures were taken to develop and implement strategies to enhance student's learning experience and encourage them to participate actively in their studies.
4. **Gamification can be preferred as a participation and motivation method:** To improve the level of engagement among students, the technique of gamification was implemented. This involved integrating several game elements, such as leaderboards, badges, points, and levels, into the educational system.
5. **Instructors should use technology tools such as student response systems and breakout rooms in online courses:** Breakout rooms play a crucial role in a completely virtual flipped classroom. Students facilitate peer-based learning via

focused group discussions. Moreover, student response systems, such as Quizizz, utilized to gauge comprehension at the conclusion of live lessons.

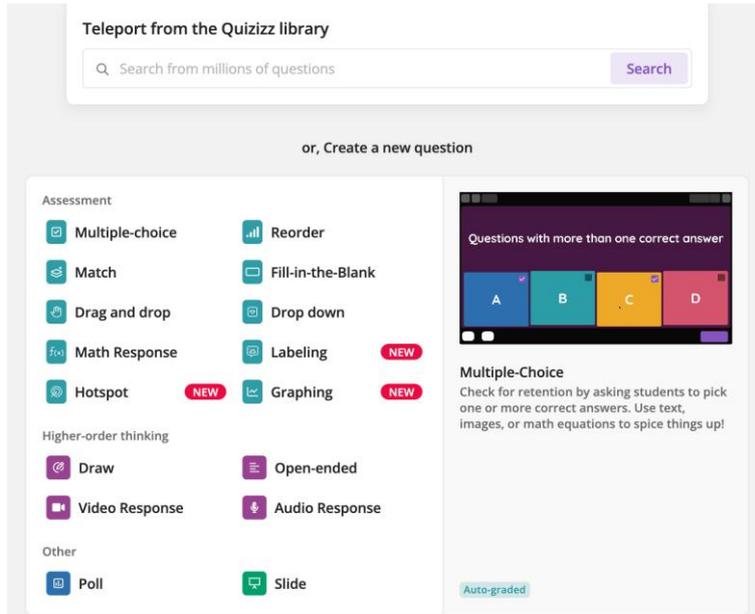


Figure 1. Quizizz

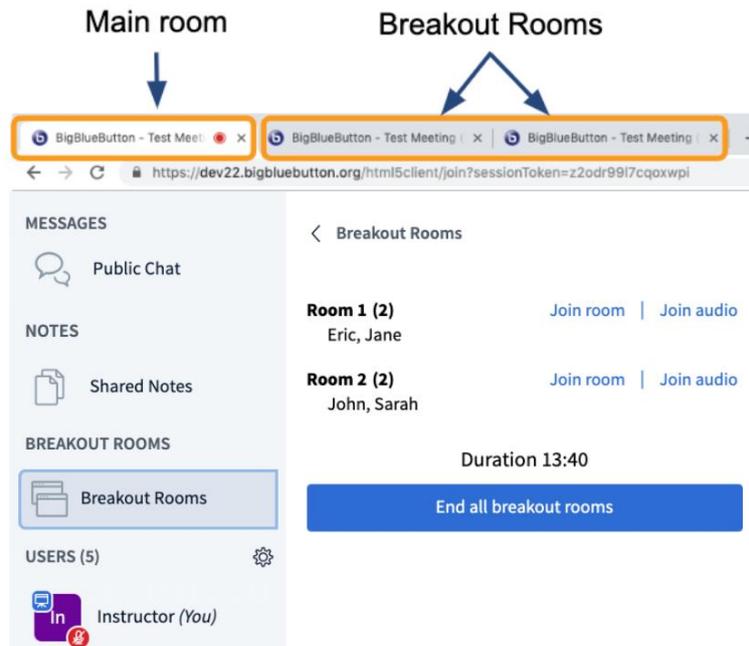


Figure 2. Breakout Rooms on Bigbluebutton

2.4. Analysis

The researcher calculated the difference between students' post-test and pre-test scores in the experimental and control groups to determine the effectiveness of fully online flipped learning. This created a progress score series, which was then used to compare the average progress of the two groups. The t-test for independent samples was used to compare the average difference score of the group that used fully online flipped learning to that of the group that did not. The goal was to determine if the difference in progress between the two groups was significant. The researcher used SPSS (Statistical Package for the Social Sciences) Statistics 29.0.0 to analyze data.

On the other hand, a thematic analysis approach was employed to analyze opinions. This involved generating codes through open coding and refining them into broader categories through constant comparison, ultimately leading to distinct themes. Triangulation and member checking were carried out to ensure the accuracy and validity of the findings.

2.5. Limitations

Despite the rigorous methodology employed in this study, several limitations should be acknowledged. Firstly, the sample size, comprising 59 participants, while sufficient for the scope of this study, may limit the generalizability of the findings to a broader population. Additionally, the study was conducted within the context of a single course at a specific state university, potentially limiting the external validity of the results to other academic settings or disciplines. Moreover, the study's reliance on self-reported feedback from participants introduces the possibility of response bias, as individuals may provide responses that they believe align with perceived expectations. It's also worth noting that the study was conducted over 14 weeks, and longer-term effects beyond this timeframe were not explored. Finally, while efforts were made to mitigate potential biases, the possibility of observer or researcher bias in the qualitative analysis cannot be entirely ruled out. Despite these limitations, the findings of this study contribute valuable insights into the effectiveness and experiences associated with the fully online flipped classroom approach within the context of information security education.

3. RESULTS

3.1. How does fully online flipped learning affect student's achievement?

The purpose of this study was to compare the impact of two different methods, online learning and fully online flipped learning, on student success. The study also aimed to explore the difference in student achievement between those who listened to lectures in online live classes and those who participated in small group discussions in breakout rooms.

The research was conducted using pre-tests and post-tests for both the experimental and control groups at the beginning and end of the application. The pre-test scores were subtracted from the post-test scores within each group to analyze the difference. These difference scores were then calculated for both groups and analyzed using an independent samples t-test to determine whether there was a significant difference between the two groups.

Table 1.
Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Differences	Exp.	29	98,5172	31,81826	5,90850
	Contr.	30	79,5333	37,17780	6,78771

Upon examining Table 1, it can be observed that the experimental group's average difference score ($X = 98.52$) is higher than the control group's average difference score ($X = 79.53$). To test the statistical significance of the difference between these two averages, a t-test table has been included below. This table provides a detailed analysis of the t-test results and helps determine if the observed difference is statistically significant or just due to chance.

Table 2.
Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
Differences	Equal variances assumed	1,034	,314	2,104	57	,040	18,98391	9,02307	,91552	37,05230
	Equal variances not assumed			2,110	56,187	,039	18,98391	8,99907	,95792	37,00990

Upon comparing the averages of the difference scores with the t-test for independent samples; it becomes evident that there is a significant difference between the average progress scores in the experimental group where fully online flipped learning was used and the control group where online learning [$p < 0.01$].

This indicates that a fully online flipped learning approach significantly impacts student success. Therefore, this approach is more effective in enhancing learning outcomes than traditional online learning.

3.2. Students' perspective regarding the advantages of fully online flipped learning

Students have expressed several positive views regarding the benefits of a fully online flipped classroom. During the study, the researcher asked the experimental group participants about their thoughts on the fully online flipped classroom model and how it benefited them. It was found that 15 students, which accounts for 52% of the participants, expressed that this model helped them retain the knowledge better, resulting in a more **permanent learning** experience.

"By sharing the content in advance, I can review the topics repeatedly, which helps me remember the information for a longer time." (S3)

"I can study the courses at my own pace. I also complete my missing information from the activities in the discussion rooms." (S21)

Out of the total number of students who participated in the study, 11, or 38%, reported that this approach was more **enjoyable** and engaging, leading to a more effective learning experience.

"Sharing information with my classmates while following the lessons makes learning more fun." (S15)

"The discussions in the group rooms and the teacher visiting and directing the discussions are excellent. I need to catch up on time. The classes are enjoyable." (S26)

According to the survey results, out of the total number of students who took part, 9 students, which accounts for 31% of the sample, expressed their satisfaction with the **peer learning** aspect of this approach. This suggests that a significant number of students found the peer learning experience to be positive and beneficial.

"Group work in online classes is easier and more flexible. We can complete projects more easily by communicating with our friends online." (S1)

"Interacting online with classmates from different regions allows me to share different perspectives." (S12)

The survey among the students revealed that out of the total number of participants, 7 (which accounts for 24%) experienced a positive sense of **competition** about the specific approach being evaluated. This suggests that the approach motivated these students to perform better and fostered a healthy competitive environment.

"Rankings and ratings on online platforms create a sense of competition among students. This causes me to show more participation and effort." (S20)

"Contests and prizes make learning more fun. Competing with other students helps me be more motivated." (S4)

Among the students who participated in the study (n=5), 17% reported that using this particular approach has positively impacted their ability to **communicate** effectively during in-class activities and discussions.

"I carried out activities with other students whose voices I had never heard. I easily asked questions I did not know." (S8)

"Thanks to this course, my communication with my classmates increased. This caused me to participate more in classes." (S9)

3.3. Student's views on the disadvantages of fully online flipped learning

When exploring the potential drawbacks of using the fully online flipped classroom model, 31% of the participants (n=9) raised concerns about technical issues. According to these students, the approach faced several challenges related to its technical functionality. Examples of the **technical issues** cited included poor internet connectivity, difficulties with accessing online materials, and problems with the online platform used for the flipped classroom model. These challenges were seen as significant impediments to the effective implementation of the model.

"Unfortunately, I often have to experience technical difficulties while learning online. It can be frustrating to worry about missing lectures and important information." (S13)

"Technical issues can be a real hassle. I missed class once because I had trouble with my microphone. That stressed me out." (S1)

One of the most commonly reported challenges was the presence of **reluctant group members**, specifically mentioned by 28% (n = 8) of the students. This suggests that the reluctance of some group members to participate in the flipped classroom model can hinder the overall success of the learning experience.

"When doing group projects, I sometimes find that other group members are unwilling to cooperate. This makes the project more challenging." (S22)

"In tasks that require collaboration, some friends turn off their microphones and cameras and remain silent." (S5)

A total of six students who participated in the study reported experiencing **anxiety due to missing classes**, which was identified as one of the disadvantages of this learning approach. This highlights the potential negative impact that absenteeism can have on the well-being of students and further emphasizes the need for effective strategies to address this issue.

"When I cannot attend classes, I think I miss the class content, and it is difficult to compensate for this deficiency." (S6)

"Missing online classes means losing points. We could not be absent." (S29)

According to the survey conducted, it was found that only 17% (n = 5) of the total number of students who participated in the research reported feeling a sense of **harmful competition** while engaging with this approach. This indicates that most students felt no negative impact while experiencing it. It can be inferred that the system successfully created a positive and healthy environment for learning.

"Sometimes the competition in classes can be very intense. Competing in exams and competing with other groups can sometimes be stressful." (S24)

"The leaderboard became more important than anything for some guys. That spoiled the atmosphere." (S17)

4. DISCUSSION AND RECOMMENDATIONS

The study's findings indicate that a fully online flipped classroom approach significantly impacts student success and enhances learning outcomes compared to traditional online learning. The results revealed a significant difference between the average progress scores in the experimental group using the fully online flipped learning approach and the control group using online learning. This suggests that the fully online flipped classroom model is more effective in improving student performance.

The study also found that most participants reported positive experiences with the fully online flipped classroom model. Over half of the students expressed that this model helped them retain knowledge better, resulting in a more permanent learning experience. Additionally, many students found the approach more enjoyable and engaging, leading to a more effective learning experience. This indicates that the fully online flipped classroom model can enhance student engagement and satisfaction. Furthermore, the study revealed that many students positively perceived peer learning. Students expressed satisfaction with the peer learning aspect of the fully online flipped classroom model, suggesting that peer interaction can benefit learning in this context. Additionally, a sense of positive competition was reported by some students, indicating that the approach motivated them to perform better and fostered a healthy competitive environment.

However, the study also identified some challenges associated with the fully online flipped classroom model. Technical issues, such as poor internet connectivity and difficulties with accessing online materials, were reported by a significant number of students. These challenges hindered the effective implementation of the model and highlighted the importance of addressing technical functionality issues. Reluctant group members were also identified as challenging in the fully online flipped classroom model. The reluctance of some group members to participate can hinder the overall success of the learning experience. This suggests the need for strategies to encourage active participation and collaboration among all students.

Another drawback of a fully online flipped classroom model is that students cannot afford to be absent due to the fear of missing out on points during the formative assessment. Since the online model emphasizes self-paced learning, students must keep up with the course material and complete assessments on time. This can be challenging for students who miss a class, as they may struggle to catch up on the material covered and complete the checks within the given time frame. As a result, students may experience increased stress and pressure to stay engaged with the course, even when unforeseen circumstances prevent them from attending.

In conclusion, the findings of this study support the effectiveness of a fully online flipped learning approach in enhancing student performance and learning outcomes. The model improved knowledge retention, engagement, and satisfaction among students. However, challenges related to technical issues, reluctant group members, and absenteeism must be addressed to

ensure the successful implementation of the flipped classroom model. Educators should consider strategies to mitigate these challenges and create a positive and supportive learning environment.

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