EXPLORING INITIAL STUDENT PERCEPTIONS OF INTERACTIVE TOOLS IN FLIPPED CLASSROOMS: A PRELIMINARY ANALYSIS IN REMOTE LEARNING CONTEXTS

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Abstract

This study aims to compare male and female students' perceptions of the flipped classroom model supported by interactive tools, Nearpod and Lumio, in learning. The research employed a descriptive qualitative method and was conducted in a Grade 11 class at a high school in South Tangerang City. Data was collected through questionnaires to measure students' responses to the flipped classroom model and their experiences using Nearpod and Lumio as complementary tools in flipped classroom learning. The flipped classroom provided students with the opportunity to experience remote learning during the "before class" phase by utilizing digital technology in the form of interactive tools. The results of the flipped classroom model revealed that male students tended to be more motivated and have more meaningful learning experiences compared to female students. Meanwhile, the results on the use of interactive tools, Nearpod and Lumio, in flipped classroom learning indicated that male students were more attracted to interactive tools in terms of their usefulness in learning. This is because male students found digital media beneficial when it provided competitive learning experiences through quizzes and games. In contrast, female students were more interested in interactive tools in terms of interface and usability, as well as motivation enhancement. Female students felt more motivated when digital media was easy to use and gave them opportunities for active participation in learning. Regarding continued use, male students recommended Lumio more, while female students preferred Nearpod for future learning. Based on these findings, it can be concluded that the use of interactive tools in the flipped classroom positively impacts the motivation and learning experiences of both male and female students.

Keywords: flipped classroom, interactive tools, remote learning

1 INTRODUCTION

In recent years, the flipped classroom model has attracted the attention of many researchers and educational practitioners as an innovative approach to improving student learning outcomes. With the increasing use of distance and blended learning, especially after the COVID-19 pandemic, the flipped classroom model has begun to be widely applied in secondary schools. This model reverses traditional teaching methods by delivering material outside the classroom

and utilizing class time for discussions, problem-solving, and interactive activities (O'Flaherty & Phillips, 2015). Several studies have shown that the flipped classroom can enhance students' understanding and learning outcomes, particularly in technology-based and blended learning environments that combine face-to-face and remote learning. The flipped classroom model has been proven to increase students' conceptual understanding by up to 70% compared to traditional teaching methods (Karaca & Ocak, 2017). Furthermore, other studies have revealed that the flipped classroom enhances student engagement and motivation due to the increased interaction between teachers and students (Lo et al., 2017). Students report the greatest improvement in more active learning environments where deeper student interaction occurs (Strelan et al., 2020).

In both online and classroom learning, the challenge often faced is maintaining student motivation and engagement. The use of interactive tools in learning has the potential to significantly enhance students' learning experiences in the context of the flipped classroom model (Aidoo et al., 2022). Ideal interactive tools for the flipped classroom model include Nearpod and Lumio.

Nearpod can increase student engagement through its features that support various interactive activities such as quizzes, polls, and instant assessments (Musa & Momani, 2022). As a technology-based platform, Nearpod can boost student motivation with its interactive features (Alawadhi & Thabet, 2023). In science learning, such as physics, Nearpod contributes to improving students' understanding of complex topics by providing more interactive material access and immediate feedback (Siswati et al., 2023). Lumio, with its collaborative capabilities, also strengthens interactive learning, although research on its application in secondary schools remains limited. The fact that this tool supports various interactive activities such as quizzes, polls, and instant assessments makes it ideal for the flipped classroom model.

The researcher is interested in studying the application of Nearpod and Lumio in the flipped classroom since these tools can address challenges in physics learning, particularly in increasing student motivation and understanding of difficult materials. Physics is often considered a challenging subject by students, especially when studied in the context of distance or blended learning (Mercado, 2021). Therefore, the application of interactive technology in the flipped classroom is expected to facilitate students' understanding of complex physics concepts.

The flipped classroom theory is based on the principle that independent learning outside the classroom allows students to be better prepared for discussions and classroom activities

(Akçayır & Akçayır, 2018). The integration of Nearpod and Lumio into this model provides an interactive dimension that can enhance student engagement and facilitate deeper understanding through various technological features. The use of interactive tools in blended learning can improve learning outcomes and strengthen students' experiences in understanding the material (Castro, 2019).

This study explores students' initial perceptions of the application of the flipped classroom supported by interactive tools, particularly in physics learning. The focus of the study is on secondary school students and their perceptions of the use of interactive tools in a distance learning context. Unlike Nearpod, the use of Lumio in the secondary school context is still limited in the literature, making this study offer new insights into its effectiveness in improving material understanding and student engagement, as well as strengthening interactive learning. This distinction makes this study different from previous research that has not extensively explored Lumio's potential at the secondary education level. This research is also expected to provide new insights into how the flipped classroom supported by interactive technology can influence students' motivation and learning outcomes, especially in understanding difficult physics materials.

2 METHODOLOGY

This study employs a **qualitative descriptive approach** to understand students' perceptions of the flipped classroom model assisted by interactive tools, Nearpod, and Lumio. The use of a qualitative descriptive method is intended to describe the phenomena that emerge in the research (Kozleski, 2017). The research was conducted in a high school located in South Tangerang. It involved one 11th-grade class that had participated in learning through the flipped classroom model assisted by Nearpod and Lumio. All students went through three stages of learning activities: before class, during class, and after class.

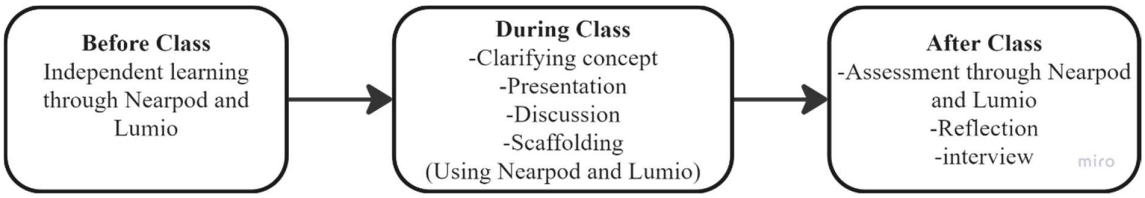


Figure 1. Learning Design of Flipping a Class Using Nearpod and Lumio (adapted from (Estes, 2014))).

Before class: Students independently studied the material through the Nearpod and Lumio platforms, which provided interactive features such as quizzes, polls, audio, video, and several educational games. In this phase, students were expected to prepare by understanding basic concepts before face-to-face learning in the classroom. During class: The learning process took place in the classroom using Nearpod and Lumio as interactive aids. At this stage, students actively participated in discussions, problem-solving, and collaborative activities, using Lumio features that enabled direct student involvement and teamwork. After class: Students reflected on the learning process that had taken place. The researcher distributed questionnaires to measure students' perceptions of the flipped classroom model, Nearpod, and Lumio. The data obtained from the questionnaires were analyzed descriptively to describe students' responses to learning with the flipped classroom model using interactive tools, Nearpod and Lumio. Three questionnaires were given to students: the questionnaire on student responses to learning with the flipped classroom model, the student response questionnaire on the utilization of Nearpod in learning through the flipped classroom model, and the student response questionnaire on the utilization of Lumio in learning through the flipped classroom model. Each questionnaire consists of several aspects as shown in the table below.

Table 1. Aspects in the three questionnaires of the study.

	Aspect 1	Aspect 2	Aspect 3	Aspect 4
Questionnaire on student responses to learning with the flipped classroom model	Motivation to Participate in Learning	Meaningful Experience		
Student response questionnaire on the utilization of Nearpod in learning through the flipped classroom model	Interface and Usability	Motivation Enhancement	Benefits for Learning	Extended Use
Student response questionnaire on the utilization of Lumio in learning through the flipped classroom model	Interface and Usability	Motivation Enhancement	Benefits for Learning	Extended Use

This study uses a Likert scale with four answer options, where each answer was assigned a score from 1 to 4 based on the categories of strongly disagree, disagree, agree, and strongly agree. Data from each questionnaire were calculated as percentages for each measured aspect and then classified according to the interpretation table as shown below.

Table 2. Criteria for interpreting scores on the questionnaire.

Score (%)	Criteria
0 – 20	Very weak
21 – 40	Weak
41 – 60	Adequate
61 – 80	Strong
81 – 100	Very strong

(The Likert Scale Modification according to (Riduwan, 2005))

3 FINDINGS AND DISCUSSION

3.1 Characteristics of the Participants

This study describes students' initial perceptions regarding implementing the flipped classroom model supported by interactive platforms, Nearpod and Lumio. The respondents were 11th-grade students from a high school in South Tangerang City, who participated in flipped classroom learning with the assistance of Nearpod and Lumio. After completing the lessons, students were asked to evaluate the effectiveness of the flipped classroom model and the use of Nearpod and Lumio in facilitating their learning experience.

The characteristics of the students can be observed in the table that displays the percentage distribution by gender and age. In this study, the analysis of student perceptions was conducted based on gender, with 56% male and 44% female students. This analysis provides insights into how each group perceives the implementation of the flipped classroom model and the interactive tools used.

Table 3. Characteristics of the participants.

	Category	Percentage
Gender	Male	56%
	Female	44%
Age	16 y.o.	75%
	17 y.o.	19%
	18 y.o.	6%

3.2 Initial Student Perceptions of the Flipped Classroom Model

The flipped classroom model has emerged as one of the most popular innovations in education in recent years, particularly in the digital learning era. This model allows students to be more active in the learning process because they can prepare themselves independently before in-class activities begin, which then allows for deeper interactions during face-to-face sessions (Zainuddin & Attaran, 2016). In the context of this research, it is crucial to understand students' initial perceptions of the flipped classroom model, particularly in terms of their motivation and learning experience. Student perceptions play a vital role in determining the success of this model's implementation because their initial perceptions often dictate their engagement and learning outcomes in flipped classroom-based instruction (Ruiz-Jiménez et al., 2024).

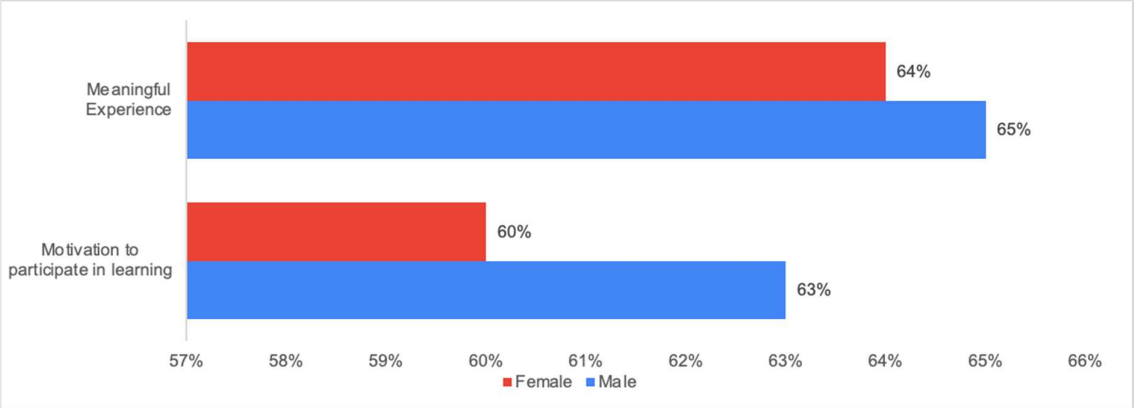


Figure 2. Comparison of Initial Perceptions between Male and Female Students Regarding the Flipped Classroom Model.

Table 4. Indicators on the Aspects of Perception toward the Flipped Classroom Model.

Aspects	Indicators
Meaningful Experience	Ease of understanding physics concepts
	Readiness for in-class learning
	Compatibility with learning styles
	Improvement in learning comprehension
	Increased participation in learning
Motivation to participate in learning	Enthusiasm in following the lessons
	Boost in motivation to learn
	Enjoyable classroom atmosphere
	Desire to continue learning with the flipped classroom model

Based on the analysis of students' initial perceptions of the flipped classroom model, it was found that male and female students experienced almost the same learning experience during the implementation of this model. In terms of experience, male students scored an average percentage of 65%, while female students scored 64%. According to the interpretation table, both percentages fall into the "strong" category, indicating that both male and female students had meaningful learning experiences using the flipped classroom model.

Students reported that using the flipped classroom model made it easier to understand physics concepts, which are often considered difficult to learn. This is because they were better prepared for classroom learning since the flipped classroom model allows them to study independently before participating in class activities. In this study, the interactive learning platforms Nearpod and Lumio were used to support independent study. With the support of these interactive tools, flipped classroom lessons in class, which focus more on discussion and collaboration, became more interactive. This is the main reason for the increased student participation and improved conceptual understanding, as quizzes and games were embedded in the lessons. The findings on student learning experiences in the flipped classroom model are supported by (O'Flaherty & Phillips, 2015) research, which showed that the flipped classroom model can enhance student engagement in the learning process, as students are better prepared for class activities after studying the material independently.

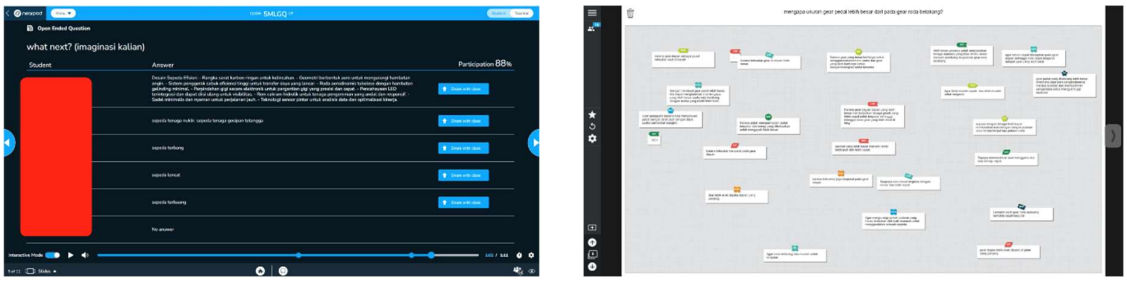
In terms of student motivation to engage in learning using the flipped classroom model, there were differences in perceptions between male and female students. Female students scored an

average percentage of 60%, categorized as "adequate," while male students scored an average percentage of 63%, categorized as "strong." This indicates that male students felt more motivated to engage in learning when using the flipped classroom model.

According to the indicators of students' perceptions of the flipped classroom model with the help of interactive tools, the data analysis revealed that male students had a higher average percentage in terms of enthusiasm for learning and increased learning motivation. Meanwhile, female students had a slightly higher average percentage in terms of classroom atmosphere and the desire to continue using the flipped classroom model. Studies show that using technology in the flipped classroom model can increase student engagement and learning outcomes, especially through interactive platforms (Günbatar, 2021). Male students are often more interested in the technical and competitive aspects of learning (Weber & Custer, 2005). This explains why male students higher learning motivation in the flipped classroom context have, as this model combines technology and independent learning. On the other hand, the more interactive and collaborative learning atmosphere in the flipped classroom is often more appreciated by female students. Other research indicates that female students tend to respond more positively to a supportive environment and social interaction-based learning (Steen-Utheim & Foldnes, 2018). Female students tend to respond positively to collaborative learning environments that foster group discussions and interactions (So & Brush, 2008). This is the reason why female students are more likely to continue using the flipped classroom model.

3.3 Students' Responses to the Use of Interactive Tools in the Flipped Classroom

To enrich students' learning experiences in the digital age, technology enhances, and measures student engagement is essential. Recent studies show that interactive learning tools like Nearpod and Lumio play a crucial role in creating a more dynamic and collaborative learning environment. These tools not only increase active student participation but also deepen the understanding of the concepts being taught (Zainuddin, Chu, et al., 2020). Moreover, the use of interactive technology in the flipped classroom has been found to facilitate more personalized learning, tailored to individual needs and learning styles (Aydin & Demirer, 2022). In this study, students' responses to the use of interactive tools are critical to analyze, as their perceptions will significantly impact the successful implementation of the flipped classroom model in future research.



(a) (b)

Figure 3. The discussion feature (a) in Nearpod dan (b) in Lumio.

In this research, teachers used Nearpod and Lumio during the early phase of the flipped classroom, before class, as independent learning tools for students. Links to Nearpod and Lumio were provided before the classroom session, where teachers prepared presentations embedded with interactive features such as collaborative boards, quizzes, games, videos, and virtual labs. Teachers were able to monitor which students engaged in self-study using Nearpod and Lumio. In the next phase, during class, students used these interactive tools for material reinforcement and group discussions. Features like collaborative boards, group worksheets, and team-based games on Nearpod and Lumio enabled active discussions and collaboration, both of which were trackable within these tools. In the final phase of the flipped classroom, after class, students performed comprehension tests using the assessment features available on Nearpod and Lumio.

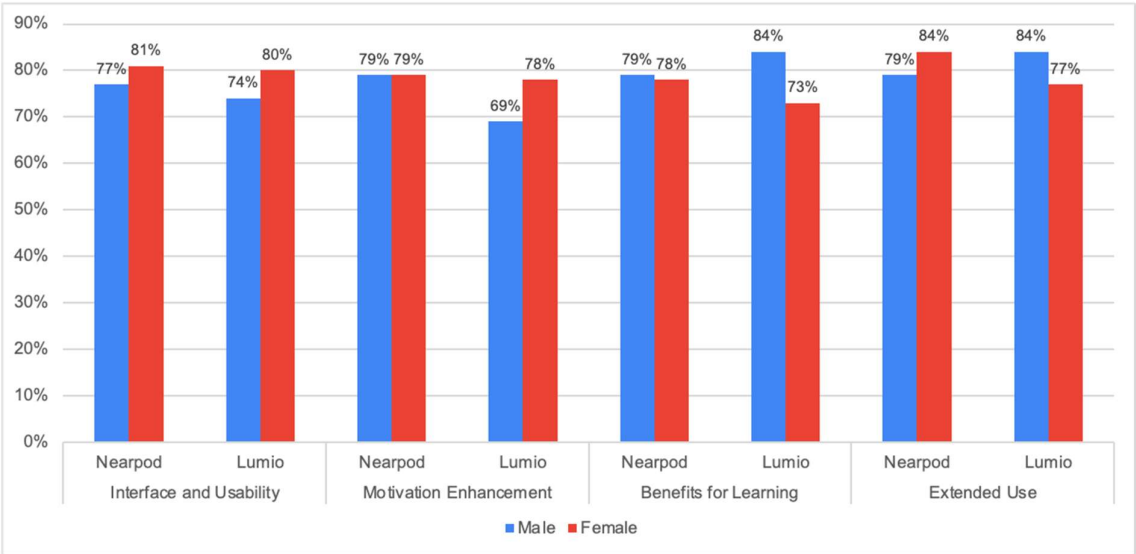


Figure 4. Comparison of Male and Female Students' Perceptions of Nearpod and Lumio in Flipped Classroom.

Table 5. Indicators of Perception Aspects Regarding the Use of Nearpod and Lumio in Flipped Classroom.

Aspects	Indicators
Interface and Usability	Engaging media
	User-friendly
	Features that support learning activities
Motivation Enhancement	Increases enthusiasm for learning physics
	Enhance motivation for learning physics
	Excitement when using interactive tools
Benefits for Learning	Helps in understanding physics concepts
	Increases participation in physics learning
	Help achieve better grades
Extended Use	Interactive tools are suitable for physics learning
	Supports the use of interactive tools not only in physics but also in other subjects
	Interactive tools can effectively support learning in the flipped classroom model

3.3.1 Students' Perception of Using Nearpod and Lumio: Interface and Usability

The analysis of questionnaire data regarding students' perceptions after participating in flipped classroom learning supported by Nearpod and Lumio revealed notable differences in male and female students' views on using these interactive tools. Based on Figure 4, in the interface and usability aspect, the average percentage of female students was higher than male students for both Nearpod and Lumio. The percentage of female and male students was higher for Nearpod than for Lumio. Nearpod was rated very strong by female students with a percentage of 81%, while male students gave an average percentage of 77%, falling in the strong category. Meanwhile, Lumio was rated as strong by both female and male students, with an average percentage of 80% from females and 74% from males.

From the indicators in Table 5 and the data analysis, it can be concluded that female students prefer learning supported by interactive media that is engaging, easy to use, and offers features that facilitate the learning process. This finding is supported by research from (Ashong & Commander, 2012), which shows that female students tend to respond more positively to technology that encourages social interaction and collaboration. Features that enable class

discussions and collaboration are key elements in increasing female students' engagement. (Alserri et al., 2018) also added that learning media offering interactive tools with a user-friendly design and visual appeal significantly increases student engagement, especially among female students.

3.3.2 Students' Perception of Using Nearpod and Lumio: Motivation Enhancement

Regarding motivation enhancement, the average percentage for both female and male students for Nearpod was 79%, affirming that this interactive tool strongly appeals to both gender groups. However, a significant difference emerged in the use of Lumio, with female students scoring 78%, compared to male students' 69%, although both values still fall into the strong category. According to the indicators in Table 5, increased motivation among students is reflected in greater enthusiasm for learning, heightened motivation, and excitement about participating in learning activities using interactive tools like Nearpod and Lumio. Based on the data analysis, it was found that male students were more enthusiastic about learning with interactive tools. Male students tend to be more enthusiastic when learning involves game elements due to the competitive and challenging aspects that motivate them to engage more deeply (Robertson, 2012). The gamification elements in Nearpod and Lumio make the learning experience more interesting and enjoyable for male students, thereby increasing their engagement in the learning process.

The average increase in motivation and enthusiasm in interactive learning using these tools was found to be higher among female students. Female students have a more positive perception of digital platforms that offer interactive and collaborative features, which in turn boosts their motivation and enthusiasm for learning (Horng et al., 2022). These elements provide female students with a greater sense of control over their learning process, significantly contributing to their motivation levels.

3.3.3 Students' Perception of Using Nearpod and Lumio: Benefits for Learning

In the next aspect, the benefit of learning, the results were interesting. Male students had a higher average percentage than female students for both Nearpod and Lumio. Figure 4 shows that for Nearpod, the average percentage between male and female students was nearly the same, with male students at 79% and female students at 78%. Nearpod, in terms of benefits for learning, falls into the strong category for both gender groups. However, there was a significant difference for Lumio, where male students rated it 84% (very strong), while female students

rated it 73% (strong). This suggests that male students prefer Lumio more, while female students prefer Nearpod in terms of learning benefits.

From Table 5 and the data analysis, it was found that male students liked Nearpod and Lumio because they could achieve high scores during quizzes, games, and assessments. This aligns with a study by (Khan et al., 2017), which notes that male students tend to favor digital platforms like Nearpod and Lumio because they offer opportunities to participate in quizzes and games, increasing their engagement. This motivates male students as they can see their scores immediately, providing a competitive and interactive learning experience. Female students, on the other hand, tend to prefer digital platforms that support collaboration and discussion, making them more active participants and contributing to their understanding (Feng et al., 2023). This is consistent with the data analysis, which found that female students gave higher ratings for the indicators of material comprehension and increased engagement in learning using Nearpod and Lumio. Male students focused more on the competitive and evaluative aspects of learning, such as success in quizzes and assessments, while female students emphasized ease of understanding and enhanced participation (Aguillon et al., 2020).

3.3.4 Students' Perception of Using Nearpod and Lumio: Extended Use

The final aspect examined was the continued use of Nearpod and Lumio. This aspect looked at students' perceptions of their desire to continue using interactive tools in future learning. Male and female students had different perceptions. Male students were more inclined to continue using Lumio, while female students preferred Nearpod. For Nearpod, the average percentage for male students was 79% (strong), while female students rated it 84% (very strong). For Lumio, female students gave a higher average percentage of 84% (very strong) compared to male students, who rated it 77% (strong). According to the indicators for continued use in Table 5 and the data analysis, male students were more likely to recommend interactive tools for use in other subjects, not just physics. Male students appreciated the variety in applying technology across different subjects, which provided a more flexible and contextual learning experience (San Jose et al., 2023). Female students, however, believed that interactive tools were best suited for physics learning and were appropriate as a supporting medium for the flipped classroom model. This is in line with a study by (Lane et al., 2022) which shows that female students prefer using interactive tools, particularly in concept-oriented subjects like physics. They found that interactive platforms help clarify difficult concepts, supported by features like virtual labs such as PhET Colorado.

Digital interactive tools support the flipped classroom because students can access material at home via digital media, while class time is used for more collaborative and problem-solving learning activities. Interactive tools enhance student engagement by providing immediate feedback and features such as quizzes and discussions that help reinforce understanding of concepts (Zainuddin, Shujahat, et al., 2020).

4 CONCLUSION

This study provides an overview of student perceptions regarding the flipped classroom model using interactive tools, Nearpod and Lumio, based on gender groups—female and male students. The data on these perceptions were obtained from three questionnaires: a questionnaire on perceptions of the flipped classroom model, a questionnaire on perceptions of the use of Nearpod, and a questionnaire on perceptions of the use of Lumio in learning. Based on data analysis supported by previous studies, it can be concluded that the implementation of the flipped classroom with the use of interactive tools, Nearpod and Lumio, positively contributes to student motivation and learning experiences, especially at the secondary education level. Furthermore, male students tend to be more motivated, and experience more meaningful learning compared to female students when learning with the flipped classroom model. The analysis of data related to perceptions of Nearpod and Lumio, supported by prior studies, revealed differences in perceptions between male and female students regarding these tools. Male students had a higher average percentage in terms of the usefulness of the tools in learning, which is linked to features like quizzes and games that provide a competitive and interactive learning experience. Additionally, male students are more inclined to prefer and recommend continued learning using Lumio, while female students are more likely to recommend Nearpod for further learning. Female students favored Nearpod and Lumio when viewed from the aspects of interface and usability as well as the aspect of increased motivation. This is because female students prefer digital media that are interactive and user-friendly. The features provided in Nearpod and Lumio, which support class discussions and collaboration, are key elements in increasing the learning motivation of female students.

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