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Flipped Classroom Model in High School Mathematics

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Abstract

The aim of this study was to examine the effect of the flipped classroom model on 10th grade students' mathematics achievement and mathematical attitudes. The research has as a pre test post test quasi-experimental design with a control group. The participants consisted of 67 tenth grade students in two groups as control (n=33) and experiment (n=34). A non-interventional, regular mathematics instruction (technology integrated face to face classroom model) currenlty being implemented by state schools was applied in the control group. Flipped classoom model was used in the experimental group. The data were collected by using the "Mathematics Achievement Test" and the "Attitudes towards Mathematics Instrument". In the analysis of the data, a repeated samples t-test and independent samples t-test were used. The critical value was taken as .05 for all statistical tests. The findings of the study revealed that the experimental group students in flipped classroom model had statistically significantly higher scores on both mathematics achievement and mathematical attitudes than the control group students. Based on the findings of the current study, it was suggested that, flipped classroom model can be used in high school mathematics courses.

Ters Yüz Sınıf Modelinin Lise Matematik Dersinde Uygulanması

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Öz

Bu araştırmanın amacı, tersyüz sınıf modelinin onuncu sınıf öğrencilerinin matematik başarılarına ve matematiğe yönelik tutumlarına etkisini incelemektir. Çalışma ön test son test kontrol gruplu yarı deneysel desen ile desenlenmiştir. Araştırmanın katılımcılarını onuncu sınıfta öğrenim görmekte olan 67 öğrenci oluşturmaktadır. Çalışma grubu kontrol (n=33) ve deney (n=34) olmak üzere iki gruba ayrılmıştır. Kontrol grubunda herhangi bir müdahale yapılmamış, devlet okullarında hali hazırda öğretmenlerin kullanmakta oldukları öğretim modeli (teknoloji destekli yüz yüze eğitim) uygulanmıştır. Deney grubunda tersyüz sınıf modeli uygulanmıştır. Araştırmanın verileri "Matematik Başarı Testi" ve "Matematiğe Yönelik Tutum Ölçeği" kullanılarak toplanmıştır. Verilerin analizinde, bağımlı örneklemler için t-testi ve bağımsız örneklemler için t-testi kullanılmıştır. Anlamlılık seviyesi tüm istatistiksel tester için .05 olarak kabul edilmiştir. Araştırma bulgularına göre, tersyüz sınıf modeli ile öğrenim gören deney grubu öğrencilerinin matematik başarılarının ve matematiğe yönelik tutumlarının kontrol grubu öğrencilerinden istatistiksel olarak anlamlı düzeyde yüksek olduğu saptanmıştır. Mevcut çalışmanın bulgularına dayanarak, tersyüz sınıf modelinin lise matematik derslerinde kullanılması önerilmektedir.

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Introduction

Blended learning approach which is defined as the usage of web-based technology in combination with face-to-face learning models for an educational purpose has increasingly been the subject of researches in the field of educational technology (Bersin, 2004). According to several research findings, blended learning has positive effects on students' academic achievement, attitudes, persistence, and course satisfaction (Delialioglu & Yildirim, 2007; Deschacht & Goeman 2015; Rovai & Jordan, 2004; Taradi, Taradi, Radic & Pokrajac, 2005; Tuckman 2002). Yet, some research findings have emphasized that blended learning has less or no effect on these variables compared to face-to-face learning approaches and that blended learning environments should be designed to include more communication, interaction, and activity in class rather than solely focusing on the usage of technological content (Graham, 2006; Means, Toyama, Murphy, & Baki, 2013; Oliver & Trigwell, 2005). It is claimed that the Flipped Classroom (FC) model can overcome this deficiency that blended learning methods face (Bishop & Verleger, 2013; Moffett & Mill, 2014).

The Flipped Classoom (FC) model, considered to be a sub-branch of blended learning is seen as an important development in the field of educational technologies in recent years (Tucker, 2012). This model, which was proposed and relatively new in the early 21st century, has brought a different perspective to the design of today's learning-teaching processes. The main objective of developing this approach is to be an alternative to the traditional methods to create more time in the classroom for active and real life learning activities. The FC is a learning approach where traditional learning enviroments are supported by web based technologies and blended with distance learning. Becker, Cummins, Davis, Freeman and Ananthanarayanan (2017) have considered this model as the most important development in educational technologies in blended learning approaches. The FC model aims to design learning environments that are independent of time, class environment, course tools, equipment and to offer active learning environments where students communicate and interact with their peers and teachers (Baker, 2000). The FC model has two basic dimensions, out of class and in class activities. For out of class activities, teacher prepares the course content via technology and presents it to the students with a teaching management system. For in class dimension, teacher designs problem solving activities related to these online contents as individual and group study (Gencer, Gurbulak & Adiguzel, 2014). In other words, the FC model is a system which is defined as the displacement of the exercise, project and homework given to the students for reinforcing the subject with theoretical part of the course and develops the skills of supporting students' learning and solving the problems they face (Bishop & Verleger, 2013). The FC model provides learning environments that are independent from lesson time and classroom environment, allows students to access the course content at their own desired time and place and lets them repeat as much as they wish according to their learning speed and style. With this model, students learn in accordance with their own learning speed and learning styles in a flexible learning environment (Tucker, 2012). In most of the time spent in the classroom, students participate in learning activities that they are active such as communicating, interacting with their peers and teachers, problem solving, questioning and discussion (Baker, 2000; Milman, 2012).

According to many educational researchers, one of the most important disadvantages of traditional face to face learning approaches do not provide enough intra class learning activities for students that they can be active due to time limitation and excessive cognitive load (Balaman & Tuysuz, 2011; Chen & Looi, 2007). In the FC model; it is essential that the learning environment is individualized, teacher has an active role as a guide to students, students take the role of learning responsibility and that more learning activities are planned in the classroom.

The use of internet and internet tools (rich audio and video content) has become indispensable for the new generation called digital citizens. To prepare courses as video content and let them follow through a teaching management system can be interesting for this generation who likes to watch videos from social media tools such as Yotube, Facebook, Instagram (Ozturk & Talas, 2015). The FC model uses the interest of students in web browsing and video viewing for educational purposes.

Previous research point out that, students studied with FC model, are more engaged with learning. Their learning skills are improved, they take more responsibility for their learning, their interaction with their teachers and peers are increased, and for teachers, the classroom management is easier (Baker, 2000; Bergmann & Sams, 2012; Fulton, 2012; Lage, Platt & Treglia, 2000; Milman, 2012; Siegle, 2014; Strayer, 2007). In addition, it has been stated that the model has positive effects on academic performance and permanence, cognitive load, attitudes, learning motivation, critical thinking, individual and independent learning and information technology literacy

(Abeysekera & Dawson, 2015; Bates & Galloway, 2012; Kong, 2014; Lemmer, 2013; Sun, Xie & Anderman, 2018). According to the findings of these studies, it is clearly seen that flipped classroom model is considered as an important development in educational technology; and therefore, its' application in the classrooms becomes widespread.

Individuals' academic achievements on a discipline are related to their attitudes toward the discipline. In general, attitude is defined as the tendency of people to react positively or negatively to a certain object (Turgut & Baykul, 2011). Attitudes involve not only curiosity and assessment but also the way a person learns because it involves such things as curiosity and assessment that stimulates interest in something in individual (Avci, Coskuntuncel & Inandi, 2011). Therefore, attitude is an important concept for the educators. In the literature it is clearly seen that, from primary school to tertiary education, mathematics has been the head of the disciplines where students develop negative attitudes (Mata, Monteiro & Peixoto, 2012; Peker & Mirasyedioglu, 2003; Zan & Martino, 2007). Whereas, mathematics is the door opener of a better life and career for many people (Stafslien, 2001). As well, mathematics is also seen as an assistant to understand life and the environment and produce ideas about them (Dursun & Dede, 2004). Therefore, one of the important objectives of the reform studies on education has been to provide a system that can help students to learn by understanding mathematics (Kazemi & Franke, 2004). Aysan, Tanriogen, and Tanriogen (1996) aimed to investigate the reasons for the failure of students in mathematics courses and stated that the teaching methods, the lack of adequate exercise, teacher behaviors, and the development of negative attitudes were the most important factors. Similarly, some studies showed that teachers and students state problems related with not having enough time for learning activities in the classroom, with classrooms that are too crowded, and students' being exposed to excessive cognitive load (Aybek, 2007; Kalem & Fer, 2003; Prince, 2004).

The FC model as a new approach in educational technologies provides students flexible and free learning environments, allows them to plan their learning according to their learning pace, gives them to take responsibility of their own learning, and offers much more learning activities during the class time compared to traditional learning aproaches. Previous studies showed that students' mathematics achievement are related with the number of problem solving activities carried out in the classroom (Ozsoy, 2014; Soylu & Soylu, 2006), doing effective repetition and practice (Dursun & Dede, 2004; Lamb & Fullarton, 2002), and using technology and alternative teaching methods (Baki, 2001; Din & Calao, 2001). Accordingly, it is expected that FC model uses technology to provide students opportunities for more problem-solving activities and for more practice and repetatitions since the FC model has student-centered features such as allowing students to repeat the subject as many times as they wish and learn the subjects according to their learning speed. However; the FC model has some limitations such as internet access problems, students coming to class without watching video contents, some students' resistance to do new practices and the lack of instant feedback during video sessions (Bergmann & Sams, 2012; Ramirez, Hinojosa & Rodriguez, 2014).

In the current study, it is expected that FC model would help students to have more positive attitudes toward mathematics and increase their mathematics achivement. Because, the most important feature of the FC model is transfering theoretical part of the course to the students via a teaching management system outside the classroom and to allow more individual and group learning activities in the classroom (Baker, 2000; Filiz & Kurt, 2015; Pierce & Fox, 2012). Although the studies on the application of the FC model continue to increase, the effects of FC in Turkish education context have not been fully discovered (Aydın & Demirer, 2017; Çakıroğlu & Öztürk, 2016). The aim of this study is to investigate the effect of using a flipped classroom model on 10th grade students' mathematics achievement and attitudes toward mathematics.

Method

Research Design

To examine the effect of FC model on students' mathematics achievement and attitudes toward mathematics, a quasi-experimental design was used. In this study, students were already assigned to the classrooms by the management of the school; therefore, a quasi-experimental design was used as true experimental design with random sampling and selection could not be used (Buyukozturk, 2015).

Participants

The participants of the study were 10th grade students studying in a state high school in the city of Tokat, Turkey, at the spring term of 2017-2018 academic year. There were five 10th grade classes in the school where the research was carried out. The mathematics achievement average scores in the previous year of these 5 classes were examined for assigning the participants of study group. Two classes whose mathematics achievement averages were closest to each other, assigned as the experimental group (Group A) and the control group (Group B). The control group consisted of 33 students, while the experimental group consisted of 34 students. As presented in Table 1, there was no statistically significant difference in the mean of the mathematical achievement scores of the control and experimental groups in the previous year, $t(65)=1.28$, $p>.05$.

Table 1. Mathematical Achievement Averages of Study Group

Groups	***N***	$\bar{X}$	***SD***	***t***	***df***
Class A	34	67.54	16.15	1.28	65
Class B	33	68.13	19.67		

$^*p<.05$

Data Collection Tools

Mathematics achievement test: The mathematics achievement test that contains the Tetragons and Polygons in the field of geometry in mathematics as a multiple choice test consisting of 40 items was developed by two mathematics teachers. One of these teachers has a doctoral degree and the other one has a master's degree in mathematics education. The achievement test was used as a pretest before the implementation and as a posttest at the end of the implementation. For the content validity of the test, two experts, one of whom is a faculty member in the Faculty of Arts and Sciences and the other one is a faculty member in the Mathematics and Science Department of the Faculty of Education has been consulted. According to the expert opinions, it is stated that there were enough items covering the content of the tetragons and polygons unit in the achievement test. Before the implementation, the pilot application of the achievement test was conducted with 94 11th grade students who studied in the same school and had taken the mathematics course before. In the item analysis, Kuder-Richardson-20 (KR-20) formula was used to determine the internal reliability of multiple choice tests. The fact that the KR-20 reliability coefficient is close to (+1.00) indicates that reliability is high (Buyukozturk, 2015). As a result of the analyzes, the KR-20 reliability coefficient for all 40 items was calculated as 0.87. The discriminant coefficients of the items in the achievement test ranged from 0.29 to 0.61 and the mean discrimination coefficient for the entire test was calculated to be 0.41. If the item discrimination coefficients are greater than .40, it is stated that the test has a high degree of discrimination (Basol, 2018). The difficulty levels of the test items ranged from 0.25 to 0.84 and the mean difficulty of the whole test was 0.56. The medium difficulty of test items (.50) is a desired level and increases the reliability of the test (Basol, 2018). Based on these findings, no items were removed from the test and no correction was required.

The attitudes towards mathematics instrument: In the current study, the Attitudes Toward Mathematics Instrument was used to determine students' attitudes towards mathematics. The instrument that consists of 40 items was developed by Tapia (1996) and adapted to Turkish language by Tabuk & Hacıomeroglu (2015). It has a 5 point Likert type scale (1: strongly disagree to 5: strongly agree). The high score obtained from the attitudes towards mathematics instrument indicates a positive attitude. In the current study, the instrument was used before and after the experimental process as a pre-test and a post-test. The validity and reliability study of the original scale was performed by Tapia and Marsh (2002) and the Cronbach alpha internal consistency coefficient was calculated as .97 for the whole instrument. Results of confirmatory factor analysis showed that the instrument consisted of four factors: self-confidence (15 items), motivation (5 items), enjoyment (10 items), and value of mathematics (10 items). The Cronbach alpha internal consistency coefficient was calculated to be .96 for the self-confidence factor, .93 for the value of mathematics, .88 for the enjoyment factor, and .88 for the motivation factor of the instrument. The Cronbach alpha value was calculated as .87 for the instrument adapted to Turkish language (Tabuk & Hacıomeroglu, 2015). In the current study, it was calculated .88 for all measurements, indicating high score reliability.

Data Collection

In the current study, FC model was applied in the experiemental group and technology integrated face to face classroom model was applied in the control group. Video contents have been prepared for a flipped classroom in an instructional management system (EBA- http://eba.gov.tr/ebaders) by the researcher. The contents in the EBA application were shared with the experimental group students during 8 weeks. Experiment group students have accessed to these contents at home with their usernames and passwords and have studied the contents before the classroom time. In the classroom environment, they have asked the teacher about the points they had not understand from watching the video contents and they have participated in learning activities that they have been active such as problem solving, question-answer, individual, and group-study with their peers. In the control group, no intervention was made and the course flow continued as usual. The teacher lectured by using educational technology such as smart board and interactive materials, used classroom exercises, and assigned homework for students to do at home.

Data Analysis

The main assumptions for the use of parametric tests are the normal distribution of the data and the large sample at least 30 participants each group of the study (Buyukozturk, 2015). The sample size in the current study was greater than 30 in both the experimental group (n = 34) and the control group (n = 33) and the data obtained from the achievement test and the attitudes towards mathematics instrument were close to normal distribution since the kurtosis and skewness values were between -1 and +1 (Buyukozturk, 2015). As these assumptions were met in the current study, independent samples t-test was used for examining the statistical differences between intergroup factors (experimental group, control group) and dependent samples t-test was used for examining the statistical differences between intra-group factors (pretest, posttest).

Research Ethics

In the current study, ethical rules were met in data collection and analysis process by getting study permit and informing study group. The necessary permissions were obtained from Tokat National Education Directorate for data collection procedure (Number: 27001677-44-E14265175, Date: 19.12.2016).

Findings

In order to test the pre-experimental equivalence of the study group, mathematics achievement and attitudes toward mathematics scores were compared by using independent samples t-test. Results of the analysis revealed that experimental and control group students' pre-test mean scores were not statistically significanlty different from each other both for the mathematics achievement, $t(65)= .491$, $p>.05$, and for the attitudes toward mathematics, $t(65)=.509$, $p>.05$ (Table 2).

Table 2. Findings for the Equivalence of Groups

Measurements	Groups	*N*	$\bar{X}$	*SD*	*t*	*df*
Mathematics Achievement Test	Experimental Group	34	31.62	5.87	. 491	65
	Control Group	33	32.35	6.35		
Attitudes Toward Mathematics Instrument	Experimental Group	34	3.13	.53	1.94	65
	Control Group	33	3.15	.55		

*$p<.05$

Findings Regarding Mathematics Achievement

Dependent samples t-test was used to investigate the mean difference between the pre and post achievement tests scores of the experimental group students. Results of the analysis revealed that, the difference between pre-test (M=31.62, SD=5.87) and the post-test (M=70.07, SD=14.36) was statistically significant, $t(33)=14.62$, $p<.05$, large effect size, d=.87 (Table 3).

Table 3. Dependent Sample t-test for Experimental Group Students' Mathematics Achievement

Measurements	***N***	$\bar{X}$	***SD***	***t***	***df***
Pre test	34	31.62	5.87	14.62*	33
Post test	34	70.07	14.36		

*p<.05

Dependent samples t- test was used to examine the difference between the pre-test and post-test application of the achievement test of the control group students. Results of the analysis revealed that, the difference between pre-test ($\bar{X}$ =32.45, *SD*=6.31) and the post-test ($\bar{X}$=63.10, *SD*=12.55) mean scores was statistically significant, *t*(32)=14.93, *p*<.05, large effect size, *d*=.84 (Table 4).

Table 4. Dependent Sample t-test for Control Group Students' Mathematics Achievement

Measurements	***N***	$\bar{X}$	***SD***	***t***	***df***
Pre test	33	32.45	6.31	14.93*	32
Post test	33	63.10	12.55		

*p<.05

As seen above, dependent sample t-test results showed that both experimental group and control group students' mathematics achievement scores were increased from pre-test to post-test. With regard to the post-test mathematics achievement scores, the mean scores of the experimental group ($\bar{X}$= 70.07, *SD* =14.36) was higher than the mean scores of the control group ($\bar{X}$= 63.10, *SD* = 12.54). In order to examine whether this diffence was statistically significant, independent samples t-test was used. Results of the analysis revealed that experimental group and the control group students' post-test mathematics achievement scores were statistically significantly different, *t*(65)=2.12, *p*<.05, with a medium effect size, *d*=.51 (Table 5).

Table 5. Comparison of Mathematics Achievement Post-test Mean Scores of Control and Experimental Group

Groups	***N***	$\bar{X}$	***SD***	***t***	***df***
Experimental Group	34	70.07	14.36	2.12*	65
Control Group	33	63.10	12.55		

*p<.05

Findings Regarding Attitudes towards Mathematics

The difference between the pre-test and post-test Attitudes Toward Mathematics Instrument mean scores of the experimental group students was examined by using dependent samples t-test. Results of the analysis revealed that there was a statistically significant difference between the pre-test ($\bar{X}$=3.13, *SD*=.40) and the post-test ($\bar{X}$=3.55, *SD*=.55) mean scores, *t*(33)=3.40, *p*<.05, have medium effect size, *d*=.68 (Table 6).

Table 6. Mathematical Attitudes of Experimental Group Students

Measurements	***N***	$\bar{X}$	***SD***	***t***	***df***
Pre-test	34	3.13	.40	3.40*	33
Post- test	34	3.55	.55		

*p<.05

The difference between the pre-test and post-test Attitudes Toward Mathematics Instrument mean scores of the control group students was examined by using dependent samples t-test. Results of the analysis revealed that there was no statistically significant difference between the pre-test ($\bar{X}$=3.15, *SD*=.48) and the post-test ($\bar{X}$=3.18, *SD*=.58) mean scores of the atttudes toward statistics of the control group students, *t*(32)= 1.71, *p*>.05 (Table 7).

Table 7. Mathematical Attitudes of Control Group Students

Measurements	***N***	$\bar{X}$	***SD***	***t***	***df***
Pre-test	33	3.15	23.04	1.71	32
Post- test	33	3.18	19.21		

*p<.05

Independent samples t-test was used to investigate the difference between experimental and control group students' post-test mean scores of the Attitudes Toward Mathematics Instrument. Results of the analysis revealed experimental group students ($\bar{X}$=3.55, *SD*=.48) had statistically significanlty higher mean scores than the control group ($\bar{X}$=3.18, *SD* = .40) students, $t(65)=3.43$, $p<.05$. This mean difference had a large effect size, d=.82 (Table 8).

Table 8. Comparison of Mathematical Attitudes Post-test Mean Scores of Control and Experimental Group

Groups	***N***	$\bar{X}$	***SD***	***t***	***df***
Experimental Group	34	3.55	.48	3.43*	65
Control Group	33	3.18	.40		

*p<.05

Discussion and Conclusion

In the current study, the mathematics achievement of the experimental group students studying with the FC model was higher than the control group students studying with the technology integrated face to face classroom model, at the end of the semester. This study showed that the FC model might have positive effects on students' mathematics achievement. This might be through the educational advantages of the FC model. One of the most prominent features of the flipped classroom model is to include many learning activities such as problem solving, discussion, question-answer, individual, and group study in the classroom (Bergmann & Sams, 2012; Bishop & Verleger, 2013; Johnson & Renner, 2012). In the current study, outside of the classroom, the experimental group students followed the theoretical part of the subject via EBA, which is an online teaching management system. In the classroom, they have developed their own learning by taking part in active learning activities such as question-answer, problem solving, and individual and group studies. The activities have been carried out in the classroom support students' conceptual learning and help to make abstract concepts more concrete (Dursun & Dede, 2004). Therefore, the reason why the students studying with the flipped classroom model is more successful than students studying technology integrated face to face classroom might be that this model allows more time for problem solving, exercises and real life activities in the classroom (Akyuz & Pala, 2010; Baepler, Walker & Driessen, 2014; Cukurbasi & Kiyici, 2017; Herreid & Schiller, 2013; Ozer & Anil, 2011; Pierce & Fox, 2012; Seaton, Parker, Marsh, Craven & Yeung 2014).

Another educational advantage of the FC model is to enable students to repeat as many times as possible with the help of video contents (Bergmann & Sams, 2012). In the current study, experiment group students have come to the classroom by studying video content in the online teaching management system as much as they wish according to their own learning pace and they had a chance to ask questions to their teacher in classrooom. Therefore, the flipped classroom model allowed unlimited repetition of the lectures and hence could be effective in increasing students' mathematics achievement. Previous findings indicate that there is a positive relationship between mathematics achievement and repetition of the lectures (Polya, 2014; Savas, Tas & Duru, 2010).

Students' readiness, which is one of the laws of education, is an important factor for explaining academic achievement in any subject (Cooper, Robinson & Patall, 2006; Unal & Ozdemir, 2008). One advantage of the flipped classroom model is that students who watch video contents before entering the classroom come to class as more prepared than the students studying with face-to-face learning models (Yilmaz, 2017). Accordingly, the higher mathematics achievement in the experimental group in this study might be explained by FC model helping students' readiness for learning.

Students exhibit desired behavioral changes as well as high academic achievement in learning environments where classroom communication and interaction are healthy. Many research findings reveal that classroom environments, which have effective communication and interaction, are effective in increasing achievement, and individuals with improved social skills learn more easily (Cakmak & Aktan, 2016; Greenberg, Weissberg, O'brien, Zins, Fredericks, Resnik, & Elias, 2003). Communication and interaction within the classroom are often included in the implementation of the FC model. There is a plenty of time in the class for many learning activities such as question-answer, discussion, individual and group studies which require student-student and student-teacher communication and interaction. During this time, students can freely ask questions to the teacher, get immediate feedback and interact with their peers.

In the current study, it was observed that the experimental group students studying with the FC model developed more positive attitudes toward mathematics than the control group students studying with the technology integrated face to face classroom model. Student-centered characteristics of the FC model might be effective in the emergence of this result. The FC model offers students free, individualized, and flexible learning environments where they can learn according to their learning pace and style (Strayer, 2007; Tucker, 2012). In addition, the flipped classroom model enables usage of information and communication technologies such as computers, tablets, mobile devices and internet actively, both in and out of the classroom (O'Flaherty & Phillips, 2015). For today's digital citizens, the usage of these technologies is inevitable. Therefore, the usage of technological tools that students like in lessons may have improved their attitudes towards mathematics as previous findings indicate that using technology in lessons positively impacts students' attitudes towards the course (Koseoglu, Yilmaz, Gercek & Soran, 2007; Yorganci & Terzioglu, 2013).

Based on the findings of the current study, we suggest that flipped classroom applications should be used in mathematics courses for high school students. In the current study, videos were preferred as a mean for delivering the content in the online learning environment. For further studies, using a mean that includes interaction, animation and simulation, or a combination of the videos and audios with texts, and their impacts on students' learning and attitudes can be examined.

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Statement of Publication Ethics

We declare that the research has no unethical problems and observe research and publication ethics. The necessary permissions were obtained for data collection procedure (Tokat National Education Directorate, 19.12.2016, 27001677-44-E14265175).

Conflict of Interest

We declare that the current study has no conflict of interest.

Researchers' Contribution Rate

Authors	Literature review	Data Collection	Data Analysis	Results	Conclusion
Oğuzhan Tekin	☒	☒	☒	☒	☒
Esma Emmioğlu-Sarıkaya	☒	☒	☒	☒	☒

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Appendix 1

Bartın University Journal of Faculty of Education
The Ethical Issues Declaration Form For Authors

Article Title	Flipped Classroom Model in High School Mathematics
Discipline	Instructional Technologies
Type of Article	Compilation
Year of Data Collection	2018

As the author of the article, I declare in this form that scientific and ethical rules are followed in this article and that the article does not require the permission of ethical committee for the reason that the data collection procedure has been already done.

Date 07/05/2020

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