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Impact of flipped classroom models on student engagement and academic performance in higher education

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Abstract
The integration of technology in education has driven the adoption of innovative pedagogical strategies like the flipped classroom model, which emphasizes active learning by shifting content delivery outside the classroom and reserving in-class time for interactive activities. This study investigates the impact of flipped classrooms on student engagement and academic performance in higher education. Conducted with 100 undergraduate students across biology and engineering disciplines, the research employs a mixed-methods approach, combining surveys, interviews, and academic performance data analysis. Findings reveal that the flipped classroom model significantly enhances student engagement compared to traditional lecture-based teaching. Students reported greater participation in class discussions, collaborative learning, and peer interactions, attributing their improved engagement to the flexibility of self-paced pre-class learning and dynamic in-class activities. However, the impact on academic performance was less conclusive. While students in the flipped classroom group achieved slightly higher scores, the difference was not statistically significant, suggesting that the effectiveness of this model depends on factors like the quality of pre-class materials and student preparedness. This study highlights the potential of flipped classrooms to foster active learning and engagement in higher education, while also identifying areas for improvement, such as supporting self-regulated learning and enhancing pre-class resources. The findings underscore the need for future research to explore long-term outcomes and strategies to optimize the flipped classroom model for diverse learners.

Keywords: Flipped classroom, active learning, student engagement, academic performance

Introduction

With the quick changes in educational methods and the integration of technology into the classroom, teachers are looking for new and creative ways to boost student interest and raise academic performance. One such strategy that is becoming more popular is the flipped classroom style. Unlike traditional lecture-based methods where instructors deliver content during class and students' complete assignments afterward, the flipped classroom inverts this dynamic. This method involves students interacting instructional content at home, usually via recorded lectures, books, or interactive resources, and using class time for group projects, debates, and problem-solving exercises (Bergmann & Sams, 2012) [1].

This pedagogical shift aligns with the principles of active learning, because it promotes deeper connection in the classroom and empowers students to take greater responsibility of their education. Research suggests that flipped classrooms have the potential to increase engagement by promoting active participation and peer collaboration (Freeman *et al*., 2014) [3]. Moreover, it provides students the chance to review complex concepts at their own speed before applying them in interactive classroom settings, potentially reducing cognitive load and enhancing comprehension (Mason *et al*., 2013) [4].

Despite these encouraging results, it is still unclear how the flipped classroom paradigm affects students' academic achievement. While some studies report significant improvements in student achievement due to deeper engagement with course material (Zhu *et al*., 2017) [5], others argue that its effectiveness is contingent on factors such as the quality of pre-class resources and students' preparedness (Bishop & Verleger, 2013) [2]. This discrepancy highlights the need for further investigation into how flipped classrooms influence both student engagement and academic performance, particularly in higher education contexts. This study aims to close this gap by investigating how university students' involvement and academic performance are affected by flipped classrooms.

By comparing these outcomes with those of traditional lecture-based methods, the study aims to shed light on the advantages and difficulties of flipped classes in higher education environments.

Objectives

1. To analyse the engagement levels of students in a flipped classroom setting.
2. To evaluate the engagement levels of students in a traditional lecture-based setting.
3. To compare the engagement levels between the flipped classroom group and the traditional lecture group.
4. To assess the academic performance of students in a flipped classroom.
5. To measure the academic performance of students in a traditional lecture-based classroom.
6. To compare the academic performance between students taught through flipped classroom model and traditional lectures.

Hypothesis

HO1: There is no significant difference in engagement levels between the flipped classroom group and the traditional lecture group.

HO2: There is no significance difference in academic performance between the flipped classroom group and traditional group.

Literature Review

The flipped classroom approach has been defined and implemented in various ways across higher education, with research frequently highlighting its role in fostering an active and engaging learning environment. Bergmann and Sams (2012) [1], who are credited with pioneering this instructional model, emphasized that it promotes student engagement by transferring the responsibility for learning to the students. This shift allows learners to study content at their own pace prior to classroom sessions, where they can then actively apply concepts in interactive activities.

Numerous studies suggest that flipped classrooms enhance student engagement. For example, Freeman *et al*. (2014) [3] found that students in flipped environments reported greater satisfaction and engagement compared to those in traditional classroom settings. Additionally, having access to challenging material before class can help lower the cognitive load during in-class exercises, as highlighted by Mason *et al*. (2013) [4].

Research on the impact of flipped classrooms on academic performance has yielded mixed results. Some studies, such as Zhu *et al*. (2017) [5], indicate that this instructional method can enhance academic outcomes by promoting deeper engagement with the material. However, other research suggests that the effectiveness of the flipped model may largely depend on the quality of both the pre-class content and the in-class activities (Bishop & Verleger, 2013) [2].

While evidence increasingly supports the positive influence of the flipped classroom approach, further empirical studies are necessary to better understand its effects on student engagement and academic performance across different educational settings.

Methodology

A mixed-methods approach, including both quantitative and qualitative data collection, was employed to evaluate the impact of the flipped classroom model. The research was carried out at a university over the duration of a semester.

Participants

The study involved two groups of university students enrolled in undergraduate courses in the fields of biology and engineering. One group was taught using traditional lecture-based methods, while the other group engaged in flipped classroom learning. In total, 100 students participated, with 50 in each group. Demographic data were collected to ensure comparability between the two groups.

Data Collection

- **Surveys:** Pre- and post-course surveys were administered to assess student engagement, motivation, and perceptions of learning. The surveys contained Likert-scale questions to quantify engagement and academic satisfaction.
- **Academic Performance:** Course grades, exam results, and assignment scores were compared between the two groups to evaluate academic performance.
- **Interviews:** Semi-structured interviews were conducted with 20 students (10 from each group) to gain qualitative insights of their responses.

Analysis

Survey responses and academic performance data were evaluated using statistical techniques such as chi-square tests and t-tests to determine significant differences between the groups. Thematic analysis was applied to qualitative interview data to identify common themes and patterns related to student engagement and experiences.

Data Analysis and Interpretation

HO1: There is no significant difference in engagement levels between the flipped classroom group and the traditional lecture group.

Table 1: Calculation of χ^2

Group	Observed data		Expected data		Total	DF	χ^2	Total χ^2
	Engaged	Not engaged	Engaged	Not engaged	N			
Flipped	42	8	36	14	50	1	χ^2f.e=1, χ^2f.ne=2.57	7.14
Traditional lecture	30	20	36	14	50		χ^2t.e=1, χ^2t.ne=2.57	
Total	72	28	72	28	100			

The p-value (0.008) is less than the calculated χ^2 value (7.14) at 0.05 level, so reject the null hypothesis. There is a significant difference in engagement levels between the flipped classroom group and the traditional lecture group. The flipped classroom model significantly enhances student engagement in comparison to traditional lectures.

HO2: There is no significance difference in academic performance between the flipped classroom group and traditional group.

Table 2: Calculation of t-value

Group	Mean	SD	N	F	P	T-Value
Flipped	75	10	50	98	1.984	1.875
Traditional teaching	71.25	10	50			

The p-value (1.984) is slighted greater than the calculated t value (1.875), so the null hypothesis is failed to reject at 0.005 level. The findings indicate that there is no statistically significant difference in academic performance between the flipped classroom group and the traditional lecture group.

Major Findings

Hypothesis HO1: There is no significant difference in engagement levels between the flipped classroom group and the traditional lecture group

1. There is a statistically significant relationship between the teaching method and student engagement levels.
2. The flipped classroom model was found to significantly enhance student engagement compared to the traditional lecture-based approach.
3. The flipped group showed greater involvement in class discussions, increased interaction with peers, and more active participation in collaborative learning activities.
4. The qualitative interviews also highlighted that student in the flipped classroom found the format more dynamic and engaging. They appreciated the opportunity to explore the material at their own pace before applying it in the classroom, which they believed helped them retain information better.

Hypothesis HO2: There is no significant difference in academic performance between the flipped classroom group and the traditional lecture group

1. There was no statistically significant difference in academic performance between the flipped classroom group and the traditional lecture group.
2. The flipped classroom group demonstrated higher mean performance; the improvement was not sufficient to establish a statistically significant difference.

Results and Discussion

Student Engagement

Survey results indicated that students in the flipped classroom group reported significantly higher levels of engagement than those in the traditional lecture group. The flipped group showed greater involvement in class discussions, increased interaction with peers, and more active participation in collaborative learning activities. Specifically, 85% of flipped classroom students reported feeling more engaged in the learning process compared to 60% of traditional classroom students.

The qualitative interviews also highlighted that student in the flipped classroom found the format more dynamic and engaging. They appreciated the opportunity to explore the material at their own pace before applying it in the classroom, which they believed helped them retain information better.

Student Responses: The qualitative data (from interviews) further supported these findings. Students expressed greater satisfaction with the dynamic nature of the flipped classroom. They appreciated being able to engage at their own pace with the material outside of class and found it helpful in reinforcing content before applying it in classroom discussions.

Why Engagement Increased: The shift in the learning approach allowed students to be more proactive. They could learn content independently at home and then collaborate and discuss it actively in class, leading to a deeper understanding of the material. In contrast, traditional lecture-based classes, which often involve passive listening, did not promote the same level of interaction or engagement.

The study confirmed that flipped classrooms significantly enhance student engagement. Students in the flipped classroom group reported higher levels of participation in learning activities, more frequent interactions with peers, and increased involvement in collaborative exercises. This is consistent with previous studies (e.g., Freeman *et al*., 2014) [3] that argue flipped classrooms promote active learning by shifting the responsibility of content review to students before class, allowing in-class time for interactive discussions and problem-solving activities.

Academic Performance

When comparing academic performance, the results were mixed. On average, students in the flipped classroom group scored slightly higher on midterm exams and assignments (a 5% increase in average scores). However, the difference was not statistically significant. Further analysis revealed that the improved performance was more pronounced in students who actively engaged with the pre-class materials and participated fully in the in-class activities. For students who did not complete pre-class tasks or participated minimally in activities, academic performance remained similar to the traditional group.

The results related to academic performance were more mixed. While the flipped classroom group had slightly higher scores on average (about a 5% increase) on midterm exams and assignments, the difference was not statistically significant. This suggests that while the flipped classroom might offer benefits in terms of engagement and motivation, the actual effect on academic performance is not as straightforward.

Educational Implications

The findings have significant implications for educators:

- **Active Learning Strategies:** The results suggest that **active learning strategies** in the classroom (such as collaborative activities, discussions, and problem-solving exercises) are crucial for increasing engagement and improving learning outcomes.
- **Support for Self-Regulated Learning:** Since flipped classrooms require students to manage their learning outside the classroom, the study suggests that educators should provide support to help students develop these skills. This could involve offering time management

workshops, structured study guides, or reminder systems to keep students on track.
- **Improving Pre-Class Materials:** To maximize the effectiveness of the flipped classroom, educators should ensure that pre-class materials are high-quality and engaging. This could involve using diverse formats (e.g., videos, readings, interactive modules) to cater to different learning preferences.

Conclusion
This study has demonstrated that the flipped classroom model significantly enhances student engagement in higher education by promoting active learning, collaboration, and participation. Students in the flipped classroom expressed greater satisfaction with the learning process, as the model allowed them to explore content independently and engage in dynamic, interactive activities during class.

However, the impact on academic performance was less definitive. While students in the flipped classroom group achieved slightly higher scores on average, the difference was not statistically significant. This suggests that academic outcomes in flipped classrooms depend on several factors, including student preparation, self-motivation, and the quality of pre-class materials.

The findings underscore the potential of the flipped classroom model to transform traditional teaching methods, particularly in fostering student engagement. For the model to achieve its full potential, educators should provide support for self-regulated learning and ensure the availability of high-quality, engaging pre-class materials.

Future research should explore the long-term effects of flipped classrooms and identify strategies to support students who struggle with self-directed learning. By addressing these challenges, educators can create inclusive learning environments that maximize the benefits of the flipped classroom approach.

Conflict of interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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