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ORIGINAL PAPER

Effect of flipped classroom model on academic achievement, academic satisfaction and general belongingness

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Abstract
The effect of the flipped classroom model on students' academic achievement, academic satisfaction, and general belongingness was investigated using an experimental design. Purposive sampling was used to select 94 undergraduate students as participants. The participants were divided into three groups: one experimental group with the flipped classroom model and two control groups with the traditional classroom and distance education models. The groups attended the same course content sessions that are suitable for their classroom model over eight weeks. For analysis, descriptive statistics, dependent groups *t*-tests, Wilcoxon signed-rank test, ANCOVA, and ANOVA tests were performed. Students' academic achievement, academic satisfaction, and general belongingness levels significantly increased in the flipped classroom compared with the other classroom models. Suggestions for future research and limitations of the study are provided.

Keywords Academic achievement · Academic satisfaction · Distance education · Flipped classroom · General belongingness · Traditional classroom

Introduction

One of the expected outcomes of education is permanent learning. To this end, different teaching methods are used in classrooms, but other learning environments are also tested. In particular, among the teaching methods, student-centered learning and individual learning come to the fore. Specifically, following the development of internet technologies, learning environments have shifted from face-to-face to virtual. Thus, time and space boundaries have been eliminated for learning environments.

One of classroom management goals is improving learning and making students' learning experiences enjoyable (Turan, 2015a, b). However, effective classroom teaching in classrooms is possible only by choosing the right methods and techniques (Taspinar, 2012) and student-centered environments. Students actively participate in tasks and undertake their learning (Hannafin et al., 1997; Means, 1994; Shea et al., 2012). The integration of various technologies into the education process provides many physical

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and instructional advantages (Arabaci & Polat, 2013). To ensure effective learning, it is necessary to apply student-centered contemporary teaching methods and classroom management approaches (Carswell & Venkatesh, 2002; Polat, 2016), one of which is distance education. Unlike the face-to-face education environment, distance education offers global learning opportunities with temporal and spatial flexibility. Therefore, distance education environments support the individualized teaching process by considering the stages appropriate to individuals' learning speeds (Altıparmak et al., 2011). Under the concept of distance education, different learning types are known by other names, including web-based teaching/learning.

French (1999) defined web-based teaching as providing information to the students via computer networks (cited by Oral & Kenanoglu, 2012). Web-based distance education involves creating a meaningful learning environment in which learning is encouraged and supported by a hypermedia-based curriculum using the resources available on the web (Bay & Tuzun, 2002; Chrisman & Harvey, 1998). Because of its independence from time and place, web-based distance education is widely acknowledged (Aslanturk, 2002; Ohler, 1991; Zaborova et al., 2017). While web-based distance education enables fast and interactive learning, its tools and materials provide a rich source of information and encourage users to structure and exchange information. Moreover, it facilitates more counseling, discussion, and information exchange; it is considered student-centered, democratic, and individual-based (Keser et al., 2002). The essential advantages of web-based education are creating a virtual campus and enabling asynchronous education. Students and teachers are not in the same classroom at the same time. It is an ideal model that allows students to access the content at any time and to make use of resources as quickly and economically as possible (Carswell & Venkatesh, 2002).

Despite the benefits of web-based distance education, there are various problems or concerns, including: (1) failure in program planning; (2) trainers' insensitivity to the change in their roles; (3) low quality in teaching; (4) uncertainties in the use of resources and materials; (5) lack of technical expertise; (6) uncertainty in access to technical support (MacDonald et al., 2001). Another problem in distance education is students' lack of motivation because of deficiencies in social interaction (Karabatak & Turhan, 2017; Yolcu, 2015). As an extension of this problem, the rate of withdrawal of students participating in a distance education environment is higher than for the traditional education (Rovai, 2001). In other words, inadequate interaction, lack of motivation, failure to meet expectations, and low satisfaction rates cause distance education students to withdraw from the program as the physical remote environments in distance education ensure that students cannot feel that they belong to a community (Emmanuel-Frenel, 2017; Rovai, 2002; Tinto, 1993). Therefore, creating a sense of belonging in distance education enables individuals to keep their interest in education alive and will have a positive influence on success and satisfaction (Ilgaz & Askar, 2009).

Sense of belonging refers to the subjective state of feeling that the student is individually approved, respected, involved, and supported by other school individuals (Goodenow, 1992; Goodenow & Grady, 1993). Although the sense of belonging to school is one of the essential affective characteristics that students are expected to have for their school (Sari, 2013), this feature is often missing in distance education (Alexander, 2001). If the sense of belonging in distance education is not adequately addressed, students are unlikely to acquire learning resources if they do not feel part of a community (Lapointe & Reiseter, 2008). But a limited amount of research has focused on the sense of belonging in distance education (Emmanuel-Frenel, 2017; Peacock & Cowan, 2019; Thomas et al., 2014).

Emmanuel-Frenel (2017) investigated how the perceived value placed on student support services correlates with students' sense of belonging to the academic community. A qualitative study by Thomas et al. (2014) involved how the sense of belonging was understood and experienced by students and the strategies used by academics to foster belonging in online learning. Peacock and Cowan's (2019) study recognized that sense of belonging could promote and consolidate online learning and suggest how tutors can nurture online learners' sense of belonging. Lapointe and Reisetter (2008) sought to understand students' perceptions of the online learning community and current interactive pedagogy effectiveness. Moreover, in the study, the issue of whether these students had different expectations of and value for online and traditional learning communities was investigated. Koole (2010) examined the relationship between self and belonging in online social settings and the factors that would affect this relationship.

As in distance education, there are various problems in face-to-face education: the lack of time flexibility, the lack of equal opportunities in education, failure to adapt technological tools, and inadequate classroom environments because of the increasing number of students (Yolcu, 2015). To minimize the drawbacks in both learning environments, researchers have developed a new classroom layout by combining the classroom environment with the web, called 'flipped classrooms'. The flipped classroom model is designed to improve teaching and learning quality despite crowded classes, a shift in teaching from face-to-face to online environment, decreased resources over time, and difficulty updating resources (Larcara, 2014).

Flipped learning refers to a blended approach that can be contrasted with the traditional approach to education (Gilboy, 2015; Strayer, 2012). Flipped learning is student-centered, and the focus of learning passes from teachers to students, thus allowing students to have a more flexible learning environment for building knowledge (Chao et al., 2002). This system enables learners to reach out to the content they will learn in the classroom environment with the help of asynchronous plans (lecture videos and articles, various electronic data sources, visuals, pictures, and presentations) outside the school environment and, thus, ensures effective learning. The flipped classroom is a learning environment that replaces homework with classroom teaching and enables learners to focus on the problems that they face in their learning processes (Gencer et al., 2014; Verleger & Bishop, 2013). In other words, the flipped classroom system encourages individuals to learn the theoretical content at home and to practice it at school (Strayer, 2012; Zownorega, 2013). Therefore, it promotes student–teacher interaction more, provides opportunities for real-time feedback, increases student participation, and allows learning according to students' pace (Goodwin & Miller, 2013). Among the flipped classroom method's most significant advantages are that it provides learning environments where students can access information regardless of time and place and support individual learning (Bergman & Sams, 2012; Davies et al., 2013; Talbert, 2012).

The flipped classroom environment has been considered frequently both in the education process and academic research because of its advantages. In the studies related to the flipped classroom model, generally, students' academic achievement and satisfaction, motivations, and engagement levels (Stone, 2012) were investigated. For example, by Alamri's (2019) mixed-method research involved the effectiveness of a flipped classroom for students' academic performance and satisfaction. In this study, when researchers compared traditionally and flipped classrooms, the academic performance of students in the flipped classroom group was at a high level. Also, almost all students were found to have a high level of satisfaction and generally enjoy learning in the flipped classroom environment. Mixed-method research by Turan (2015a, b) identified students' perspectives about

the flipped classroom and revealed the impact of this environment on student achievement, cognitive load, and motivation. The flipped classroom method increased students' accomplishments and motivation and decreased their mental load levels. Furthermore students demonstrated positive views about the technique. Another mixed-method study by El-Banna et al. (2017) examined differences in academic achievement and teaching satisfaction between a flipped and traditional classroom environment in a nursing school. The results of the study revealed that students in the flipped classroom scored higher in examinations. It was also stated that instructors should provide students with sufficient knowledge and logic to use the flipped classroom.

A quasi-experimental study by Missildine et al. (2013) aimed to determine the effects of a flipped classroom and innovative learning activities on academic success and satisfaction. The traditional course only, course and course capture back-up, and the flipped classroom environment of course capture with innovative classroom activities were compared. Examination scores of students in the flipped classroom group were higher than in the other groups. Students were less satisfied with flipped classrooms. Another quasi-experimental study by Kazanidis et al. (2019) investigated the effectiveness of the flipped classroom approach in teaching instructional media design subjects by comparing students' academic performance and training satisfaction in traditional course-based instruction with those in a flipped classroom. There were significant differences in academic performance and educational satisfaction between the two groups, with students in the flipped classroom performing better. An experimental study by Karabatak and Polat (2020) compared the traditional classroom model, distance education model, and flipped classroom model designed according to ARCS (attention, relevance, confidence, and satisfaction) motivation strategies of motivation and academic achievement. The training process did not lead to a significant change in the motivation of the students for the traditional classroom model and distance education classroom model but did for the flipped classroom model. Goedhart et al. (2019) examined the effects of a flipped classroom trial conducted during a Master's course. Half of the course was taught in a traditional course-style while flipped classrooms replaced the remaining half. Although activities facilitated deeper learning, not all students agreed that the flipped classroom environment contributed to positive learning outcomes. The researchers suggested that this result be investigated further.

The quasi-experimental mixed-methods research by Davies et al. (2013) explored how technology can teach technical skills and determine the benefits of *flipping* the classroom in terms of student achievement and satisfaction with the class. The environments with the flipped approach and simulation-based approach were both more efficient than the traditional classroom environment. The aim of Limniou et al.'s (2018) study was for students to express their views of traditional and flipped classroom teaching approaches delivered by two teachers. Although all students had similar preferences for following either the traditional or the flipped classroom, a significant difference was observed in students' views related to teachers' contributions to teaching approaches, students' higher-order thinking skills development, and students' choice of learning material. Yilmaz's (2017) study aimed to explore the impact of the students' e-learning readiness on student satisfaction and motivation for the flipped classroom model of instruction. Path analyses with structural equation modeling verified that students' e-learning readiness was related to their satisfaction and motivation while undertaking academic tasks in the flipped classroom model of instruction.

McLaughlin et al. (2013) investigated whether 'flipping' a traditional course delivered synchronously to two campuses would improve student academic performance, engagement, and perception. It was found that the flipped classroom can enhance the quality of the

students' experiences in the course through thoughtful course design, enriched dialogue, and promotion of learner autonomy. The effect of flipped and non-flipped classrooms on students' active learning and engagement in a course was investigated in an experimental study by Stone (2012), who reported that flipping the class in a small classroom flipped the class result in large learning gains and positive attitudes towards the learning process. Many students agreed that flipped classrooms positively influenced their learning and performance in the classroom environment.

In the studies reported in the literature, students' sense of belonging in different learning environments (e.g., face-to-face, distance learning) has been examined. However, no study involved the effects of the flipped classroom environment on students' sense of belonging. Our study fills a gap in the literature. We investigated the flipped classroom model's impact on learners' sense of belonging and their academic success and academic satisfaction. These three variables were examined for three different classroom model environments in this study: the flipped classroom model, distance education model, and traditional classroom model.

Method

In this section, the research model, participants, Implementation Process, data collection tools, and data analysis are discussed.

Research model

In this quantitative study, an experimental design was used to investigate the effect of the flipped classroom model on participants' academic achievement, academic satisfaction, and general belongingness. The experimental design is called an intervention or group comparisons study that keeps various groups under observation to establish any possible change within groups (Creswell, 2012).

In the experimental model, a true experimental research design involves a pretest, a posttest, control groups, and random assignment of participants from a previously-determined subject pool (Creswell, 2012). In this study, one experiment and two control groups were formed. The research groups and procedures are described in Table 1. As seen in the table, the learning period took eight weeks for all groups, and the same questionnaires were used for both pretest and posttest.

Table 1 shows the random design with the pretest–posttest control group. For eight weeks, the traditional classroom model was implemented with the Control-1 group in a face-to-face environment Distance education was implemented with the Control-2 group in a web-based environment. The flipped classroom model was implemented with the Experimental group in both face-to-face and web-based environments together. The same questionnaires were used for both pretest and posttest for all groups.

Participants

We used purposeful sampling in which the participants are determined by the researcher (Cohen et al., 2005; Silverman, 2006). For this reason, the study was carried out with the

Table 1 Research design and procedures

Group	Pretest	Learning period (8 weeks)	Posttest
Control Group-1	Academic achievement test Academic satisfaction scale General belongingness scale	Traditional education (face-to-face environment)	Academic achievement test Academic satisfaction scale General belongingness scale
Control Group-2	Academic achievement test Academic satisfaction scale General belongingness scale	Distance education (web-based environment)	Academic achievement test Academic satisfaction scale General belongingness scale
Experimental group	Academic achievement test Academic satisfaction scale General belongingness scale	Flipped classroom (face-to-face and web-based environments)	Academic achievement test Academic satisfaction scale General belongingness scale

selected undergraduate students who have the skills to use information and communication technologies and have easy access to the internet. Participation in the study was voluntary.

This study was conducted in a faculty of education at a state university in middle-eastern Turkey. In this education faculty, 72.50% of these students are female, and 27.50% are male. Therefore, 75 (79.79%) of the 94 students who participated in the application were girls, and 19 (20.21%) were boys. Regarding daily internet use, 33 students who used the internet for 1–3 h, 47 students used it for 4–6 h, and 14 students used it for more than seven hours. Almost all students accessed the resources from home/dormitory, and four of them accessed them from school. Regarding accessing the resources, 72 of the students stated that they had no problems, 12 of them indicated that they had issues, and 10 indicated that they had a few problems. The main problems mentioned by the participants were technical issues, internet access or connection problems, login issues, and time restriction issues.

One critical element in experimental studies is the homogeneous structure of the groups (Creswell, 2012). A single instructor conducted courses. Before the implementation process, an academic achievement test was administered to all participants to ensure homogeneity and the equivalence of the groups. Therefore, students were divided into three groups by the researchers. But most of the students in the education faculty were female, but there were 6 or 7 male students in each group. Students were informed about the operation of the courses in three groups (face-to-face education, distance education, and flipped classroom). Later, students who wanted to change their groups were allowed to do so without disrupting the equivalence of the groups. The distribution of the participants in the groups is given in Table 2.

As shown in Table 2, while experimental and control groups were formed, the genders of participants were also taken into account and their academic achievement levels. As shown in Table 2, there was no significant difference between the pretest scores of the Control-1 ($X = 30.57$), Control-2 ($X = 29.56$) and Experimental ($X = 30.15$) groups

Table 2 Gender distribution of participants

Group	Female	%	Male	%	$\bar{X}$	sd	*F*	*p*
Control-1	24	25.53	6	6.38	30.57	12.815	.80	.812
Control-2	25	26.60	7	7.45	29.56	10.555		
Experimental	26	27.66	6	6.38	30.34	6.741		
Total	75	79.79	19	20.21	30.15	10.197		

[$F_{(2, 91)} = 0.08$, $p > 0.05$]. For this reason, the groups were considered similar before the implementation processes.

Implementation process

Before the implementation process, necessary permissions were obtained from the university where the study was carried out. Then, the participants were informed about the implementation, and the pretests were administered. Then, groups were formed based on participants' academic achievement test scores and genders, as shown in Table 2. The syllabus and all planned activities were followed in the same sequence in three groups. The course was prepared in a modular structure. The implementation of the Information Technology course lasted for eight weeks, and each module was completed over a week. The modules are given in Table 3.

As seen in Table 3, in the implementation process, the traditional classroom model was used for the Control-1 group, distance education model for the Control-2 group, and flipped classroom model for the Experimental group. In all three classroom models, the instructor delivered all the resources (documents, videos, and study files prepared by the instructor) to the participants for their use every week. Within the classroom models framework, the participants in the Control-1 group attended the courses in face-to-face sessions, and practices were conducted in the computer laboratory. With the Control-2 group, web-based synchronous (virtual classroom) and asynchronous (documents, videos, and study files prepared by the instructor) sessions were conducted, and participants were allowed to use the computer laboratory at any time.

Participants in the experimental group benefitted from the web-based asynchronous environment and resources (documents, videos, and study files prepared by the instructor) used by the Control-2 group. Also, they attended face-to-face sessions. The procedures in the flipped classroom out as follows:

- The instructor gave the experimental group an assignment with all the web-based environment resources before coming to the class.
- Participants watched videos and presentations, took notes, and completed their homework (wherever they were), and prepared questions about what they could not do in their homework.
- Participants communicated with the instructor in a web-based environment about what they needed to ask before the face-to-face sessions.

Table 3 Modules, environment and materials

Week	Modules	Environment and materials		
		Control-1	Control-2	Experimental
Week 1	Basic concepts related to information technologies	Face-to-face sessions in the computer laboratory and resources (documents, videos, and study files)	Web-based synchronous sessions (virtual classroom) and asynchronous resources (documents, videos, and study files)	Web-based asynchronous resources (documents, videos, and study files) and face-to-face sessions in the computer laboratory
Week 2	Operating systems			
Week 3	Word processing programs			
Week 4	Word processing programs			
Week 5	Calculation tables			
Week 6	Calculation tables			
Week 7	Preparation of presentations			
Week 8	Preparation of presentations			

- In the face-to-face sessions, in line with the nature of the questions, the instructor grouped participants before discussing the issues they had in the group and helped each other. The instructor assisted when necessary in these sessions.
- For questions that could not be answered, the instructor directed the participants to resources to find answers.
- The instructor asked students to do another example to test whether they had learned the module.

At the end of the implementation process, all posttests were administrated to the participants in three groups.

Instruments

For data collection, three questionnaires were used: Academic achievement-test, Academic Satisfaction Scale, and General Belongingness Scale. Detailed explanations of the scales are given below.

Academic achievement test

The Academic achievement test developed by Bingöl and Halisdemir (2017) consists of 26 questions. Item difficulty index values (Pj) ranged from 0.21 to 0.49. The average difficulty (p) of the test was 0.59. The test's Kuder Richardson-20 reliability was found to be 0.51.

Academic satisfaction scale

A five-point Likert-type Academic Satisfaction Scale developed by Schmitt et al. (2008) was used to determine the satisfaction level of university students. For this scale, individuals are asked to evaluate themselves for each item within the range from Strongly Disagree (1) to Strongly Agree (5). The internal consistency reliability of the scale was reported as 0.81 (Schmitt et al., 2008). The scale was adapted to Turkish by Balkis (2013). The internal consistency coefficient of the scale was reported as 0.86 for the Turkish version. Some of the 5-item scale items are "All in all, I am satisfied with the education I can get in this school" and "I'm happy with the amount I learn in my classes". In our study, this reliability coefficient was 0.85.

General belongingness scale

The General Belongingness Scale, developed by Malone et al. (2012), consists of 12 items with two dimensions (Acceptance/Inclusion and Rejection/Exclusion). The scale uses a seven-point Likert-type response ranging from Strongly Disagree (1) to Strongly Agree (7). The scale was adapted to Turkish by Duru and Balkis (2015). The internal consistency coefficient of the whole scale and its dimensions called "Acceptance", "Inclusion and Rejection", and "Exclusion" were calculated as 0.92, 0.89, and 0.09, respectively. Analyzes for confirmatory factor analysis of the scale supported the model ($\chi^2/df = 2.076$. GFI = 0.92, RMSEA = 0.07, SRMR = 0.04, CFI = 0.96, TLI = 0.95, RFI = 0.91, NFI = 0.93). Some of the items are "When I am with other people, I feel included" and "I feel accepted by

others" in the Acceptance/Inclusion dimension and "I feel like an outsider" and "I feel as if people do not care about me" in the Rejection/Exclusion dimension. In this study, the internal consistency coefficient of the scale was calculated as 0.93.

Data analysis

The Kolmogorov–Smirnov (K-S) test was used to examine whether the data were normally distributed (Dewan & Somanathan, 2007). Values between − 1.5 and + 1.5 are acceptable for normal distribution (Can, 2013; Tabachnick & Fidell, 2007). In this study, the K-S test, skewness, and kurtosis coefficients were calculated to ascertain whether group scores showed normal distribution or not for this purpose.

In this study, statistical analyses were performed with parametric tests (dependent groups *t*-test) or non-parametric tests (Wilcoxon signed-rank test). ANCOVA (Analysis of Covariance) was used to compare control and experimental groups. For the ANCOVA to give accurate results, the data of the groups are required to show normal distribution, their variances should be equal, a linear relationship should exist between the common variable and the dependent variable, and the slope of the regression lines should be equal (Buyukozturk, 2011; Can, 2013; Kalayci, 2010; Tabachnick & Fidell, 2007). However, ANOVA (Analysis of Variance) is used when ANCOVA does not satisfy assumptions. In cases where significant differences were observed, post hoc tests were employed to find the source of difference. LSD was used when the equal variance assumption was met and Tamhane's T2 test was used if there was a violation of the equal variance assumption.

Effect sizes were calculated in addition to statistical significance (Cohen et al., 2005). Statistical tests reveal whether there is a significant difference between two or more means, but they do not give information about the magnitude of differences (Can, 2013). The effect size *d* was calculated for the dependent groups with significant differences between scores, and η2 was calculated for the independent groups with significant differences between scores. The value of *d* is considered to indicate a very high effect size if it is greater than 1, a high effect if it is between 1 and 0.8, a medium effect if it is between 0.7 and 0.5, and a low effect if it is between 0.4 and 0.2 (Cohen, 1992; Thalheimer & Cook, 2002). The value of η2 is considered a high effect if it is greater than 0.14, a medium effect if it is between 0.13 and 0.06, and a low effect if it is between 0.05 and 0.01 (Can, 2013).

Findings

In this section, results are reported based on students' academic achievement, academic satisfaction, and general belongingness levels.

Findings related to academic achievement

Because data related to the academic achievement of the groups were normally distributed, dependent groups *t*-tests were performed to compare groups' pretest and posttest scores. The results are given in Table 4.

Table 4 Difference between pretest and posttest in academic achievement for three instructional groups

Group	Test	N	$\bar{X}$	SD	df	*t*	*p*	*d*
Control-1	Pretest	30	30.57	13.356	29	−5.980	.000*	−1.09
	Posttest	30	45.13	9.508				
Control -2	Pretest	32	29.56	10.555	31	−11.816	.000*	−2.09
	Posttest	32	48.44	9.239				
Experimental	Pretest	32	30.34	6.741	31	−12.044	.000*	−2.13
	Posttest	32	53.50	7.964				

*$p < .001$

As shown in Table 4, significant differences ($p < 0.001$) were found between the pretest ($X = 30.57$) and posttest ($X = 45.13$) scores of the Control-1 group, between the pretest ($X = 29.56$) and posttest ($X = 48.44$) scores of the Control-2 group, and between the pretest ($X = 30.34$) and post-test ($X = 53.50$) scores of the Experimental group. Also, high effect size values ($d_{control\text{-}1} = -1.09$; $d_{control\text{-}2} = -2.09$; $d_{experimental} = -2.13$) were observed in all groups after the implementation process. The most important finding is that the experimental group had the highest increase in terms of academic achievement.

ANCOVA was used to compare the academic achievement posttest scores of the Control-1, Control-2, and Experimental groups. Before conducting ANCOVA, four assumptions were tested. According to the first assumption, the data showed a normal distribution. For the second assumption, the variances of the achievement posttest scores were determined to be equal ($F = 6.955$, $p = 0.54$). For the third assumption, the slopes of the regression lines were close to each other and there was a linear relationship between the dependent variable (pretest) and the common variable (posttest), thus justifying conducting ANCOVA. For the last assumption, the group x pretest interaction for academic achievement posttest scores was found to be statistically nonsignificant ($F = 1.826$; $p = 0.167$). These findings show that the regression lines for testing the posttest scores apply equally to the pretest scores. This means that the fourth assumption was also met.

After all assumptions had been tested, ANCOVA was applied. Adjusted academic achievement pretest scores for each group were calculated along with descriptive statistics. The new value for the Control-1 group was 45.00, for the Control-2 group was 48.63, and for the Experimental group was 53.44. ANCOVA was conducted to determine whether this change between academic achievement pretest and posttest scores was statistically significant. ANCOVA results are shown in Table 5.

Table 5 ANCOVA results comparing posttest achievement of three groups while controlling pretest achievement

Source of variance	Sum of squares	SD	Mean of squares	*F*	*p*	LSD	η^2
Pretest	1012.564	1	1012.564	14.649	.000*	c > a	.13
Group	1113.641	2	556.821	8.056	.001*	c > b	
Error	6220.778	90	67.874				
Total	235.014	94					

*$p <= .001$; a = Control-1, b = Control-2, c = Experimental

Table 6 Changes in academic satisfaction between pretest and posttest for three instructional groups

Group	Test	N	$\bar{X}$	SD	df	*t*	*p*	*d*
Control-1	Pretest	30	3.85	.506	29	.688	.497	–
	Posttest	30	3.74	.944				
Control-2	Pretest	32	3.48	.621	31	−1.354	.185	–
	Posttest	32	3.68	.714				
Experimental	Pretest	32	3.70	.413	31	−5.079	.000*	−.89
	Posttest	32	4.29	.660				

*$p < .001$

Table 7 ANCOVA results comparing posttest satisfaction of three instructional groups while controlling for pretest satisfaction

Source of variance	Sum of squares	df	Mean of squares	*F*	*p*	LSD	η^2
Pretest	5.375	1	5.375	9.712	.002*	c > a	.12
Group	6.878	2	3.439	6.213	.003*	c > b	
Error	49.812	90	.553				
Total	1495.24	94					

*$p <= .01$; a = Control-1, b = Control-2, c = Experimental group

Academic achievement pretest scores were included in the analysis as a covariate or control variable, and the significance of the difference between the three groups' achievement posttest scores was tested (Table 5). There was a significant difference between the adjusted academic achievement posttest scores according to the pretest scores [$F_{(2-90)} = 8.056$, $p = 0.001$]. To determine the magnitude of the difference, the effect size ($\eta^2 = 0.13$) was calculated and was found to be moderate. According to the LSD test conducted to identify the differences between the adjusted posttest scores of the three groups, the academic achievement of the experimental group using the flipped classroom model was higher than for Control-1 using the face-to-face classroom model and for Control-2 using the distance education.

A dependent groups *t*-test was performed to compare the pretest and posttest satisfaction scores of the three groups. The results are provided in Table 6.

As seen in Table 6, although no significant difference was observed between pretest ($X = 3.85$) and posttest ($X = 3.74$) academic satisfaction for Control-1 group and between pretest ($X = 3.48$) and posttest ($X = 3.68$) academic satisfaction for Control-2 group ($p > 0.05$), a significant difference was found between pretest ($X = 3.70$) and posttest ($X = 4.29$) academic satisfaction of the Experimental group ($p < 0.001$). Moreover, the effect size for the experimental group is high ($d = -0.89$).

ANCOVA was used to compare the academic satisfaction posttest scores of Control-1, Control-2, and Experimental groups. According to the first assumption of ANCOVA, the data showed normal distribution. For the second assumption, the variances of posttest scores were equal ($F = 5.929$, $p = 0.17$). For the third assumption, the slope of the regression lines was close to each other. There was a linear relationship between the dependent variable (pretest) and the common variable (posttest) and it, suggesting suitability for ANCOVA. For the last assumption, the group x pretest interaction on academic

achievement posttest scores was statistically nonsignificant [$F=0.457$; $p=0.635$]. These findings show that the regression lines calculated for testing the post-test scores were equal based on the pre-test scores. This means that the fourth assumption was also met.

The adjusted academic satisfaction pre-test scores for each group were calculated with descriptive statistics. The new value for Control-1 group was 3.66, for Control-2 group was 3.77, and for the Experimental group was 4.28. ANCOVA was conducted to determine whether the change in academic satisfaction between pretest and posttest was statistically significant (Table 7).

Academic satisfaction pretest scores were included as a control variable while the significance of between-group differences in academic satisfaction posttest scores was tested (Table 7). There was a significant difference between the three instructional groups in their posttest satisfaction scores when pretest was controled [$F_{(2-90)}=6.213$, $p=0.003$]. Regarding the magnitude of the difference, the effect size ($\eta^2=0.12$) size was moderate. According to the LSD test conducted to reveal the differences between the adjusted posttest scores of the groups, the academic satisfaction of the experimental group using the flipped classroom model was higher than for Control-1 using the face-to-face classroom model and for Control-2 using distance education.

Findings related to general belongingness

To compare the three instgructional groups on acceptance/inclusion, pretest and posttest scores for the General Belongingness Scale were compared using a dependent groups *t*-test (Table 8).

As seen in Table 8, there was no significant difference between pretest ($\bar{X}=4.13$) and posttest ($\bar{X}=4.03$) scores for acceptance/inclusion of the Control-1 group, or between pretest ($\bar{X}=3.96$) and posttest ($\bar{X}=4.10$) scores of the Control-2 group. But a significant change was found between the pre-test ($\bar{X}=4.33$) and posttest ($\bar{X}=4.59$) scores of the experimental group ($p<0.001$). The effect size of 0.61 for the experimental group was medium. Thus, the acceptance/inclusion dimension of the general belongingness scale had the highest pretest–posttest increase for the experimental group with the flipped classroom model.

It was checked whether ANCOVA test assumptions were met before attempting to compare acceptance/inclusion posttest scores of the three groups. The data did not show a normal distribution, and the variances were not equal ($F=6.106$, $p=0.006$). Therefore,

Table 8 Difference between pretest and posttest acceptance/inclusion for three instructional groups

Group	Test	n	$\bar{X}$	ss	SD	*t*	*p*	*d*
Control-1	Pre-test	30	4.13	.549	29	.623	.538	
	Post-test	30	4.03	.880				
Control-2	Pre-test	32	3.96	.429	31	−1.243	.223	
	Post-test	32	4.10	.732				
Experimental	Pre-test	32	4.33	.480	31	−3.430	.002*	−.61
	Post-test	32	4.59	.374				

*$p<=.01$

Table 9 ANOVA results for comparison of three instructional groups on acceptance/inclusion posttest scores

Groups	N	$\bar{X}$	Source of variance	Sum of squares	SD	Mean of squares	F	*p*	Tamhane	η^2
Control-1	30	4.03	Between groups	5.824	2	2.912	5.481	.003*	c > a	.12
Control-2	32	4.11	Within groups	43.401	91	.477			c > b	
Experimental	32	4.59	Total	49.224	93					
Total	94	4.25								

*$p <= .01$; a = Control-1, b = Control-2, c = Experimental group

ANOVA was used to compare acceptance/inclusion posttest scores of the three groups (Table 9).

Table 9 reveals a significant difference between the three groups in terms of their acceptance/inclusion posttest scores [$F_{(2,91)} = 5.481$; $p < 0.05$]. To identify the source of the difference, Tamhane's T2 test used to identify that the difference was between the experimental group ($X = 4.59$) and Control-1 ($X = 4.03$) and Control-2 ($X = 4.11$) in favor of the experimental group. The effect size was medium level ($\eta^2 = 0.12$). In summary, the experimental group with the flipped classroom model had higher scores than the two control groups in terms of the acceptance/inclusion dimension of the General Belongingness Scale.

Pretest and posttest scores for the rejection/exclusion dimension showed a normal distribution for Control-1 data, but not for Control-2 and Experimental groups. Therefore, for Control-1, pretest and posttest rejection/exclusion scores were compared using a dependent group *t*-test. The results provided in Table 10 confirm no significant difference between pretest ($X = 4.05$) and posttest ($X = 3.96$) rejection/exclusion scores in Control-1 group.

To compare pretest and posttest rejection/exclusion scores for Control-2 students, the Wilcoxon signed-rank test was performed. The results Table 11 confirm no significant difference between the pretest and posttest scores for Control-2 group [$Z = -2.868$; $p = 0.062$].

The Wilcoxon signed-rank test was also performed for the experimental group to compare rejection/exclusion pretest and posttest scores. The results in Table 12 show no significant pretest–posttest difference in rejection/inclusion scores for the Experimental group [$Z = -1.217$; $p = 0.224$].

ANOVA was performed to compare the three groups on their rejection/exclusion posttest scores. The results in Table 13 show a significant difference among the groups in rejection/exclusion posttest scores [$F_{(2,91)} = 5.551$; $p < 0.05$]. According to

Table 10 Difference between pretest and posttest rejection/exclusion scores for Control-1 group

Group	Test	*n*	$\bar{X}$	SD	df	*t*	*p*
Control-1	Pretest	30	4.05	.838	29	.425	.674
	Posttest	30	3.96	1.093			

Table 11 Difference between pretest and posttest scores for rejection/exclusion for Control-2 group

Pretest and posttest	*N*	Mean ranks	Sum of ranks	*Z*	*p*
Negative ranks	8	13.34	111.50	−2.868	.062
Positive ranks	19	14.03	266.50		
Ties	5				
Total	32				

Table 12 Comparisons of pretest and posttest rejection/exclusion scores for Experimental group

Pretest and posttest	*N*	Mean ranks	Sum of ranks	*Z*	*p*
Negative ranks	8	9.06	72.50	−1.217	.224
Positive ranks	12	11.46	137.50		
Ties	12				
Total	32				

Table 13 ANOVA results for comparison of three instructional groups on posttest rejection/exclusion scores

Group	N	$\bar{X}$	Source of Variance	Sum of squares	SD	Mean of squares	F	p	Tamhane	η^2
Control-1	30	3.96	Between groups	7.389	2	3.690	5.551	.008*	c > a	.10
Control-2	32	4.30	Within groups	65.321	31	.718				
Experimental	32	4.65	Total	72.700	93					
Total	94	4.31								

*$p <= .01$; a = Control-1, b = Control-2, c = Experimental group

the Tamhane's T2 test, a significant difference existed between the experimental group ($\bar{X} = 4.65$) and Control-1 group ($\bar{X} = 3.96$), in favor of the experimental group and with a medium effect size ($\eta^2 = 0.10$). The experimental group scores using the flipped classroom model had higher rejection/exclusion posttest scores.

Conclusion and discussion

In this study, the effects of the flipped classroom model on students' academic achievement, academic satisfaction, and general belongingness were investigated. For over eight weeks, an Information Technology course was taught to experimental and control groups using different learning techniques and classroom models.

When the three instructional groups were compared in terms of academic achievement, significant differences were observed between the pretest–posttest changes of the groups and among the groups' posttest scores. One of the critical findings is that the experimental group with the flipped classroom model had the largest increase in academic achievement, with a very high effect size. Results of the study by Karabatak and Polat (2020) indicated that the academic achievement levels of students in the flipped classroom model using ARCS motivation strategies were significantly higher than those of the students in the distance education classroom model and the traditional classroom model. For the flipped classroom model, the instructor gives the course resources to the students before face-to-face sessions. Regardless of time and environment, students study these resources and mostly take advantage of the videos. Then, by using these resources, students try to do the homework given by the instructor. Also, they have an opportunity to ask the instructors and their group members about the points that they do not understand while doing the homework in a face-to-face environment. These steps in flipped classrooms can make learning more effective. Naturally, this situation can be interpreted as an essential explanation of why students in the flipped classroom model have higher academic achievement than other classroom models.

This finding is parallel to the results of some other studies of the effect of flipped classrooms on academic achievement (Alamri, 2019; Chen Hsieh et al., 2017; Davies et al., 2013; Karabatak & Polat, 2020; El-Banna, 2017; Evseeva & Solozhenko, 2015; Karadeniz, 2018; Karagol & Esen, 2018; Kazanidis et al., 2019; Kim et al., 2014a, b; McLaughlin et al., 2013; Orhan, 2019; Peterson, 2016; Sergis et al., 2018; Stone, 2012; Zainuddin & Halili, 2016; Zhonggen & Guifang, 2016). In addition to academic achievement, a few studies also confirmed an increase in motivation, which is a critical element in academic achievement, in the flipped classrooms (Chao et al., 2015; Chen Hsieh et al., 2017; Evseeva & Solozhenko, 2015; Peterson, 2016; Zainuddin & Halili, 2016). Moreover, in other studies, increases in students' academic skills (Asiksoy & Ozdamlı, 2016; Deslauriers et al., 2011; González-Gómez et al., 2016; Hung, 2014; Kong, 2014; Kostaris et al., 2017; Love et al., 2013; O'Flaherty & Phillips, 2015; Roach, 2014; Schultz et al., 2014; Turel & Sanal, 2018) and participation (Chen et al., 2014; Deslauriers et al., 2011; Hung, 2014; Willey & Gardner, 2013) were observed.

On the other hand, other empirical studies reported no significant effect of the flipped classroom model on students' academic achievement (Frydenberg, 2013; Winter, 2013) or small but statistically-significant improvements (Mason et al., 2013; Murphree, 2014; Talley & Scherer, 2013; Tune et al., 2013; Wilson, 2013). In another study by Goedhart et al. (2019), the combination of personalized pre-classroom learning and peer-learning

classroom activities facilitated deeper learning in the flipped classroom. However, although students' experience was positive in our study, not all students agreed that flipped classroom environments contributed to positive learning outcomes. Therefore, future research is needed to clarify this situation by considering various variables that could affect students' academic achievement in flipped classrooms.

When students' academic satisfaction scores were compared for the three groups, nonsignificant results were found in the distance education and traditional education environments. However, a statistically significant increase occurred in students' academic satisfaction in the flipped classroom. Students in the flipped classroom had a more considerable increase in their satisfaction level than students in distance education and traditional education classrooms. In the flipped classroom model, students attend face-to-face sessions and have an opportunity to learn subjects or topics that they do not understand from their friends or instructors. This situation can lead to an increase not only in academic success but also in student satisfaction.

Similar results were found in other studies focusing on the flipped classroom model (Alamri, 2019; Alsowat, 2016; Cigdem et al., 2016; Davies et al., 2013; El-Banna, 2017; Kazanidis et al., 2019; Moraros et al., 2015; Yilmaz, 2017; Zhonggen & Guifang, 2016). Cigdem et al. (2016) found that self-regulation, interaction among learners, and course content are the critical predictors of academic satisfaction in the flipped classrooms. Also, they posited that instructor–student interaction did not influence students' academic satisfaction. Despite the significant results of some prior studies, other studies reported a noninsignificant link between flipped classrooms and academic satisfaction (Missildine et al., 2013; Whillier & Lystad, 2015). Moreover, Strayer (2012) concluded that students were less satisfied in the flipped classrooms than in traditional classrooms. Thus, to examine academic satisfaction, future research should include various variables, including students' readiness to be part of a flipped classroom, their self-regulation and learning abilities, their interactions among students, and the course content that affects learning in a flipped classroom.

Finally, in this study, the three groups were compared in terms of the general belongingness level of students. Despite nonsignificant pretest–posttest changes for the control groups, a significant difference was observed for flipped classroom students. In terms of posttest scores, students in the flipped classroom had higher belongingness than the control groups. In the flipped classroom model, the instructor divided students into groups according to the topics they did not understand during the face-to-face session and allowed them to learn from each other. It can be said that peer learning occurs while students study with their group friends in the same classroom environment. Thus, this situation is likely to enable students to feel belonging to a group or a community, and therefore students' sense of belonging develops.

In the literature, the belongingness level of participants was not included as a variable in studies related to the flipped classroom model. Our study is among the first to combine general belongingness as a research variable focusing on the flipped classroom model. However, it has been included in studies related to blended learning (Keskin & Seferoglu, 2017; Rovai & Jordan, 2004; Tayebinik & Puteh, 2012) and online learning (Alexander, 2001; Emmanuel-Frenel, 2017; Koole, 2010; Lapointe & Reiseter, 2008; Peacock & Cowan, 2019; Thomas et al., 2014) approaches. In these studies, it was found that belongingness was higher in blended learning environments. Moreover, Keskin and Seferoglu (2017) found that preservice teachers in blended learning environments had a good sense of belonging to their profession and their family and friends. Thus, future research should include the sense of general belonging when evaluating the flipped classroom model.

Thomas et al. (2014) found that a sense of belonging could lead to greater learner satisfaction, and Emmanuel-Frenel (2017) found that increased use and satisfaction regarding student support services in distance education were associated with students' sense of belonging to the learning community.

Limitations of the study

There are some limitations to this study. Because participants consisted of undergraduate students, this study cannot be generalized to other groups regarding the effects of the flipped classroom model on students' academic achievement, academic satisfaction, and general belongingness level. Thus, future research should be conducted with different participants from various levels of education. Another limitation is related to the implementation process. For this study, the implementation lasted for eight weeks because of the difficulty in preparing course materials, but more time is needed to prepare course materials. Future research should take this time limitation factor into account. In line with this issue, the Ministry of National Education of Turkey, with support from universities, should provide resources for the preparation of digital materials, videos, and presentations for flipped classrooms. The last limitation is that the criteria for selecting the participants and the course might have affected participants' academic achievement, academic satisfaction, and general belongingness because, in this study, the flipped classroom was formed for the Information Technologies course and participation in the study was voluntary and involved participants who could use technology effectively. Therefore, replication of the study is suggested with various courses and participants to identify the effects of the flipped classroom model.

Conclusion

In conclusion, technology integration into education influences students' attention towards course content, learning pace, motivation, self-confidence, and attitudes towards courses, as well as increasing self-evaluation and academic achievement (Arabaci & Polat, 2013). This study confirmed that a flipped classroom model that integrates technology into the educational environment improved students' academic achievement, academic satisfaction, and general belongingness. Currently, international organizations such as the European Union (EU) and the Organization for Economic Development and Cooperation (OECD) and countries such as the United States, Japan, Singapore, and Australia have allocated large budgets for projects based on the use of information technologies in education (Gokoglu, 2014). To increase the quality of education in Turkey, similar projects and investments have been employed. Specifically, the Digital Transformation in Higher Education Project that started in February 2019 requires the transformation of learning processes into the digital environment and the flipped classroom model. Similar projects should be introduced to the Turkish educational system to improve the quality of education.

References

Alamri, M. M. (2019). Students' academic achievement performance and satisfaction in a flipped classroom in Saudi Arabia. *International Journal of Technology Enhanced Learning, 11*(1), 103–119. https://doi.org/10.1504/IJTEL.2019.096786

Alexander, S. (2001). Learning in 3-D: Three-dimensional virtual classrooms recapture the sense of belonging often missing from distance learning. *Online Learning, 5*(7), 30–32.

Alsowat, H. (2016). An EFL flipped classroom teaching model: Effects on English language higher-order thinking skills, student engagement and satisfaction. *Journal of Education and Practice, 7*(9), 108–121.

Altiparmak, M., Kurt, I. D., & Kapidere, M. (2011). *E-Learning and open source code management systems in education*. Akademik Bilişim'11, 2–4 Şubat 2011. Canakkale Onsekiz Mart University.

Arabaci, I. B., & Polat, M. (2013). Digital natives, digital immigrants and classroom management. *Electronic Journal of Social Sciences, 12*(47), 11–20.

Asiksoy, G., & Ozdamlı, F. (2016). Flipped classroom adapted to the ARCS model of motivation and applied to a physics course. *Eurasia Journal of Mathematics, Science and Technology Education, 12*(6), 1589–1603.

Aslanturk, O. (2002). *Design and implementation of a web-based distance education management system.* Unpublished Master's thesis, Hacettepe University, Ankara.

Author (2019).

Balkis, M. (2013). Academic procrastination, academic life satisfaction and academic achievement: The mediation role of rational beliefs about studying. *Journal Cognitive and Behavioral Psychotherapies, 13*(1), 57–74.

Bay, O. F., & Tuzun, H. (2002). Delivering course content with web in higher educational institutions—Part I. *Journal of Polytechnic, 5*(1), 13–22.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. International Society for Technology in Education.

Bingöl, A., & Halisdemir, N. (2017). Development of academic achievement test for the university students in basic information technologies course. *The Journal of Academic Social Science Studies, 54,* 541–554.

Can, A. (2013). *Quantitative data analysis by scientific research process with SPSS*. Pegem Publishing.

Carswell, A. D., & Venkatesh, V. (2002). Learner outcomes in an asynchronous distance education environment. *International Journal of Human-Computer Studies, 56*(5), 475–494.

Chao, C. Y., Chen, Y. T., & Chuang, K. Y. (2015). Exploring students' learning attitude and achievement in flipped learning supported computer aided design curriculum: A study in high school engineering education. *Computer Applications in Engineering Education, 23*(4), 514–526.

Chen Hsieh, J. S., Wu, W. C. V., & Marek, M. W. (2017). Using the flipped classroom to enhance EFL learning. *Computer Assisted Language Learning, 30*(1–2), 1–21.

Chen, Y., Wang, Y., & Chen, N. S. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Computers and Education, 79,* 16–27.

Cigdem, H., Ozturk, M., & Topcu, A. (2016). Self-regulation and ınteractivity types as the predictors of learner satisfaction with flipped courses: Evidence from a vocational college. *The Eurasia Proceedings of Educational and Social Sciences, 5,* 135–138.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155–159.

Cohen, L., Manion, L., & Morrison, K. (2005). *Research methods in education* (5th ed.). Routledge Falmer.

Chrisman, N. R., & Harvey, F. J. (1998). Extending the classroom: Hypermedia-supported learning. *Journal of Geography in Higher Education, 22*(1), 11–18.

Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research and Development, 61*(4), 563–580.

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science, 332*(6031), 862–864. https://doi.org/10.1126/science.1201783

Dewan, I., & Somanathan, R. 2007. *Poverty targeting in public programmes: A comparison of some non-parametric tests and their application to Indian microfinance* (Working paper no. 154). Centre for Development Economics, Delhi School of Economics.

Duru, E., & Balkis, M. (2015). The analysis of relationships between person-environment fit, sense of belongingness, academic satisfaction and academic achievement. *Ege Journal of Education, 16*(1), 122–141.

El-Banna, M. M., Whitlow, M., & McNelis, A. M. (2017). Flipping around the classroom: Accelerated Bachelor of Science in Nursing students' satisfaction and achievement. *Nurse Education Today, 56,* 41–46.

Emmanuel-Frenel, R. (2017). *A study of the relationship between distance learners' perception of the value of student support services and a sense of belonging in the university's learning community*. Gwynedd Mercy University.

Evseeva, A., & Solozhenko, A. (2015). Use of flipped classroom technology in language learning. *Procedia-Social and Behavioral Sciences, 206,* 205–209.

Frydenberg, M. (2013). Flipping excel. *Information Systems Education Journal, 11*(1), 63–73.

Gencer, B., G., Gurbulak, N., & Adiguzel, T. (2014, February). Eğitimde yeni bir süreç: Ters-yüz sınıf sistemi. In *International Teacher Education Conference (ITEC 2014) Proceeding Book,* pp. 889–896, Istanbul, Turkey.

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutrition Education and Behavior, 47*(1), 109–114.

Goedhart, N. S., Blignaut-van Westrhenen, N., Moser, C., & Zweekhorst, M. B. M. (2019). The flipped classroom: Supporting a diverse group of students in their learning. *Learning Environments Research, 22*(2), 297–310. https://doi.org/10.1007/s10984-019-09281-2

González-Gómez, D., Jeong, J. S., & Rodríguez, D. A. (2016). Performance and perception in the flipped learning model: An initial approach to evaluate the effectiveness of a new teaching methodology in a general science classroom. *Journal of Science Education and Technology, 25*(3), 450–459.

Goodenow, C. (1992). Strengthening the links between educational psychology and the study of social contexts. *Educational Psychologist, 27,* 177–196.

Goodenow, C., & Grady, K. E. (1993). The relationship of school belonging and friends' values to academic motivation among urban adolescent students. *The Journal of Experimental Education, 62*(1), 60–71.

Goodwin, B., & Miller, K. (2013). Evidence on flipped classrooms is still coming in. *Educational Leadership, 70*(6), 78–80.

Gokoglu, S. (2014). *Evaluation of technology integration into learning environments by using system based mentoring model*. Unpublished Master's thesis, Karadeniz Technical University, Trabzon

Hannafin, M. J., Hill, J. R., & Land, S. M. (1997). Student-centered learning and interactive multimedia: Status, issues, and implication. *Contemporary Education, 68*(2), 94–99.

Hung, H. T. (2014). Flipping the classroom for English language learners to foster active learning. *Computer Assisted Language Learning, 28*(1), 81–96. https://doi.org/10.1080/09588221.2014.967701

Ilgaz, H., & Askar, P. (2009). Sense of community in online distance education environment scale development study. *Turkish Journal of Computer and Mathematics Education, 1*(1), 27–35.

Kalayci, Ş. (2010). *SPSS applied multivariate statistics techniques*. Asil Publishing.

Karabatak, S., & Polat, H. (2020). The effects of the flipped classroom model designed according to the ARCS motivation strategies on the students' motivation and academic achievement levels. *Education and Information Technologies, 25*, 1475–1495.

Karabatak, S., & Turhan, M. (2017). Effectiveness of web-based problem-based school administrator training program and its effect on participants' attitudes towards web-based learning. *PEGEGOG, 7*(4), 663–712.

Karadeniz, A. (2018). The effect of the flipped classroom model on learners' academic achievement, attitudes and social presence. *Anadolu Journal of Educational Sciences International, 8*(1), 195–213.

Karagol, I., & Esen, E. (2018). The effect of flipped learning approach on academic achievement: A meta-analysis study. *Hacettepe University Journal of Education*. https://doi.org/10.16986/HUJE.2018046755

Kazanidis, I., Pellas, N., Fotaris, P., & Tsinakos, A. (2019). Can the flipped classroom model improve students' academic performance and training satisfaction in higher education instructional media design courses? *British Journal of Educational Technology, 50*(4), 2014–2027.

Keser, H., Gocmenler, G., & Kalfa, F. D. (2002). Web tabanlıöğretimmateryalihazırlamasürecinintemele vrelerive internet kullanımınayönelikbiruygulamaörneği. *Sakarya University Journal of Education Faculty, 4,* 189–197.

Keskin, S., & Seferoglu, S. (2017). An investigation of prospective teachers' sense of belonging and perceptions of the community of inquiry. *Mehmet AkifErsoy University Journal of Faculty of Education*. https://doi.org/10.21764/maeuefd.309133

Kim, M. K., Kim, S. M., Khera, O., & Getman, J. (2014a). The experience of three flipped classrooms in an urban university: An exploration of design principles. *The Internet and Higher Education, 22,* 37–50. https://doi.org/10.1016/j.iheduc.2014.04.003

Kim, S. H., Park, N. H., & Joo, K. H. (2014b). Effects of flipped classroom based on smart learning on self-directed and collaborative learning. *International Journal of Control and Automation, 7*(12), 69–80.

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers and Education, 78,* 160–173.

Kostaris, C., Stylianos, S., Sampson, D. G., Giannakos, M., & Pelliccione, L. (2017). Investigating the potential of the flipped classroom model in K-12 ICT teaching and learning: An action research study. *International Forum of Educational Technology and Society, 20*(1), 261–273.

LaPointe, L., & Reisetter, M. (2008). Belonging online: Students' perceptions of the value and efficacy of an online learning community. *International Journal on E-Learning, 7*(4), 641–665.

Larcara, M. (2014). Benefits of the flipped classroom model. In J. Keengwe (Ed.), *Promoting active learning through the flipped classroom model* (pp. 132–144). IGI Global.

Limniou, M., Schermbrucker, I., & Lyons, M. (2018). Traditional and flipped classroom approaches delivered by two different teachers: The student perspective. *Education and Information Technologies, 23*(2), 797–817.

Love, B., Hodge, A., Grandgenett, N., & Swift, A. W. (2013). Student learning and perceptions in a flipped linear algebra course. *International Journal of Mathematical Education in Science and Technology, 45*(3), 317–324. https://doi.org/10.1080/0020739X.2013.822582

MacDonald, C. J., Stodel, E. J., Farres, L. G., Breithaupt, K., & Gabriel, M. A. (2001). The demand-driven learning model: A framework for web-based learning. *The Internet and Higher Education, 4*(1), 9–30. https://doi.org/10.1016/S1096-7516(01)00045-8

Malone, G. P., Pillow, D. R., & Osman, A. (2012). The general belongingness scale (GBS): Assessing achieved belongingness. *Personality and Individual Differences, 52,* 311–316.

Mason, G., Shuman, T., & Cook, K. (2013). Comparing the effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course. *IEEE Transactions on Education, 56*(4), 430–435.

McLaughlin, J. E., Griffin, L. M., Esserman, D. A., Davidson, C. A., Glatt, D. M., Roth, M. T., & Mumper, R. J. (2013). Pharmacy student engagement, performance, and perception in a flipped satellite classroom. *American Journal of Pharmaceutical Education, 77*(9), 1–8.

Means, B. (1994). Introduction: Using technology to advance educational goals. In B. Means (Ed.), *Technology and education reform: The reality behind the promise* (pp. 1–21). Jossey-Bass.

Missildine, K., Fountain, R., Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. *Journal of Nursing Education, 52*(10), 597–599.

Moraros, J., Islam, A., Yu, S., Banow, R., & Schindelka, B. (2015). Flipping for success: Evaluating the effectiveness of a novel teaching approach in a graduate level setting. *BMC Medical Education, 15,* 27. https://doi.org/10.1186/s12909-015-0317-2

Murphree, D. S. (2014). "Writing wasn't really stressed, accurate historical analysis was stressed": Student perceptions of in-class writing in the inverted, general education, university history survey course. *History Teacher, 47*(2), 209–219.

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education, 25,* 85–95.

Ohler, J. (1991). Why distance education? *The Annals of the American Academy of Political and Social Science, 514*(1), 22–34.

Oral, B., & Kenanoglu, R. (2012). The effect of the web-based distance learnings systems on students' success, retention of the learnings and attitudes towards the computer. *Journal of Electronic Education Sciences, 1*(2), 68–85.

Orhan, A. (2019). The effect of flipped learning on students' academic achievement: A meta-analysis study. *Cukurova University Faculty of Education Journal, 48*(1), 368–396.

Peacock, S., & Cowan, J. (2019). Promoting sense of belonging in online learning communities of inquiry in accredited courses. *Online Learning, 23*(2), 67–81. https://doi.org/10.24059/olj.v23i2.1488

Peterson, D. J. (2016). The flipped classroom improves student achievement and course satisfaction in a statistics course: A quasi-experimental study. *Teaching of Psychology, 43*(1), 10–15.

Polat, H. (2016). *Investigation of classroom management in online learning environments in terms of various variables.* Unpublished doctoral dissertation, Firat University, Elazig.

Roach, T. (2014). Student perceptions toward flipped learning: New methods to increase interaction and active learning in economics. *International Review of Economics Education, 17,* 74–84.

Rovai, A. P. (2001). Classroom community at a distance: A comparative analysis of two ALN-based university programs. *The Internet and Higher Education, 4*(2), 105–118.

Rovai, A. P. (2002). Building sense of community at a distance. *The International Review of Research in Open and Distance Learning*. https://doi.org/10.19173/irrodl.v3i1.79

Rovai, A. P., & Jordan, H. (2004). Blended learning and sense of community: A comparative analysis with traditional and fully online graduate courses. *The International Review of Research in Open and Distributed Learning, 5*(2), 1–13.

Sari, M. (2013). The sense of belonging to school in high school students. *Anadolu University Journal of Social Sciences, 13*(1), 147–160.

Schmitt, N., Oswald, F. L., Friede, A., Imus, A., & Merritt, S. (2008). Perceived fit with an academic environment: Attitudinal and behavioral outcomes. *Journal of Vocational Behavior, 72,* 317–335.

Schultz, D., Duffield, S., Rasmussen, S. C., & Wageman, J. (2014). Effects of the flipped classroom model on student performance for advanced placement high school chemistry students. *Journal of Chemical Education, 91*(9), 1334–1339.

Sergis, S., Sampson, D. G., & Pelliccione, L. (2018). Investigating the impact of flipped classroom on students' learning experiences: A self-determination theory approach. *Computers in Human Behavior, 78,* 368–378.

Shea, P., Hayes, S., Smith, S. U., Vickers, J., Bidjerano, T., Pickett, A., et al. (2012). Learning presence: Additional research on a new conceptual element within the Community of Inquiry (CoI) framework. *The Internet and Higher Education, 15*(2), 89–95. https://doi.org/10.1016/j.iheduc.2011.08.002

Silverman, D. (2006). *Interpreting qualitative data* (3rd ed.). Sage.

Stone, B. B. (2012, May). Flip your classroom to increase active learning and student engagement. In *Proceedings from 28th Annual Conference on Distance Teaching and Learning, Madison, Wisconsin, USA*.

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation, and task orientation. *Learning Environments Research, 15,* 171–193. https://doi.org/10.1007/s10984-012-9108-4

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. Allyn & Bacon/Pearson Education.

Talbert, R. (2012). Inverted classroom. *Colleagues*, *9*(1), 1–2. http://scholarworks.gvsu.edu/colleagues/vol9/iss1/7

Talley, C., & Scherer, S. (2013). The enhanced flipped classroom: Increasing academic performance with student-recorded lectures and practice testing in a "flipped" stem course. *Journal of Negro Education, 82*(3), 339–347.

Taspinar, M. (2012). *Teaching principles and methods from theory to practice*. Elhan Book.

Tayebinik, M., & Puteh, M. (2012). Blended learning or e-learning? *International Magazine on Advances in Computer Science and Telecommunications, 3*(1), 103–110.

Thalheimer, W., & Cook, S. (2002). How to calculate effect sizes from published research: A simplified methodology. *Work-Learning Research, 1,* 1–9.

Thomas, L., Herbert, J., & Teras, M. (2014). A sense of belonging to enhance, participation, success and retention in online programs. *The International Journal of the First Year in Higher Education, 5*(2), 69–80.

Tune, J. D., Sturek, M., & Basile, D. P. (2013). Flipped classroom model improves graduate student performance in cardiovascular, respiratory, and renal physiology. *Advances in Physiology Education, 37*(4), 316–320.

Turan, S. (2015a). Fundamentals of classroom management. In M. Sisman & S. Turan (Eds.), *Classroom management* (pp. 1–19). Pegem Publishing.

Turan, Z. (2015). *The evaluation of flipped classroom method and examination of its effects on academic achievement, cognitive load and motivation*. Unpublished doctoral dissertation, Atatürk University, Erzurum.

Turel, Y. K., & Sanal, S. O. (2018). The effects of an ARCS based e-book on students' achievement, motivation and anxiety. *Computers and Education, 127,* 130–140. https://doi.org/10.1016/j.compedu.2018.08.006

Verleger, M. A., & Bishop, L. J. (2013, June). *The flipped classroom: A survey of the research*. Paper presented at 120th American Society of Engineering Education Annual Conference and Exposition, Atlanta, GA.

Whillier, S., & Lystad, R. P. (2015). No differences in grades or level of satisfaction in a flipped classroom for neuroanatomy. *Journal of Chiropractic Education, 29*(2), 127–133.

Willey, K., & Gardner, A. (2013, September). *Flipping your classroom without flipping out*. Paper presented at 41 SEFI Conference, Leuven, Belgium. Retrieved from https://www.academia.edu/5153284/Flipping_your_classroom_without_flipping_out.

Wilson, S. G. (2013). The flipped class: A method to address the challenges of an undergraduate statistics course. *Teaching of Psychology, 40,* 193–199. https://doi.org/10.1177/0098628313487461
Winter, J. B. (2013). *The effect of the flipped classroom model on achievement in an introductory college physics course*. Unpublished Master's thesis, Mississippi State University.
Yilmaz, R. (2017). Exploring the role of e-learning readiness on student satisfaction and motivation in flipped classroom. *Computers in Human Behavior, 70,* 251–260.
Yolcu, H. (2015). Blended learning and its applications basics. *The Journal of Academic Social Science Studies, International Journal of Social Science, 33,* 255–260.
Zaborova, E. N., Glazkova, I. G., & Markova, T. L. (2017). Distance learning: Students' perspective. *Sociological Studies, 2*(2), 131–139.
Zainuddin, Z., & Halili, S. (2016). Flipped classroom research and trends from different fields of study. *The International Review of Research in Open and Distributed Learning, 17*(3), 313–340.
Zownorega, J. S. (2013). *Effectiveness of flipping the classroom in an honors level, mechanics-based physics class.* Unpublished Master's thesis, Eastern Illinois University.

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