The effects of the flipped classroom model designed according to the ARCS motivation strategies on the students' motivation and academic achievement levels

Songül Karabatak [1] · Hakan Polat [1]

Abstract

This study aimed to determine the effects of the traditional classroom model, distance education model and flipped classroom model designed according to ARCS (attention, relevance, confidence and satisfaction) motivation strategies on motivation and academic achievement levels. For this purpose, the study was conducted by using an experimental pretest-posttest control group design. Purposive sampling was used to determine the participants. Frequency, percentage, mean, dependent groups t-test and ANOVA test were utilized for data analysis. The results indicated that the academic achievement levels of the 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. In addition, the training process did not lead to a significant change in the motivation of the students in the traditional classroom model and distance education classroom model, but did lead to a significant change in the motivation of the students in the flipped classroom model. In response to the results of the study, various suggestions were made.

Keywords ARCS motivation strategies · Academic achievements · Traditional classroom · Distance education · Flipped classroom

1 Introduction

Classroom management is a science that examines the effective management of the classroom. It is mainly used in education management and supervision, education

---

✉ Songül Karabatak
s_halici@hotmail.com

Hakan Polat
hakanpolat@firat.edu.tr

[1] Department of Informatics, Firat University, Elazig, Turkey

Springer

programmes and teaching, and psychological counselling and guidance. Classroom management can be defined as the application of school management to the classroom. For example, determining the rules to be obeyed in a class, the provision of discipline, the use of the teacher's authority, the effective use of time and the formation of a classroom climate are all related to education management.

Since the target group is students, the most important dimension of classroom management is the management of instruction, because effective classroom management focuses on this dimension (Çelik 2009). The instructional dimension includes activities such as the preparation and use of suitable materials for the teaching process, the use of appropriate educational technologies, teaching methods and techniques for the purposes of the course, and the preparation of the physical environment. Therefore, the success of instruction is directly related to the success of classroom management.

The teaching environment is also an important dimension for classroom management. Today, distance learning environments are frequently used learning environments like face-to-face classroom environments. Moore and Kearsley (2011, p. 2) defined distance education as "a planned, institutional and managerial activity that includes learning and teaching methods in different places and uses different technologies by applying private lesson design and teaching methods". While distance education is an environment in which the teacher and the learners are not in the same place and the instructor arranges and presents the educational service from a central location, face-to-face education is an environment in which the learners and the instructor interact simultaneously at the same time and in the same environment.

Web-based training is also a kind of distance education, but cannot be defined clearly. The most advantageous aspects of web-based education compared to face-to-face training are that it offers the opportunity for appropriate learning with low-cost education and flexible learning with its independence from time and place. For this reason, time management, one of the class management dimensions, is managed differently depending on the environment used.

Other benefits of web-based distance education are providing a wide range of educational resources (databases, electronic journals, software libraries and various links), supporting an active and dynamic learning environment, and requiring interactions that allow learners to experience personal meaningful experiences (Al and Madran 2004; Carswell and Venkatesh 2002; MacDonald et al. 2001). However, in addition to the benefits of web-based distance education, there are various problems or concerns, with the lack of obligatory preparations for the planning of programmes, insensitivity to changes in instructors' role, low-quality education, uncertainties in the use of resources and materials, a lack of technical expertise and the uncertainty of access to technical support being the main ones (MacDonald et al. 2001). Another problem in distance education is a lack of motivation due to a lack of social interaction (Karabatak and Turhan 2017; Yolcu 2015). The lack of time flexibility and of equal opportunities in education, the inability to adapt to technological developments rapidly and the increase in the number of students in the classroom in face-to-face education have led educational researchers to develop new classroom models (Yolcu 2015). One of these classroom models is the flipped classroom model.

The flipped classroom model is a classroom model developed to improve the quality of both teaching and learning in spite of the crowded classes, the shift of teaching online, the reduction of resources over time and the difficulty of updating (Larcara

2014). Flipped learning refers to a student-centred blended learning approach in contrast to traditional education (Gilboy et al. 2015). This system enables learners to access the subjects they need to learn outside school with the help of asynchronous systems or resources (course videos and articles, various electronic data sources, images and presentations), thus it provides effective learning. This system, which is defined as the displacement of homework and in-class course work, provides the opportunity for learners to focus on the problems they face in their individual learning processes (Gençer et al. 2014; Verleger and Bishop 2013). In other words, the flipped classroom system enables students to learn theoretical knowledge at home and apply what is learned in school (Zownorega 2013). Therefore, the flipped classroom system promotes student-teacher interaction, provides opportunities for real-time feedback, increases student engagement and motivation, and allows learners to learn at their own pace (Goodwin and Miller 2013).

Another dimension of effective classroom management is relationship management. Therefore, relationships, communication and motivation in the classroom should be well managed (Çelik 2009). The ARCS motivation model is a model that emphasizes the effective use of teaching techniques, communication and relationships in both web-based and face-to-face classes.

The ARCS motivation model was created by Keller to demonstrate the relationship between motivation and performance, and is based on Vroom's expectancy theory (Acar 2009; Kelly and Weibelzahl 2005), one of the effective theory of motivation in educational psychology (Arnone and Small 1999). There are four key strategy categories in the model: *Attention*, *Relevance*, *Confidence* and *Satisfaction*. Each category consists of three subcategories. Table 1 shows the categories of the ARCS motivation model.

The categories seen in Table 1 are useful in diagnosing learners' motivational profiles and in creating motivational tactics that are appropriate for the specific problems that are identified (Keller 2010, p. 47). *Attention* strategies are aimed at awakening and sustaining curiosity and interest. *Relevance* strategies are related to the needs, interests and motives of learners. *Confidence* strategies help students develop a positive expectation for success. *Satisfaction* strategies provide internal and external support to the students' efforts (Acar 2009).

In the literature, there are studies showing that the ARCS motivation model has been applied successfully in face-to-face teaching (Aşıksoy and Özdamlı 2016; Hung 2014; Kong 2014; Naime-Diefenbach 1991; Schultz et al. 2014), technology-supported

Table 1 ARCS Motivation Model

Attention	Relevance	Confidence	Satisfaction
A.1	R.1	C.1	S.1
Perceptual Arousal	Goal Orientation	Learning Requirements	Natural Consequences
A.2	R.2	C.2	S.2
Inquiry Arousal	Motive Matching	Personal Control	Positive Consequences
A.3	R.3	C.3	S.3
Variability	Familiarity	Success opportunities	Equity

(Keller 1983, 1987)

teaching (Çetin 2007; Gabrielle 2003; Gokcul 2007), online and distance education (Huett 2006; Li and Moore 2018; Malik 2014) and web-supported teaching (Acar 2009; ChanLin 2009; Turel and Sanal 2018). Among these studies, the flipped classroom model was compared with the traditional classroom model in experimental studies (Astleitner and Hufnagl 2003; Aşıksoy and Özdamlı 2016; Kostaris et al. 2017), and used the different face-to-face teaching materials, e-mails, instructional texts, videos and various teaching tools that were in flipped classrooms (Gençer et al. 2014). Gençer et al. (2014) also stated that studies on the integration of the distance education system into the flipped classroom system should be increased in Turkey, as this situation could provide important benefits for students' learning. In addition, no study could be found that compares the traditional classroom model using the face-to-face environment, the distance education model using the web-based environment, and the flipped classroom model using both the face-to-face and the web-based environment. Therefore, this study aimed to examine the effects of the traditional classroom model, the distance education model and also the flipped classroom model designed according to the ARCS motivation model on the motivation and academic achievement levels of students. For this purpose, answers were sought to the following questions:

1. Do the pre-training motivation levels of students in the flipped classroom model, the traditional classroom model and the distance education model differ significantly?
2. Do the post-training motivation levels of students who participate in the flipped classroom model, the traditional classroom model and the distance education model differ significantly?
3. Do the pre- and post-training motivation levels of students differ significantly?

    3.1. Do the pre- and post-training motivation levels of students in the traditional classroom model differ significantly?
    3.2. Do the pre- and post-training motivation levels of students in the distance education model differ significantly?
    3.3. Do the pre- and post-training motivation levels of students in the flipped classroom model differ significantly?

4. Do the pre- and post-training academic achievement levels of students in the flipped classroom model, the traditional classroom model and the distance education model differ significantly?
5. Do the post-training academic achievement levels of students -initially have the same academic achievement level- in the flipped classroom model, the traditional classroom model and the distance education model differ significantly?

2 Method

2.1 Research model

The present study aimed to determine the effects of the flipped classroom model designed according to the ARCS motivation strategies on the motivation and academic achievement levels of students. For this purpose, a comparison of the flipped classroom

model with the distance education model and the traditional classroom model was made. Therefore, one experimental group and two control groups were used. *An experimental design* of quantitative research methods was used to collect data before and after the training process. *Experimental designs* are also known as "intervention studies" or "group comparison studies". Experimental designs are procedures in quantitative research in which the investigator determines whether an activity or materials make a difference in the results of participants (Creswell 2012, pp. 20–21).

A true experimental design was used in the experimental model. In true experimental designs, subjects are randomly assigned to groups. In this design, firstly, groups are created through random assignment from the previously determined subject pool. Group participants are randomly determined (Creswell 2012, p. 309). The formation of the experimental design is as shown in Table 2.

The random design with the pretest-posttest control group used in the study is seen in Table 2. The traditional classroom model was applied to Control Group 1, the distance education model was applied to Control Group 2 and the flipped classroom model was applied to the Experimental Group for eight weeks. The same scales and academic achievement tests were applied to all three groups before and after the training process.

2.2 Study group

The participants of the study were determined by purposive sampling method among the undergraduate students. In purposive sampling, participants of the research are determined by researchers (Cohen et al. 2005; Silverman 2006). So during the determination of the students in the control and experimental groups, the criteria of ability to use information and communication technologies effectively and Internet accessibility including willingness were taken into account.

For the purpose of the study, an experimental group and two control groups were formed. Having a homogeneous structure of the study groups is an important factor in experimental studies (Creswell 2012, p. 298). Therefore, in order to have a homogeneous structure, an academic achievement test was applied to all students before the experimental process and the equivalence of the groups was provided by this test. As a result of the equivalence, Control Group 1 consisted of 31 students, Control Group 2

Table 2 Pretest-posttest Control Group Design

Study Group	Pretest	Process – Model	Posttest
Control Group 1	Academic Achievement Test	Face-to-Face Learning (Traditional Classroom Model)	Academic Achievement Test
	Course Interest Survey		Course Interest Survey
Control Group 2	Academic Achievement Test	Web-based Learning (Distance Education Model)	Academic Achievement Test
	Course Interest Survey		Course Interest Survey
Experimental Group	Academic Achievement Test	Flipped Learning	Academic Achievement Test
	Course Interest Survey	(Flipped Classroom Model)	Course Interest Survey

consisted of 33 students and the Experimental Group consisted of 35 students. The demographic characteristics of the students in the experimental and control groups and their pre-training academic achievement levels are shown in Table 3.

As can be seen in Tables 3, 80.6% of the students were female ($n = 25$) and 19.4% were male ($n = 6$) in Control Group 1, 73.5% of the students were female (n = 25) and 23.5% were male ($n = 9$) in Control Group 2, and 77.1% of the students were female ($n = 27$) and 22.9% were male ($n = 8$) in the Experimental Group. Table 3 also shows that there was no significant difference ($F_{(2,97)} = .061; p > .05$) between the pre-training academic achievement levels of Control Group 1 ($\bar{X}_{AA-1} = 30.42$), Control Group 2 ($\bar{X}_{AA-1} = 29.94$) and the Experimental Group ($\bar{X}_{AA-1} = 30.80$). Therefore the academic achievement levels of the groups were equivalent. The average age of the students was 20.5 years.

2.3 Training process planning

Activities were planned before the training process. For this reason, firstly the teaching process was designed within the framework of the ARCS motivation model. Morrison (2003) states that when designing a teaching system, it is first necessary to implement a motivational design and then to implement ARCS motivation model strategies.

2.3.1 Motivational design process

The motivational design used in the study is shown in Fig. 1.

Figure 1 shows the 10-step motivational design process indicated by Keller (2010). According to this design process, information about the students (audience) and the course was obtained in the first two steps. In the third step, various researches were conducted to increase the interest of the students in the lesson, to motivate them and to improve their performance. In the literature, it was observed that students had concerns about their own competencies in information technologies, and their computer use competencies, their the lack of equal comprehension level caused stress and technology-related anxiety in most students (Cabı and Ergün 2016). In addition, it is evident that students who have low access to information technologies are more anxious about computer technologies than other students (Bahar and Kaya 2013). For this reason, it was decided to create a flipped classroom model where web-based and face-to-face training were used together in order to decrease these concerns, increase their motivation, and improve their performance. The process between the fourth step and the ninth step was carried out with analysis and interviews conducted by

Table 3 Demographic Characteristics and Pre-Training Academic Achievement Levels of the Students

Group	Female	%	Male	%	$\bar{X}_{AA-1}$	sd	F	p
Control Group 1	25	80.6	6	19.4	30.42	13.157	.061	.941
Control Group 2	25	73.5	9	23.5	29.94	10.357		
Experimental Group	27	77.1	8	22.9	30.80	6.411		

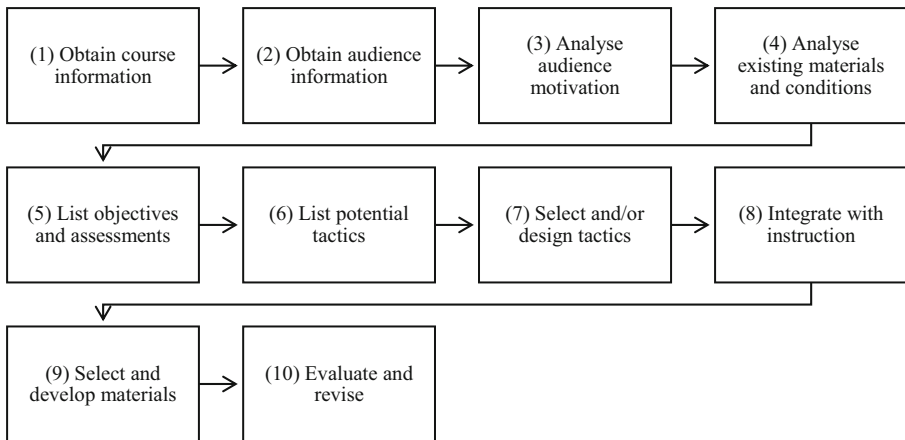*AA-1* Pre-training academic achievement test score

Fig. 1 ARCS Motivational Design Activities. (Source: Keller 2010)

the six lecturers of Basic Information Technology Use courses at Firat University. Firstly, the positive and negative aspects of face-to-face and web-based learning were discussed and learning objectives and assessments were determined. Possible strategies and tactics were discussed. In light of opinions and recommendations, the training process was conducted within the framework of flipped classroom model strategies. In this classroom model, it was appropriate to use a face-to-face laboratory environment and web-based environment together with the use of various resources and videos to be prepared by the instructor. Therefore, training videos were prepared by two lecturers. It was decided to conduct the evaluation and revision process after the training process in accordance with the opinions of the students.

2.3.2 Implementation of ARCS motivation model strategies

ARCS motivation strategies are suitable for the flipped classroom model. For this reason, the ARCS motivation model strategies in Table 1 were integrated into the teaching process. The process of the flipped classroom model is as follows:

- Before the instructor and students come together in a face-to-face environment, the instructor presents the syllabus in the web-based environment and specifies the aims and objectives of the module during the course (R.2. Motive Matching). He/she loads all resources that need to be used (related course documents, videos and other work files) to the web-based environment (C.2. Personal Control). Among these sources, there are videos about the implementation of homework assignments and similar applications of homework to students (R.1. Familiarity).
- Students follow the course video(s) and presentation(s) at any time, take notes, and try to do the homework and practice assignment (R.3. Motivation Match). They prepare questions related to what they cannot do.
- Students ask the lecturer what they should ask in the web-based environment before the face-to-face course (A.2. Inquiry Arousal).
- The instructor groups the participants according to the types of student questions. Participants discuss what they cannot do and help each other in the group (A.3.

Variability). Then the faculty tries to help the groups and provides feedback that supports the students' efforts and abilities (C.3. Success opportunities).

- For questions that cannot be answered, the instructor directs students to search for answers to questions and tries to make them learn (A.1. Perceptual Arousal).
- The instructor gives another practice assignment to students to determine whether they have learned the module and also states the evaluation criteria (C.1. Learning Requirements).
- The instructor shares the other homework or practice assignments with the students (S.1. Natural Consequences – Intrinsic Effort). The instructor tries to determine the learning levels of the students according to the evaluation criteria (S.3. Equity), adds scores according to the learning levels and gives feedback on the results of the evaluation (S.2. Positive Consequences – Extrinsic Rewards).

2.3.3 ARCS motivation strategies in flipped classroom management dimensions

ARCS motivation model strategies effectively use the dimensions of classroom management. In accordance with the objectives of the course, the course syllabus is prepared in the instructional dimension, and the course materials and resources are prepared and shared with the learners. In the time management dimension, learning can be adjusted according to the learning speed of the student and there is no limitation for the learning time. In the relationship management dimension, there are both group and trainer interaction in a face-to-face environment. There is also interaction with the educator, independent of time and space, in the web-based environment. A positive climate is created for both the face-to-face and web-based environment for the behaviour management dimension. Both environments are intended to be used effectively to solve problems.

2.4 Experimental training process

Before the training process, firstly the students were informed about the application. Then pre-test data were collected from the groups via the Course Interest Survey (CIS) and Academic Achievement Test. From the second week, the subjects in the course syllabus were taught with the applications in each group. The course syllabus was prepared as a modular structure. The training process continued for eight weeks and one module was scheduled for each week. There were basic concepts of basic information technologies in the first module, operating systems in the second module, word processing programs in the third and fourth modules, spreadsheets in the fifth and sixth modules, and presentation preparation in the seventh and eighth modules.

In the training process, the traditional classroom model for Control Group 1, the distance education model for Control Group 2 and the flipped classroom model for the Experimental Group were used. Within the framework of these models, face-to-face (in computer labs) courses were given to the students in Control Group 1 and applications were made. The students in Control Group 2 participated in lessons in a web-based environment synchronously (virtual classroom) and asynchronously (documents, videos and work files prepared by the instructor). Students were also allowed to use computer labs at any time.

The students in the Experimental Group benefited from the web-based asynchronous environment and sources used by Control Group 2. The web-based environment was supported by face-to-face training. After the modules were completed in all groups, the posttests were applied to the students.

2.5 Data collection tools

In this study, the Academic Achievement Test and CIS were used as data collection tools.

The *Academic Achievement (AA) Test* was developed by Bingöl and Halisdemir (2017). Researchers calculated the item difficulty index values of the questions in the test ranged between .21 and .49. The average difficulty of the test was found to be .59. As a result of Kuder-Richardson-20 analysis, the KR-20 value of the test was calculated as .51 (Bingöl and Halisdemir 2017).

The *Course Interest Survey (CIS)* was used to determine whether students were interested in a course organized according to the ARCS motivation model in the experimental and control groups. The CIS was developed by Keller and Subhiyah (1987). A Likert-type scale is used consisting of 34 items. There are options between 1 (Not True) and 5 (Completely True) for each item response in the scale. Keller (2006) calculated that the reliability coefficient of the scale was .93. The reliability coefficient of the scale, which was adapted to Turkish by Acar (2009), was calculated as .92.

2.6 Data analysis

The SPSS 22 program was used to analyse the data. The normal distribution of the data was tested before the analysis of the data and skewness and kurtosis values were calculated. The results obtained are shown in Table 4.

As can be seen in Table 4, according to the skewness and kurtosis values, data are normally distributed, because, according to Tabachnick and Fidell (2013), if the skewness and kurtosis values are between $+1.5$ and -1.5, the data show normal distribution. Frequency, percentage and arithmetic mean were evaluated, and t-test and one-way analysis of variance were performed to analyse the data. The LSD test, one of the post hoc tests, was used to determine the source of significant difference.

Table 4 Arithmetic Mean and Normality Distributions of Dimensions

Test	Dimension	$\overline{X}$	sd	Skewness	Kurtosis
Pretest	Attention Pretest	3.26	.5175	.241	.088
	Relevance Pretest	3.53	.5972	.078	−.412
	Confidence Pretest	3.68	.5915	−.510	.168
	Satisfaction Pretest	3.09	.6397	−.119	−.582
Posttest	Attention Posttest	3.44	.5245	.407	−.216
	Relevance Posttest	3.56	.6649	.012	−.744
	Confidence Posttest	3.65	.6565	−.009	−.936
	Satisfaction Posttest	3.30	.5684	.614	.048

The effect size was calculated if significant differences occurred in the comparisons. The effect size is the coefficients that give information about the magnitude of the significant difference between the scores of the groups compared. The effect size d coefficient was calculated for the dependent groups with significant differences between the scores, and the η2 coefficient was calculated for the independent groups with significant differences between the scores. The value of d is considered a *very large* effect if it is greater than 1, as a *large* effect if it is between 1 and .8, as a *medium* effect if it is between .7 and .5 and as a *small* effect if it is between .4 and .2 (Cohen et al. 2005; Thalheimer and Cook 2002). The value of η2 is considered a *large* effect if it is greater than .14, a *medium* effect if it is between .13 and .06, and a *small* effect if it is between .05 and .01 (Can 2013).

3 Findings

In order to determine the effects of the traditional classroom model, the distance education model and the flipped classroom model designed according to the ARCS motivation strategies on students' motivation and academic success, various analyses were carried out and the findings are presented under this heading.

An ANOVA test was used to determine whether there was a significant difference in the pre-training motivation levels of the students in the flipped classroom model, traditional classroom model and distance education model. The results of the analysis are shown in Table 5.

As shown in Table 5, there are significant differences in pre-training motivation levels in the dimensions of attention ($F_{(2,97)} = 6.911$; $p < .01$), relevance ($F_{(2,97)} = 7.489$; $p < .01$) and satisfaction ($F_{(2,97)} = 1.408$; $p < .01$) of students in the flipped classroom model, the traditional classroom model and the distance education model, but there is no significant difference in the confidence ($F_{(2,97)} = 7.210$; $p > .01$) dimension. According to the LSD test results, students in the traditional classroom model have higher motivation levels than those in the distance education and flipped classroom models in the dimensions of attention and satisfaction. And students in the traditional and flipped classroom models have higher motivation levels than those in the distance education classroom model in the dimension of relevance. In addition, the effect sizes ($\eta2 < .14$) of the significant differences between the groups – classroom models – are at the *medium* level for the three dimensions.

An ANOVA test was used to determine whether there was a significant difference in the post-training motivation levels of the students in the flipped classroom model, traditional classroom model and distance education model. The results of the analysis are shown in Table 6.

As can be seen in Table 6, there are significant differences between the post-training motivation levels in the dimensions of attention ($F_{(2,97)} = 4.964$; $p < .01$), relevance ($F_{(2,97)} = 4.104$; $p < .01$), satisfaction ($F_{(2,97)} = 6.393$; $p < .01$) and confidence ($F_{(2,97)} = 11.46$; $p > .01$) of students in the flipped classroom model, in the traditional classroom model and in the distance education model. According to the results of the LSD test, it is evident that the motivation levels of the students in the traditional and flipped classroom models are higher than those of the students in the distance education model in the attention and satisfaction dimensions. In the relevance dimension, the students in

Table 5 Comparison of the Pre-Training Motivation Levels of Classroom Models

| Dimensions | Groups | N | $\overline{X}$ | ANOVA | | | | | | | |
				Source of Variance	Sum of Squares	df	Mean Square	F	p	LSD	η2
Attention	Traditional Classroom (1)	31	3.52	Between Groups	3.307	2	1.653	6.911	.002	1 > 2	.12
	Distance Education (2)	34	3.08	Within Groups	23.206	97	.239			1 > 3	
	Flipped Classroom (3)	35	3.21	Total	26.513	99					
Relevance	Traditional Classroom (1)	31	3.81	Between Groups	4.722	2	2.361	7.489	.001	1 > 2	.13
	Distance Education (2)	34	3.27	Within Groups	30.581	97	.315			3 > 2	
	Flipped Classroom (3)	35	3.55	Total	35.304	99					
Confidence	Traditional Classroom (1)	31	3.77	Between Groups	.977	2	.489	1.408	.250		–
	Distance Education (2)	34	3.54	Within Groups	33.661	97	.347				
	Flipped Classroom (3)	35	3.74	Total	34.639	99					
Satisfaction	Traditional Classroom (1)	31	3.42	Between Groups	5.243	2	2.622	7.210	.001	1 > 2	.13
	Distance Education (2)	34	3.01	Within Groups	35.271	97	.364			1 > 3	
	Flipped Classroom (3)	35	2.87	Total	40.515	99					

$P < .05$

Table 6 Comparison of the Post-Training Motivation Levels of the Classroom Models

Dimensions	Groups	N	$\overline{X}$	ANOVA							
				Source of Variance	Sum of Squares	df	Mean Square	F	p	LSD	η2
Attention	Traditional Classroom (1)	31	3.54	Between Groups	2.529	2	1.264	4.964	.009	1 > 2	.09
	Distance Education (2)	34	3.22	Within Groups	24.704	97	.255			3 > 2	
	Flipped Classroom (3)	35	3.57	Total	27.233	99					
Relevance	Traditional Classroom (1)	31	3.54	Between Groups	3.414	2	1.707	4.104	.019	3 > 2	.08
	Distance Education (2)	34	3.34	Within Groups	40.348	97	.416				
	Flipped Classroom (3)	35	3.79	Total	43.762	99					
Confidence	Traditional Classroom (1)	31	3.57	Between Groups	8.156	2	4.078	11.46	.000	3 > 1	.19
	Distance Education (2)	34	3.35	Within Groups	34.509	97	.356			3 > 2	
	Flipped Classroom (3)	35	4.02	Total	42.665	99					
Satisfaction	Traditional Classroom (1)	31	3.46	Between Groups	3.725	2	1.862	6.393	.002	1 > 2	.12
	Distance Education (2)	34	3.03	Within Groups	28.257	97	.291			3 > 2	
	Flipped Classroom (3)	35	3.42	Total	31.982	99					

the flipped classroom model have a higher motivation level than the students in the distance education model; and in the confidence dimension, the students in the flipped classroom model have higher motivation levels than the students in other classroom models. While the effect size of the significant difference between the groups for the attention, relevance and satisfaction dimensions is *medium* ($\eta2 < .14$), the effect size for the confidence dimension is *large* ($\eta2 = .19$).

In order to determine whether there was a significant change in the pre- and post-training motivation levels of the students in the traditional classroom model, the dependent groups t-test was performed and the results are shown in Table 7.

As can be seen in Table 7, there are no statistically significant differences between the pre- and post-training motivation levels in the dimensions of attention ($\overline{X}_{pre} = 3.52$; $\overline{X}_{post} = 3.54$; $t_{30} = -.109$; $p > .05$), relevance ($\overline{X}_{pre} = 3.81$; $\overline{X}_{post} = 3.54$; $t_{(30)} = 1.666$; $p > .05$), confidence ($\overline{X}_{pre} = 3.77$; $\overline{X}_{post} = 3.57$; $t_{(30)} = 1.364$; $p > .05$) and satisfaction ($\overline{X}_{pre} = 3.42$; $\overline{X}_{post} = 3.46$; $t_{(30)} = -.251$; $p > .05$) of the students in the traditional classroom model. This situation shows that the face-to-face training process does not have a significant effect on the motivation of the participants.

In order to determine whether there was a significant change in the pre- and post-training motivation levels of the students in the distance education model, the dependent groups t-test was performed and the results are shown in Table 8.

As can be seen in Table 8, there are no statistically significant differences between the pre- and post-training motivation levels in the dimensions of attention ($\overline{X}_{pre} = 3.08$; $\overline{X}_{post} = 3.22$; $t_{(33)} = 1.799$; $p > .05$), relevance ($\overline{X}_{pre} = 3.27$; $\overline{X}_{post} = 3.34$; $t_{(33)} = -.595$; $p > .05$), confidence ($\overline{X}_{pre} = 3.54$; $\overline{X}_{post} = 3.35$; $t_{(33)} = 1.949$; $p > .05$) and satisfaction ($\overline{X}_{pre} = 3.01$; $\overline{X}_{post} = 3.03$; $t_{(33)} = -.214$; $p > .05$) of the students in the distance education model. This situation shows that the web-based training process does not have a significant effect on the motivation of the participants.

In order to determine whether there was a significant change in the pre- and post-training motivation levels of the students in the flipped classroom model, the dependent groups t-test was performed. The results are shown in Table 9.

As shown in Table 9, there are statistically significant differences between the pre- and post-training motivation levels in the dimensions of attention ($\overline{X}_{pre} = 3.21$; $\overline{X}_{post} =$

Table 7 Comparison of the Pre- and Post-Training Motivation Levels of the Students in the Traditional Classroom Model

Group	Test	N	$\overline{X}$	sd	t	df	p
Traditional Classroom Model	Attention_Pretest	31	3.52	.571	−.109	30	.914
	Attention_Posttest	31	3.54	.581			
	Relevance_Pretest	31	3.81	.593	1.666	30	.106
	Relevance_Posttest	31	3.54	.684			
	Confidence_Pretest	31	3.77	.557	1.364	30	.183
	Confidence_Posttest	31	3.57	.675			
	Satisfaction_Pretest	31	3.42	.586	−.251	30	.804
	Satisfaction_Posttest	31	3.46	.619			

Table 8 Comparison of the Pre- and Post-Training Motivation Levels of the Students in the Distance Education Model

Group	Test	N	$\overline{X}$	sd	t	df	p
Distance Education Model	Attention_Pretest	34	3.08	.441	−1.799	33	.081
	Attention_Posttest	34	3.22	.435			
	Relevance_Pretest	34	3.27	.577	−.595	33	.556
	Relevance_Posttest	34	3.34	.608			
	Confidence_Pretest	34	3.54	.572	1.949	33	.060
	Confidence_Posttest	34	3.35	.465			
	Satisfaction_Pretest	34	3.01	.524	−.214	33	.832
	Satisfaction_Posttest	34	3.03	.438			

3.57; $t_{(34)} = -4.856$; $p < .05$), relevance ($\overline{X}_{pre} = 3.55$; $\overline{X}_{post} = 3.79$; $t_{(34)} = -2.221$; $p < .05$), confidence ($\overline{X}_{pre} = 3.74$; $\overline{X}_{post} = 4.02$; $t_{(34)} = -3.015$; $p < .05$) and satisfaction ($\overline{X}_{pre} = 2.87$; $\overline{X}_{post} = 3.42$; $t_{(34)} = -3.869$; $p < .05$) of the students in the flipped classroom model. This situation shows that face-to-face and web-based environments used together in the training process does not have a significant effect on the motivation of the participants.

The effect size of the significant differences between the pre- and post-training motivation levels of the students in the flipped classroom model is at a *large* level for the attention (d = .82) dimension and a *medium* level for the relevance (d = .38), confidence (d = .51) and satisfaction (d = .65) dimensions.

The t-test was performed to determine whether a significant change occurred between the pre- and post-training academic achievement levels of the students in the flipped classroom model, the traditional classroom model and the distance education model. The results are shown in Table 10.

As can be seen in Table 10, it is evident that there are statistically significant differences between the pre- and post-training academic achievement level of the students in the traditional classroom model ($\overline{X}_{AA-1} = 30.42$; $\overline{X}_{AA-2} = 45.48$; $t_{(30)} = -6.256$; $p < .05$), the distance education model ($\overline{X}_{AA-1} = 29.94$; $\overline{X}_{AA-2} = 48.53$; $t_{(33)} = $

Table 9 Comparison of the Pre- and Post-Training Motivation Levels of the Students in the Flipped Classroom Model

Group	Test	N	$\overline{X}$	sd	t	df	p	d
Flipped Classroom Model	Attention_Pretest	35	3.21	.454	−4.856	34	.000	.82
	Attention_Posttest	35	3.57	.494				
	Relevance_Pretest	35	3.55	.516	−2.221	34	.033	.38
	Relevance_Posttest	35	3.79	.644				
	Confidence_Pretest	35	3.74	.632	−3.015	34	.005	.51
	Confidence_Posttest	35	4.02	.636				
	Satisfaction_Pretest	35	2.87	.684	−3.869	34	.000	.65
	Satisfaction_Posttest	35	3.42	.554				

Table 10 Comparison of the Academic Achievement Levels of Classroom Models

Group	Test	N	$\overline{X}$	sd	t	df	p	d
Traditional Classroom	AA-1	31	30.42	13.157	−6.256	30	.000	1.12
	AA-2	31	45.48	9.549				
Distance Education	AA-1	34	29.94	10.357	−12.267	33	.000	2.10
	AA-2	34	48.53	8.976				
Flipped Classroom	AA-1	35	30.80	6.411	−13.156	34	.000	2.22
	AA-2	35	53.11	7.873				

AA-1 Pre-training academic achievement test score; *AA-2* Post-training academic achievement test score

*p < .05

−12.267; p < .05) and the flipped classroom model ($\overline{X}_{AA-1} = 30.80$; $\overline{X}_{AA-2} = 53.11$; $t_{(34)} = -13.156$; p < .05). This finding shows that the training processes have significant effects on the academic achievement levels of the students in all three classroom models.

The effect sizes of the academic achievement levels of the students in the traditional classroom model (d = 1.12), the distance education model (d = 2.10) and the flipped classroom model (d = 2.22) are *very large*. When the effect size of the academic achievement levels of the three classroom models is compared, it can be seen that the flipped classroom model has the largest effect.

An ANOVA test was used to determine the significant difference between the post-training academic achievement levels of the students in the flipped classroom model, the traditional classroom model and the distance education model. The results of the analysis are shown in Table 11.

As can be seen in Table 11, there are statistically significant differences between the post-training academic achievement levels of the students in the traditional classroom model ($\overline{X}_{AA-2} = 45.48$; $t_{(30)} = -6.256$; p < .05), the distance education model ($\overline{X}_{AA-2} = 48.53$; $t_{(33)} = -12.267$; $p < .05$) and the flipped classroom model ($\overline{X}_{AA-2} = 53.11$; $t_{(34)} = -13.156$; p < .05). According to the LSD test results, the significant difference is between the academic achievement levels of the participants in the flipped classroom model and the academic achievement levels of the other classroom models, and

Table 11 Comparison of the Post-Training Academic Achievement Levels of the Classroom Models

Group	N	$\overline{X}$	sd	ANOVA							
				Source of Variance	Sum of Squares	df	Mean Square	F	p	LSD	η2
Traditional Classroom (1)	31	45.48	9.549	Between Groups	979.635	2	489.817	6.333	.003	3 > 1	.12
Distance Education (2)	34	48.53	8.976	Within Groups	7501.755	97	77.338				
						99				3 > 2	
Flipped Classroom (3)	35	53.11	7.873	Total	8481.390						

students in the flipped classroom model have higher academic achievement levels than those in the distance education and traditional classroom models.

The effect size of the significant difference between the post-training academic achievement levels of the students in the flipped classroom model, the traditional classroom model and the distance education model is also *medium* ($\eta 2 = 0.12$).

4 Results, discussion and conclusion

This study aimed to determine the effects of the traditional classroom model, distance education model and flipped classroom model designed according to the ARCS motivation strategies on the motivation and academic achievement levels of students. For this purpose, the findings obtained from the analyses were interpreted and discussed along with literature.

According to the findings, the pre-training motivation level of the students in the flipped classroom model, the traditional classroom model and the distance education model showed significant differences in the attention, relevance and satisfaction dimensions, but did not show any significant difference in the confidence dimension. As a result of the analyses, in the attention and satisfaction dimensions the pre-training motivation level of the students in the traditional classroom model was higher than that of the students in the other classroom models. In the relevance dimension, the pre-training motivation levels of the students in the traditional and flipped classroom models were higher than the motivation level of the students in the distance education model. In addition, the effect sizes of the significant differences between the classroom models were at the *medium* level for three dimensions.

The results showed that there were significant differences between the post-training motivation levels of the students in all three classroom models in the attention, relevance, satisfaction and confidence dimensions. According to the analysis, after the training process the students in the traditional and flipped classroom models had significantly higher motivation levels than those in the distance education model in the attention and satisfaction dimensions; the students in the flipped classroom model had a significantly higher motivation level than those in the distance education model in the relevance dimension; and the students in the flipped classroom model had a significantly higher motivation level than those in the other classroom models in the confidence dimension. The effect size of the significant differences between classroom models was at the *medium* level for the attention, relevance and satisfaction dimensions but at the *large* level for the confidence dimension.

According to the findings, the traditional classroom model and the distance education model did not have significant effects on students' motivations, whereas the flipped classroom model using the ARCS motivation strategies had a significant and positive effect on students' motivation. In the flipped classroom model, the effect size of the significant difference between the pre- and post-training motivation level was at the *large* level for the attention dimension and at the *medium* level for the relevance, confidence and satisfaction dimensions.

In the studies using the ARCS motivation model but not using the flipped classroom model, the attention, relevance, confidence and satisfaction levels of the experimental group benefiting from face-to-face learning (Dede 2003) and face-to-face learning as

well as web-based learning using ARCS motivation strategies (Acar and Uslu 2014) were slightly higher than those of the control group, but these differences were not significant. However, in the studies conducted by Gabrielle (2003), Çetin (2007), Acar (2009), and Ünsal (2014), the motivation levels of the experimental group benefiting from web-based and technology-supported learning using ARCS motivation strategies were higher and more meaningful than those of the control group. In Huett's (2006) study, the confidence, relevance and satisfaction motivation levels of the experimental group showed significant differences compared to the control group but the level of attention motivation level did not show a significant difference.

This result of the study establishes a significant difference in motivation for students in the flipped classroom model. Because one of the most significant problems in distance education systems is the motivation of learners (Bennett and Monds 2008; Bilgiç and Tüzün 2015; Bonk 2001; Karabatak and Turhan 2017). The results from both this study and the literature showed that students could be more motivated in the face-to-face training process. However, the results also revealed that the face-to-face training process alone could not provide sufficient motivation for the students and motivation strategies are important when deciding on materials to be used or material development in order to motivate students in the teaching process. For example, Mills and Sorensen (2004) stated that the software program, incorporates appropriate strategies in the dimensions of attention, relevance, confidence and satisfaction to motivate and actively engage the student in the learning process. By maintaining the attention of the students and gaining their confidence and satisfaction, the software program helps students to maintain a desire to practise, learn and succeed. For this reason, it is very important to prepare the program according to ARCS motivation models to increase the effectiveness of this novelty model. In addition, it is of great importance that the course materials and videos to be used in the web-based environment are prepared by the instructor.

In the study, attention was paid to the fact that the pre-training academic success levels of the groups were equal. The post-training academic achievement levels of the students in the three classroom models increased significantly compared to the pre-training level. However, comparing the effect size of the pre- and post-training academic achievement levels of the classroom models, the flipped classroom model had the largest effect. In addition, the findings showed that the post-training academic achievement levels of classroom models differed significantly. This difference was particularly in favour of the flipped classroom model and the effect size of the difference was seen at the *medium* level.

In Ünsal's (2007) study using the ARCS motivation model but not using the flipped classroom model, the experimental group in which the blended learning approach was applied was more successful than the face-to-face learning group. The study by Usta (2007) also statistically agreed that students in blended education were more successful than those in online education. In Acar's (2009) and Ünsal's (2014) studies, the academic achievement level of the experimental group using ARCS motivation in web-based environment was higher than that of the control group in face-to-face classroom environments. Huett's (2006) study reported a significant difference in performance measurements in favour of the experimental group. In Gokcul's (2007) study, the experimental group used computer software based on Keller's ARCS motivation model and was more successful than the control group, who participated

in the classroom. In Li and Keller's (2018) study, it was stated that the ARCS model was applied in a variety of learning contexts internationally. The study reports that most of these studies were conducted quantitatively and experimentally, and mostly related to motivation and learning achievement. However, inconsistent results were obtained regarding the effects of the ARCS model in these studies.

Some studies observed that the flipped classroom approach enhanced the participants' academic ability or performance (Aşıksoy and Özdamlı 2016; Deslauriers et al. 2011; Hung 2014; Kong 2014; Love et al. 2013; Roach 2014; Schultz et al. 2014; Turel and Sanal 2018), motivation (Aşıksoy and Özdamlı 2016) and participation (Chen et al. 2014; Deslauriers et al. 2011; Hung 2014) as in this study. The findings of most of the studies related to the ARCS motivation model and flipped classroom approach and the findings of this study are in line with each other. However, the findings of Frydenberg's (2012) and Winter's (2013) studies were not consistent with the findings of this study. Using a flipped classroom approach, Frydenberg (2012) found no increase in the achievement of the students when compared with the traditional approach. In the study by Winter (2013), no increase was observed in the achievement of students using the flipped classroom approach.

The findings of this study indicated that all three classroom models contributed positively to the academic achievements of the students. However, the highest academic achievement increase occurred in the flipped classroom model. This increase in academic achievement level is due to the strategies of the ARCS motivation model, because using ARCS motivation strategies in the flipped classroom model provides effective use of classroom management dimensions. In addition, in the flipped classroom model, before the students participate in the face-to-face environment, students have to use the course materials provided in a web-based environment and study the subjects in the course syllabus. This also enables the students to try to answer the questions that they have not answered with their friends and to learn by interacting, doing and living in a face-to-face environment. In addition, reinforcement of the subject with different practice examples in the face-to-face education process causes students to increase their academic achievement. Goodwin and Miller (2013) also stated that when flipped classrooms are correctly applied, students can improve their learning.

The findings of both this study and the previous studies showed that a systematically designed technological learning environment could have a positive impact on students' motivation, performance and individual learning. The findings also indicated that academic success would increase when these environments were supported by face-to-face classroom environments. Eşgi (2006) also stated that the most effective education that is conducted today in technological environments is complementary or supportive training organized both in the web-based environment and in the face-to-face environment. As a result, to enhance students' motivation and their academic achievement, the flipped classroom model is more effective than the traditional classroom model and distance education model in terms of classroom management.

5 Suggestions

Some limitations should be taken into account when interpreting the results of this study. For example, the study group consisted of voluntary undergraduate students.

Therefore, only the academic achievement levels of the students were taken into account in order to ensure the equivalence of the classroom models. However, the equivalence of students' motivation levels was ignored. While the pre-training motivation levels of the students in the traditional class were generally higher than those of students in the other classroom model in most of the dimensions the motivation levels of the students in the flipped classroom model were found to be higher than those of the students in the other classroom models. However, repeating the study with students whose motivation level is equal will also contribute to the field.

In particular, it may be advisable to do the courses with appropriate content by using distance education and the flipped classroom model designed according to the ARCS motivation strategies in higher education institutions. In addition, the use of the flipped classroom model and ARCS motivation strategies in pre-tertiary education institutions should be expanded. However, a flipped classroom model is a class model that requires extracurricular time and effective planning for teachers and students. For this reason, pedagogical shifts of both teachers and students should be ensured for the transition from a traditional classroom model to a flipped classroom model. This shifting process should be provided to teacher candidates by taking courses in educational sciences and to teachers through in-service training.

Compliance with ethical standards

Conflict of interest   None.

References

Acar, S. (2009). The effects of ARCS motivation strategies on learners academic succeses, permanances of learning, motivations and attitudes in web supported performance based learning. Unpublished PhD Thesis. Gazi University, Ankara, Turkey.

Acar, S., & Uslu, D. (2014). The effect of "e-learning system –virtual class" application on students motivation in web-based instruction. *EJOVOC (Electronic Journal of Vocational Colleges), 4*(2). https://doi.org/10.1501/OTAM_0000000385.

Al, U., & Madran, R. O. (2004). Web-based distance education systems: Required features and standards. *Bilgi Dünyası, 5*(2), 259–271.

Arnone, M. P., & Small, R. V. (1999). Evaluating the motivational effectiveness of children's websites. *Educational Technology, 39*(2), 51–55.

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

Astleitner, H., & Hufnagl, M. (2003). The effects of situation-outcome-expectancies and of ARCS-strategies on self-regulated learning with web-lectures. *Journal of Educational Multimedia and Hypermedia, 12*(4), 361–376.

Bahar, E., & Kaya, F. (2013). The attitudes of social programs students in vocational high schools towards the use of information technologies. *Journal of Higher Education & Science, 3*(1), 70–79.

Bennett, C. F., & Monds, K. E. (2008). Online courses: The real challenge is "motivation". *College Teaching Methods and Styles Journal, 4*(6), 1–6.

Bilgiç, H. G., & Tüzün, H. (2015). Problems in web-based distance education programs of higher education institutions. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi, 1*(3), 26–50.

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

Bonk, C. (2001). Online teaching in an online world. http://www.publicationshare.com/docs/faculty_survey_report.pdf Accessed 25 December 2018.

Can, A. (2013). SPSS ile bilimsel araştırma sürecince nicel veri analizi. Ankara: Pegem Publishing.

Cabı, E., & Ergün, E. (2016). The impact of instructional technologies and material development course on the teacher candidates' concern about using educational technologies. *Başkent University Journal of Education, 3*(1), 37–43.

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

Çelik, V. (2009). *Sınıf yönetimi*. Ankara: Nobel Publishing.

Çetin, U. (2007). The effect of the computer assisted education software based on ARCS motivation model on students achievement and permanance of learning. Unpublished Master's Thesis, Gazi University, Ankara, Turkey.

ChanLin, L. J. (2009). Applying motivational analysis in a web-based course. *Innovations in Education and Teaching International, 46*(1), 91–103.

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

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

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative. Fourth edition*. New Jersey: Upper Saddle River.

Dede, Y. (2003). The effect of the ARCS motivation model upon the students' motivation towards mathematics. *Pamukkale University Journal of Education, 14*(14), 173–182.

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

Eşgi, N. (2006). The effect of the printed material and face to face teaching on students' success on web based teaching. *The Journal of Turkish Educational Sciences, 4*(4), 459–475.

Frydenberg, M. (2012). Flipping Excel. *2012 Proceedings of the Information Systems Educators Conference,* 1–*1*, New Orleans: EDSIG.

Gabrielle, D. M. (2003). *The effects of technology-mediated instructional strategies on motivation, performance and self-directed learning. Unpublished Ph.D. dissertation*. USA: Florida State University.

Gençer, B. G., Gürbulak, N., & Adıgüzel, T. (2014). Eğitimde yeni bir süreç: Ters-yüz sınıf sistemi. In International teacher education conference (ITEC).

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.

Gokcul, M. (2007). The effects of computer software based on Keller's ARCS motivational model on the academic achievement and retention at teaching of mathematics. Unpublished Master's Thesis, Çukurova University, Adana, Turkey.

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

Huett, J. B. (2006). The effects of ARCS-based confidence strategies on learner confidence and performance in distance education (pp. 1–142). University of North Texas.

Hung, H. (2014). Flipping the classroom for English language learners to foster active learning, (October), 37–41, https://doi.org/10.1080/09588221.2014.967701.

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. https://doi.org/10.14527/pegegog.2017.024.

Keller, J. M. (1983). Motivational design of instruction. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status* (pp. 383–403). Hilldale: New Jersey, Lawrance Erlbaum Associates Inc..

Keller, J. M. (1987). Development and use of ARCS model in instructional design. *Journal of Instructional Development, 10*(3), 2–10.

Keller, J. M. (2006). *Development of two measures of learner motivation: CIS and IMMS*, version: 060222. Unpublished manuscript in progress. Florida State University.

Keller, J. M. (2010). *Motivational design for learning and performance: The ARCS model approach*. New York: Springer Science+Business Media.

Keller, J. M., & Subhiyah, R. (1987). *Manual for course interest survey (CIS)*. Tallahassee, FL, USA.

Kelly, D., & Weibelzahl, S. (2005). *Raising confidence levels using motivational contingency design techniques*. Dublin: National College of Ireland.

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 & Education, 78*, 160–173.

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

Larcara, M. (2014). Benefits of the flipped classroom model. Advances in educational technologies and instructional design: Promoting active learning through the flipped classroom model, 132–144.

Li, K., & Keller, J. M. (2018). Use of the ARCS model in education: A literature review. *Computers & Education, 122*, 54–62. https://doi.org/10.1016/j.compedu.2018.03.019.

Li, K., & Moore, D. R. (2018). Motivating students in massive open online courses (MOOCs) using the attention, r, confidence, satisfaction (ARCS) model. *Journal of Formative Design in Learning, 2*(2), 102–113.

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.

Malik, S. (2014). Effectiveness of ARCS model of motivational design to overcome non completion rate of students in distance education. *Turkish Online Journal of Distance Education, 15*(2), 194–200.

Mills, R. J., & Sorensen, N. (2004). *Kids college 2004: An implementation of the ARCS model of motivational design*. USA: Utah University.

Moore, M. G., & Kearsley, G. (2011). *Distance education: A systems view of online learning*. Cengage Learning.

Morrison, D. (2003). *E-learning strategies: How to get implementation and delivery right first time*. England: John Wiley and Sons Inc.

Naime-Diefenbach, B. (1991). Validation of attention and confidence as independent components of the ARCS motivational model. Unpublished doctoral dissertation, Florida State University, Tallahassee.

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.

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.

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

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

Turel, Y. K., & Sanal, S. O. (2018). The effects of an ARCS based e-book on student's achievement, motivation and anxiety. *Computers & Education, 127*, 130–140.

Ünsal, H. (2007). Evaluation of blended learning acticity on multiple levels. Unpublished PhD Thesis, Gazi University, Ankara, Turkey.

Ünsal, N Ö. (2014). *Research conducted on determinatıon the interest level of learners in lessons and teaching materials who learn ten-finger f keyboard according to Acar method.* Unpublished Master's thesis, Gazi University, Ankara, Turkey.

Usta, E. (2007). *The effects of blended learning and online learning on academic achievement and student satisfaction*. Gazi Üniversitesi, Ankara, Turkey: Unpublished PhD Thesis.

Verleger, M. A., & Bishop, L. J. (2013). The flipped classrom: A survey of the research. 120th ASEE Conference & Exposition. *American Society for Engineering Education.*, 20–26.

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.

Yolcu, H. (2015). Blended learning and its applications basics. *The Journal of Academic Social Science Studies, International Journal of Social Science, 33*, 255–260.

Zownorega, J. S. (2013). *Effectiveness of flipping the classroom in a honors level, mechanics-based physics class*. Unpublished Master's Thesis. Eastern Illinois University.