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Are flipped classrooms less stressful and more successful? An experimental study on college students

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Abstract

The flipped classroom model, which is a technology-supported model that employs active learning strategies, has been studied many times. However, the effect of the model on psychological variables has not been adequately questioned. In this context, this study aims to investigate the effects of flipped classroom model on the students' assignment stress and academic achievement. For this purpose, a quasi-experimental study was designed; the pre- and post-test control group model was used. The study was conducted with the participation of 44 undergraduate pre-service teachers for 11-week period in Material Design and Use in Education course. Students' assignment stress was measured with a scale, while their academic achievement was evaluated by considering course success and material development scores. Also, students' opinions were investigated in the process. The experimental group students followed the courses outside the class through interactive videos, and they completed the given assignments in-class with the group collaboration. On the other hand, the control group students followed the lessons in-class (face-to-face), and they completed the given assignments outside of the class with the group collaboration. Consequently, it was found that the assignment stress of the students in the experimental group decreased more than the students in the control group. In addition, the course success of the students in the experimental group increased more than the students in the control group. However, there was no significant difference between the material development scores of groups. Finally, a significant portion of the students' who experienced the flipped classroom model, reported positive opinions about the model.

Keywords: Flipped classroom, Assignment stress, Course success, Material development

Introduction

Educational expectations of people have evolved with the impacts of strong external factors such as growing population and emerging technologies. Traditional education systems have become insufficient to meet these expectations. In these systems, the learning process is often carried out in a limited environment, and with limited time and materials. However, individuals with different learning speeds cannot be expected to be efficient in the same environment and at the same time (Hussain et al., 2020; Kharat et al.,

2015; Munir et al., 2018). These problems of the education systems constitute a substantial ground to search for new and effective teaching methods. In this context, the new approaches integrated with technology in education can be adopted. Hence, allocating more time and space for technology in learning environments can help learners develop 21st-century skills as well as advancing the education system by reforming it (Mitsiou, 2019). Flipped classroom is one of the effective models that is suggested to achieve these essential reforms. According to Bergmann and Sams (2012), the main purpose of flipped classroom is to maximize the efficiency of time spent face-to-face in the learning process. In flipped learning, the traditional education is flipped and tasks such as obtaining information are realized by the students before attending the class. For this purpose, the teachers prepare course contents with videos and presentations, and enable the students to access them before the class. Thus, more time is allocated in the classroom to answer the students' questions and focus on challenging skills such as solving real-life problems, and active learning events (Howell, 2021; Roehl et al., 2013; Tucker, 2012; Yean, 2019).

Flipped classroom model offers active and social learning opportunities by providing collaborative and interactive learning activities. In this respect, this model is regarded in many studies that it is based upon active learning theory depending on constructivist approach (Cho et al., 2021; Hung, 2015; Lewis et al., 2018; Prashar, 2015; Williams et al., 2018). The social constructivist approach is particularly taken as the theoretical basis of the flipped classes in different studies (Mehring, 2018; Moraros et al., 2015; Moreno-Guerrero et al., 2020). Teachers in flipped classrooms have the role of guidance, and they provide opportunities for the students to learn by doing. Thus, learners have the chance of developing themselves by constructing their knowledge. This approach makes the class time more productive and provides a wide range of practices for creative social learning activities. Also, teachers can devote more time to interactive and collaborative exercises that are necessary for high-level skills such as critical thinking and reasoning (Moraros et al., 2015; Nickerson, 2018).

Studies have been carried out to examine the effects of flipped learning on different variables. Some studies indicate that this approach increases academic achievement in different fields (Bösner et al., 2015; Kong, 2014; Mattis, 2015; Murillo-Zamorano et al., 2019; Street et al., 2015; Strelan et al., 2020; Wiginton, 2013; Yestrebsky, 2015). Also, student participation increases in the flipped classes, which are based on active learning and individual learning responsibility (Brewer & Movahedazarhouligh, 2018; Chen et al., 2014; Hung, 2015; Prashar, 2015). In addition, there are studies which claim that flipped classes have positive effects on self-efficacy (Marquard, 2014; Wiginton, 2013), and critical thinking skills (Kong, 2014). The flipped classes are gaining relative importance as time goes on, partly due to the prevalence and accessibility of technological resources in the field of education. However, the effectiveness of this methodology is still debated (Galindo-Dominguez, 2021). For example, the effect of this model on assignment stress is still a matter of interest in the literature. Therefore, this study focuses on the effects of flipped classroom model on students' academic achievement as well as particularly their assignment stress.

Assignments are the tasks that are given to students by teachers for them to complete in out-of-school times (Cooper, 1989). The literature shows that the assignments used to discipline the minds of the students since the early twentieth century, and they have

positive impacts on students' academic achievements (Foyle, 1984; Keith et al., 2004). Also, the assignments develop learners' study skills, attitudes toward school (Cooper & Valettine, 2001) and self-regulation skills (Bempechat, 2004). In addition, they provide the opportunity to continue the learning process outside the formal education (Stevenson, 2021). Cooper and Valettine (2001) claimed that the assignments have negative as well as positive effects on the learners. Students can be bored with the assignments that require a long time of studying. Walker et al. (2004) describes assignments as tedious drudgery, and an element of stealing out-of-school time. In addition, when given quite frequently, assignments are mostly characterized as a burden or stressor for both families and students. Assignment stress that lasts throughout academic life can cause emotional reactions that have a larger impact on the individual over time (Pope & Simon, 2005). According to Katz et al. (1981), stress causes negative reactions rather than positive reactions. Therefore, students with a high level of assignment stress are expected to maintain their learning experiences accompanied by highly negative effects. Katz et al. (2012) found that there is a negative relationship between the students' assignment stress and self-efficacy. Similarly, Liu and Lu (2012) indicated that there is a positive association between the students' assignment stress and depression. Therefore, new pedagogical methods that eliminate the stress can be useful to maximize the efficiency of time spent on doing assignments. Students in traditional education mostly do their assignments at home or dormitories without the support of teachers and peers. While flipped classroom is a flexible method that attribute individual learning responsibility to the learners in a flexible way (Ng et al., 2021), the students do their assignments collaboratively under the guidance of their peers and teachers within the classroom (Marquard, 2014). In addition, flipped classroom approach is flexible (Baepler et al., 2014; Fulton, 2012; Moraros et al., 2015) and entertaining (Lemmer, 2013). Moreover, students have positive attitudes toward this approach (Chen et al., 2014; Holmes et al., 2015; Pannabecker et al., 2014; Roach, 2014), and it facilitates learner motivation (Abeysekera & Dawson, 2014; Kakosimos, 2015). Consequently, it is thought that flipped classrooms can change the perceptions of the learners towards the assignments and reduce their assignment stress.

The aim of the study

The aim of the study is to investigate the effects of flipped classroom model on the students' assignment stress and academic achievement. In line with the purpose of the research, answers to the following questions were sought.

1. Is there a significant difference between the assignment stress of the experimental and control group students?
2. Is there a significant difference between the academic achievement of the experimental and control group students?
3. Is there a significant difference between the course success scores?
4. Is there a significant difference between the material development scores?

Method

Research design

The aim of the study is to investigate the effects of flipped classroom model on the students' assignment stress and academic achievement. For this purpose, a quasi-experimental study was designed, and one experimental and one control group were formed by random assignment of study groups (Fraenkel & Wallen, 2008). The study was conducted for 11 weeks in the context of Material Design and Use in Education (MDUE) course. The experimental group students followed the courses outside the class through interactive videos, and they completed the given assignments in-class with the group collaboration. On the other hand, the control group students followed the lessons in-class (face-to-face), and they completed the given assignments outside of the class with the group collaboration. Both groups were given a pre-test and post-test to collect data, and semi-structured interviews were conducted with the experimental group students to enrich research findings.

Study group

The study group consisted of pre-service teachers taking the MDUE Course, from a faculty of education at a university in Turkey. Due to the limited number of students taking this course, convenient sampling and volunteerism were taken as the basis and 46 students were voluntarily involved in the process. In the study, students were randomly assigned to each group. 24 pre-service teachers were assigned to the experimental group, and 22 pre-service teachers were placed in the control group. However, two students in the control group did not participate in the experimental process and post-test. Therefore, these students were excluded from the study. Consequently, the study was conducted with 44 students, 24 (8 female, 16 male) in the experimental group and 20 (8 female, 12 male) in the control group. The average age of the students is 20.15 (SD = 0.96). Assignment stress and course success pre-test scores were compared for controlling the homogeneity of the groups. Moreover, the students' ICT course scores in the previous semester were used to determine the students' ICT skills. The scores of the groups were compared by independent samples t-tests (see Table 1).

As seen in Table 1, there is no statistically significant difference between assignment stress, course success, and ICT skills scores of the groups. Additionally, students' accessibility to technology was investigated and all of the students in each group had personal computers and internet access. As a result, it can be said that the groups were similar before the study.

Table 1 t-test comparisons before the experiment

Variables	Group	N	Mean	SD	t	Sig. (*p*)
Assignment stress	Experimental	24	16.66	6.11	0.653	0.51
	Control	20	15.40	6.74		
Course success	Experimental	24	10.63	3.16	− 0.388	0.70
	Control	20	11.00	3.22		
ICT skills	Experimental	24	69.42	11.96	− 0.074	0.26
	Control	20	69.70	13.24		

Data collection instruments

Assignment stress scale

The Assignment Stress Scale, developed by Demirer and Aydın (2016), used to determine the effect of flipped classroom model on the assignment stress of the students. This scale was developed to measure the assignment/task stress of university students instead of measuring the stress level in general such as the Perceived Stress Scale (Cohen et al., 1994; Örücü & Demir, 2009) or in different factors in higher education such as Higher Education Stress Inventory (Dahlin et al., 2005). It is a Likert-type scale (0: Never, 1: Rarely, 2: Sometimes, 3: Often, 4: Always) consisting of 10 items, such as "When I think about my assignment/task, I feel restless.", "When I have assignment/task to do, I feel various pains (stomachache, headache, etc.).", "I worry that I won't be able to complete my assignment/task on time.". The validity and reliability study of the scale was conducted by Demirer and Aydın (2016) with the participation of 1178 university students. As a result of the exploratory factor analysis, it was concluded that the scale consisted of 10 items and had a 3-factor (cognitive indicators, emotional indicators, and physiological indicators) structure. After the confirmatory factor analysis, the scale was determined to have a good fit ($x^2/df = 2.591$; RMSEA = 0.05; GFI = 0.97; AGFI = 0.95; NFI = 0.95; CFI = 0.97, RFI = 0.93). In the current study, Cronbach's alpha internal consistency coefficient of the scale was calculated as 0.90. Students can get a minimum of 0 point and a maximum of 40 points on this scale. No cut-off point was established for the scale, and it was understood that as the score on the scale increases, the assignment stress level increases, too.

Measurement of academic achievement

Course success test A multiple-choice test was developed by researchers to determine the impact of flipped classroom model on the students' academic achievement. The purpose of this test is to measure learners' knowledge in the field of educational material design and development. The objectives of MDUE course were identified, and a question pool consisting of 42 items was created. The question pool was reviewed by a language expert, a measurement and evaluation expert, and two field experts. Based on the feedback from experts, some questions were removed, and some of them were edited considering the content validity. The pilot test (37 items) was performed to 162 students who previously took this course. After the item analysis, 28 items with item difficulty index (Pj) between 0.20 and 0.80 and item discrimination power (rjx) over 0.30 were involved in the test. The average difficulty of the test was calculated as 0.55. K-20 reliability coefficient of the test consisting of 28 items was found as 0.71. The test scores were based on the number of correct answers ranging from the lowest score of "0" and the highest score of "28".

Evaluation of developed educational materials Seven different assignments were given to the students, and by means of these assignments, students were requested to use their knowledge learned in the course into developing educational material. These assignments are as follows:

1. Groups design and report a sample course based on ASSURE instructional design model.
2. Groups prepare a concept map based on an educational objective.

3. Groups prepare a course presentation by the principles and techniques of effective presentation.
4. Groups prepare educational material using QR code technology.
5. Groups design an educational web site according to design principles.
6. Groups prepare an interactive course video involving voice and quiz elements.
7. Groups prepare an e-book involving button, video, and text elements.

Four different checklists were used to evaluate the educational materials produced by the students:

- *Instructional Design Checklist* was used to evaluate the instructional design assignments. This checklist was prepared by the researchers based on the steps of the ASSURE instructional design model, and opinions of two experts. The prepared form consists of 20 items and includes a scoring scale between 0 and 5 according to the level of proficiency.
- *Concept Map Checklist* was used to evaluate concept maps developed by the students. This checklist was developed by the researchers considering the literature and the opinions of two experts. The aim of this checklist is to evaluate the students' knowledge and transfer skills about the features and functions of concept maps. It consists of 10 items and includes a scoring scale between 0 and 10 according to the level of proficiency.
- *Visual Design Checklist* was used to evaluate the visual materials developed by the students. The checklist was developed by the researchers considering the visual design principles and the opinions of two experts. In the checklist, there are 15 items that reveal proficiency in visual design principles such as contrast, balance, emphasis, movement, white space, proportion, hierarchy, repetition, rhythm, pattern, unity, and variety. It includes a scoring scale between 0 and 3 according to the level of proficiency. This checklist was used to evaluate more than one assignment in the study. It was used in the evaluation of educational materials such as the educational website, presentation, and interactive book that students developed by using their knowledge of visual design principles.
- *Interactive Video Checklist* was used to evaluate the interactive videos. The checklist was developed by the researchers considering the literature and the opinions of two experts. In this checklist, holistic knowledge of the subject, the use of interaction elements, compliance with the visual design principles, accurate sound and the use of clear language were checked. It consists of 10 items and includes a scoring scale between 0 and 10 according to the level of proficiency.

All checklists were reviewed by a language expert, a measurement and evaluation expert, and two field experts. Necessary corrections were made in line with the feedback received from the experts and their final versions were given.

Semi-structured interviews

A semi-structured interview form was prepared to collect data on student opinions. The main purpose of this interview is to explore the views of students who have experienced

flipped learning. In this context, semi-structured interview questions were prepared to reveal the opinions of the students about the flipped classrooms, advantages, and disadvantages (benefit, convenience, difficulty, motivation), and its psychological effects (preparation for the lesson, doing homework/activity, evaluation, etc.). The form was revised considering the feedback from a language and a field expert. Interviews were conducted with 10 randomly selected students from the experimental group. The interviews were conducted face-to-face and the students were asked for permission to record the audio. One more researcher was included in the process of controlling the text data to check the accuracy of the data while the audio recordings were transferred to the text.

Experimental procedure

The implementation of the study is shown in Fig. 1.

The experimental implementation was completed in 11 weeks. While pre-tests were given in the first week, post-tests were delivered in the last week. The course activities were carried out by the same instructor with the experimental and control groups in nine weeks. As seen in Fig. 1, the experimental group students followed the courses outside the class through interactive videos, and they completed the given assignments in-class with the group collaboration. On the other hand, the control group students

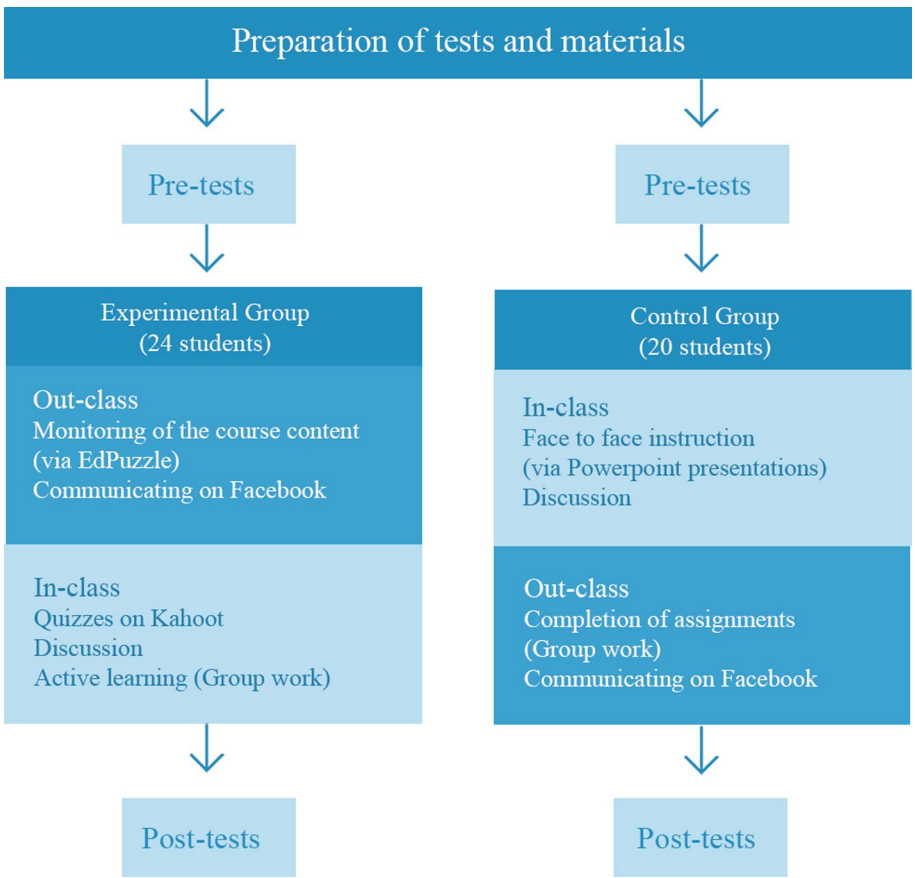

Fig. 1 Implementation process

followed the lessons in-class (face-to-face), and they completed the given assignments outside of the class with group collaboration in 1 week. The experimental and control groups were requested to complete these assignments in groups of three.

While interactive videos presented to the experimental group were prepared by Camtasia Studio, presentations for the control group were designed by MS PowerPoint. The course contents were conducted equivalently in both groups. In the control group, course contents were presented using the projector in the classroom environment. In the experimental group, interactive videos prepared by the instructor were shared with students on the EDpuzzle learning management system. Students were given one week to watch these videos about the next class. One of the disadvantages suggested by the literature of flipped classes is the inability of making sure whether students watched the videos or not (Bergmann & Sams, 2012). EDpuzzle platform was used to overcome this disadvantage and the information regarding whether or not the experimental group students watched the videos was reported. Also, the students were forced to watch the videos by inserting a variety of questions into the videos. A sample question shared through EDpuzzle is shown in Fig. 2.

Instant messaging was used in both groups for student–student and student–teacher communication. In flipped classes, the learners might need feedback while watching the videos (Enfield, 2013; Gündüz & Akkoyunlu, 2019; Kurbanoglu & Akkoyunlu, 2017), and therefore quizzes were used to address this need. Kahoot quiz application was used for improving the interaction in the classroom, testing the efficiency of videos, and providing feedback to the learners. These quizzes were utilized in the classroom using a projector, computer, and smartphones. In the control group, in-class question–answer and discussion activities were done to provide feedback to students.

Validity and reliability of the study

In the experimental research process, the following points were considered to ensure the internal validity of the study. The participants were assigned to the experimental and control groups unbiasedly. The tests applied to the experimental and control groups are the same. In the study, it was also observed that the pre-tests of both groups

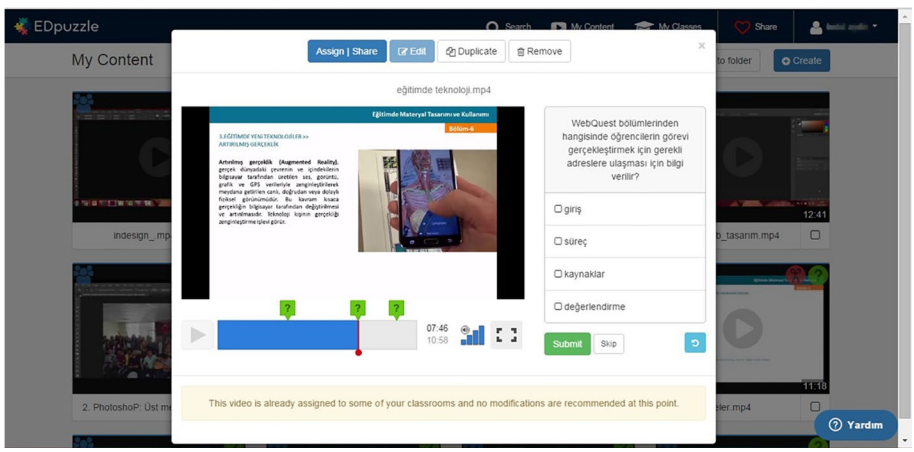

Fig. 2 EDpuzzle video editing and interaction elements

were homogeneous before the experiment, and the groups showed similarity before the experiment. The course activities were carried out by the same instructor with the experimental and control groups. The qualitative findings were given with direct quotations. Sufficient time and interaction were provided for the interviews. During the interviews, the points that the participants did not understand were clarified by asking alternative questions. To increase external validity; the research method, study group, data collection tools, and how the data were analyzed and interpreted were explained in detail. A consensus was reached among the researchers in the analyzes made to increase the internal reliability, and the findings were presented without any comment. To increase external reliability, the findings of the study were checked by an expert in the field of teacher education.

Data analysis

At the end of the study, a descriptive analysis was made, and the results were used to outline the data and to check the necessary assumptions before analysis. Regarding normality, histogram and box plot graph were used and the skewness and kurtosis coefficients of variables were checked to be between ± 1. In this respect, it was concluded that each variable is normally distributed, and hence the normal distribution assumption was met (George & Mallery, 2003). Then, Mahalanobis distance values were controlled, and it was found that the multivariate normal distribution assumption was ensured. Thus, parametric tests were applied.

Independent samples t-test was used before the experimental process to determine whether there is a significant difference between the students' assignment stress and their course success scores. Although there was not any significant difference between pre-test scores of the groups, post-test scores were compared by one-way analysis of covariance (ANCOVA) to fully equalize the effect of pre-test scores. ANCOVA assumptions were tested, and it was seen that all of the assumptions were met.

In order to evaluate educational material development scores, seven different assignments were collected from the students throughout the process. These assignments were evaluated by two different experts using the checklists. Pearson Correlation analysis was applied between the scores to determine the reliability of scoring among experts. As a result, when the scores given by the experts for each assignment were compared, it was seen that there was a high level of correlation between 0.624 and 0.836 ($p = 0.00$). In this case, it can be said that a reliable scoring for transfer scores is made, and interrater reliability is ensured. In this regard, the scores of the groups regarding the seven different assignments were examined by the multivariate analysis of variance (MANOVA). For the dependent variables, it is seen that there are separate analyses examining the effect of the same independent variable. In such cases, Bonferroni correction should be made to prevent type I error (Pallant, 2005). In the easiest way, Bonferroni correction should be revised according to the number of analyses to be made with the same independent variable of alpha (commonly used value 0.05) (Tabachnick et al, 2007). In this context, Bonferroni correction ($p < 0.05/7 = 0.007$) was used so as not to make a Type I error for the MANOVA results. All assumptions of MANOVA are checked and met before the analysis.

Power analysis was performed to determine the number of participants required for the study (Cohen et al., 2003). To determine the minimum number of samples required in the study, G*Power 3.1 was used. As a result of the calculation, it was suggested that 34 participants would be sufficient for 80% power ($\alpha = 0.05$, effect size = 0.5). In the current study, the number of participants was 44 and, more than the minimum sample size calculated. In addition, partial eta squared (η^2) was calculated to determine the effect size, using the 0.01, 0.06, and 0.14 considered as small, medium, and large effect sizes (Richardson, 2011). Also, observed power values calculated and used for interpretation of the results. High observed power supports the possibility of ANCOVA or MANOVA to detect statistical significance for truly existing differences, and power detected at 0.80 or higher is considered large (Hair et al., 2019).

In the qualitative part, the interview data were audio-recorded with the permission of the participants, and then the recordings were transcribed. In order to check the accuracy of the transfer process, the converted texts were confirmed by the second researcher. Thus, the validity of the study was tried to be increased (Sandelowski, 1986). The data obtained from the interviews were analyzed descriptively. In order to increase the internal validity of the interview method, the findings were later confirmed by the individuals participating in the research (Morse, 2016; Silverman, 2016). The salient findings are presented in the discussion section to enrich the quantitative findings.

Results

Assignment stress

The ANCOVA analysis was performed to determine whether there was a statistically significant difference among the mean scores of assignment stress of the groups. The results are shown in Table 2.

As seen in Table 2, there is a statistically significant difference between the means of the assignment stress scores ($F_{(1,41)} = 50.549$, $p < 0.01$). After the implementation, assignment stress scores of the experimental group students were significantly less than those of the control group. Additionally, a large effect size was noted (partial $\eta^2 = 0.55$), and the observed power was high ($1.00 > 0.80$). Thus, the large effect size supports the practical significance of the flipped learning intervention, with about 55% of the difference in scores between groups being due to applied method rather than chance. Similarly, high observed power supports that ANCOVA is more likely to detect statistical significance for differences that actually exist. Thus, the results demonstrate the practical importance of flipped learning on students' assignment stress scores.

Table 2 ANCOVA results for the assignment stress

Group	N	Pre-test means (SD)	Post-test means (SD)	Adj means	$F_{(df1, df2)}$	Sig. (*p*)	P. η^2	Power
Control	20	15.40 (6.74)	15.15 (6.15)	15.45	$50.549_{(1, 41)}$	0.00*	0.55	1.00
Experimental	24	16.66 (6.11)	6.42 (4.02)	6.16				

*$p < 0.01$

Table 3 ANCOVA results for the course success

Group	N	Pre-test means (SD)	Post-test means (SD)	Adj means	$F_{(df1, df2)}$	Sig (*p*)	P. η^2	Power
Control	20	11.00 (3.22)	15.50 (2.87)	15.37	$27.155_{(1, 41)}$	0.00*	0.39	0.99
Experimental	24	10.63 (3.16)	19.58 (3.61)	19.68				

*$p < 0.01$

Table 4 ANOVA results for each assignment

Dependent variable	Group	Mean (SD)	Sum of squares	Mean square	$F_{(1,42)}$	Sig. (*p*)	P. η^2	Power
Asgmt. 1	Control	52.55 (4.03)	41.482	41.482	3.030	0.089	0.067	0.40
	Experimental	54.50 (3.40)						
Asgmt. 2	Control	74.50 (7.49)	15.928	15.928	0.362	0.551	0.009	0.09
	Experimental	75.70 (5.83)						
Asgmt. 3	Control	75.30 (7.23)	2.819	2.819	0.069	0.795	0.002	0.06
	Experimental	74.79 (5.63)						
Asgmt. 4	Control	67.40 (6.29)	42.552	42.552	1.253	0.269	0.029	0.19
	Experimental	69.37 (5.41)						
Asgmt. 5	Control	74.25 (4.38)	6.837	6.837	0.439	0.511	0.010	0.10
	Experimental	75.04 (3.54)						
Asgmt. 6	Control	78.50 (3.92)	47.348	47.348	3.939	0.054	0.086	0.49
	Experimental	80.58 (3.03)						
Asgmt. 7	Control	81.75 (4.01)	3.712	3.712	0.278	0.601	0.007	0.08
	Experimental	81.16 (3.33)						

Academic achievement

In order to evaluate the academic achievement of the students, their course success scores and material development scores were analyzed. The ANCOVA analysis was performed to determine whether there was a statistically significant difference among the mean scores of course success of the groups. The results are shown in Table 3.

As seen in Table 3, there is a statistically significant difference between the means of course success scores in favor of the experimental group ($F_{(1,41)} = 27.155$, $p < 0.01$). Additionally, a large effect size was noted (partial $\eta^2 = 0.39$), and the observed power was high ($0.99 > 0.80$). Thus, the large effect size supports the practical significance of the flipped learning intervention, with about 39% of the difference in scores between groups being due to applied method rather than chance. Similarly, high observed power supports that ANCOVA is more likely to detect statistical significance for differences that actually exist. Thus, the results demonstrate the practical importance of flipped learning on students' course success scores.

The MANOVA analysis was conducted to determine the effect of the instructional method on the students' developed educational materials. The multivariate test results indicate that there is no significant difference between the material development scores of the experimental and control groups (Wilks' Lambda $= 0.837$, $F_{(7,36)} = 1.004$, $p = 0.445 > 0.05$). The results of individual ANOVA which compare the material development scores of the experimental and control groups for each assignment are given in Table 4.

As seen in Table 4, there is no statistically significant difference between all assignment scores for the material scores of the experimental and the control groups ($p > 0.05$). In addition, it is seen that the effect size and observed power values are generally low.

Discussion and conclusion

In this experimental study, the effect of the flipped classrooms on students' assignment stress and academic achievement in the educational material development course was examined. In addition, quantitative findings were enriched with the opinions of the students. As a result, it was seen that the assignment stress of the students who experienced the flipped learning in a small study group and under the current study conditions were reduced. Some scholars emphasize that flipped classrooms could provide more flexible and efficient learning environments (Baepler et al., 2014; Durak et al., 2019). Zhao et al. (2021) underlines that students' self-efficacies increase in flipped classrooms by having the opportunity of putting theory into practice. Besides, learners develop beliefs that they could be successful when they come up with an output as they did in their assignments. In flipped classrooms, students do their assignments collaboratively under the guidance of their peers and teachers within the classroom (Julia et al., 2020; Lee, 2018; Marquard, 2014). Therefore, the flipped classrooms which transform assignments into in-class tasks could psychologically relieve the students and decrease their assignment stress.

In the interviews conducted with 10 students, most of the students ($f = 7$) stated that flipped learning made them feel more relaxed and decreased their assignment stress, as they did not have to take their assignments home. Some other students underlined that the teacher's guidance role had a relieving effect on their psychology. The students also emphasized that when they had problems while doing assignments at home, they used to feel under stress by spending more time on the task, however, when they did their assignments in the classroom, they were able to resolve any possible problems in cooperation with their peers. Some of the students also stated that they felt comfortable and independent in flipped learning as it offered an individual learning experience in a flexible way. Some students' opinions on this issue are as follows:

> *"…This method made me feel better psychologically. I did not feel in a rush to submit my assignment."*
> *"Psychologically, I was very comfortable, because I came prepared to the classes as I had watched videos. There was no stress as I was doing my assignment at school and had face-to-face communication with the teacher. I was not stressed about understanding the subject…"*

In this study, it was seen that there is a significant difference in favor of the experimental group in terms of course success between the experimental and control groups. However, there is no statistically significant difference between all assignment scores for the material development scores of the experimental and the control groups. Many studies indicate that flipped classrooms increase academic achievement or success in various disciplines (Bösner et al., 2015; Haghighi et al., 2019; Kong, 2014; Mattis, 2015; Polat & Karabatak, 2022; Street et al., 2015; Wiginton, 2013; Yestrebsky, 2015). Bösner et al. (2015) found a significant increase in academic achievement, and

they based the reason for this on the fact that flipped classroom provides students with the opportunity of a more interactive and practice-based process. Street et al. (2015) state that flipped classroom increases learning achievement in that it enables active learning experience in the classroom, provides interactive materials, peer interaction, cooperation, and question–answer and discussion sessions. The main purpose of this model is to create more time for performing active learning in the class, especially in practice-based sciences (Kay et al., 2019; Lewis et al., 2018). Moreover, some students expressed that this approach could be effective in increasing success with regards to involving cooperation and guidance of teachers. A student's opinion that supports this issue is as follows:

> *"…flipped classroom is quite a successful model. Firstly, I liked group work very much. Secondly, it enabled me to complete the assignments in the classroom. Thirdly, the teacher had a guiding role towards us, and it was very useful to support us whenever we needed because we would not have this opportunity at home…"*

Although the success of the course was high in favor of the experimental group, the reason why the group performances regarding material development scores were similar may be due to the fact that learning transfer is a very difficult process (Barnett & Ceci, 2002; Perkins & Salomon, 1992). Practice-based activities in flipped classrooms are usually conducted in a classroom environment. Some students stated that they could not come up with a product in the desired way because of the limited time and materials in the classroom. A student emphasized that: *"I had a technical issue once. Therefore, I had to re-do my assignment. It was problematic for me to stick to the time in class."* In addition, if the necessary materials for the activities to be carried out in class are not provided before coming to the class, students' performance might decline (Enfield, 2013). Students might have focusing problems on assignments while doing them in the classroom. Furthermore, as students' pace of doing assignments are not the same, some learners could not finish them within the proposed time, while some others felt bored with waiting after they had finished their tasks (Thoms, 2012). These psychological and environmental impacts might be the reason why the material development scores of the experimental group are not different from the control group. Besides, the fact that the control group is given one week to submit their assignments and they have higher accessibility to different materials outside the classroom can be the reason why a difference between the groups does not occur.

In the literature, students have generally positive opinions about the flipped classrooms (Campillo-Ferrer & Miralles-Martínez, 2021; Chen et al., 2014; Davenport, 2018; Holmes et al., 2015; Pannabecker et al., 2014; Roach, 2014). Similarly, some studies show that students enjoy the flipped classrooms because it is flexible and fun (Pinto & Little, 2014; Rodríguez et al., 2019). In the current study, students have mainly positive opinions about the flipped classroom. They also considered this model as efficient, pleasant, different, and exciting. Students have the benefits of active learning as well as individual learning in flipped classes (Bishop & Verleger, 2013). Students also claimed that it was very useful to have an individual learning process. Moreover, they could learn at their own pace by re-watching videos, and they were able to study comfortably at home whenever they wanted without time and space limitation.

Limitations and implications

Although this study has some limitations, some suggestions can be made based on the results of the study. This study was conducted for an 11-week period of a semester to a small group (44) of students. This may restrict the generalizability of our findings. Therefore, future studies may examine the effects of flipped classrooms with larger quantities of participants. Also, some students claimed that because of the limited time and materials in the classroom, they could not come up with an exact outcome in the desired way in the assignments. In this regard, teachers using this model should be flexible about allowing students to continue their assignment outside the classroom. Some students felt bored with waiting in the classroom and doing nothing after they were finished with their assignments. These students can be required to guide their peers. On the other hand, course contents should be prepared to make in-class time more productive, and in-class time should be planned effectively. In the activities conducted in the classes, problems encountered by the students should be resolved by the teacher.

In the out-of-classroom activities, some students could not watch course videos due to technical difficulties such as internet access. To resolve this issue and to ensure equality of opportunity, course contents should be given to these students through flash memories, DVDs, CDs and so on. Students can also be given the opportunities of watching videos in computer labs, libraries, etc. if the school has these facilities. Thus, the students should be motivated to watch the videos out of the classroom. To facilitate this, tools such as EDpuzzle that provides interaction and the reports of watching videos can be used. Also, effective digital tools that allow communication and interaction can be useful in this process. During the implementation of this model, instant messaging applications could be used to ensure communication between student–student and student–teacher. In this study, limited digital tools (Edpuzzle, Kahoot, Camtasia Studio etc.) were used, and it was seen that these tools had positive impacts in the implementation of the study. Therefore, the effects of using different media and materials in the flipped classroom can be investigated in future studies.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests
The authors declare that they have no competing interests.

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