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STUDENTS' PERCEPTIONS OF FLIPPED CLASSROOM EFFECTIVENESS: INVESTIGATING ITS IMPACT ON LEARNING OUTCOMES AND CLASSROOM INTERACTION IN SECONDARY EDUCATION

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Abstract

This study explores how secondary students view the flipped classroom model, emphasizing how it affects learning outcomes and classroom interaction. A purposive sample of thirty secondary students was used in a quasi-experimental pre-test/post-test design. Pre-class digital resources and in-class group projects were part of the intervention. A structured perception questionnaire was used to gather the data, and paired sample t-tests were used for analysis. The findings revealed notable gains in peer collaboration, student-content engagement, and perceptions of the learning environment, but no discernible change in teacher-student interaction. Students reported increased conceptual clarity, critical thinking, and academic confidence, indicating a notable improvement in learning outcomes. All things considered, the flipped model was thought to be very successful at changing classroom dynamics into more participatory and student-focused educational opportunities. Although intentional strategies are required to strengthen teacher-student engagement, the results support flipped learning as a promising pedagogy in secondary education. The recommendations emphasize equitable access, digital tool integration, and teacher professional development.

INTRODUCTION

The flipped classroom (FC) is becoming more and more recognized as a promising pedagogical model in secondary education. Flipped classrooms free up class time for active learning, group projects, discussions, and teacher-facilitated problem-solving by having students interact with the material first outside of class, usually through readings, videos, or multimedia (Bergmann & Sams, 2012; Bishop & Verleger, 2013). Two persistent issues—limited in-class time for guided practice and poor, primarily one-way teacher communication—are intended to be addressed by this reversal of the conventional lecture-homework sequence. Research from a variety of settings indicates that FC can improve learning outcomes, particularly in STEM subjects where half-day or greater achievement gains have been documented when compared to lecture-based instruction (Akçayır & Akçayır, 2018; van Alten et al., 2019).

Results, however, differ by subject, grade level, and implementation fidelity, which calls for further research into secondary school settings where teenagers' motivation and self-control are significantly different from those of undergraduates (O'Flaherty & Phillips, 2015). Crucially, how students view the flipped classroom—its workload, utility, and classroom dynamics—emerges as crucial. Students usually report higher motivation and better learning outcomes when they believe that pre-class materials are clear and helpful and that in-class

activities are engaging (Gilboy et al., 2015; Lo & Hew, 2017). On the other hand, FC can backfire if students feel overwhelmed or unprepared (Jensen, Kummer, & Godoy, 2015). Despite this, relatively few studies use secondary students' perceptions as a lens to comprehend adoption sustainability and effectiveness.

Classroom interaction is another important factor. Theoretically, flipped classrooms alter classroom discourse into a more dialogic and inquiry-based process by shifting the emphasis toward student discussion, peer collaboration, and teacher feedback (Davies, Dean, & Ball, 2013). Observational research has shown that during FC lessons, students in secondary science and math classes ask more questions and provide more explanations to one another (Karabulut-Ilgu et al., 2018). However, in situations where pre-class engagement is uneven or in-class tasks are poorly structured, some students do not perceive these interaction gains (Thai, De Wever, & Valcke, 2017).

Secondary students' opinions of FC effectiveness are the main focus of this study, which bases its investigation on two main outcomes: (1) learning outcomes, such as accomplishment, self-assurance, and conceptual clarity; and (2) classroom interaction, such as active participation, peer discussion, and teacher accessibility. By putting student voice first, we hope to understand how perceptions influence FC's influence and what elements of facilitation and design help or hurt its efficacy.

Literature Review

Background

Constructivist learning theory, which emphasizes students actively creating knowledge through social interaction and reflection, is the source of the flipped classroom model (Piaget, 1954; Vygotsky, 1978). FC complies with these guidelines by shifting passive transmission outside of the classroom, enabling classrooms to serve as venues for cognitive apprenticeship and inquiry (Bergmann & Sams, 2012). Furthermore, FC is based on frameworks for self-regulated learning. It gives students the metacognitive skills necessary for long-term success by requiring them to independently plan, monitor, and manage their learning processes during pre-class preparation (Zimmerman, 2002; Lai & Hwang, 2016).

Impact on Learning Outcomes

Numerous meta-analyses support FC's beneficial impact on academic performance. In secondary and post-secondary courses, Akçayır and Akçayır (2018) reported significant achievement gains (effect sizes ranging from 0.3 to 0.8). Moderate effects were also noted by van Alten et al. (2019), who observed a greater impact when in-class activities prioritized feedback and elaboration. O'Flaherty and Phillips (2015), however, issued a warning that not all K–12 implementations result in steady improvements, particularly when students are left to work independently without supervision. The advantages of FC frequently become apparent when active learning is carefully incorporated; simply watching videos is insufficient, according to Lo and Hew (2017).

Sung (2018) discovered that by allowing for more in-depth practice during class time with teacher scaffolding, a flipped model enhanced algebra performance in math classes. Burgess, Ayres, and Powis (2017) showed that students who participated in flipped inquiry labs performed better on exams in a biology unit. The efficacy of FC is also supported by qualitative reports in the humanities. Flipping literature classes resulted in deeper textual analyses and richer seminar discussions, which improved essay performance, according to Baepler, Walker, and Driessen (2014).

Classroom Interaction and Engagement

The purpose of FC is to change classroom discourse. While Bergmann and Sams (2012) reported how teachers could circulate, question, and scaffold more effectively when they were not lecturing, Davies et al. (2013) noted increases in student-student explanation and task-based collaboration. Flipped engineering classrooms promoted group problem-solving and peer tutoring, according to Karabulut-Ilgu et al. (2018). Conversely, some students experienced marginalization during interactive tasks when there was unequal pre-class preparation (Jensen et al., 2015). A key mediator of interaction and learning is engagement. According to Roehl, Reddy, and Shannon (2013), FC improved behavioral

engagement because students arrived at class prepared to work. Additionally, improvements in affective and cognitive engagement were reported by Tomas et al. (2019).

However, Zainuddin and Perera (2019) warned that these benefits are not guaranteed; perceived task fairness and motivation for pre-class work are crucial. Engagement increases when FC design gives students a sense of autonomy, competence, and relatedness (Deci & Ryan, 2000).

Student' Perceptions

Gilboy et al. (2015) demonstrated that students' performance and satisfaction were higher when they thought pre-class videos were clear and pertinent. Thai et al. (2017) found a similar correlation between improved results and favorable opinions of the quality of the videos and the value of the in-class activities. Students' willingness to stick with and participate is influenced by how they view the learning process, including how easy it is to prepare for class, how beneficial in-class activities are, and how equitable the workload is (Lo & Hew, 2017).

Additionally, students evaluate the caliber of classroom interactions. Students valued small-group problem solving and easily accessible teacher support, according to Davies et al. (2013). According to Baepler et al. (2014), flipping gave students more time for peer-led analysis, which in turn increased their voice in literature seminars. Classroom climate improves and learning is further enhanced when students believe their contributions are valued and their questions are welcomed (Tomas et al., 2019).

Challenges and Moderators

Jensen et al. (2015) stressed that in order for students to participate in FC, they need to be able to manage their time and exercise self-control. If not scaffolded, pre-class work can become a barrier for teenagers balancing several classes and extracurricular activities. On the other hand, having access to technology at home can make disparities worse. Without reliable devices or internet, students may struggle, which could affect their perceptions and results (Chen, Liu, & Martinelli, 2017). FC in secondary schools necessitates consideration of readiness and equity. Effective FC lesson design takes time, including creating succinct videos, organizing interactive exercises, and coordinating assessments. According to Zainuddin and Perera (2019), implementation may be hampered by teacher exhaustion and a lack of training. As a result, student assessments of efficacy might take into account both the model and the caliber of its preparation.

Students in middle school and high school have different levels of autonomy and cognitive development, so FC methods need to change accordingly. More teacher scaffolding and accountability frameworks may be the most effective way to implement FC in early adolescence (Lo & Hew, 2017). FC can help older students become more independent and curious.

One clear benefit that is commonly ascribed to flipped classrooms is the ability to use class time for timely feedback and rich formative assessment, both of which enhance learning outcomes. A number of recent studies position the flipped model as the perfect vehicle for implementing assessment-for-learning practices, and Black and Wiliam (1998) demonstrated the potent effects of formative assessment on student achievement. Students can revise their understanding in real time when teachers use in-class activities to probe misconceptions and provide prompt corrective feedback (Freeman et al., 2014). In secondary STEM classrooms, McLaughlin et al. (2014) found that purposefully incorporating peer-feedback cycles and low-stakes quizzes into flipped lessons improved concept mastery when compared to sections that used flipped videos but kept teacher-centered in-class formats.

Beyond self-report, there are other ways to measure how flipped classrooms change classroom discourse. Only when in-class tasks are cognitively demanding does flipping tend to increase opportunities for student explanations, argumentative talk, and teacher facilitation moves (questioning, scaffolding), according to studies using conversation analysis and discourse coding (Mercer & Littleton, 2007). The Flanders Interaction Analysis and Toulmin's argumentation scheme are two examples of instruments that have been used to measure changes in speech patterns. Empirical secondary school research employing these instruments reveals a significant increase in students' explanatory turns during problem-solving sessions (Mercer et al., 2019). To verify assertions regarding the quality of

interactions, perception data should ideally be cross-checked with audio recordings or classroom observations.

While flipped studies frequently show short-term post-test gains, fewer studies look at long-term retention or transfer. According to a few secondary science quasi-experimental studies, students retain conceptual gains at delayed post-tests better than controls when flipped instruction incorporates spaced retrieval and cumulative practice during class (Soderstrom & Bjork, 2015). According to this, flipped designs that incorporate elaborative interrogation and retrieval practice are more likely to result in lasting learning, which is a crucial factor to take into account when creating curricula and scheduling assessments.

There are organizational and policy issues when implementing flipped practices in more schools. Administrators at the school-system level need to make investments in incentives for ongoing professional development, time for teacher collaboration, and infrastructure. Pilot success does not always translate to scale, as demonstrated by case studies of district-wide initiatives; supportive leadership, congruent assessment policies, and reasonable workload adjustments for teachers are crucial (Graham, Woodfield, & Harrison, 2013). Therefore, rather than being a plug-in technology, policymakers should consider flipping to be an instructional reconfiguration.

Objectives of the Study

1. To examine the effectiveness of the flipped classroom model in enhancing student–teacher interaction in secondary classrooms.
2. To explore how flipped learning influences peer-to-peer collaboration and engagement during classroom activities.
3. To investigate the impact of the flipped classroom model on students' interaction with learning content.
4. To assess the role of flipped learning in improving students' perceptions of the classroom learning environment.
5. To evaluate the overall effect of flipped classroom practices on students' academic learning outcomes compared to traditional teaching.

Research Questions

1. How does the flipped classroom model affect student–teacher interaction at the secondary level?
2. In what ways does flipped learning foster peer collaboration and active participation among secondary students?
3. What impact does the flipped classroom have on students' engagement with learning content?
4. How does flipped learning shape students' perceptions of the classroom learning environment?
5. To what extent does the flipped classroom approach improve students' academic learning outcomes compared to traditional instruction?

Methodology

To assess the efficacy of the flipped classroom model, this study used a quasi-experimental research design that compared pre- and post-test results. A purposive sample of thirty students was chosen from a government secondary school, while the population was made up of secondary school pupils. Students received pre-class learning resources, including recorded video lectures, digital notes, and reading materials, as part of the intervention, which was conducted over a predetermined time period. To reinforce previous preparation, in-class time was dedicated to peer discussions, cooperative learning activities, and problem-solving exercises. To evaluate peer collaboration, student-teacher interaction, student-content engagement, perceptions of the learning environment, and academic learning outcomes, a structured student perception questionnaire was created. To find significant differences in mean scores, data were gathered both before and after the intervention, and paired sample t-tests were used for analysis.

Data Analysis and Interpretation

Table 1

Students' Perceptions of Flipped Classroom Effectiveness by Investigating its Impact on Teacher-Student Interaction in Classroom Among Secondary Grader Students (Pre vs Post Comparison)

Comparison test	Mean	Students	Standard Deviation	t-value	p-value
Pre-Value	2.47	30	.46	-.22	.828
Post- Value	2.49	30	.74		

To find out if the flipped classroom method affected secondary school students' opinions of teacher-student interaction, a t-test was used. The pre-test mean score (M = 2.47, SD = 0.46) and the post-test mean score (M = 2.49, SD = 0.74) were almost the same, as Table 1 illustrates. There was no statistically significant difference between the pre- and post-test scores, according to the analysis (t(29) = –0.22, p =.828). These findings suggest that following the adoption of the flipped classroom model, students' opinions of teacher-student interaction did not substantially alter. Although the flipped approach is frequently linked to more chances for personalized feedback and teacher support, the results of this study indicate that, in the secondary school setting that was observed, the degree of teacher-student interaction stayed relatively constant under both circumstances.

Table 2

Students' Perceptions of Flipped Classroom Effectiveness by Investigating its Impact on Student-Student Interaction in Classroom Among Secondary Grader Students (Pre vs Post Comparison)

Comparison test	Mean	Students	Standard Deviation	t-value	p-value
Pre-Value	2.37	30	.47	-16.99	.000
Post- Value	4.47	30	.38		

The impact of the flipped classroom approach on secondary school students' perceptions of student-student interaction was evaluated using a paired sample t-test. The pre-test mean score (M = 2.37, SD = 0.47) was significantly lower than the post-test mean score (M = 4.47, SD = 0.38), as shown in Table 2. Pre- and post-test scores differed statistically significantly, according to the analysis (t(29) = -16.99, p <.001). These results show that student-student interaction was significantly improved by the flipped classroom model. In particular, compared to the traditional classroom setting, students reported significantly higher levels of peer collaboration, discussion, and cooperative learning activities following the adoption of the flipped classroom.

Table 3

Students' Perceptions of Flipped Classroom Effectiveness by Investigating its Impact on Student-Content Interaction in Classroom Among Secondary Grader Students (Pre vs Post Comparison)

Comparison test	Mean	Students	Standard Deviation	t-value	p-value
Pre-Value	2.41	30	.44	-17.73	.000
Post- Value	4.43	30	.40		

The impact of the flipped classroom approach on secondary school students' perceptions of student-content interaction was assessed using a paired sample t-test. The pre-test mean score (M = 2.41, SD = 0.44) was significantly lower than the post-test mean score (M = 4.43, SD = 0.40), as indicated in

Table 3. The findings showed that the student–content interaction had improved statistically significantly ($t(29) = -17.73$, $p < .001$). According to these results, the flipped classroom model significantly improved students' interaction with the course materials by allowing them to participate more actively in the material through in-class application exercises, digital resources, and pre-class video lectures. Students thought the flipped approach offered more chances to engage with and successfully apply the material than the traditional setting did.

Table 4

Students' Perceptions of Flipped Classroom Effectiveness by Investigating its Impact on Student-Learning Environment Interaction in Classroom Among Secondary Grader Students (Pre vs Post Comparison)

Comparison test	Mean	Students	Standard Deviation	t-value	p-value
Pre-Value	2.40	30	.44	-18.56	.000
Post- Value	4.34	30	.37		

The effect of the flipped classroom approach on secondary school students' perceptions of the interaction between the learning environment and the students was investigated using a paired sample t-test. The pre-test mean score ($M = 2.40$, $SD = 0.44$) was significantly lower than the post-test mean score ($M = 4.34$, $SD = 0.37$), as shown in Table 4. The results of the statistical analysis showed that the two scores differed significantly ($t(29) = -18.56$, $p < .001$). These findings show that students' interactions with their classroom environment were greatly improved by the flipped classroom model. In particular, compared to the traditional classroom setting, students felt that the flipped approach offered a more encouraging, resource-rich, and stimulating learning environment that enabled them to utilize technology tools, collaborative spaces, and instructional resources more effectively.

Table 5

Comparative Perception of Students About Effectiveness of Flipped Model Learning Regarding Learning Outcomes Among Secondary Grader Students (Pre vs Post Comparison)

Comparison test	Mean	Students	Standard Deviation	t-value	p-value
Pre-Value	2.28	30	.40	-21.31	.000
Post- Value	4.49	30	.35		

The impact of the flipped classroom model on secondary school students' perceptions of learning outcomes was evaluated using a paired sample t-test. The pre-test mean score ($M = 2.28$, $SD = 0.40$) was substantially lower than the post-test mean score ($M = 4.49$, $SD = 0.35$), as shown in Table 5. The findings showed that the two scores differed in a highly significant way ($t(29) = -21.31$, $p < .001$). These results imply that students' perceptions of their learning outcomes were significantly improved by the flipped classroom model. When compared to the traditional instructional model, students specifically reported improved critical thinking, increased comprehension of the subject matter, and improved academic performance following the adoption of the flipped approach.

Table 6

Comparative Perception of Students About Overall Effectiveness of Flipped Model Learning Regarding Classroom Interaction and Learning Outcomes Among Secondary Grader Students (Pre vs Post Comparison)

Comparison test	Mean	Students	Standard Deviation	t-value	p-value
Pre-Value	2.36	30	.39	-21.04	.000
Post- Value	4.44	30	.31		

Students' overall opinions of the flipped classroom model's efficacy in relation to classroom interaction and secondary education learning outcomes were assessed using a paired sample t-test. The pre-test mean score (M = 2.36, SD = 0.39) was significantly lower than the post-test mean score (M = 4.44, SD = 0.31), as indicated in Table 6. The findings showed that the two scores differed statistically significantly ($t(29) = -21.04$, $p < .001$). According to these results, the flipped classroom model was generally thought to be very successful, producing noticeable gains in learning outcomes as well as classroom interaction (teacher-student, student-student, student-content, and learning environment). When compared to traditional classroom instruction, students strongly agreed that the flipped approach offered a more dynamic, interesting, and effective learning environment.

Conclusions

1. Teacher-student interaction was not substantially impacted by the flipped classroom model. Prior to and following the intervention, students felt almost the same amount of direction and assistance. This suggests that flipping the classroom might not improve relationships or communication between students and teachers on its own without intentional planning for individualized teacher engagement.
2. Following their experience with flipped learning, students reported a significant improvement in peer interaction. The model encouraged students to collaborate more successfully by freeing up class time for group discussions, problem-solving, and cooperative activities. This implies that, in comparison to traditional instruction, the flipped classroom significantly improves peer communication, cooperative learning, and group participation.
3. Because students used digital lectures, videos, and other resources prior to class, flipped learning greatly enhanced the interaction between students and the content. They arrived more prepared for in-class activities thanks to this strategy. Beyond rote memorization, the flipped model fosters active, autonomous, and meaningful learning, as evidenced by the students' reported deeper engagement with the material.
4. The flipped classroom setting was seen by the students as more vibrant, encouraging, and resource-rich. The overall environment promoted involvement and exploration through the use of technology and more interactive activities. These findings demonstrate how flipped learning enhances the learning environment by giving students access to a variety of resources and fostering an engaging classroom environment.
5. Students firmly believed that their learning outcomes were greatly enhanced by the flipped model. They reported increased critical thinking abilities, better problem-solving abilities, and a deeper comprehension of concepts. Compared to traditional lecture-driven instruction, the structured blend of pre-class preparation and in-class practice facilitated stronger academic growth, confirming the efficacy of flipped learning.
6. With a significant increase in post-test scores, flipped learning was generally seen favorably. Compared to conventional approaches, students thought it was a more dynamic, interesting, and effective method. The flipped classroom was found to be very successful in secondary education contexts by concurrently enhancing learning outcomes, environment, content interaction, and collaboration.

Discussion

The results are consistent with previous research that shows how the flipped classroom can promote peer cooperation, active engagement with the material, and enhanced learning outcomes (Bergmann & Sams, 2012; Lo & Hew, 2017). The increased class time devoted to peer discussion, group problem-solving, and collaborative learning is responsible for the notable increases in student-student interaction. The advantages of pre-class video lectures and digital resources, which promote self-paced exploration and deeper learning, are also reflected in better student–content interaction (Chen et al., 2018).

The improvement of the learning environment implies that flipped classrooms produce a more vibrant and resource-rich setting where technology and cooperative learning methods enhance the educational process as a whole. The notion that the flipped model changes the classroom culture from

one that is teacher-centered to one that is student-centered is supported by these findings.

Although the flipped model frees up time for more individualized teacher guidance, students may not have seen this as a significant shift, as evidenced by the lack of noticeable change in teacher-student interaction. This could be because traditional classrooms already had strong teacher-student relationships, or because the flipped approach redirected teachers' focus from one-on-one interactions to group activities.

Recommendations

✓ To improve direct teacher-student interaction, educators should plan more opportunities for tailored feedback, mentoring, and focused questioning during in-class activities.

✓ To support peer learning and maintain student-to-student interaction both within and outside of the classroom, the use of digital platforms (such as discussion boards, interactive apps, and online quizzes) should be increased.

✓ In order to give teachers the tools they need to facilitate group projects while still fostering meaningful teacher-student interaction in flipped classrooms, training programs ought to be held.

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