# FLIPPED CLASSROOM IMPLEMENTATION IN SCIENCE TEACHING

*Research article*

Fuat Serkan Say  (iD)

Mersin University

serkansay@mersin.edu.tr

Fatih Serdar Yıldırım (iD)

Akdeniz University

fatihserdaryildirim@gmail.com

Fuat Serkan Say was born in Kayseri in 1985. He studied Science Education at Atatürk University. Following his graduate education at Karadeniz Technical University, he completed his Ph.D. in Primary Education at Pamukkale University, in 2016. He still works as a faculty member at Mersin University

Dr. Fatih Serdar Yıldırım graduated from Selçuk University Faculty of Education Biology Teaching Departmant in 1999; got master degree at the same University in 2011; completed (PHD) doctorate education at Gazi University Enstitute of Educational Sciences biology teaching Department in 2016; and is still working as a science teacher in Ministry of National Education

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Fuat Serkan Say

serkansay@mersin.edu.tr


Fatih Serdar Yıldırım

fatihserdaryildirim@gmail.com

## Abstract

Along with the fast development in the internet technologies, every day new learning and teaching approaches are introduced and implemented. In this context, the aim of this research is to reveal the effect of Flipped Classroom model on the academic success of the students for the subject of Interaction of Matter with Heat of 8th grade Science course and opinions of students on the Flipped Classroom Model. Study group of the research consists of a total of 63 8th grade students, studied in a state middle school located in the central part of city of Konya during the 2017-2018 school year. In the research, mixed method, a method that allows integration of research results via utilization of quantitative and qualitative data collection methods conjointly is used. As the quantitative data collection tool, "Success Test" developed by a group of four, consisting of four professionalist science teachers and researchers, and as the qualitative data collection tool, "Semi-Structured Review" form, developed by the researcher have been used. In the research, a quasi-experimental design with a posttest control group has been used. As the result of the research; It was concluded that the academic achievement of the experimental group was statistically significant and positively higher than the control group. Students consisting the experimental group has expressed that with the flipped classroom application, their success and their participation to the class has improved and they found this method to be more fun than listening to the lecturing as per the current program requires. Also, the students have stated their absence of internet access at home and the problems they encounter due to hardware inadequacies of their computers are the drawbacks of the implementation.

*Keywords: Flipped classroom, EBA course, academic success.*

## 1. Introduction

Along with the fast paced changes in all the industries of the global world, factors such as population growth and technological advancements define and change the personal needs of humans.

Fast improvements in the field of science and technology have also caused important changes in fields such as economics, health, art and literature. Another field that has been deeply influenced by the improvements in technology and expected to show changes in paradigms of which is education sector. Among all, the ones that are effected by such changes the most are the children and youngsters who are also called as the Generation Z or the digital citizens (Prensky, 2001). Following the generations X and Y, people born after 1995 in some sources and 2000 in others, are called the Generation Z (Taş, Demirdöğmez, Küçükoğlu, 2017).

The most important characteristic of Z generation individuals is their ability to integrate technology much faster in their daily lives. These individuals, as per such characteristics have differentiated by the precious generations and it is observed that educational technologies should be actively used during this generation's course of education (Orhan, Kurt, Ozan, Vural & Türkan, 2014). This situation reveals the fact that different methods and tools should be developed and used in education as well as in all fields. Because traditional education models have proven to be insufficient to meet the needs arising from changing individual differences.

In today's world, considering the differences in the learning style and learning speed of individuals, it is necessary to use learning environments that vary according to individual needs, instead of models where all individuals are given the same education. There is a need for learning experiences in which individuals can transfer the knowledge they have learned through active learning activities to their daily lives. Therefore, it is thought that flipped classroom model can be effective in meeting educational needs and providing change (Roehl, Reddy, Shannon, 2013; Tucker, 2012).

In recent years, the use and popularity of the flipped classroom model is now widely preferred in many areas, including education and engineering (Bolat, 2016; Muir, 2017). In the literature, concepts such as inverted classrooms, flipped classrooms, inverted learning, flipped learning and class at home, homework in school are used for the flipped learning model. While the "classroom" was the focal point at the early implementations of this model, lately this focal point has shifted to "learning". While "flipped classrooms" concept had been used commonly at the early implementations, later this concept has been substituted with "flipped learning" (Hayırsever, Orhan, 2018).
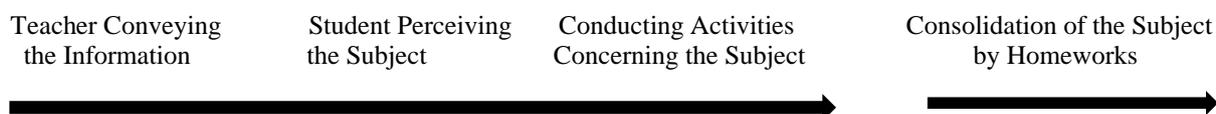
The term "Flipped classroom" has been used for the first time by chemistry teachers Bergman and Sams, working at the Woodland Park High located in the state of Colorado of the United States of America, in the year of 2006. Bergman and Sams defined this model, in which they aim to allocate more time for constructivist activities in the classroom, as what is traditionally done in school is done at home and what is done at home is done in school (Bergman ve Sams, 2012).

Flipped classroom model consists of two main components. These components are defined as "Out-of class implementations" and "In-class active education activities" (Kara, 2016). Flipped classroom practice is confused with online education, blended learning and distance education programs (Hamdan, McKnight, McKnight, Arfstrom, 2013).

However, in online education, students and teachers are not in the same environment. On the other hand, in distance education teacher-student interaction is very limited. When evaluated in terms of the presence and interaction of the teacher and the student in the same environment, the model closest to the flipped classroom practice is the blended learning model. Even though the blended learning also includes an online element, activities done using information technologies are mostly done in the classroom environment within the framework of teacher - student communication (Allen, Seaman, & Garrett, 2007).

The flipped classroom model model is a pedagogical model developed to utilize the time spent in the classroom in the most efficient way by using educational technologies. In this model, unlike traditional education, tasks such as acquiring knowledge are performed by students before they come to class. Thus, more time is allocated for the in-class active learning activities (Roehl, Reddy, Shannon, 2013; Tucker, 2012).

**Traditional Model**

| Teacher Conveying the Information | Student Perceiving the Subject | Conducting Activities Concerning the Subject | Consolidation of the Subject by Homeworks |

**Flipped Classroom Model**

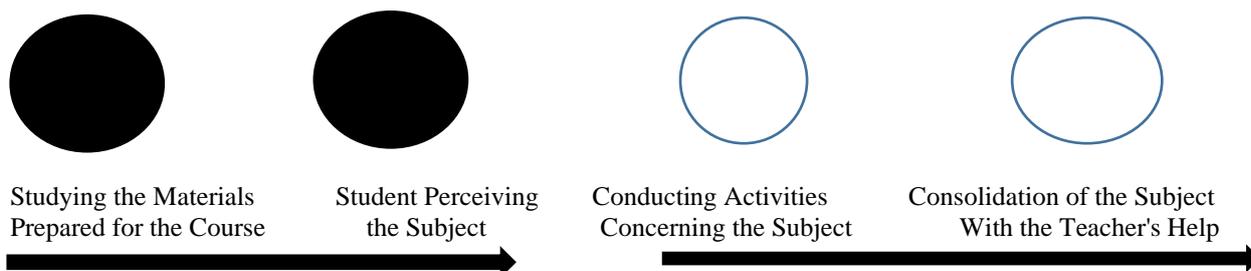| Studying the Materials Prepared for the Course | Student Perceiving the Subject | Conducting Activities Concerning the Subject | Consolidation of the Subject With the Teacher's Help |

Figure 1. Comparison of Flipped Classroom Model and Traditional Education Model (Zownorega, 2013)

From the perspective of traditional learning, in teacher-centered education, the teacher is not a guide in reaching information for his students, but in the role of giving information directly. In the traditional approach, the teacher is active and the students are passive. However, in the flipped classroom model, it is guaranteed that the students are active in the in-class activities. Utilization of information technologies for educational activities in out-of-classroom settings and allocating more time in the classroom for activities, projects and experiments with the flipped classroom application is another important factor in terms of both interactive learning and effective use of materials (Kahramanoğlu, Şenel, 2018). However, it is crucial to make good planning before the implementation of this model. Miller (2012) stated that there are five basic elements to be considered when planning the flipped classroom model:

1. Why one should learn: Learners should be told why they should learn this content and their willingness should be ensured.
2. Accombination of the models: Learning effectiveness can be increased with conjoint implementation of the flipped classroom model with another model (game-based learning, project-based learning, etc.).
3. Technology: The technology to use with the flipped classroom model should be selected.
4. Reflection: It should be ensured that the learners show the content they have learned and their learning behaviors are seen perceptibly with the flipped classroom model.
5. Time and place: It should be determined in what settings and how it will be implemented.

It is expected that the model to be implemented with the planning elements emphasized by Miller (2012) will be suitable for the intended purpose and thus be more effective.It is observed that both in Turkey and around the world, number of studies on the flipped classroom model has been increased dramatically in the recent years (Farah, 2014; Bell, 2015; Yestrebsky, 2015; Çalışkan, 2016; Yavuz, 2016; Çakır, 2017; Çibik, 2017; İyitoğlu, 2018; Öztürk, 2018;). As can be seen on the studies concluded, flipped learning model has a positive contribution on the academic success (Johnson ve Renner, 2012; Farah, 2014; Aydın, 2016; İyitoğlu, 2018;; Öztürk, 2018; Yestrebsky, 2015), attitude towards the subject (Bell, 2015; Ceylaner, 2016;

İyitoğlu, 2018) and motivation (Turan, 2015; Aydın, 2016; Çukurbaşı ve Kıyıcı 2017; İyitoğlu, 2018;) of the learners.

Also, in our country serious actions are being taken on the integration of technology into education. When the investments of the Ministry of Development in Public Information and Communication Technologies (ICT) for the year of 2018 are examined, it is seen that the education sector has a share of approximately 29.05% (Ministry of Development, 2018). In addition, according to the reports of the Ministry of Development, "FATİH Project" is the ICT project with the highest appropriation for 2018 with 1 billion TL (Ministry of Development, 2018). The "Fatih Education Project", which was first implemented in 2010 with the protocol signed, was initiated for more and more effective use of information technology tools in the learning-teaching process with the aim of improving equality of opportunity among individuals in education and training. The steps of this project consist of five main components;

1) Providing Hardware and Software Infrastructure,
2) Providing and Managing Educational e-Content,
3) Effective IT Utilization in Educational Programs,
4) In-Service Training of the Teachers,
5) Ensuring Conscious, Secure, Manageable and Measurable IT Utilization (Fatih Project, 2017)

Within the scope of the project, interactive boards (smart boards) are being installed in classrooms in schools, tablet computers are provided for both students and teachers, network infrastructure installations are being made and fiber internet services are provided (Fatih Project, 2017). An interactive classroom management application is used in students' and teachers' tablets. With this software called "V Class", which has two versions, one for the teachers and one for the students, the interaction between the interactive board, teacher's tablet and students' tablets is provided, and the teacher can control the students' tablets.
Within the scope of the e-content component of Fatih Project, EIN platform has been in use since 2012 to provide educational content for teachers, students and the public. With the EIN Course module, teachers can share their work with teachers and students in a virtual environment, send homework and exams to students and follow up their work. The "V Class" software, created for EIN Course application and the "Effective IT Utilization in Education Programs" component provided great convenience for teachers in terms of integrating technology into education.

Observation of the academic success of the students V Class software and EIN Course modules are preferred and flipped classroom model is implemented in classes of which and hearing of their opinions on this matter are important factors for this research to contribute to other researches made on the researches made on the flipped classroom model at middle school level in Turkey and to be original and up-to-date for the process of implementation of the progresses made within the educational technologies to the teaching process of the science classes.

In this context, the aim of this research is to examine the effect of Flipped Classroom model on the academic success of the students for the subject of Interaction of Matter with Heat of 8th grade Science classes and opinions of students on the Flipped Classroom Model.

## 2. Methodology

### 2.1. Research model

In the research, mixed methods, a method that allows integration of research results via utilization of quantitative and qualitative data collection methods conjointly. Mixed research includes the collection, analysis and interpretation of a single study or qualitative and quantitative research data within the studies (Leech and Onwuegbuzie, 2009). Quantitative and qualitative data are collected in a single step and in two different processes in a simultaneous or convergent pattern, and similarities and divergences are tried to be discovered (Creswell and Clark, 2014). Quantitative aspect of the research consists of a quasi-experimental design with a posttest control group while the qualitative aspect consists of interviews made with students in person. As the quantitative data collection tool, the "Achievement Test" developed by a group of four, consisting of four professionalist science teachers and researchers, and as the qualitative data collection tool, "Semi-Structured Review" form, developed by the researcher have been used. Semi-structured interview form is on of the techniques used for data collection in the qualitative area. In this method, participants are expected to answer the question. These answers are recorded in audio and converted to the written format after (Creswell, 2005; Yıldırım ve Şimşek, 2016)

### 2.2 Study group

Study group of the research consists of a total of 63 8th grade students, studied in a state middle school located in the central part of city of Konya during the 2017-2018 school year. Of the students who participated in the research, 33 are girls and 30 are boys. The groups were considered to be equivalent, since the students saw the subject of application for the first time and the classes were formed with the same academic grade point average. The table below shows the number of students in the experimental and control groups by gender.

Table 1. *Numbers of experimental and control groups by gender*

| Gender | Experimental Group | Control Group | Total |
|---|---|---|---|
| Girls | 15 | 15 | 30 |
| Boys | 17 | 16 | 33 |
| Total | 32 | 31 | 63 |

### 2.3 Implementation process

The study has been carried out based on the subject of Interaction of Matter with Heat of 8th grade Science course during the 2017-2018 school year. Prior to the implementation, students were given practical information on how to use the EIN system, how to watch videos and what to do if they encounter any problems. In the study, the two-week topics in which the experimental group continues the application process, the videos prepared by the researcher, the information notes and the materials such as pictures, videos, simulation, exercises, tests and educational games in the Education Information Network (EIN) were sent to all students in the class before the application via EIN. In addition, since the EIN module provides the

opportunity to see the percentage of completion and success of the materials sent by the student or throughout the classroom, the teacher had the opportunity to follow up. At the beginning of the course, the subjects / points that were not understood by the students were repeated, the questions they asked were answered and plenty of practical activities were performed. However, in the control group, the teacher lectured on the subject, examples were solved and homework assignments were given. After the implementation, both groups took the "Achievement Test". After the application, a semi-structured interview form prepared by the researcher was used to collect the opinions of the students in the experimental group.

### 2.4 Data collection tools and analysis

For the purpose of the research, an achievement test was developed by the instructor of the course and semi-structured interview form was used as a qualitative data collection tool to measure the academic achievement of the students. In order to ensure the validity and reliability of the semi-structured interview form, three experts were interviewed and the form was finalized in light of their opinions.

In the study, an achievement test was prepared by the researcher and four science teachers in accordance with the subject of Interaction of Matter with Heat in the 8th grade Science course. In order to determine the scope validity of the measurement tool, the unit was examined several times and a multiple choice achievement test of 20 questions, 5 questions for each acquisition related to the 4 gains of "Interaction of Matter with Heat" in the eighth grade Science curriculum was prepared. While evaluating the achievement test answers, 1 point was awarded for the correct answer and 0 points for the wrong answer. The highest possible score for the test is 16. A pilot implementation was conducted with 242 students for the validity and reliability studies of the achievement test. As a result of the pilot implementation, 4 items with distinctive indices less than 0.2 were excluded from the test. As the result of the analysis, the average difficulty index (r) of the test was found to be 0.62. The value found is within the ideal difficulty range expected for these types of test (Atılgan, 2006). Item difficulty indices, which show the correct response rate of the items used in tests where knowledge and skills such as skill and achievement tests are measured, item difficulties are expected to be around 0.50 (Büyüköztürk et al. 2013). Following the pilot application, Kuder Richardson-20 (KR-20) reliability was used to examine the internal consistency of the achievement test. Kuder Richardson-20 (KR-20) reliability is used in cases where the answers given to the test items are "True", "False" or "0", "1 and test items have different item difficulties (p) (Büyüköztürk, 2005). Tests with a reliability coefficient of .70 and above are generally considered to have sufficient reliability (Fraenkel and Wallen, 2009). As a result of the calculation, the reliability coefficient (KR – 20) of the test was found to be 0.84. SPSS 22 was used in the analysis of the results obtained from the academic achievement test. Normality test was performed to determine whether the responses by the groups demonstrated normal distribution. Kolmogorov-Smirnov test was picked to be the normality test. As a result of the normality test, the data is observed to demonstrate a normal distribution (F = 0.92, P> 0.05). As the data showed normal distribution, independent t test was used to determine the significance of the difference between the groups.

In the study, individual interviews were conducted with semi-structured interview technique, and 32 of the experimental group students were selected by the criteria of active participation and willingness to interview in order to establish their opinions on the flipped classroom. While preparing the interview form questions, the related literature was searched, and the interview form consisting of 5 questions to determine positive-negative opinions, difficulties and motivations experienced in reverse-straight classes was formed by taking 2

expert opinions. Descriptive analyzes are performed with the results of the interviews with students about flipped classroom applications, descriptive analyzes were performed on the findings. In presenting the qualitative findings, the interview questions formed the thematic framework.

## 3. Findings

In this section, the statistical analysis of the students' answers to the questions in the achievement test were presented as quantitative findings and the data of the semi-constructivist interviews conducted with the students as qualitative findings.

### 3.1 Quantitative findings of the research

Table 2. *Statistical analysis of the achievement test*

|  | Groups | Mean | Std. Deviation | t | df | p |
|---|---|---|---|---|---|---|
| General Success | Experimental | 11,3750 | 3,27010 | 2.786 | 61 | ,007 |
|  | Control | 9,1613 | 3,03421 |  |  |  |

(p<0,05)

Table 1 shows the average scores of the answers given by the experimental and control group students to the questions in the achievement test. The difference between the mean scores of the groups was found to be statistically significant and in favor of the experimental group (p <0.05). In this respect, it can be said that the application of flipped learning model positively affects students' academic achievement levels.

### 3.2 Qualitative findings of the research

In this part of the research, the data that are obtained in the form of semi-structured interviews with experimental group students will be analyzed at the end of the applications.

**Student views on satisfaction from flipped learning environment**

As a result of the interviews, the majority of the students stated that they were pleased to have been in the flipped learning environment. The students stated that they perceived the subject better in general. The students expressed their satisfaction with the application in different ways. Some students' views about their satisfaction with the flipped learning environment are as follows:

S2: "*Yes, I enjoyed the program very much. Because thanks to the flipped classroom I perceived the subject easier*".
S6: "*Yes, I'm very pleased. Because with this application, I can go over the subjects again*".
S8: "*Yes, I'm very pleased. Because this way, I was informed about the subject before coming to the classroom. Thus, I can ask more questions to the teacher*".

S11: *"Yes, I'm pleased. I didn't had the chance to make enough practice on the Science course before. But now I can apply what I've learned better before coming to the classroom".*
S11: "*I liked it very much. I study on the EIN before the classroom and thus, my participation in the class increases and I understand better ".*
S30: "*Yes, I'm pleased, I can work with the EBA at any time. The lectures are very nice and interesting, also I understand better*".

It can be said that the students developed a positive view towards the flipped learning environment. On the other hand, the students state that in the flipped classroom environment, they perceive the subjects better and practice-based activities came to the forefront and that they are more successful than before and that it provides a more relaxed and free learning environment than the classroom environment because they can repeat the subject whenever they want.

**Student Opinions on the Advantages of Sharing of the Subjects on the EIN Before the Class**

Some of the students' views about the advantages of coming to the classroom by studying before class are as follows:

S6: "Yes, it has advantages, because my my participation in the class has increased".
S7: "Yes, it has advantages, because I understand the lesson much better after studying it at home".
S14: "Yes, it is very advantageous, because when I study the subject beforehand, I learn the sections that I couldn't understand before by researching and if I cannot learn, I ask my teacher in class".
S19: "I think it is advantageous. I can answer the teacher's questions during the class because I know the subject beforehand".
S24: ""Yes, it has advantages, because I'm more ready for class so I can solve more questions with the teacher in the classroom".
S26:  "Yes, it has advantages, because I understood the subject much better".
S31: "I think it is advantageous, because now, I get better scores at tests".

The interviews indicated that it was advantageous for all students to share the subject content from the EIN on the internet before the class. Students stated that they understood the subject better with this application and their participation in the course increased.

**Opinions of students about the problems faced while studying in flipped learning environment**

During the interviews, it is seen that most of the students did not have any problems but some of them had problems in entering the EIN system. Some student views on the problems they encountered in entering the flipped learning environment:

S5: "Since we didn't have internet access at home, I had to go to my friend's house to study".
S9: "Some days the computer froze and the videos didn't play".
S11: "The speed of the internet in our house was sometimes insufficient".
S16: "My computer at home was an old model, so I had trouble opening the videos".
S28: "I can only ask the teacher the subjects I have hard times understanding at the school now and I think it is a problem".

The problems that the students faced in the flipped classroom practice were generally observed as problems caused by lack of computer hardware or computers and internet speed. The lack of interaction with teachers outside the classroom can also be considered as a problem.

**Student views on the advantages of reverse-face learning environments over traditional classroom:**

In the interviews with students, the majority stated that the flipped learning environment is much better than the traditional classroom environment. Some students' opinions about this are as follows:

S3: "In flipped learning I learn the subjects faster and without getting bored".
S10: "I think the flipped learning environment is superior because it makes learning easier".
S12: "Flipped learning environment is more fun, I don't get bored".
S15: "Sometimes the time allocated may not be enough for the subjects in the classroom but flipped learning method allows me to go over them at home".
S17: "I can learn the subject before going to class in the flipped learning environment, so that we understand the subjects through the practices we do at school".
S27: "I think Reverse-face learning gives me the opportunity to study individually so that I understand the subject better".

In this study, it is seen that students find flipped learning environment more advantageous than traditional classroom environment. Students state that it is much more fun and enjoyable to study in a flipped learning environment. On the other hand, it can be said that in the flipped classroom environment, there is no such situation that the lectures cannot be completed.
The absence of any time or space constraints in the flipped learning environment has been expressed by most students as a great convenience. In addition, being able to go over the subject and the constant access to the resources provided to them were expressed as the superiority of the reverse-face learning environment.

**Students' views on the effect of conducting more activities and face-to face practices in the classroom due to coming to the classroom environment having studied the subjects beforehand on learning:**

Students' answers on the matter of their teachers answering their questions concerning the problems they face during in-class activities, practices and the problems they encounter is as follows:

S1: "My performance has improved thanks to coming to the class having prepared".
S7: "It has had a positive impact on me, in the classroom, we go over the subjects that I studied at home and thus I don't forget the subjects".
S14: "By asking my teacher what I did not understand and with the activities we conducted, I understood the subjects better".
S23: "The subjects became more permanent in my memory because I repeated the subjects more".
S29: "I think I perceived the subject better".
S30: "I didn't use to participate in the classroom as much as I do now".

During the interviews, it was observed that all of the students responded positively to this interview question. In addition, they say that thanks to the flipped practices, they generally understand the subject better, participate more in class in the classroom, and the knowledge they obtain is more permanent.

## 4. Discussions, conclusions and recommendations

When the literature is analyzed, it is seen that the researches related to the flipped classroom model are mostly carried out at undergraduate level and in disciplines such as mathematics, engineering, medicine and foreign language education. In this study, flipped learning model was used in science teaching and the effect of the applied model on the academic achievements of the students in science lesson and their opinions about the reverse face learning model are examined. In this respect, it is thought that the findings obtained from the research will make important contributions to the related literature.

The results of the research show that the achievement test scores of the experimental group students studying with the flipped classroom model on the 8th grade science class's "Interaction of Matter with Heat" subject are significantly higher than the scores of the control group students studying with the current program. It is also seen in the different research results that the high science achievement test scores of the students in the experimental group of the flipped classroom model are due to the fact that the students learn the theoretical information about the subjects outside the classroom and when they come to the classroom, they are more likely to have more activities, exercises and problem solving (Alsancak Sırakaya, 2015; Aydın, 2016; Boyraz, 2014; Çakır ve Yaman,2018; Karaca ve Ocak, 2017; Sezer, 2015; Tomory ve Watson, 2015; Yavuz, 2016). Contrary to the results of this study, in studies conducted by Marlowe (2012), Clark (2013), Deveci Topal and Akhisar (2018) no significant difference between the flipped classroom experimental group and the students in the traditional group has been found.

At the end of the research, one of the findings obtained from the interviews with the students stated that the students asked more questions to their teachers with the application of flipped classroom and their time of communication with the teachers in the classroom has increased. This is in line with the conclusion of studies of Fulton (2012) and Herold (2012) that show they can get help from the teacher at any time and have the chance to ask the teacher more questions.
One of the results obtained from the student interviews; that the flipped classroom practice increases their success and that they have the opportunity to go-over the topics they do not understand. The students also stated that they remembered what they had learned better and coming to the classroom having studied the subject has increased their participation in the lesson. This result shows similarity to the results of the studies conducted by Frydenberg (2012, Herold et al. (2012) and Stone.

Although the results of the research show that students like the flipped learning model and find it fun, some students encounter problems in practice. These problems are the lack of internet in the home environment, low internet speed or the lack of technical equipment of computers. The results of this study are consistent with the problems that the students participating in Görü Doğan's (2015) study have about the accessibility of the videos and the internet connection, and in Turan and Göktaş's (2015) study, where the students expressed the lack of technical tools as a disadvantage of the flipped learning model. Also similar to the results of this study, Turan (2015) has mentioned technical problems as one of the difficulties faced in the flipped classroom practice and Aydın (2016), on the study examining the effect of

the flipped classroom practice on the academic achievements of the students has stated technical and hardware problems as the problems encountered.

With this research, the applicability of flipped learning, one of the new learning models, for the Science classes is examined. As a result of the research, students expressed positive views for the flipped learning model and stated that this kind of learning environment would contribute to their learning. Today, in the education system, a new learning-teaching approach or model, method and various applications are produced day by day and all these innovations are used in many levels of education.Therefore, in order to implement the flipped learning model effectively, the technical infrastructure, especially the high-speed internet, should be reinforced and the students should be encouraged and motivated to study out-of-the-class using the videos, animations, simulations, interactive activities and course contents offered in the online mediums.

It is clear that the students express almost exclusively positive opinions about the flipped classroom model applications and find this method fun and effective. From this point of view, in order to make more accurate determinations, it is thought that the study of the flipped classroom model in terms of different levels and variables in education programs of other subjects would contribute.

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