The Association between Flipped Learning Readiness, Engagement, Social anxiety, and Achievement in Online Flipped Classrooms: a Structural Equational Modeling

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Abstract

This study explored the association between flipped learning readiness (FLR), engagement, social anxiety, and achievement in online flipped classrooms among 200 freshman university students enrolled to an information technology course. The relational screening model was applied in order to reveal associations between variables. The study was conducted in two Turkish state universities. The students were sampled using the convenience sampling method. The data collection tools employed were a demographic data form, the Online Student Engagement Scale, the Online Learners' Interactions and Social Anxiety Scale, the FLR scale, and also achievement tests. Structural equational modeling was employed in the testing of the hypothesized model. Results from the structural equation modeling revealed that engagement and FLR were positively associated with student achievement, whilst there was a negative association revealed between social anxiety and achievement in the online flipped classroom. The study also revealed engagement as the most significant predictor of achievement in the online flipped classroom.

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1 Introduction

Over the past two decades, online education has become integral within higher education, and progressed with a dynamic growth (Martin et al., 2020) due to the ubiquity of information and communication technologies, increases in Internet access options, and the inherent flexibility of online course offerings (Lim, 2016). In recent years, there has been a rapid transition to online education, as well as online education having become even more necessary and prominent due to the COVID-19 global pandemic. Expansion in the implementation of online education has led to a corresponding increase in research into online education, and has led researchers to consider how to ensure its effectiveness. Quality (Esfijani, 2018), engagement (Dixson, 2015; Martin et al., 2020; Soffer & Nachmias, 2018), and achievement (Akçayir & Akçayir, 2018) are vitally important parameters in online education and as such have been investigated by scholars who have suggested that it has recently become possible to create more effective, interactive, engaging, and active learning environments (Driscoll et al., 2012).

The literature emphasizes notable active student-centered instructional strategies including the flipped classroom (FC) (O'Flaherty & Phillips, 2015; Yılmaz, 2017), computer-supported collaborative learning (Jeong et al., 2019), problem-based learning (Şendağ & Odabaşı, 2009), and Massive Open Online Courses (MOOCs) (Hew & Cheung, 2014). The FC has been revealed to be an effective student-centered approach (Lai & Hwang, 2016; Strelan et al., 2020) in terms of improving the quality of both teaching and learning (Larcara, 2015), providing a flexible and adaptive learning environment (Schwarzenberg et al., 2018), increasing student engagement (Murillo-Zamorano et al., 2019), increasing student-teacher interaction, (Bergmann & Sams, 2012), and increasing student academic achievement (Missildine et al., 2013). FC, which is gradually becoming more popular in the higher education context (Bond, 2020), includes out-of-class activities that involve individual learning and in-class activities such as group learning (Bishop & Verleger, 2013). Compared to other blended learning models, out-of-class activities and in-class activities are inverted in the FC model.

The literature has documented various benefits of online learning, especially linked to its inherent flexible structure (Kemp & Grieve, 2014), and has suggested that well-planned online learning is pedagogically promising (Grieve et al., 2017). The growth of online education has directed researchers to implement FC models within online learning environments, taking inspiration from studies in which the conventional FC model was found to be effective. The online FC variant is based on the conventional FC model, differing only in the way that the teachers and students meet (Stöhr et al., 2020). Similar to conventional FC, online FC consists of out-of-class activities followed by in-class interactive learning activities. They differ, however, in that face-to-face teaching activities are transformed into an online teaching module. Before the class meets online, students are tasked with watching prerecorded lecture videos and to access and utilize online learning resources, which is similar to the conventional FC model. Recently a few studies have investigated the online FC and numerous instructional advantages have been reported (e.g., Stöhr et al., 2020; Tang et al., 2020; Yen, 2020). In particular, one key result identified was the

maintaining of student attention to the course. However, despite increases in online learning implementations, there exists a paucity of research studies that specifically address online FC models (Stöhr et al., 2020).

The current study is therefore potentially one of the first studies that aims to investigate associations between online flipped learning readiness (FLR), engagement, social anxiety, and achievement in online FC models. FLR is a concept related to students' readiness to learn and their intent to adequately prepare themselves (Lee & Choi, 2019), and as such it relates closely to the quality of pre-class learning. One of the concerns that tempers the advantages of the FC model is lower levels of student FLR. Students' readiness for flipped learning is a central aspect that needs to be assessed in order to better understand the effectiveness of FC learning (Hao, 2016; Lai & Hwang, 2016). Studies have shown that some students do not exhibit higher FLR, especially in those accustomed to teacher-centered processes (Hao, 2016; McCarthy, 2016; Missildine et al., 2013; van der Velde et al., 2021). As the literature has emphasized, these students may be in need of more structured guidance and feedback, especially in terms of improving their self-regulated learning skills, which are a necessity for pre-class activities (Kim et al., 2014).

FLR can substantially impact on the success of FC (Hao, 2016), which facilitates benefits from the intended advantages of in-class learning. Previous literature on FC has investigated the association between FLR and several variables (Hao, 2016; Yıldız-Durak, 2018). The literature provides a nuanced picture of the relationship between FLR, engagement, and achievement. Engagement is the effort that students employ during the learning process (Bond, 2020) and is linked to their FLR (Peled et al., 2015) and achievement (Wang, 2017). When students' FLR increases, their engagement level also increases (Yıldız-Durak, 2018) and, naturally, as students engage more, they become more successful (O'Flaherty & Phillips, 2015). However, there is a dearth of studies investigating the associations between social anxiety and the aforementioned variables. Social anxiety is considered one of the variables that should be taken into account since it has been attributed as one of the major challenges faced during the processes of online learning (Keskin et al., 2020). Social anxiety is a term that closely relates to a continuum of distress and disability (Russell & Topham, 2012) brought about by an individual's fears related to social situations such as communication and public speaking (Cederlund & Öst, 2013). As pointed out by Keskin et al., (2020), compared to face-to-face learning, interaction, collaboration, and communication with instructors and peers are significant dimensions in online learning which can trigger anxiety. Instructors that conduct online learning are suggested to benefit from the results of the current study in terms of how they implement FC in the online environment.

Moreover, the current study aims to contribute to the literature by implementing a structured FC model in online learning. In the growing body of literature that has revealed positive learning outcomes realized from FC models, it has been stated that the theoretical framework for guiding the FC process is critical (Lo et al., 2018). Accordingly, the current study implemented and tested the online learning FC model based on the "First Principles of Instruction," as depicted by Merrill (2002), which has been shown to be effective, and as suggested by Lo et al., (2018) for application in FC models.

2 Theoretical Framework and Hypotheses

2.1 Flipped Classroom Readiness and its' Sub-Dimensions

The current study takes learners' FLR as a multidimensional construct, consisting of five sub-dimensions as determined by Hao (2016), which are; "Learner Control and Self-Directed Learning," "Technology Self-Efficacy," "Motivation for Learning," "In-class Communication Self-efficacy," and "Doing Previews."

Self-directed learning focuses on learner autonomy within the learning process (Song & Hill, 2007) and the extent to which learners are able to self-regulate their own learning processes (Lee et al., 2017). Online learning platforms offer flexibility and a variety of resources, which affords learners more control over their learning. However, in order to effectively manage this process, learners may need to improve their self-directed learning skills (Karaoğlan Yılmaz & Yılmaz, 2020).

There is an extensive amount of research that points to self-efficacy as a prerequisite for successful learning (Klassen & Tze, 2014), and this is particularly important in terms of online learning (Hao, 2016; Hodges, 2008). In order for the process to be effective, students should be able to access online sources, which necessitates developing a good level of technology self-efficacy and related skills in communication (Hao, 2016). Technology self-efficacy relates to learners' beliefs about their competency in using the Internet and other computer technologies (Yılmaz, 2017). It is therefore important to consider "Technology Self-Efficacy" in FLR.

Communication self-efficacy focusses on learners' beliefs in their skills to express themselves, ask questions, and to discuss and interact with others via technology-mediated environments (Jiang et al., 2021). Good communication skills are considered highly important in the FC (Yılmaz, 2017), since a considerable amount of communication-based activities are involved in these environments and are actively encouraged by teachers. It can be concluded, therefore, that communication self-efficacy in online learning is an essential dimension.

Motivation refers to learners' desire to learn in order to accomplish the anticipated outputs (Schunk, 2018), which can significantly impact upon learning performance (Fairchild et al., 2005). In FC environments, lack of motivation can negatively influence students' interest in completing the preview materials (Zainuddun et al., 2019), which naturally influences their readiness to attend the next class. Thus, motivation for learning is also considered an essential dimension that should be taken into account in the online flipped learning environment.

The FC model requires learners to do previews, which entails them getting prepared in advance of their next class (Fulton, 2012) by completing certain tasks. Previous research has suggested that students who do not complete their assigned previews can be ill-prepared for the upcoming in-class activities and may struggle to join in any class discussions (Jiang et al., 2021; Zang et al., 2021). Thus, in terms of ensuring successful FC learning, it is critical to implement multiple strategies that regulate learners with different tendencies so as to complete the assigned previews (Chuang et al., 2018).

2.2 Flipped Classroom Readiness and Achievement

Students' FLR levels are a driving force behind improving their learning performance (Akçayir & Akçayir, 2018; Baepler et al., 2014; Mason et al., 2013). The literature has demonstrated that being prepared for the upcoming class is one of the strongest points of the FC model since it contributes to helping students to focus and develop attention to learning (Abuhmaid & Mohammad, 2020), to better understand the course content (Missildine et al., 2013), and to the development of self-paced learning skills (Love et al., 2014). Naturally, studies have reported that pre-class activities may positively contribute to students' learning outcomes (Moravec et al., 2010; Thai et al., 2017). The online FC model includes several learning sources, technologies, and different forms of content, which maximizes the effectiveness of the time spent in-class. Hence, learners take a more active role in the learning process, whilst benefitting from the variety of resources and technologies available (Mason et al., 2013). In addition, the online FC model requires learners to develop skills in self-regulation and time management (Stöhr et al., 2020). The existing literature points to a relation between FLR, its sub-dimensions, and achievement. As such, the current study addresses the following hypotheses:

H1: There is a positive association between students' FLR levels and their achievement.
H1a: There is a positive association between learner control and self-directed learning (R1) and achievement.
H1b: There is a positive association between technology self-efficacy (R2) and achievement.
H1c: There is a positive association between communication self-efficacy (R3) and achievement.
H1d: There is a positive association between motivation for learning (R4) and achievement.
H1e: There is a positive association between doing previews (R5) and achievement.

2.3 Flipped Classroom Readiness and Engagement

The FC model has been proposed as a prominent approach to ensuring student engagement (Clark, 2015), since as learners they experience active learning (Freeman et al., 2014), which implies that active learning techniques correlate positively with student engagement. However, engagement may be more problematic in the online learning environment, which offers flexible learning, and as a result, a high dropout rate (Otter et al., 2013). From this perspective, it can be seen that students who experience lower FLR tend to engage less in online FC.

All of the components of the FC model have the potential to support student engagement (Baepler et al., 2014). First, instructors repeatedly include communication-based activities and the use of a variety of online tools, technologies and resources (Gilboy et al., 2015) which requires learners to regulate their own learning

procedure, to do previews and get prepared for their next in-class. The online FC model requires learners to proceed through technology-integrated mechanism using online tools and resources and interacting with others. In order to actively engage in online FC classroom, students should possess adequate technology self-efficacy. Online FC can afford opportunities for richer discourse engaging both learners and teachers, whilst ensuring that learners with varying communication skills can benefit from the process. Communication with instructors and peers is a significant dimension in online learning, and which is therefore aligned with their engagement. Online FC includes several engaging activities in order to encourage students' motivation to acquire knowledge and skills (Prince, 2004). For the current study, the following hypotheses are proposed:

H2: There is a positive association between FLR levels and engagement.
H2a: There is a positive association between learner control and self-directed learning (R1) and engagement.
H2b: There is a positive association between technology self-efficacy (R2) and engagement.
H2c: There is a positive association between communication self-efficacy (R3) and engagement.
H2d: There is a positive association between motivation for learning (R4) and engagement.
H2e: There is a positive association between doing previews (R5) and engagement.

2.4 Flipped Classroom Readiness and Social Anxiety

In the current technological era, online learning has become the new social learning environment, but which might also create new barriers in the learning process since learners interact without physically being together. In these conditions, social anxiety should be taken into account as critical to the online learning process since it limits interaction when learners experience apprehension to effectively communicate (Çevik et al., 2021). As Leary and Kowalski (1995, p. 96) pointed out, social anxiety "occurs when people become concerned about how they are being perceived and evaluated by others" which interferes with cognitive, behavioral, and physiological processes (Steimer, 2002). The presence of social anxiety can result in emotional stress (Leitenberg, 1990), fear of social communication (Cederlund & Öst, 2013), fear of rejection and negative evaluation (Clark & Beck, 2012), and fear of being neglected (Mattick & Clarke, 1998).

Studies in the literature reflect different and interesting findings in this area. People who experience severe social anxiety in daily life often have a preference for online interaction over face-to-face interaction (Pierce, 2009), since they have more opportunity to hide any symptoms of their anxiety (Young & Lo, 2012). On the other hand, scholars report that despite living in the digital age, students still have high levels of social anxiety symptoms regarding the use of computers (Eryılmaz & Çiğdemoğlu, 2019) and other interactive features, for example using Facebook in an educational

environment (McCord et al., 2014). Furthermore, several scholars have pointed to the negative impact of social anxiety on Internet usage (Zhang & Zhou, 2018), and even a corresponding increase in Internet addiction (Korzynski et al., 2020). The purpose, nature, and content of the time spent using the Internet are amongst the indicators seen as important in determining the negative effects of Internet usage (Kim et al., 2017). These findings imply that people who use online platforms comfortably will have more positive learning experiences. It can therefore be expected that students who experience social anxiety may not be able to meet the requirements of online FC since they may be uncomfortable using the required technology for academic purposes. Studies conducted to examine online social anxiety are quite limited in the literature. However, based on the previous literature that shows the relation between students' information and communication technology skills with their FLR, it is anticipated that a negative association may exist between students' social anxiety and their FLR level. Therefore, the current study proposes the following hypotheses:

H3: There is a negative association between FLR levels and social anxiety.
H3a: There is a negative association between learner control and self-directed learning (R1) and social anxiety.
H3b: There is a negative association between technology self-efficacy (R2) and social anxiety.
H3c: There is a negative association between students' communication self-efficacy (R3) and social anxiety.
H3d: There is a negative association between motivation for learning (R4) and social anxiety.
H3e: There is a negative association between doing previews (R5) and social anxiety.

2.5 Engagement and Achievement

Engagement is closely related to students' active participation (asking questions, joining discussions, etc.), which is also one of the determinants of achievement (Harbour et al., 2015). It has been reported in the literature that whilst individuals engage in cognitively challenging activities, their engagement can be studied and measured effectively at the individual level (Appleton et al., 2006). Achievement is often regarded as a result in cognitive tasks and mediates emotional dimensions. In conclusion, engagement is a component that helps explain the critical role that emotional dimensions play in cognitive tasks and is therefore considered an important factor in measuring achievement.

Several corresponding studies have been conducted in order to understand the engagement of students in FC, and these studies have revealed students being more engaged (Butt, 2014) and with more positive learning gains (Baepler et al., 2014). Studies investigating the relationship between engagement and achievement in FC are quite limited in the current literature. One exception is Wang (2017), who showed that engagement in FC problem-solving activities has a positive and direct relationship with achievement. Thus, the current study addresses the following hypothesis:

H4: There is a positive association between students' engagement and achievement.

2.6 Social Anxiety and its Sub-Dimensions

The current study considers social anxiety as a multifaceted aspect, with sub-dimensions of "Negative evaluation," "Somatic symptoms," and "Avoidance of interaction."

Social anxiety in online learning environments is associated with the fear of negative evaluation when communicating with others (Hwang et al., 2020). Negative evaluation refers to the "negative feelings, thoughts, fear, and concerns among learners about the probability that they might be misunderstood and judged by others during their interactions in the e-learning environment" (Keskin et al., 2020, p. 10). For this reason, it is important to include "negative evaluation" as a dimension.

Somatic symptoms is another significant dimension and refers to the physical and mental discomfort of individuals (Liu et al., 2020). During online learning, individuals may develop physical reactions such as discomfort or increased heart rate (Keskin et al., 2020). For this reason, it is important to include "somatic symptoms" as a dimension.

In order to deal with social anxiety, some people purposely avoid interaction (Heimberg et al., 1999). This relates to individuals' failure to or preference not to interact and thus become dissociated from the interactive environment (Keskin et al., 2020). Avoidance of interaction in online learning includes the avoidance of discussion or asking questions, and thereby remaining silent. From this perspective, this dimension is also deemed critical to be considered in relation to online learning environments.

2.7 Social Anxiety and Engagement

Social anxiety among higher education students is a topic of study that has been investigated in the literature (Ajmal & Ahmad, 2019; Eryılmaz & Çiğdemoğlu, 2019; Russell & Shaw, 2009; Topham & Russell, 2012; Yen et al., 2012). These studies have demonstrated the negative consequences of social anxiety related to students' intention to engage in courses (Chiu & Wang, 2008), as well as problems related to student attention and learning (Robotham & Julian, 2006). For this reason, the current study assumes that social anxiety and engagement are correlated.

Social anxiety in online learning environments is associated with the fear of negative evaluation when communicating with others (Hwang et al., 2020). The literature regarding this shows that fear of negative evaluation can create a low level of social engagement (Appleton et al., 2006) where students purposely avoid interacting with others. Similarly, the negative perceptions of learners in online learning environments may result in their avoidance of social interaction (Eryılmaz & Çiğdemoğlu, 2019), which can then adversely affect their engagement (Hwang et al., 2020). Negative evaluation is an important dimension to take into account in terms of online FCs, since learners are predominantly required to engage in collaborative tasks that involve significant communication. More specifically, it is emphasized that social

anxiety has a detrimental impact on communication (Valkenburg & Peter, 2007), the forming of close relations (Asher & Aderka, 2020), and in both interacting and performing in lectures (Keskin et al., 2020). This implies that negative evaluation and students' avoidance of interaction may have a negative effect on engagement.

Unfortunately, social anxiety can also result in bouts of depression, avoidance behavior (Pierce, 2009), and also significant distress (Asher et al., 2017) when people are required to interact or communicate in social situations. This issue is associated with somatic symptoms, which also suggests a negative impact on engagement. As such, the current study proposes the following hypotheses:

> H5: There is a negative association between students' social anxiety and engagement.
> H5a: There is a negative association between negative evaluation (SA1) and engagement.
> H5b There is a negative association between somatic symptoms (SA2) and engagement.
> H5c: There is a negative association between avoidance of interaction (SA3) and engagement.

The overall theoretical framework of the study is illustrated as shown in Figure 1.

3 Methodology

3.1 Procedure

The implementation process was conducted over a 13-week Information Technology (IT) course based on an online FC model. As part of the implementation process, the study integrated Merrill's (2002) First Principles of Instruction which included
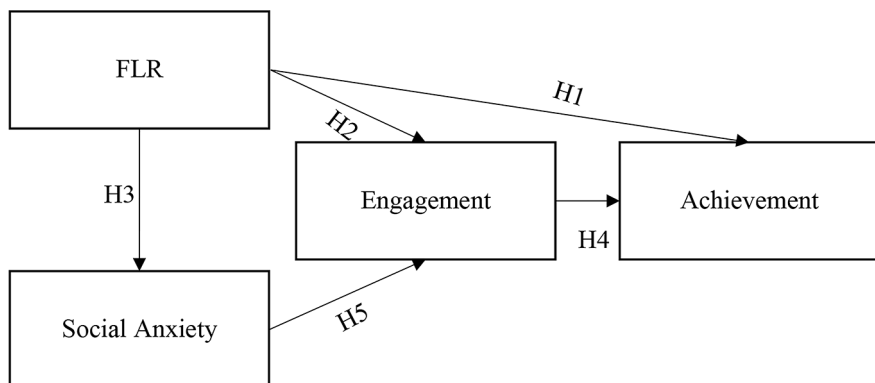

Fig. 1 *Theoretical Framework*

two main components: out-of-class activities and online in-class activities. Figure 2 presents details of these two activities.

The 13-week course includes three main topics: word processing, electronic spreadsheets, and a program for creating presentations. A video containing lectures, applications, and examples related to each week's topic were prepared. In order to make the videos more interactive and to check whether or not the students actually
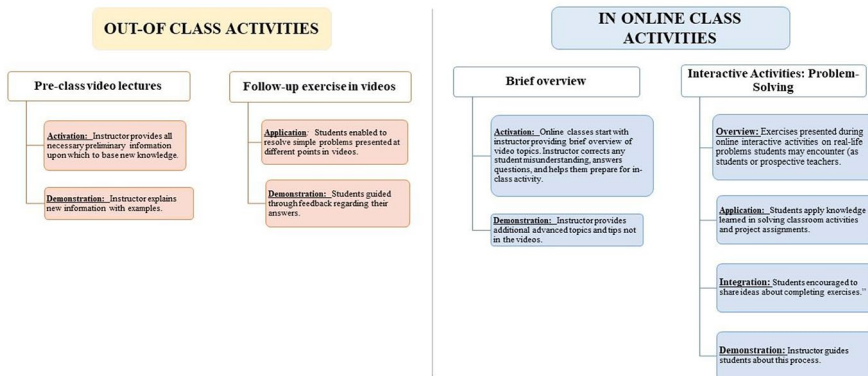

Fig. 2 *Details of Two Activities in Terms of Merrill's Principles (2002)*
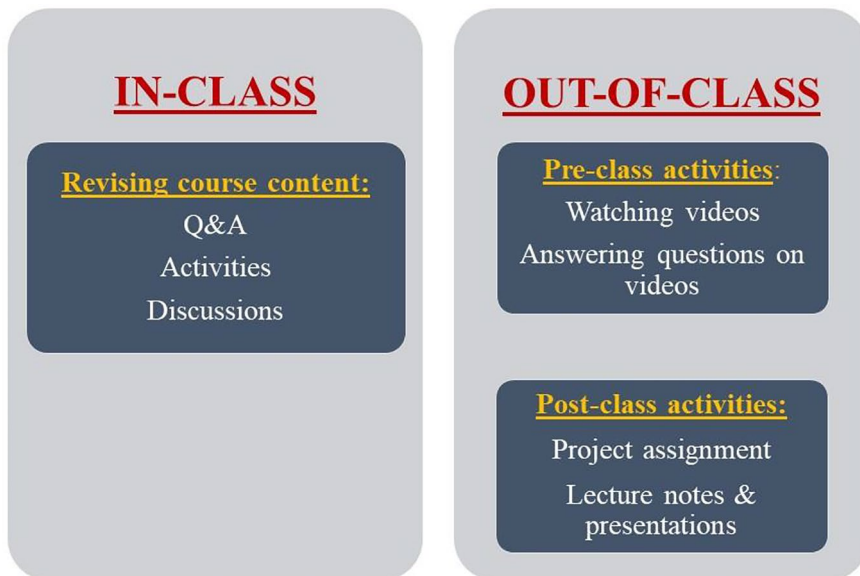

Fig. 3 Online FC Model

watched them, they were asked random questions about the content at various points throughout the videos. Figure 3 summarizes the online FC model implemented in the current study.

In addition, live-lesson recordings, lecture notes, and presentations that summarized the lecture notes were shared with the students each week via Google Classroom and Perculus. The live lessons each lasted approximately 1-1.5 h, after which recordings of the lessons were shared with the students. Google Classroom, Perculus, and Zoom were used in conducting the live lessons, whereas Edpuzzle was used for the pre-class activities. The lesson videos lasted for a duration of 20 min on average, and the number of questions asked during the videos averaged three. The questions aimed at the students were constantly answered, both those posed within LMS and during the live lessons. The online FC is illustrated in Figure 4. In the weekly live lessons, the students provided feedback about the videos they had watched. There was also a question and answer session on topics that generated both student-instructor and student-student interaction. The students interacted both verbally and in written form. In the problem-based activities, they interacted with the instructor and other students by asking questions and answering questions they were asked. From time to time, they were asked to find solutions to certain problems by working collaboratively as a group. In addition, there was an active discussion held over 2 weeks of the course, whereby students would comment on, criticize, or contribute to each other's ideas. The students were assigned homework and interacted within the LMS environment in relation to completing the tasks set. It was also ensured that they interacted continuously via the LMS. An environment was created within the LMS where the students could ask questions about the course. Therefore, the students were

Sharing next week's video each week on Classroom / Perculus.

Asking video-related questions at start of lessons. Giving weekly feedback to students according to their answers.

Revising and summarizing videos, detailing the subject, providing continuous feedback to students.

Giving assignments at end of each key topic (Word, Excel, PowerPoint).

Following each key topic, students asked to discuss on Padlet (online discussion platform). Each student to ask and post one question on the topic.
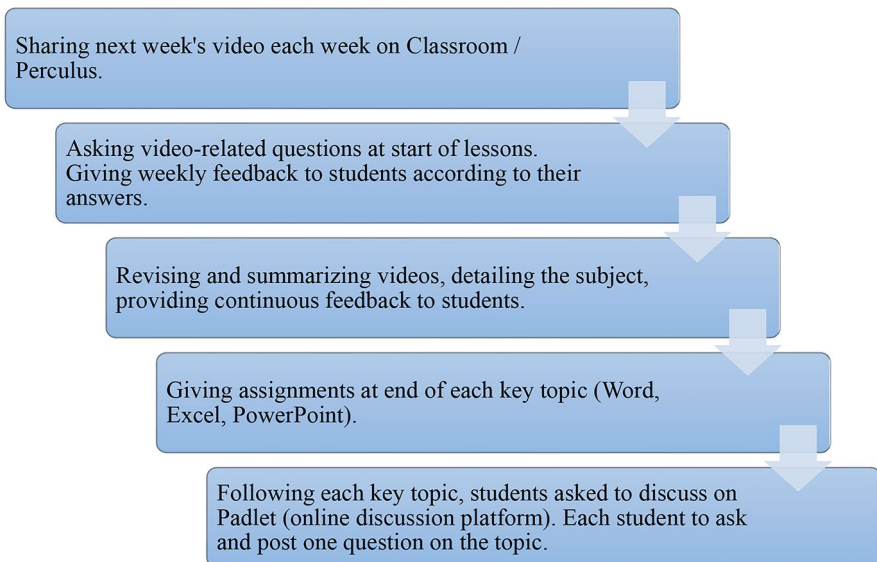
Fig. 4 Online FC

able to communicate with both their instructors and their peers during the online FC implementation.

3.2 Participants

In the current study the relational screening model was employed since the aim was to reveal relationships among certain variables. The relational screening model is an approach used to determine the existence of change, or the degree of change, between two or more variables.

The participants of the study were 200 freshman university students enrolled to an information technology course. These students were sampled according to the convenience sampling method. The study was conducted at two state universities in Turkey. Whilst 62.5% of the participant students were located at University A, 37.5% were studying at University I. Almost all of the participant students were aged between the 18 and 21 years old, and overall, 80% of the students were female and

Table 1 Demographic Characteristics of the Participants

		n	%
University	A	125	62.5
	I	75	37.5
Grade	1	187	93.5
	2	4	2.0
	3	3	1.5
	4+	6	3.0
Gender	Male	39	19.5
	Female	161	80.5
Age (years)	18–21	183	91.5
	21–24	8	4.0
	24–27	7	3.5
	27–30	0	0.0
	30+	2	1.0

Table 2 Distribution of Participants' Departments

Department	n	%
German teaching	6	3.0
Science teaching	32	16.0
Elementary Mathematics teaching	49	24.5
English teaching	7	3.5
Music teaching	3	1.5
Preschool teaching	9	4.5
Special Education teaching	5	2.5
Guidance and Psychological Counseling	3	1.5
Classroom teaching	56	28.0
Social Studies teaching	28	14.0
Turkish teaching	2	1.0

20% were male. Table 1 presents a summary of the demographic characteristics of the participants. As seen, the majority of the participant students had access to a technological device and accessed the Internet for between 3 and 5 h per day. The students hailed from 11 different departments within the education faculties of the two participant universities (see Table 2). Each student participated in the research on a voluntary basis. Ethics committee approval was obtained prior to the commencement of the study.

4 Instruments

4.1 Demographic Form

A demographic form was used to determine the various demographic characteristics of the participant students. The demographic form was developed by the researchers, and included 14 questions regarding personal information about the participants such as their gender, age, department of study, technology usage/literacy in terms of the availability of devices, and their daily Internet usage.

4.2 Online Student Engagement Scale (OSE)

The OSE was used to determine the students' engagement level. The OSE was developed by Dixson (2015) in order to measure student engagement within online learning environments. The scale was later adapted to the Turkish context by Polat et al. (2022). The 5-point, Likert-type OSE is an instrument consisting of four factors (Skills, Emotion, Participation, and Performance) and a total of 19 items. The Cronbach alpha reliability coefficient, which measures the internal consistency of an instrument, was calculated as 0.95, which is deemed as being reliable (Cortina, 1993).

4.3 Weekly Video Viewing Rates

Weekly video viewing rates were also used to determine the levels of the participant students' engagement. The percentage of students watching videos each week was recorded, and then the levels of engagement was formulated as "(Weekly video viewing rates + OSE) / 2." Since the video watching points are out of 100 and the maximum OSE score was 85, the OSE score was converted to 100 points with the formula "OSE score / 85 × 100." The OSE and video viewing rates were then averaged whilst calculating the engagement score.

4.4 Online Learners' Interactions and Social Anxiety

The Social Anxiety Scale for e-Learning Environments (SASE) was used to determine the participant students' social anxiety levels in the study. The SASE was developed by Keskin et al., (2020) in order to measure levels of social anxiety in both learner-learner interaction and learner-instructor interaction. The 7-point, Likert-type

scale consists of 23 items within three sub-dimensions (Negative evaluation, Somatic symptoms, and Avoidance of interaction). The Cronbach alpha coefficient was calculated as being 0.98, which is deemed to be reliable (Cortina, 1993).

4.5 FLR Scale

The FLR scale was used to determine students' flipped classroom readiness. The scale was developed by Hao (2016) and later adapted to the Turkish context by Yıldız-Durak (2020) in order to measure the readiness level of university students for flipped learning. The 5-point, Likert-type scale consists of 26 items within five sub-dimensions (Learner control and self-directed learning, Technology self-efficacy, Communication self-efficacy, Motivation for learning, and Doing previews). The Cronbach alpha coefficient was calculated as being 0.92, which is deemed as reliable (Cortina, 1993).

4.6 Achievement Tests

Quizzes and projects were used to determine the academic achievement of the students who participated in the study. The assessment items comprised of two quizzes on the basic concepts featured in the information technologies course. In addition, three project assignments related to three basic subjects were also employed as a means to determining the participants' achievement. The quizzes each comprised of 25 questions and were prepared by two instructors. Then, an expert reviewed the draft quizzes and any necessary revisions were then applied prior to the application. The quizzes were designed to test the students' conceptual understanding, while the three project assignments were aimed to measuring the students' achievement during the process.

4.7 Data Analysis

Structural equational modeling (SEM) was employed in order to reveal a model that explained and predicted the relations between FLR, achievement, engagement, and social anxiety. The analysis was conducted using AMOS 21. Path analysis was performed for SEM. Chi-square goodness-of-fit test (χ^2), root mean square error of approximation (RMSEA), Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), and Normed Fit Index (NFI) were used to demonstrate the level of conformity of the related pattern in the proposed model. The SEM fit indices provide information on how the data fits to the model. Overall, the goodness of fit was found to be satisfactory; $\chi^2 / df = 5.39$, GFI $= 0.99$ ($0.95 \leq$ GFI ≤ 1, Tabachnick & Fidell, 2007), TLI $= 1.09$, NFI $= 0.98$ ($0.95 \leq$ NFI ≤ 1, Tabachnick & Fidell, 2007), CFI $= 1$ ($0.95 \leq$ CFI ≤ 1; Tabachnick & Fidell, 2007). Each of these values represent a good model fit.

5 Results

5.1 Descriptive Findings

The descriptive analysis revealed that the mean of the participants' FLR was 104.30, whereas it was 84.68 for Engagement, 120.10 for Social Anxiety, and for Achievement it was 92.71. Descriptive data of the variables is presented in Table 3. All scores show normal distribution.

5.2 Measurement Model

As can be seen in Table 4, the correlation values were calculated as 0.19 between FLR and Engagement, −0.14 between Social Anxiety and Engagement, −0.27 between Social Anxiety and FLR, and 0.19 between Achievement and Engagement. The findings clearly indicate that Achievement and Engagement, FLR and Engagement, Social Anxiety and Engagement, and Social Anxiety and FLR are related to a significant degree. The model revealed that increased Engagement enhances student Achievement. Likewise, increased FLR develops Engagement. In contrast, decreased Social Anxiety improves Engagement. Finally, as FLR increases, Social Anxiety was shown to decrease.

In the study, the Cronbach's alpha values were calculated in order to test the internal consistency of the constructs. The discriminant validity was tested to the validity of the measurement model. As can be seen in Table 5, the average variance explained (AVE) values were found to be greater than 0.50, composite reliability greater than 0.70, and Cronbach's alpha greater than 0.80, which are all considered to be above the acceptable values. Thus discriminant validity was confirmed.

Table 3 Descriptive Statistics

	M	SD	Min	Max	Skew.	Kurt.
FLR	104.30	13.08	66.00	130.00	-0.52	0.44
R1	31.30	4.52	17.00	40.00	-0.47	0.38
R2	35.67	5.91	20.00	45.00	-0.38	-0.28
R3	15.65	3.06	5.00	20.00	-0.52	0.28
R4	12.95	1.87	7.00	15.00	-0.77	0.02
R5	8.74	1.50	2.00	10.00	-1.23	1.66
Engagement	84.68	9.72	55.60	100.00	-0.88	0.46
Social Anxiety	120.10	62.92	46.00	288.00	0.86	-0.19
SA1	50.55	26.62	18.00	120.00	0.71	-0.49
SA2	20.22	12.42	8.00	56.00	0.95	-0.13
SA3	49.32	27.91	20.00	139.00	1.02	0.35
Achievement	92.71	3.70	81.3	100.00	-0.69	0.02

Table 4 Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1. Achievement	1.00											
2. Engagement	0.19*	1.00										
3. FLR	0.05	0.19**	1.00									
4. R1	0.07	0.22**	0.81**	1.00								
5. R2	0.07	0.09	0.84**	0.48**	1.00							
6. R3	−0.10	0.13	0.73**	0.47**	0.49**	1.00						
7. R4	−0.03	0.18*	0.70**	0.55**	0.40**	0.58**	1.00					
8. R5	0.20**	0.12	0.62**	0.52**	0.42**	0.31**	0.46**	1.00				
9. Social Anxiety	0.02	−0.14*	−0.27**	−0.17*	−0.18*	−0.42**	−0.19**	−0.08	1.00			
10. SA1	0.03	−0.13	−0.24**	−0.13	−0.15*	−0.39**	−0.16*	−0.09	0.94**	1.00		
11. SA2	0.04	−0.05	−0.25**	−0.15*	−0.17*	−0.38**	−0.15*	−0.09	0.91**	0.81**	1.00	
12. SA3	0.00	−0.18*	−0.28**	−0.19**	−0.18*	−0.41**	−0.21**	−0.05	0.95**	0.81**	0.82**	1.00

* $p < .05$, ** $p < .01$

Table 5 AVE, CR, and CA Scores of the Scales	Scale	AVE	CR	CA
	FLR Scale	0.73	0.93	0.92
	Online Student Engagement Scale	0.66	0.88	0.95
	Social Anxiety Scale	0.86	0.95	0.98

6 Hypothesis Testing

Figure 5 shows the standardized regression weight values of the hypotheses results. Bold arrows indicate the significance of the *t*-values. As can be seen from Table 6, a total of 23 hypotheses were tested in the study. From the analysis, it was determined that FLR positively affects Engagement ($\beta=0.15$, $p<.05$). Accordingly, while the FLR total score does not have a significant effect on Achievement, it does significantly affect Engagement ($\beta=0.15$, $p<.05$) and Social Anxiety ($\beta=-0.27$, $p<.05$). Considering the sub-dimensions of FLR, R1 significantly affects Engagement ($\beta=0.18$, $p<.05$), R3 significantly affects Social Anxiety ($\beta=-0.46$, $p<.05$), and R5 significantly affects Achievement ($\beta=0.25$, $p<.05$). On the other hand, the SA3 sub-dimension significantly affects Engagement ($\beta=-0.33$, $p<.05$). Additionally, it was found that Engagement significantly affected Achievement.

Standardized Regression Weights (bold arrows show significant *t* value) (R1: Learner control and Self-directed learning, R2: Technology self-efficacy, R3: Com-
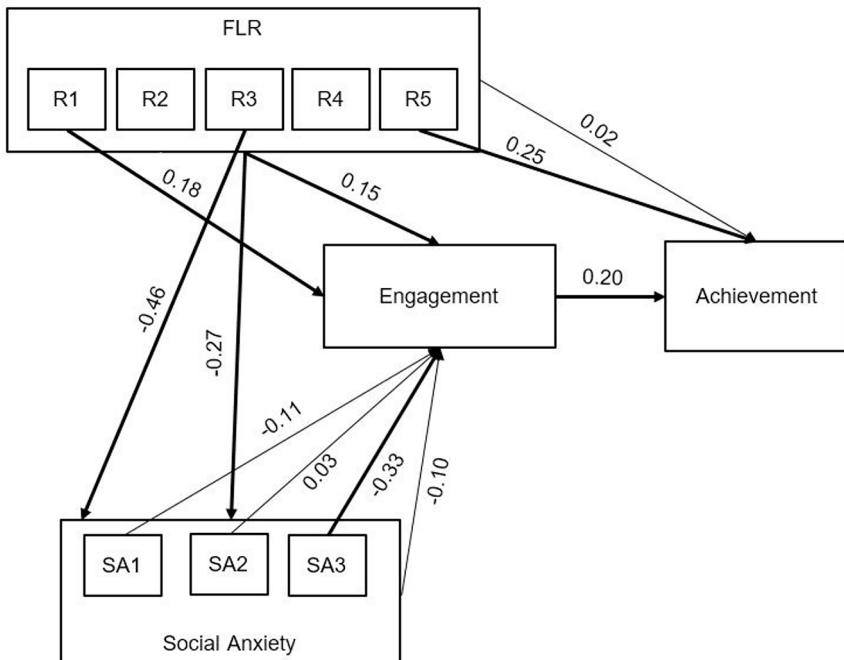

Fig. 5 Structural Equation Model Coefficients

Table 6 Hypothesis Acceptance/Rejection table

Hypothesis			Estimate	Std. Estimate	t value	Result
(H1) Achievement	<---	FLR	0.01	0.02	0.27	Reject
(H1a) Achievement	<---	R1	0.01	0.01	0.16	Reject
(H1b) Achievement	<---	R2	0.05	0.08	1.18	Reject
(H1c) Achievement	<---	R3	-0.23	−0.06	-0.93	Reject
(H1d) Achievement	<---	R4	-0.21	−0.11	-1.58	Reject
(H1e) Achievement	<---	R5	0.61	0.25	3.69**	Accept
(H2) Engagement	<---	FLR	0.11	0.15	2.27*	Accept
(H2a) Engagement	<---	R1	0.40	0.18	2.66**	Accept
(H2b) Engagement	<---	R2	-0.05	−0.03	-0.49	Reject
(H2c) Engagement	<---	R3	-0.15	−0.01	-0.22	Reject
(H2d) Engagement	<---	R4	0.52	0.10	1.45	Reject
(H2e) Engagement	<---	R5	-0.03	−0.01	-0.06	Reject
(H3) Social Anxiety	<---	FLR	-1.31	−0.27	-3.99**	Accept
(H3a) Social Anxiety	<---	R1	-0.24	−0.02	-0.27	Reject
(H3b) Social Anxiety	<---	R2	0.19	0.02	0.28	Reject
(H3c) Social Anxiety	<---	R3	-9.76	−0.46	-2.43*	Accept
(H3d) Social Anxiety	<---	R4	2.47	0.08	1.14	Reject
(H3e) Social Anxiety	<---	R5	1.63	0.04	0.60	Reject
(H4) Achievement	<---	Engagement	0.07	0.20	2.78**	Accept
(H5) Engagement	<---	Social Anxiety	-0.02	−0.10	-1.38	Reject
(H5a) Engagement	<---	SA1	-0.04	−0.11	-1.66	Reject
(H5b) Engagement	<---	SA2	0.28	0.03	0.43	Reject
(H5c) Engagement	<---	SA3	-0.12	−0.33	-4.99**	Accept

* $p<.05$, ** $p<.01$

munication self-efficacy, R4: Notivation for learning, R5: Doing previews; SA1: Negative evaluation, SA2: Somatic symptoms, SA3: Avoidance of interaction).

7 Discussion

The purpose of the current study was to investigate associations between FLR, engagement, social anxiety, and achievement during online flipped classrooms. The study revealed that engagement is the most significant predictor of achievement in online flipped classrooms. This finding contributes to the small body of literature that has investigated the association between engagement and achievement (e.g., Wang, 2017). Moreover, the bigger picture shows that the model used in the current study validates the view that any increase in FLR levels and engagement, together with a corresponding decrease in the students' social anxiety, enhances student achievement in the online flipped class scenario. The current study therefore presents evidence confirming that the important predictors of achievement in online flipped classrooms are FLR, engagement, and social anxiety. These findings support the literature, especially in terms of having investigated the association between social anxiety and achievement during online flipped classrooms.

One of the findings of the current study is that students' FLR levels have no direct effect on student achievement. However, doing previews, as one of the factors of FLR, does have a significant effect on student achievement. When students complete their preliminary study work (i.e., pre-class activities), their achievement naturally increases. As supported in the literature, students with lower levels of FLR do not finish their pre-class activities (Herreid & Schiller, 2013; Lai & Hwang, 2016), which subsequently prevents them from experiencing active learning within the in-class lessons of the flipped classroom model (Yıldız-Durak, 2020). Similarly, this finding also supports the literature which reports that pre-class activities may contribute positively to students' learning outcomes (Moravec et al., 2010; Thai et al., 2017). These findings imply that the engagement of students decreases if they fail to undertake the prescribed practice work prior to attending lessons, and thus their achievement is negatively affected.

The current study indicates that a positive relationship exists between FLR and engagement. This finding is consistent with the literature, which argues that when FLR increases, student engagement also increases (Yıldız-Durak, 2018), which ultimately translates to students success (O'Flaherty & Phillips, 2015).

The current study also revealed that learner control and self-directed learning, both factors of FLR, have a significant and direct effect on engagement, and also a significant and indirect effect on achievement in online flipped classes. Students need to study additional materials and undertake extra activities (such as projects and homework assignments) in flipped learning. As pointed out in the literature, getting prepared in advance of an upcoming class is related to self-directed learning skills (Love et al., 2014). Therefore, as students develop their self-directed learning skills, they are expected to engage more in their classes and consequently to succeed more.

One of the leading findings of the current study was to reveal the relationship between FLR and social anxiety. According to the model used in the study, a negative relationship exists between FLR and social anxiety. Students who feel ready to learn experience less anxiety and concern about their lessons, and thereby interact more during class.

The current study also showed the positive effect of communication self-efficacy as one of the factors of FLR on social anxiety. The more proficient and competent students are in communicating with their instructors and peers, the less social anxiety they are likely to experience during the course. In the current study, Google Classroom and Perculus were used to facilitate communication. The mobile versions of these two applications enabled students to instantly receive notifications. In online flipped classrooms, both course content and interaction with instructors and peers can be considered a prerequisite for learning. According to the literature, communication self-efficacy influences the level of interaction of students with their peers, instructors, and with the course content, both synchronously and asynchronously (Yıldız-Durak, 2020). The literature also argues that social anxiety negatively affects both communication and interaction, indicating that students with higher social anxiety have a lesser tendency to communicate (Eryılmaz & Çiğdemoğlu, 2019).

The current study also revealed a positive relationship exists between engagement and achievement. The literature supports this finding, as students who engage more in flipped classes (Butt, 2014) experience greater positive learning gains (Baepler

et al., 2014; Yıldız-Durak, 2017, 2018). On the other hand, the current study indicated that a negative association exists between social anxiety and engagement. As students' anxiety levels lessen, they are seen to participate more in lessons, interact more with their instructor and peers, and do what is required of them in their lessons with greater interest. This finding may support the notion that social anxiety causes avoidance from interacting with others within online environments (Eryılmaz & Çiğdemoğlu, 2019), which expectedly then negatively affects engagement. Thus, during online flipped learning, continued interaction and immediate feedback seem to be of vital importance. In the current study, low social anxiety was shown to have an effect on other variables, such as social anxiety having a negative effect on communication which consequently created problems for the students.

8 Limitations and Recommendations

It is acknowledged that the current study presents certain limitations. First, the study was conducted at two state universities in Turkey. In order to generalize the findings, it is suggested that the same model be repeated at different universities and with a variety of sociocultural structures. It is suggested that researchers verify the model with participants from different regions.

Second, the study included education faculty students who potentially have a more general interest in how to improve the quality of education. The model should therefore also be verified with students from other domains. The online FC application can be applied to different educational levels, courses, and topics.

In further studies, students' achievements could be examined using an experimental study design, by comparing FC and online FC. The current study was limited to the collection of quantitative data, whereas future studies could take on a qualitative approach to examining factors that affect student success in the online FC. Students' opinions on course activities, course books, and course videos could be sought, as well as examining students' interactions within the online environment, and their interactions within synchronous lessons and also out-of-class interactions.

9 Conclusion and Implications

The current online FC study, which was guided by the First Principles of Instruction, aims to present a significant contribution to the literature by explaining the associations between FLR, engagement, social anxiety, and achievement during online flipped classrooms. Thus, the current study has the significant potential to fill a gap in the existing literature since it introduces a model that may be applied in future research. The findings of the current study provide important implications for the improvement of higher education students' engagement in online learning procedures, which is associated with their academic achievement. The study's results are expected to guide practitioners on how to help increase student achievement in classrooms where the online flipped model is to be applied. The results of the current study provide strong evidence for the claim that the effect of students' engagement, FLR,

and social anxiety must be taken into account to ensure students' achievement in the online FC. In addition, it may be said that while instructors may design their teaching according to the online FC model, it can also be considered important to conduct studies so as to increase students' FLR levels prior to teaching in order to overcome the potential failures in the courses to be given. Again, the decrease in students' social anxiety levels was shown to increase their academic achievement. From this perspective, it may be effective to introduce classroom activities (e.g., breaking the ice, collaborative working, etc.) that will help to reduce students' social anxiety levels, and thereby to create an online flipped classroom environment where students can freely express their ideas during the lesson.

Declarations

Conflict of interest None.

Ethical approval All of the procedures performed in the current study, which involved human participants, were undertaken in accordance with the ethical standards of the institutional and national research committee, and with the 1964 Helsinki declaration and its subsequent amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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