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Students' Engagement with Online Quiz-Based Flipped Classroom: The role of Gender

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Abstract

The flipped classroom (FC) model is a modern instructional strategy where pre-class resources are provided for students to access, followed by a more active approach to learning in the class session. Students often fail to engage with the pre-class resources due to insufficient engagement and support techniques, or they do so only shortly before class, adversely affecting in-class learning activities. To address these challenges, we integrated online quizzes into pre-class recorded videos and incorporated cooperative learning theory into in-class sessions to encourage students learning engagement. An experimental study was conducted, with 151 participants randomly assigned to either an experimental group or a control group. The experimental group (n = 78) utilized the online quiz-based flipped classroom (OQFC) model, while the control group (n = 73) followed the conventional flipped classroom (CFC) model. The 8-week experiment revealed that the OQFC model significantly increased students' behavioural, agentic, and emotional engagement compared to the CFC model. However, there was no significant difference in students' cognitive engagement between the OQFC and CFC models, nor significant effect of gender on students' engagement. Educators should consider adopting the OQFC model to improve students' engagement and learning experiences.

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Practitioner Notes

1. The process of integrating online quizzes into pre-class videos can improve students' behavioural and emotional engagement in flipped classrooms.
2. Students' collaboration and agentic engagement can be enhanced with cooperative learning strategies during in-class activities.
3. The role of gender in students' engagement in online quiz-based flipped classrooms is not evident.
4. Pre-class tasks and guided group activities could be considered in low-engagement settings.
5. Active learning (e.g., quizzes and cooperative learning theory) can effectively improve conventional flipped classroom.

Keywords

Flipped classroom, quiz, engagement, gender, student.

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Introduction

Prior knowledge is one of the elements influencing students' learning engagement in the classroom. Scholars have emphasized the importance of having prior knowledge before class and using student-centred learning during learning activities (Almodaires et al., 2018; Sofroniou, 2020). Of all the teaching and learning strategies, the flipped classroom model is considered the most effective approach that enables students to have prior knowledge before class and provides student-to-teacher and student-to-student interaction during the in-class learning process (Abedi & Keshmirshekan, 2019). Samaila, et al. (2024) reported that the flipped classroom model enables students to have exposure to learning content through lecture materials either in the form of video, audio or print materials prior to class, so that during class, students are able to discuss what they have learned before the class. The model also enables instructors to take individual student's needs into cognizant, and encourages active learning and cooperative learning (Samaila et al., 2021a).

The flipped classroom model has two major activities: technology-assisted pre-class personal interaction with learning content and interactive learning during in-class activities (Merlin-Knoblich et al., 2019). These activities enable students to access the learning materials before the class and then spend more time in the class extending and deepening their knowledge and understanding of the learning materials (Masood et al., 2022). Pre-class learning activities are usually provided via an online learning system to allow students to engage in self-learning voluntarily before class. In-class interactive activities can take a variety of forms. Cheng et al. (2022) systematically reviewed 100 highly cited articles and found that the percentage of learning strategies used by teachers in flipped learning during lessons varied. 47% of the teachers used discussions, 19% employed group projects, 18% practising or doing exercises, 7% involved problem-based learning activities, 4% incorporated gamified activities, 1% used peer assessment and 0% co-opted online discussion.

The flipped classroom model uses a range of approaches including traditional flipped classrooms, collaborative group-based models, debate-driven and discussion-focused approaches, and the flipped teacher method (Samaila & Al-Samarraie, 2023). Each model uniquely leverages pre-class materials and in-class activities to foster student engagement, understanding, and learning outcomes. However, there are a number of challenges affecting the efficacy of the flipped classroom model. For example, students' failure to watch instructional videos before the class; students may not schedule time to watch the videos owing to the lack of guidance and support (Samaila et al., 2021a). Consequently, students' engagement and learning can be reduced in the following in-class activities. Moreover, the lack of theoretical support and undefined teaching strategies during in-class learning activities are part of the limitations of the conventional flipped classroom model (Bredow et al., 2021). Certain initiatives, such as watch-summary-question, annotation-summary-question, and gamification, had been previously integrated into the flipped classroom model to improve its quality (Hsia et al., 2019; Lin et al., 2019; Zou, 2020). Yet, there is need to embed effective strategies such as online quiz and cooperative learning in order to improve the efficiency and effectiveness of the flipped classroom model.

This study proposes the use of an online quiz-based flipped classroom (OQFC) model. The motivation behind the development of OQFC model is supported by the current needs highlighted

in the literature for an effective flipped classroom approach which is capable of improving students' engagement (including behavioural, cognitive, emotional, and agentic) both before and during class (Huang & Hong, 2016; Wen et al., 2016). Agentic engagement refers to students' significant and constructive contributions during the knowledge construction (Reeve & Jang, 2022). It is an important component that has recently received a considerable amount of attention. The higher the students' agentic engagement, the higher the learning participation, motivation, and outcomes (Subramaniam & Muniandy, 2019).

The OQFC model aligns with the concepts of cooperative learning theory, which encourages the student to take a substantial role in their learning responsibility. Accordingly, understanding the actual effect of gender allows for the development of a better learning approach. "An overview of research published in the previous years draw to the conclusion that females are at a disadvantage relative to men when learning about computers or learning other material with the aid of computer-assisted software" (Cooper, 2006, p. 320). On the other hand, female students are perceived to have better performance and engagement levels in computer-related courses than their male counterparts (Gebhardt et al., 2019). Based on these findings, this paper reports on an experimental study to determine the role of gender on students' engagement (e.g., behavioural, agentic, cognitive, and emotional) in the OQFC model. Findings from this study is sought to help flipped educators create an engaging pre-class of the flipped classroom model and provide clear learning steps during in-class sessions of the flipped classroom model. This study can also add value to the literature, as most previous studies ignored the impact of gender in flipped classroom studies.

Literature

In recent years, information technology has become a valuable part of the education process. This led to the educational paradigm shift from traditional teaching methods to technology-based methods and student-centred learning. Technology-based methods have provided students with multiple learning strategies (Davies et al., 2013). Among the various technology-based methods, "flipped learning" is regarded as a prospective learning method that engages students in applying their learning knowledge and conducting higher-order thinking rather than receiving direct teaching instruction (Amstelveen, 2019).

In 2014, the Flipped Learning Network identified four pillars of effective flipped learning as 1) Flexible environment, 2) Learning culture, 3) Intentional content, and 4) Professional educator. Flipped instructors should create a flexible learning space in which students can select where and when to study. Educators should have a class setting that is suitable for either individual or group study. The timeline needs to be feasible for the students, as they will be learning at their own pace and class time should be designed based on a student-centred approach (Sams et al., 2014). In addition, a flipped learning environment is deemed to have been successful when it has shifted the instruction to student-centred learning, where out-of-class time is being utilized for understanding basic concepts and in-class time is dedicated to in-depth practical and knowledge construction. As such, students are actively involved in the learning process (Sams et al., 2014). In addition, a teacher in a flipped learning environment should be able to respond to students' requirements and has knowledge and skills on how to present new information and concepts. At this juncture, flipped learning educators are to determine what they need to teach and what

students should manage on their own. A flipped educator should use intentional content to maximize class time in order to adopt a learner-centred approach and active learning strategies, dependent on the subject matter and grade level (Sams et al., 2014). The role of professional educators is highly important and more demanding in flipped classroom than in a traditional one. During class time, educators need to carefully monitor students' learning activities, guide students toward achieving stated objectives, provide constructive feedback, and assess their work. The educators need to have extensive knowledge to support the flexible environment and clarify any issues that may come up during flipped learning activities (Sams et al., 2014). It is expected that students in flipped classrooms can engage in deeper discussions, solve problems, and take control of their own learning pace (Lundin et al., 2018).

The outbreak of the COVID-19 pandemic has made a significant impact on education, and has led to increasing emphasis being placed on innovative and technological pedagogies such as blended learning and flipped classroom (Divjak et al., 2024; Lo, 2023). The FC model is suitable for online and blended learning which has been increasingly adopted by educators, especially during COVID-19 pandemic (Linling, 2023). Literature shows an increase in implementation of the FC model, particularly during the pandemic because it provides opportunities for interaction (Divjak et al., 2022). Flipped learning, when done well can improve the classroom experience, provide room for active learning, encourage student-teacher interaction and peer interaction, and engagement with learning materials. Moreover, it provides opportunities for educators to foster critical and independent thought in their students (Samaila, Tsong, et al., 2024). Other advantages of the FC model include flexibility of students' learning time and enhancing students' twenty-first century skills.

The FC model also has disadvantages. For example, teachers need extra time to invest in the preparation and implementation of the FC model as well as the preparation, participation, and engagement of students (Divjak et al., 2024). A systematic literature review reported that, to adopt and implement the flipped classroom model successfully, students must access and engage with the learning materials prior to class (Zainuddin et al., 2019). Likewise, a critical review of the flipped classroom model reported that students' engagement and commitment to watch pre-class videos and be involved in in-class learning activities are strong factors indicating the success of the flipped learning model (Akçayır & Akçayır, 2018; Gillette et al., 2018). It is also worth mentioning that much needs to be done to improve students' engagement in and out of the class so as to get the full benefit of the flipped classroom model. This study embedded online quizzes and implemented cooperative learning theory into the flipped classroom model as tools to enhance students' engagement.

Online Quiz Learning Strategy and Flipped Classroom Model

In the FC environment, videos are often provided through learning management systems as an effective way of introducing new learning materials, but can also contain pauses with questions used for formative assessment (Divjak et al., 2024). Technology can be used to facilitate quick and simple assessment of students' understanding and engagement via online quizzes taken before or during classes. The online quiz learning strategy was developed and structured to help students' self-regulation and improve their engagement, especially during out-of-class activities. In this study, five quiz questions were given to the students to answer whilst watching the pre-

class instructional videos. The use of an online quiz not only helped the students to test their knowledge but also assisted the teachers in understanding the level of their students' preparedness. Quizzes allow students to engage with important lecture materials in advance of attending class, while opportunities for deep engagement, interaction, discussion, and problem-solving are afforded during class time (O'Flaherty & Phillips, 2015). Earlier studies have indicated the impact of an online quiz learning strategy on students' engagement. For instance, it was reported that an online quiz improved students' engagement, increased peer learning opportunities and provided greater insights into students' understanding of new learning materials (Daniel & Broida, 2004; Hasan & Makary, 2021). When the quiz took place before the class, the students perceived themselves as being more prepared for class discussion and more prepared for class assessment. This increase in self-perception may inspire learners to partake in class more by paying attention, contributing to a discussion, and asking more questions (behavioural engagement) (Kinsella et al., 2017). Adopting online quizzes as part of the pre-class learning materials in a course leads to an increase in the amount of time students spend reading the learning materials while at home.

Many reports revealed that online quiz learning strategy played a vital role in improving students' learning motivation and engagement, particularly in an online learning environment (Jones et al., 2021; Kilickaya, 2017). However, more information is needed about the effect of out-of-class online quiz on students' engagement in a flipped learning environment.

Cooperative Learning Theory in Flipped Classroom Model

A scoping review conducted by Li et al. (2023) reported approximately 65% of the 435 FC articles retrieved did not connect their research to theory or a theoretical framework. Of the remaining 35%, it was difficult to determine which theoretical framework or methodology was used during the pre-class, in-class, and post-class learning activities. This underscores the need to explore the impact of other active learning theories in FC research. In this study, a cooperative learning theory was used to support both teacher and student, particularly during in-class learning activities.

Cooperative learning usually involves two or more students working in a group to achieve a common goal and the theory suggest this will lead to an increase in their learning and the learning of others (Gillies, 2016). In the cooperative learning environment, there is a change from "teacher-centred" to "student-centred"; teachers are facilitating the learning, while students are constructing the knowledge (Huang & Hong, 2016). Cooperative learning is a teaching strategy where students are grouped with different abilities to learn together, solve problems, and share their experiences (Johnson et al., 2000). Although cooperative learning theory improves students' learning skills and assists teachers in dividing students into different groups, few scholars adopted the theory in the fields of FC (Jian, 2019). Compared to traditional learning, or individual learning, cooperative learning promote students' academic engagement and communication skills (Psycharis, 2016).

Despite the advantages of the cooperative learning theory, few studies explored its application in the field of the flipped classroom (Foldnes, 2016; Manoj et al., 2018). However, given the reported benefits and the need to structure in-class activities with the aid of a learning theory. we employed cooperative learning theory to enhance the in-class activities. This allows the teacher to group the students based on homogeneity and heterogeneity, which strengthens the in-class activities

and increases students' collaboration and engagement. For example, in this study, a flipped ICT classroom was used where the stronger, average, and weaker students were put in mixed ability groups to carry out an assignment (formatting a Word document); the students worked together, and the weaker ones were observed learning from the stronger students. Cooperative learning theory is a theory that can be used to improve the efficacy of the flipped classroom model. Therefore, this study employs the cooperative learning theory to improve in-class learning activities and students' engagement.

Application of Flipped Classroom on Students' Engagement

Engagement refers to the extent to which the students participate in the learning process (Cakir, 2013). In reality, students' engagement is a complex construct and very difficult to define. However, it can be explained as learners' involvement with activities and conditions likely to generate high-quality learning (Subramaniam & Muniandy, 2019). Students are said to be engaged if they are connected to what is going on in their classes. Engagement is a multidimensional construct, which is divided into four constructs, namely, behavioural, cognitive, emotional, and agentic engagement.

Behavioural engagement refers to how students maintain active participation in a learning activity and make solid attempts to complete their academic tasks (Subramaniam & Muniandy, 2019). In other words, behavioural engagement refers to the learners' positive conduct in the classroom, such as attending class, following the rules and regulations of the class, and not making trouble in the class. Behavioural engagement is particularly important where students are independently studying away from class. Students' behavioural engagement has been widely researched, but less so in the field of the flipped classroom model.

Agentic engagement refers to the constructive contributions of the students during the teaching and learning process (Reeve, 2013). It is what the students do or say to create a more enthusiastic and supportive learning environment for themselves. Agentic engagement is a proactive, purposive, and reciprocal type of engagement that is integral to stimulating learner academic achievement (Montenegro, 2017). This construct is relatively under-researched, with only a few scholars understanding the importance of students' contributions in the class (Reeve & Jang, 2022), and as such, a flexible teaching method where students would be allowed to participate fully is needed.

Cognitive engagement is the extent to which learners are concerned and curious about how they are learning (Appleton et al., 2006). Cognitive achievement can be seen as an investment of energy and time in learning. It is an important factor to be considered in the teaching and learning process. Student needs to be cognitively engaged, particularly in an FL environment where learners watch the video lectures and complete learning activities before class (Jamaludin & Siti Zuraidah, 2014). All four types of engagement do assists the student to engage in and out of the class and have a deeper understanding of the learning materials.

Emotional engagement includes pleasure, joy, curiosity, and happiness that influence students' proactive involvement in the learning process (Subramaniam & Muniandy, 2019). This type of engagement is categorized by how learners feel about their learning. Teachers notice emotional engagement in the way students partake in classroom discussions, what information they seek,

and how they express their opinions in class. Creating student-centred learning, such as flipped learning, can increase emotional engagement. A new concept “social engagement” which refers to students’ positive interaction with teachers, the learning environment, and peers has recently been discussed and has been found to play an important role in student learning (Bond & Bergdahl, 2022).

Student engagement is a well-researched field. However, few studies measure engagement levels in terms of these four constructs (behavioural, agentic, cognitive, and emotional). The authors of this study observed that ICT students in some state universities have less engagement during the lecture of Microsoft Word topics. Students often fail to respond to questions which need them to apply their knowledge and skills to the real-world situation. Hence, the flipped classroom approach is employed to minimize the problem. In a flipped learning environment, students lead the discussion, have ample time for practical activities, and talk with each other about their learning. This might have a direct effect on students’ engagement.

Previous research on the use of the flipped classroom model showed that students who used the flipped classroom model had higher engagement than those who taught using the traditional method (Elmaadaway, 2018; Talan & Gulsecen, 2019). Bond (2020) found that the flipped classroom model increases students’ engagement, motivation, achievement, and participation (Bond, 2020). However, further investigation of the ways in which flipped learning affects both student and teacher engagement and how it could help educators make more informed decisions when implementing the approach is required, alongside a deeper understanding of student engagement in the flipped classroom environment itself. Hence, the following hypothesis was formulated.

$H_0$1: There is no significant effect of OQFC on students’ behavioural engagement.
$H_0$2: There is no significant effect of OQFC on students’ agentic engagement.
$H_0$3: There is no significant effect of OQFC on students’ cognitive engagement.
$H_0$4: There is no significant effect of OQFC on students’ emotional engagement.

Effect of Gender on Students’ Engagement in Flipped Classroom

Including gender balance and gender perspectives helps to enhance the scientific quality and social relevance of research. Moreover, the inclusion of gender expands the scope of the study and provides suggestions that benefit all students. It can help faculty and flipped educators understand how male and female students respond to the flipped classroom model (Alhasani et al., 2017). Several studies have investigated the effect of gender in flipped classroom with most focus on the achievement scores. For example, Kadry and Hami (2014) investigated the effect of gender in a mathematics flipped classroom. The result showed that females had higher mean scores than males, but no statistical differences were found. Likewise, a similar study was conducted to examine the effect of gender in a physics flipped classroom where female students demonstrated a greater benefit from the flipped classroom on academic performance than male students (Gross et al., 2015). Previous studies also showed that students might experience varied emotions toward flipped learning depending on gender (Jeong et al., 2016). A study by Yan et al. (2018) reported that female students in the flipped classroom achieved better preparation results after watching the video before class. The present literature suggests that more research is

needed to understand the effect of gender on students' engagement in a flipped learning environment. Hence, the following hypotheses were formulated:

$H_0$5: There is no significant difference between the behavioural engagement of male and female students when they are exposed to OQFC.

$H_0$6: There is no significant difference between the agentic engagement of male and female students when they are exposed to OQFC.

$H_0$7: There is no significant difference between the cognitive engagement of male and female students when they are exposed to OQFC.

$H_0$8: There is no significant difference between the emotional engagement of male and female students when they are exposed to OQFC.

Research Method

Ethical approval and permission for this study were attained from the selected university and department committee (469/2023). Approval to conduct the study with undergraduate students was obtained from the university management and the head of the department. This study employed a true experimental design. The flipped learning instructions have been applied in a third-year undergraduate ICT course. This study was conducted at two State Universities to adequately control for extraneous variables. Students from the University A and University B who registered for a general ICT course were used in the study. Experimental treatment was conducted for eight weeks. After the experiment, questionnaires were administered to all participants to measure students' level of engagement.. The students were randomly divided into two groups – one taught with the OQFC model (78 students), and the other class taught with the conventional flipped classroom (CFC) model (73 students). In the developed OQFC model, the instructor sent the learning materials to students and followed up with an online quiz before the next class. The in-class time was dedicated to briefly reviewing the concepts explained in the video, with a special emphasis on the errors detected in the online quiz. The remaining in-class time was devoted to learning activities using cooperative learning and student-centred learning. In the CFC model, the teacher sent the learning materials to students before the next class. In-class time involved the instructor teaching for 30 minutes, and students used the remaining time for group discussion and problem solving.

The Online Quiz-Based Flipped Classroom (OQFC) Group

In the OQFC group, each lecture lasted for 2 hours, including the pre-class and in-class time. The instructor sent four online video lectures to students via school learning management system and each video took 7-8 minutes. For example, the first video discussed the concept and application of ICT. The instructor also created and embedded quiz questions into the video lectures to ensure that students watch and understand the content. Examples of quiz questions include "Which of the following is not a web browser?" and "What does URL stand for?" The video lectures were accessible via the class learning management system. During the in-class time, the instructor used the first 15 minutes to explain the concept and application of ICT briefly, followed by corrections and clarifications on errors detected in the online quiz. Students then spent 1 hour on group discussion and problem-solving. Cooperative learning theory was applied to divide students into different groups, each consisting of stronger, average, and weaker students. In these groups, students interacted and learned from each other. Meanwhile, the instructor was present in the

class to guide and facilitate the learning activities. Finally, the instructor allocated 15 minutes for summative evaluation.

The Conventional Flipped Classroom (CFC) Group

In the conventional flipped classroom (CFC) group, the instructor uploaded the learning materials onto the learning management system, where students could download and access them. The learning materials consisted of four segments of video lectures and each video lasted for 7-8 minutes. The learning materials for both classes (OQFC model and CFC model) were the same, but without the quizzes in the CFC group. During the in-class time, both the instructor and students were active as they were for the OQFC group. The instructor spent 15 minutes delivering the lecture and answering questions from the students. Students also used 1 hour for group discussion and problem solving. Unlike in the OQFC model, where students were divided based on cooperative learning theory's rules, in the CFC model, students were able to choose their partners. In the end, the summative evaluation was conducted within 15 minutes.

Participants

The participants were third-year undergraduates (N=151) who registered for an Information and Communication Technology (ICT) course at two state universities. The population of the study was 250 students from which a total of 151 sample size was drawn. The participants were selected for this study using simple random sampling. This method ensures that every individual in the population has an equal chance of being chosen. Moreover, a random number generator (RNG) which produces a sequence of numbers was used to randomly distribute participates into experimental and control groups. None of the participants had a flipped classroom experience before taking part in this study. The demographic information of the participants is presented in Table 1.

Table 1

Demographic Information of the Participants

Variable	Code	Frequency	Percentage (%)
Group	Experimental Group	78	51.7
	Control Group	73	48.3
Gender	Male	94	62.3
	Female	57	37.7
Age	18-20	35	23.1
	21-23	30	19.8
	24-26	65	43.2
	27 and above	21	13.9
Total		151	100

As reported in Table 1, one hundred and fifty one (151) participants participated in the research. Seventy-eight (78) of the participants were in the experimental group, and seventy-three (73) participants were in the control group. 62.3% (f=94) and 37.7% (f=57) of the participants were male and female students, respectively. In terms of age, participants whose ages range from 24-26 have the highest participants, 43.2% (f=65), followed by 18-20 with 23.1% (f=35). Participants

whose ages range from 21-23 had the second lowest representative, 19.8% (f=30). Of the participants whose ages range from 27 and above, 13.9% (f=21) had the lowest representative.

Experimental procedure and learning activities

Figure 1 displays the experimental procedure. In the first week, students from both groups completed a questionnaire to assess their level of engagement before the intervention. From the 2nd to the 7th week, students in both groups logged into the school learning management system to access the same learning materials uploaded by the teachers and watched video lectures to gain the required knowledge before coming to class. The OQFC group answered quiz questions while watching the video lectures, whereas the CFC group only watched and learned from the video instructions. A total of two hours was allocated for pre-class and in-class learning activities for both the OQFC and CFC groups every week. The teacher applied cooperative learning theory to divide the OQFC students into mixed ability groups of four or five, while students in the CFC group formed their own groups. During the in-class activities, students in both groups engaged in discussions and problem-solving techniques. They asked questions, and teachers responded by answering, clarifying misconceptions, and providing immediate feedback. The same pattern of evaluation (that is question-and-answer sessions, presentations, and tests) was used for both groups. In the 8th week, all students were administered the questionnaire to measure the level of engagement after the intervention.

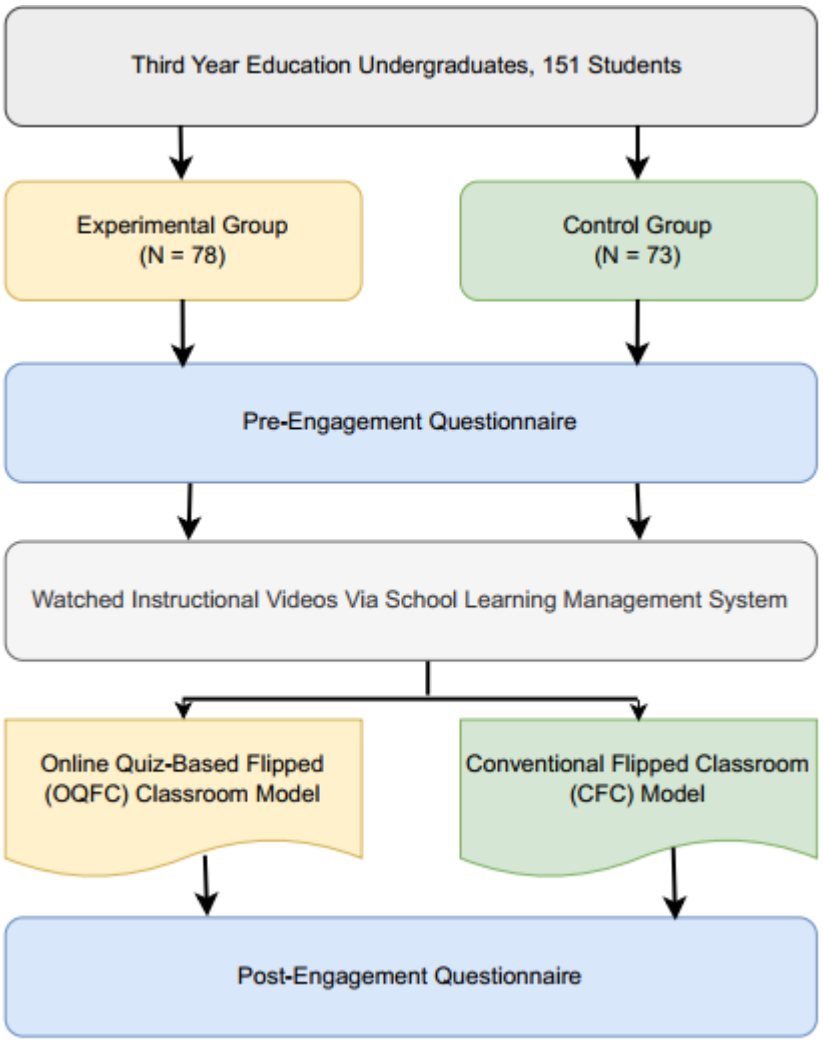

Figure 1

Experimental Procedure

Instrument

The student engagement questionnaire, whose validity and reliability analysis was examined by Subramaniam and Muniandy (2019), was adapted to measure the students' engagement levels. Students were asked to tick a column to indicate their readiness to participate in the research. By ticking the column, students agreed to voluntarily participate in the study. The questionnaire has a 5-point Likert-type scale with levels from 'strongly disagree' to 'strongly agree'. The questionnaire consisted of four sub-components, namely 'behavioural engagement', 'agentic engagement', 'cognitive engagement', and 'emotional engagement'. The validity of the modified questionnaire was ensured by contacting two experts. The inputs from the experts were acknowledged and led to the final version of the questionnaire. The general reliability of the questionnaire was 0.850. The reliability rates for the sub-components of the questionnaire were found as follows: 'behavioural engagement' (0.800), 'agentic engagement' (0.751), 'cognitive engagement' (0.821), and 'emotional engagement' (0.840). Sample items in this questionnaire

include: 1) when I'm in this ICT class, I listen very carefully. 2) I pay attention in this ICT class. 3) I try hard to do well in this ICT class. The IBM SPSS 24.0 was used to analyse the data. ANOVA was performed to determine the difference between the two groups. The statistical significance difference level was set at p = .05. Moreover, the Shapiro-Wilk test was used to check the normality of the data.

Results

Effect of OQFC on students' engagement

The analysis results of homogeneity of variance for behavioural engagement (p = .229), agentic engagement (p = .101), cognitive engagement (p = .109), and emotional engagement (p = .119) showed that the assumptions were not violated, which means that ANOVA can be conducted. The analysis results of ANOVA for behavioural, agentic, cognitive, and emotional engagement are reported in Table 2. There was a significant difference between the two groups: for behavioural engagement, $F(1, 147) = 26.466$, $p < .05$; for agentic engagement, $F(1, 147) = 10.659$, $p < .05$; and for emotional engagement, $F(1, 147) = 13.530$, $p < .05$. However, results showed that no significance difference exist in cognitive engagement $F(1, 147) = 1.470$, $p > .05$, between the two groups.

Table 2

ANOVA Results for Students' Engagement (Behavioural, Agentic, Cognitive, And Emotional)

DV	Group	*N*	F value	*p* value
Behavioural Engagement	OQFC Model	78	(1,147) = 26.466	.001
	CFC Model	73		
Agentic Engagement	OQFC Model	78	(1,147) = 10.659	.001
	CFC Model	73		
Cognitive Engagement	OQFC Model	78	(1,147) = 1.470	.227
	CFC Model	73		
Emotional Engagement	OQFC Model	78	(1,147) = 13.530	.001
	CFC Model	73		

For behavioural engagement, the adjusted mean and standard errors were 29.099 and 0.660 for the experimental group and 24.400 and 0.606 for the control group. For agentic engagement, the adjusted mean and standard errors were 23.614 and 0.561 for the experimental group and 21.128 and 0.515 for the control group. For the emotional engagement, the adjusted mean and standard errors were 20.013 and 0.538 for the experimental group and 17.329 and 0.493 for the control group. These values indicate consistently higher engagement scores across behavioural, agentic, and emotional dimensions for the OQFC model compared to the CFC model. In addition, the relatively small standard errors suggest that these mean estimates are stable and reliable across participants. See table 3 below:

Table 3

Results of Means and the Adjusted Means for the Engagement (Behavioural, Agentic, Cognitive, and Emotional)

DV	Group	*N*	Adjusted Mean	Std. error
Behavioural Engagement	OQFC Model	78	29.099	0.660
	CFC Model	73	24. 400	0.606
Agentic Engagement	OQFC Model	78	23.614	0.561
	CFC Model	73	21.128	0.515
Cognitive Engagement	OQFC Model	78	20.222	0.100
	CFC Model	73	20.121	0.111
Emotional Engagement	OQFC Model	78	20.013	0.538
	CFC Model	73	17.329	0.493

Effect of gender on students' engagement in OQFC

The analysis results indicated that there was no significant difference between the male and female for behavioural engagement, $F(1,76) = 5.257$, $p > .05$, for agentic engagement, $F(1,76) = .010$, $p > .05$, for cognitive engagement, $F(1,76) = .944$, $p > .05$, and for emotional engagement $F(1,76) = .229$, $p > .05$. See table 4

Table 4

Two-Way ANOVA Results for the Effect of Gender on Students' Engagement (Behavioural, Agentic, Cognitive, and Emotional)

DV	Group	Gender	*N*	F value	*p* value
Behavioural Engagement	OQFC Model	Male	57	(1,76) = 5.257	.094
		Female	21		
Agentic Engagement	OQFC Model	Male	57	(1,76) = .010	.922
		Female	21		
Cognitive Engagement	OQFC Model	Male	57	(1,76) = .944	.334
		Female	21		
Emotional Engagement	OQFC Model	Male	57	(1,76) = .229	.634
		Female	21		

For behavioural engagement; the adjusted mean and standard errors were 27.684 and 0.600 for the male and 30.333 and 0.988 for the female. For agentic engagement, the adjusted mean and standard errors were 23.561 and 0.559; for the male and 23.667 and 0.921; for the female. For

the cognitive engagement, the adjusted mean and standard errors were 23.368 and 0.578; for the male and 22.286 and 0.952 for the female. For emotional engagement, the adjusted mean and standard errors were 20.263 and 0.544; for the male and 19.762 and 0.896 for the female. Within the OQFC model, it can be said that females demonstrated marginally higher behavioural engagement than males, while scores for agentic, cognitive, and emotional engagement were largely equivalent across genders. In addition, the small standard errors indicate stable mean estimates and limited variability between groups. See Table 5.

Table 5

Results of Means and the Adjusted Means for the Gender

DV	Group	Gender	*N*	Adjusted Mean	Std. error
Behavioural Engagement	OQFC Model	Male	57	27.684	0.600
		Female	21	30.333	0.988
Agentic Engagement	OQFC Model	Male	57	23.561	0.559
		Female	21	23.667	0.921
Cognitive Engagement	OQFC Model	Male	57	23.368	0.578
		Female	21	22.286	0.952
Emotional Engagement	OQFC Model	Male	57	20.263	0.544
		Female	21	19.762	0.896

Discussion

This study was conducted to improve the CFC model by proposing the OQFC model. The proposed model aimed to enhance learners' engagement during pre-class and in-class activities. The findings of this study indicated that the OQFC model intervention significantly improved students' behavioural, agentic, and emotional engagement. Integrating quiz learning strategy and cooperative learning theory into the flipped classroom model proved helpful in increasing students' learning engagement and enhancing students' self-learning and interpersonal interaction. In other words, online quiz is an approach that can facilitate learning engagement, but its application does not include the promotion of students' cognitive engagement. Previous studies indicated that when an FC model was supported with extra activities, students become more committed and participated fully, leading to a higher level of engagement compared to those using a conventional flipped classroom (Samaila, Al-Samarraie, et al., 2024). Extended FC models such as Watch-summary-question based FC model, think-pair-share based FC model, and OQFC model are believed to have a more positive impact on students' learning engagement. This may be because they can guide students to have deeper thinking in the pre- class and in-class learning activities (Divjak et al., 2024; Li et al., 2023)

Due to highest improvement in behavioural engagement, the teacher observed an overwhelming student participation in the learning process. Students were found to listen carefully and pay more

attention during the learning activities. They were able to complete their activities and exercises before the next class. These findings agreed with Hasan and Makary (2021) that quiz strategy can raise the students' attention while learning.

An increase in agentic engagement was noted for students in the OQFC model compared to those in the CFC model. Due to enhancement in agentic engagement, students are likely to be able to speak up and show personal initiative proactively and reciprocally (Reschly & Christenson, 2022). Agentically engaged students have been found to take action before and during learning activities; they are able to make suggestions, offer input, and express preferences (Reeve et al., 2022). This in accordance with the previous study that the more students have a say within their learning environment, the more engagement and achievement are likely to increase; the more likely they are then to feedback positively into the learning environment (Bond et al., 2020)

Moreover, the OQFC model was found to have increased students' emotional engagement compared to the CFC model. It has been reported that integrating an online quiz into the FC model captured the attention of the students (Kinsella et al., 2017) and provides valuable possibilities for automated feedback, which can help students reflect on and direct their learning, (Divjak et al., 2024). Moreover, cooperative learning strategy during the in-class learning activities was found to play a significant role in giving an avenue for all the students to participate in the learning process. It allowed the students to chair the learning activities interact with and learn from each other. This finding is supported by Huang and Hong (2016) that activities such as student-centred learning, group learning, and group discussion improve students' engagement. A similar study reported that for students to be fully engaged in CFC, additional activities like "watch-summary-question" and "study-summary-quiz" need to be added (Masood et al., 2022).

However, the OQFC model was found to have no effect on students' cognitive engagement compared to CFC model. The findings showed that the online quiz and cooperative learning theory had no significant impact on students' cognitive engagement. This infers that both groups demonstrated comparable levels of cognitive engagement. Both groups (OQFC model and CFC model) used a student-centred learning approach in order to facilitate active learning and encourage students to take on their learning responsibilities. These might be the reasons for the insignificant difference in students' cognitive engagement. This finding supports previous studies that flipped learning instruction played a significant role in developing students' cognitive engagement (Hava, 2021; Jamaludin & Siti Zuraidah, 2014; Subramaniam & Muniandy, 2019). The insignificant difference was experienced because both groups used sophisticated learning strategies that included the use of technology. This means that students' cognitive engagement levels would be the same if both groups used a technology-based approach, as reported in the literature that technology is one of the factors influencing students' engagement (Bond & Bedenlier, 2019).

The researchers also assessed the role of gender in shaping students' engagement. The results showed no significant effect of gender on students' behavioural, agentic, cognitive, and emotional engagement. The finding of this study agrees with the result of Alhasani et al. (2017) that gender had no significant effect on students' behavioural engagement. Similarly, this finding is in line with the finding of Cakir (2013) that gender had no significant impact on students' engagement. The insignificant difference in students' behavioural engagement could be attributed to the fact that both male and female paid more attention and focused on the learning process. Meanwhile,

students' agentic engagement might have less to do with gender as it covers the ability of both male and female students to ask questions during the learning process. All of the students were open to cooperating and contributing during discussions or taking a managerial role to achieve the stated objectives. Furthermore, gender did not affect students' cognitive engagement. This implies that male and female students benefited equally from the treatment. All the demonstrated confidence in relating their previous experiences to solve practical tasks in the classroom. Irrespective of gender, students can construct and take responsibility for their learning activities. For emotional engagement, gender had no significant impact. This is due to the level of students' interest during the learning process. Both male and female students enjoyed the new method (OQFC model); their perceptions toward the OQFC model were positive, and their level of involvement in the learning process was identical.

Theoretical and Practical Implications

The theoretical implication of this study includes the inclusion of online quiz and cooperative learning theory to propose a new flipped learning named OQFC model. It was documented in the literature that students' level of commitment and engagement to succeed in the CFC model was below the average. However, an innovative flipped classroom approach, such as the OQFC model, is needed to improve students' engagement. The idea of embedding online quiz into the flipped classroom model deepened students' engagement in the flipped classroom model, particularly during the pre-class learning activities. By tradition, the students must be engaged before the class for them to fully participate in the in-class activities. Quiz strategy was found to be an effective tool for assisting students to be engaged and learn basic knowledge, especially during pre-class activities (Divjak et al., 2024).

On the other hand, the OQFC model was supported by the idea of cooperative learning theory. Integrating the theory into the flipped classroom model changes the entire structure of the model. Before, the flipped classroom model's in-class activities were characterized by unspecific activities; teachers allowed the students to use any method for group discussion and problem-solving. This is part of the challenges the flipped classroom model faces. In this regard, this study used cooperative learning theory to guide the in-class activities. The theory was found to guide the students during group discussions and students' interaction.

The reason for the significant positive effect of the OQFC model on students' engagement over the CFC model is because of the application of the online quiz and cooperative learning theory. These two ideas (online quiz and cooperative learning theory) were able to make students committed to their responsibilities and subsequently improved their overall engagement. The results of this study can serve as an indication that when the flipped classroom model is fully supported by active learning theories, especially during pre-class and in-class learning activities, both males and females would have the same identical performance.

The lack of students' commitment during pre-class is one big challenge affecting the smooth running of the flipped classroom model. The proposed OQFC model overcomes this challenge by technically motivating students to watch instructional video at the right time. Unstructured activities during in-class learning was another challenge affecting the efficacy of the flipped classroom model. To overcome this challenge, the idea of cooperative learning theory was employed. Advocates of FC contend that the success of the model is strongly related to its

foundations in active learning strategy (Li et al., 2023). This suggests that the conventional FC model can provide desired results when supported by active learning pedagogies such as online quizzes, cooperative learning, or gamifcation (Samaila, Al-Samarraie, et al., 2024). For instance, the difference in engagement between conventional FC and OQFC models disappears when both use same active-learning techniques.

It is hoped that when the OQFC model is carefully implemented, the desired result will be achieved. To successfully implement the OQFC model, both the teachers and students must have basic knowledge of the working of flipped learning instruction. Teachers and students must be open to new challenges and ready to adjust to using technology-based instruction. Teachers' and students' positive attitudes toward flipped learning instruction are another factor that would make the OQFC model successful. In a nutshell, the study highlighted evidence that teaching with the OQFC model can support students to learn actively and improve their engagement.

Limitations and Future Directions

There are limitations that need to be considered in future research. For example, the study was limited to a quantitative method only. Future research can use mixed methods to generate data from different sources, such as student and teacher perceptions. The study was conducted in public universities; therefore, the future can include private universities to extend the scope of the research. The study was limited to third-year students, which could influence the results of the study, considering their expected higher level of self-regulation. Therefore, further research could broaden student participation to include all years. The study focused on the effect of the flipped classroom model and gender on students' engagement only; future studies should examine the effect of the proposed model on other variables such as problem-solving skills, cognitive thinking skills, motivation, attitudes, attendance, and retention. While the study explored students' engagement within the FC model via self-reported questionnaires, it was acknowledged that engagement constructs could be verified in other ways. For example, future studies can assess students' agentic engagement using objective measures of their learning activities. Similarly, students' behavioral engagement, which involves students' active participation in learning activities and adherence to classroom norms, could be evaluated using available learning analytics, such as whether they accessed the videos and for how long. Further study can also look at the effect of OQFC on students' social engagement to assess students' positive interaction with peers, instructors, and learning environment. Beyond the scope of this study, future research should also consider how the OQFC model affects students' academic activities in various academic courses. Follow-up studies can be conducted to examine the OQFC model's long-term effect in secondary and elementary school subjects.

Conclusion

This study proposed an OQFC model to address the challenges of the CFC model. A true experimental design was employed to compare students' engagement and the impact of gender on learning between OQFC and CFC. The findings revealed that the OQFC model enhanced students' engagement (behavioural, agentic, and emotional), while gender was found to have no significant effect on students' engagement. As higher learning engagement is correlated with improved academic performance, these findings suggest that the OQFC model may contribute to enhanced academic outcomes for students.

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