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The Flipped Classroom Approach Based on the 5E Learning Cycle Model – 5ELFA

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Abstract

The aim of this research is to determine the effect of the Flipped Classroom Approach Based on the 5E Learning Cycle Model called 5ELFA on student achievement in a physics course. It also aims to determine the students' opinions regarding this approach. This study, conducted using a mixed methods approach, involved 94 engineering students enrolled in the Physics 101 course. In the research, in which the pretest-posttest control group design was used, students were randomly assigned to experimental and control groups. While the students in the experimental group took the physics course in the Flipped Classroom Approach Based on the 5E Learning Cycle Model for 10 weeks, only the 5E learning model was used in the control group. The quantitative data were collected from a physics achievement test and the qualitative data were collected from semi-structured interviews. The results indicated that the physics achievement post-test scores of the experimental group were significantly higher than those of the control group. Interviews with experimental group volunteers revealed that the majority of students held a positive opinion of the flipped classroom approach and they believed that it had a positive impact on the physics course.

Key words: *5E learning model; flipped classroom; higher education; physics education.*

Introduction

Discoveries in the field of physics, the fundamental branch of natural sciences, not only have a significant impact on other branches of natural science, such as chemistry, biology and astronomy, but also on applied sciences, such as medicine and engineering (Çalışkan, 2007). Breakthroughs in physics in the 21st century have accelerated technological development (Gök & Sılay, 2008). Therefore, it is undeniable that physics is a key science which enables technological improvements and consequently influences the development of society (Çalışkan, 2007; Fishbane, Gasiorowicz, & Thornton, 2003). With the objective of maintaining technological competitiveness in the global arena, countries are increasingly focused on raising qualified individuals who have comprehensive education in the primary sciences, and who are able to conduct research and transfer knowledge into technology (Bodur, 2006). As a result, the significance of effective and efficient science technology for a country's scientific development, particular in physics, is increasing daily (Mistades, 2007; Öztürk, 2009).

Although physics is an important subject, it is viewed by a large proportion of secondary school and university students as a subject that is boring and difficult to understand, with many abstract formulas that require memorisation (Levrini & Fantini, 2013). The main reason why students experience difficulties understanding physics courses is the traditional approach adopted by physics teachers (Abe & Watanabe, 2012; Karam & Krey, 2015; Korsacılar & Çalışkan, 2015). Application of the traditional approach to teaching physics results in the development of passive learners who lack scientific intellect, who are unable to concretize scientific concepts and who cannot make connections between the so-called learnt knowledge and the real world. Therefore, these students tend to fail their course and have a negative opinion of physics in general (Satterthwait, 2010; Tekbıyık & Akdeniz, 2010).

Consequently, fundamental changes should be made to the teaching-learning process in order to overcome the problems created by the traditional approach to teaching and to raise qualified individuals who are capable of fulfilling modern needs (Karakuş & Öztürk, 2016).

Innovations related to the Internet and technology and their implications in education have provoked the need for contemporary approaches and implementations in order to provide an effective and efficient education (Bodur, 2006). In recent years, the flipped classroom approach has become the most popular constructive approach, which has resulted from technological and hence pedagogical developments (Bergman & Sams, 2014; Chen, Wang, Kinshuk, & Chen, 2014; Fautch, 2015). In literature, this approach, with the concepts turned upside down (flipped), and inside out (inverted), was first implemented by two chemistry teachers, Jonathan Bergmann and Aaron Sams, in 2007 (Bergmann & Sams, 2014). In the flipped classroom approach, the instructor shares the lesson content outside the classroom via technology, and thus, concept learning occurs out of class asynchronously. Consequently, classrooms are converted into an environment for practice, where students are encouraged to actively participate in class activities, such as problem-solving tasks, discussions, and laboratory experiments (Butt, 2014; Letina, 2015; Ogan & Williams 2015). In other words, pre-learning tasks (understanding, comprehension, focusing, etc.) are undertaken by the learner prior to attending the class, and consolidation, knowledge construction and meaningful learning tasks transpire in the classroom (Bristol, 2014; Findlay-Thompson & Mombourquette, 2014; Milman, 2012). The flipped classroom approach is an appealing method for modern learners, who are inclined to use the Internet to satisfy their needs – the so-called Internet generation (Alsancak Sırakaya, 2015).

A review of the literature reveals that studies conducted on the flipped classroom approach suggest that it has many advantages. One of the most important benefits is the resulting increased teacher-student and student-student interaction (Springen, 2013). Video lessons reduce the time the teacher is required to spend on content teaching and revision and enable the teacher to use this time effectively for active learning activities; hence, learners are encouraged to take a more active role in their learning (Seaman & Gaines, 2013). This not only provides the teacher with more time to spend focusing on students' intellectual and emotional needs, but also supports the students by engaging them in tasks which require advanced level cognitive skills (Goodwin & Mille, 2013; Sarawagi, 2013). Moreover, contrary to the traditional approaches, in the flipped classroom approach, the students find more opportunities to debate with their teacher as well as with each other (Bergmann & Waddell, 2012). According to Milman (2012), the main benefit of the flipped classroom approach is the promotion of teamwork within the classroom. The advantages that Fulton (2012) stated are that the students can access the video lessons whenever and wherever they want, and they have the opportunity to learn at their own pace. When this approach is used, students are encouraged to think, both in and outside of the classroom (Kellinger, 2012). Another positive aspect of the approach is its suitability for use in various teaching strategies. An additional benefit is that this approach enables parents to monitor lessons and thus, to provide more accurate guidance to their children (Love, Hodge, Grandgenett, & Swift, 2013). Several literature studies have been conducted on physics education using the flipped classroom approach in comparison to the traditional method (Bates & Galloway, 2012; Deslauriers, Schelew, & Wieman, 2011; Zownorega, 2013). In order for the flipped classroom approach to be effective, it is suggested that appropriate teaching models are adopted (Marlowe, 2012). Therefore, in this study, a flipped classroom approach adapted to the 5E learning model, which is known to have increased the effectiveness of the teaching environment, particularly in science education, was used. The 5E learning model was developed by Roger Bybee based on research findings specified by the National Science Education Standards (Trowbridge, Bybee, & Powell, 2004). The 5E learning model nurtures active research skills and activities, which are required for learning and comprehension; hence, it fulfills the students' expectations. In this method, learning takes place in five stages: engage, explore, explain, elaborate and evaluate (Martin, 2006). Further studies of the literature have indicated that the 5E learning model has a positive impact on physics education (Bıyıklı & Yağcı, 2015; Budprom, Suksringham, & Singsriwo, 2010; Kapartzianis & Kriek, 2014; Lye et al., 2014).

The aim of this research is to identify the effect of the Flipped Classroom Approach Based on the 5E Learning Cycle Model (5ELFA) on students' achievement in a physics course and to gather feedback from the students on the applied approach. To identify the influence and determine the participants' views, answers to the following research questions were sought:

1) Does the 5ELFA have a significant impact on the students' achievement in physics?
2) What are the views of students on the 5ELFA?

Method

Research Design

In this study, which consists of quantitative and qualitative data, a mixed methods research design was used, which included the pretest-posttest control and experimental groups. The research design is presented in Table 1.

Table 1
Research design

Groups	Pre-test	Application	Post-test
Experimental	Physics achievement test	5ELFA	Physics achievement test Semi-structured interview
Control	Physics achievement test	5E learning model	Physics achievement test

Participants

The study was conducted with the participation of 94 freshman Engineering Faculty students, taking the Physics 101 course during the fall semester of the academic year 2015/2016 at Near East University. Students were randomly assigned to experimental and control groups. After the grouping of students, the experimental group, in which the 5ELFA was implemented, consisted of 47 students, and the control group, which was exposed only to the 5E learning model, was also composed of 47 students.

Data Collection Tools

A physics achievement test was used to gather the quantitative data in the study. The qualitative data in the research were gathered by recording interviews using a semi-structured form.

Physics Achievement Test

The Physics 101 course includes the following concepts: motion in one dimension, vectors, motion in two dimensions, the laws of motion, the energy of a system, conservation of energy, linear momentum and collisions, angular momentum and fluid mechanics. The physics achievement test was created by the researchers and it included the following concepts: motion in one dimension, vectors, motion in two dimensions, the laws of motion, the energy of a system. Its aim was to evaluate students' achievement in Physics 101. The achievement test was administered as a pre-test before the experimental process in order to identify whether the students' level of pre-knowledge was equivalent within the two separate groups and as a post-test after the process to evaluate students' achievements in physics. The writing process of the multiple-choice physics achievement test is explained below.

While developing the test, the coursebooks used in the Engineering Faculty General Physics 101 course were firstly analysed. A list of can do statements was created considering the learning outcomes, depending on the subjects. A pool of 50 questions evaluating the learners' skills at each level was created. While the question pool was being developed, particular attention was paid to including items that expressed more complex skills such as analysis, synthesis and evaluation. Thus, a multiple-choice test comprising 36 questions based on Bloom's Taxonomy cognitive domain at lower levels was developed, and was moderated by five physics instructors to ensure content validity. The content validity was ensured by evaluating the expert feedback and making the necessary changes. In relation to the moderators' feedback, the test items were sequenced from easy to more challenging questions, and negative statements were not used in the test.

The re-written test was piloted in order to perform a validity and reliability analysis before it was administered. The piloting was conducted with 115 sopohmore students who had previously taken the Physics 101 course. After the piloting, in order to improve the achievement test validity, the questions item difficulty (p) and discrimination (r) indices were calculated. After the item analysis, questions that had an item difficulty index (p) between 0.82 and 0.85 were removed from the achievement test. The difficulty index of the test items was between 0.20 and 0.80 although there was difference between the difficulty level of each item, and the mean difficulty of the test was approximately 0.50, which is important for test reliability (Büyüköztürk, Çokluk, & Köklü, 2013). Thus, by deleting these two questions, the 34-question multiple-choice physics achievement test was finalised. The physics achievement test's minimum item discrimination index was calculated as 0.32, the maximum discrimination index as 0.80 and the mean item discrimination index was calculated as 0.54. The test's minimum item difficulty index was calculated as 0.38, the maximum item difficulty index as 0.67 and the mean item difficulty index was calculated as 0.49.

The Kuder-Richardson-20 (KR-20) reliability coefficient of the physics achievement test was calculated to be 0.943. A reliability coefficient over 0.70 demonstrates that the test is reliable (Field, 2009). Thus, the 34-item physics achievement test was determined to be both valid and reliable. Correct answers scored 1 point and incorrect answers 0 points. Additionally, unanswered questions scored 0 points. The highest score that could be obtained from the physics achievement test was 34 and the lowest score was 0. When the physics achievement test was evaluated, the total score for each student was converted to a 100-point system. Table 2 shows the item distribution of the physics achievement test according to the tested concepts.

Table 2
Number of questions according to concepts in the physics achievement test

Concept Name	Number of questions
Motion in one dimension	5
Vectors	8
Motion in two dimensions	6
The laws of motion	8
Energy of a system	7

Some example questions from the physics achievement test are presented in Figure 1.

Question 18
A motorcycle moving at a constant tangential speed of 60 m/s, takes one lap around a circular track in 50 seconds. Find the magnitude of the acceleration of the motorcycle.

a) 6 m/s^2
b) 6.5 m/s^2
c) 7 m/s^2
d) 7.5 m/s^2
e) 8 m/s^2

Question 23
Vector A represents a displacement in metres expressed in unit vector notation as $A=2\hat{i}+3\hat{j}$, Vector B represents a second displacement $B=-\hat{i}+2\hat{j}$. Find the dot product of two vectors.

a) 1 m
b) 2 m
c) 3 m
d) 4 m
e) 5 m

Question 31
A car is moving along a straight line according to $x=t^4/6-7t^3/6+3t^2/2+5$. Find the velocity of the car at 1.8 seconds.

a) -2 m/s
b) 2 m/s
c) -3 m/s
d) -4 m/s
e) 3 m/s

Figure 1. Some example questions from the physics achievement test

Semi-Structured Interview Form

In order to gather feedback on the flipped classroom approach from students in the experimental group, a semi-structured interview form was developed by the researchers. While preparing the interview questions, content validity was ensured by review of the literature. To ensure that the questions were clear and served their intended purpose, they were reviewed by experts. The necessary changes were made and the questions were finalised based on the feedback from five experts. An example of how expert suggestions were implemented would be the adaptation made to the question given to students: 'What is your general view regarding 5ELFA?' which was replaced by 'What was your view regarding 5ELFA prior to the experimental process?' and 'What is your view regrading 5ELFA after the experimental process?'. Face-to-face interviews with 23 volunteer students were conducted at the end of the experimental process. To ensure that there was no loss of data, interviews were recorded and later transcribed.

Data Analysis

The data gathered from the achievement test, which was administered before the experimental process to determine the equivalence of students' physics achievement in the experimental and control groups, were applied to independent groups as a t-test. Covariance analysis (ANCOVA) was used to determine any differences between the achievement scores of the experimental and control group students after the experiment. Additionally, for each analysis, the effect size index or eta-square (η^2), was calculated. The effect size enables the interpretation of how much of the test result variance depends on the independent variable and how much on the group variable. Moreover, it simplifies the interpretation of which variation has the greater impact when the differences between average points cannot be explained in standard units. The eta-square (η^2) values being .01, .06 and .14 show that there is a small, medium and large influence, respectively (Büyüköztürk, Çokluk, & Köklü, 2013).

The qualitative data gathered from semi-structured interviews were analysed using the NVivo 10 program and the content analysis method, with the data presented in tables according to frequency.

Examining the Groups' Physics Pre-Knowledge Equivalence before the Experimental Process

Prior to the experimental process, the experimental and control groups' physics achievement scores were examined. The physics achievement test was used as a pre-test and applied before beginning the experiment to identify the readiness levels of the control and experimental groups. Both groups' pre-test mean scores were compared to an independent t-test. The following statistical parameters were analysed in the study: sample size (N), the arithmetic mean (M), standard deviation (SD), standard error mean (df), t value (t) and statistically significant value (p). Table 3 illustrates the experimental and control groups' pre-test mean scores and their comparative analysis.

Table 3
Independent t-test on the physics achievement pre-test of the experimental and control group students

Groups	N	M	SD	df	t	p
Experimental	47	63.55	7.192	92	3.179	0.942
Control	47	58.89	7.019			

*Note:*Significant at the .05 level of confidence*

As can be seen in Table 3, the experimental group's pre-test mean score was M=63.55, whereas the control group's mean score was M=58.89. The results indicate that there was no significant difference between the achievements of the control and experimental groups ($t_{(92)=}$ 3.179, p> 0.05). This finding indicates that both groups of participants had the same academic knowledge level prior to the experiment.

Material Preparation for the Experimental Process

Video Lessons

The video lessons to be viewed by the experimental group students before attending the class were prepared by the researchers according to the stages of the 5E learning model, which are engage, explore and explain (Figure 2).

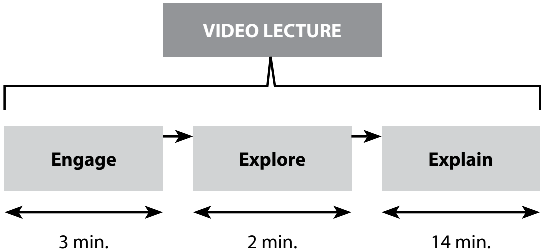

Figure 2. The planning of the video lessons, prepared according to the 5E learning model

The engage stage video of the 5E learning model included the actualization of the lesson subject based on real life situations. The video, which was aimed to surprise, entertain or intrigue the students, had a duration of less than 3 minutes.

The video that was prepared for the explore stage of the 5E learning model was added to the end of the engage stage video. The explore stage included open-ended questions designed to assist with questioning and investigating the relationship between the real-life event shown in the video and the topic of the lesson. This stage was approximately 2 minutes long and included the researcher's image and voice.

The video that was prepared for the explanation stage of the 5E learning model was added to the end of the explore stage video. The video, which contained an explanation of the topic was no more than 14 minutes long and included open-ended, multiple-choice and true/false quiz questions to encourage interaction. The explanation stage video also included the researcher's image and voice.

The short videos prepared for the engage, explore and explanation stages were combined using the Camtasia Studio 8 program, resulting in the production of one video. These videos, designed for the experimental group, had a duration of approximately 19 minutes. In the literature it has been stated that videos intended for the flipped classroom approach for higher education should be no longer than 20 minutes, otherwise students will become distracted, disinterested or lose motivation (Moraros et al., 2015; Phillips & Trainor, 2014).

Figure 3. The Screencast channel where the video lessons were uploaded

The interactive video lessons were created using a Wacom Graphic tablet, the Camtasia Studio 8 program and the Smooth Draw 3.2 drawing program. The videos, which were prepared weekly, were uploaded to Screencast.com and the lesson link was shared via Moodle. Thus, students were able to watch the video lessons using the link on Moodle MLS by providing their names, surnames and e-mail addresses. The experimental group students were able to access these videos, which were published two days prior to the physics lessons every week, by using their smartphones, tablets or PCs. A screenshot of the video channel is provided in Figure 3.

Experimental Process

During the orientation week, before the experimental process commenced, students took a pre-test. During the following week, students were randomly allocated to the experimental and control groups. The students in the experimental group received an explanation pertaining to how the lessons would be conducted and were supervised on how to enrol into the Physics 101 domain opened on Moodle by the researchers. The experimental process took place over a 10-week period, with 3 lessons per week for the experimental and control groups. The Physics 101 lessons in both the experimental and control groups were conducted by one of the researchers, who is also a physics teacher. The subjects taught during the implementation process were identical in both the experimental and the control group and were chosen from the physics coursebook used at the Engineering Faculty. The post-test was administered to the experimental and control groups during week 11. Later, semi-structured interviews were conducted with volunteer students from the experimental group.

	EXPERIMENTAL GROUP 5ELFA	**CONTROL GROUP 5E Learning Model**
HOME 	• Watching videos, which include the engage, explore and explain stages of the 5E learning model. • Answering quiz questions • Researching the explore questions • Note-taking • Question preparation	Previous week's homework
CLASSROOM 	• ***Elaborate:*** • Discussion on the questions in the elaborate stage • Reviewing points in the video which were not clear to students • Simulations • Students planning experiments • Doing classwork ***Evaluate:*** • Question-answer activity • Daily life examples • Problem-solving (min 3, max 5 problems)	• Submission of previous week's homework ***Engage:*** Watching the engage stage video of the 5E model ***Explore:*** Asking and answering the explore stage questions of the 5E model ***Explain:*** Explaining the lesson subject and asking short questions ***Elaborate:*** Discussion on questions from the explain stage Giving homework ***Evaluate:*** Question-answer activity Daily life examples Problem-solving (min 1, max 2 problems)

Figure 4. The symbolic illustration of how lessons were conducted in the experimental and control groups

Video lessons were made available to the experimental group students via Moodle MLS two days before the physics lesson on a weekly basis. These videos consisted of the first three stages (engage, explore, explain) of the 5E learning model. The last two stages of the 5E learning model, elaborate and evaluate, took place in the classroom. On the other hand, in the control group, physics lessons were only conducted according to the 5E learning model, and all five stages took place in the class, face-to-face. The symbolic illustration of how lessons were conducted in the experimental and control groups is given in Figure 4.

Results

The Comparison of the Experimental and Control Group Students' Physics Achievement after the Experimental Process

After the experimental process, it was investigated whether there was a difference in the students' physics achievement level between the experimental group (in which the 5ELFA was used) and the control group (in which only the 5E learning model was used). In order to neutralize any possible effects of the pre-test results on the post-test scores of the experimental and control groups, the groups' pre-test scores were kept under control and the post-test scores were submitted to covariance analysis to determine the differences. In order to achieve this, both groups' arithmetic means and standard deviation values were calculated from the physics achievement test, which was given as a pre-test and post-test. The following statistical parameters were analysed in the study: sample size (N), the arithmetic mean (M), standard deviation (SD) and adjusted Mean (M_a). These calculations are presented in Table 4.

Table 4

Descriptive data of physics achievement pre-test and post-test for two groups

Maximum Points	Groups	Pre-test			Post-test		
		N	M	SD	N	M	SD
100	Experimental	47	63.55	7.19	47	81.40	12.02
	Control	47	58.89	7.01	47	66.53	8.45

As can be seen in Table 4, the experimental group's post-test mean score (M=81.40) was higher than the group's pre-test mean score (M=63.55). Similarly, the control group's post-test mean score (M=66.53) increased when compared to the pre-test mean score (M=58.89). Moreover, after the experimental process, the experimental group's post-test mean score was higher than the control group's post-test mean score.

To determine whether the difference between the experimental and control groups' post-test mean values had a statistical significance, a covariance analysis (ANCOVA) was conducted on the post-test. Pre-test scores served as a covariate.

To conduct ANCOVA with the physics achievement test's post-test data, the interaction with the "achievement test pre-test scores of group x" was examined and was found to be insignificant (p>.05). This discovery shows that the statistical control variables depending on the physics achievement of the experimental and control groups' estimated regression curve angles are the same. The regression curve angles are required to be the same in order for ANCOVA to be conducted. To enable a comparison of the physics achievement test's pre-test and post-test scores for the experimental and control group, the adjusted mean values were firstly determined according to the physics achievement test's pre-test mean values, which are shown in Table 5.

Table 5

Physics achievement post-test score mean and adjusted mean values

Group	N	M	M_a
Experimental	47	81.40	78.94
Control	47	66.53	68.99

As can be seen in Table 5, which shows the scores the students achieved on the physics achievement test, the experimental group's post-test mean was M=81.40 while the control group's was M=66.53. The groups' adjusted mean values were M_a=78.94 for the experimental group and M_a=68.99 for the control group. According to the adjusted means, it can be deduced that the experimental group achieved a higher mean than the control group. The results of the ANCOVA test, which was conducted to determine if there was a significant difference between the experimental and control groups' adjusted mean values, are given in Table 6.

Table 6

The covariance analysis results of the experimental and control groups' post-test mean scores of the physics achievement test

Variance Source	Square Total	SD	Square Means	f	p
Controlled Variance (Physics achievement pre-test)	5193.449	1	5193.449	99.630	.000
Group	2094.628	1	2094.628	40.183	.000
Error	4743.572	91	52.127		
Total	529435	94			

According to the covariance analysis results in Table 6, when the experimental and control groups' pre-test scores are controlled, a significant difference ($F_{(1,91)}$= 40.183, p<.05) can be observed in the groups' post-test adjusted means. Depending on the results of the Bonferroni test, which was conducted on the groups' adjusted post-test scores, it can be stated that the experimental group's post-test mean 78.94 was higher than the control group's post-test mean 68.99. In order to determine the impact of this difference, which is in favour of the experimental group, the eta square value (η^2) was calculated and was found to be 0.306. As the value is higher than 0.14, this shows that there is a significant influence. This result indicates that the experimental group's physics achievement scores showed a significant increase when compared to the control group's physics achievement scores ($F_{(1,91)} = 40.183$, $p<.05$).

Student Views on the Flipped Classroom Approach Based on the 5E Learning Cycle Model

Students' Initial and Final Thoughts on the Approach

The experimental group students were asked the following question: "What were your initial thoughts at the beginning of the semester when you were told your physics lessons were going to be conducted using the 5ELFA and what were your thoughts on this approach at the end of the semester? Explain". Codes and frequencies (f) determined after the qualitative data analysis, derived from student responses, are given in Table 7.

Table 7
Student views on the flipped classroom approach

Theme	Codes	Frequency (f)
Opinions Prior to the Application	It wouldn't work	9
	Surprised	6
	Worried	5
	I didn't think much about it	4
	Afraid	4
	It would be fun	2
Opinions Regarding the Success of the Application	It is better than the old approach	15
	It's a fun approach	9
	It's an unnecessary approach	2

In Table 7, the codes related to the theme "opinions prior to the application" can be seen. In relation to this theme, students expressed that they "thought it would not work" (f=9), "were surprised" (f=6), "were worried" (f=5), "didn't think much about it" (f=4) and "were afraid" (f=4), when they discovered that the physics lessons would be conducted using the flipped classroom approach. These results reveal that the majority of the students held negative opinions regarding the flipped classroom approach when they were informed about its future application. Several examples of the students' initial negative perceptions regarding the flipped classroom approach are provided below:

> *"When our teacher explained the approach and said we were going to be using it in our physics lessons, I didn't really think it would make a difference. And I didn't really think much about it." (S8)*
>
> *"Actually I had heard about this approach but I didn't know much about it. As soon as our teacher said we would be using it in our physics lessons, I got worried." (S17)*

From the data collected, it was determined that only two students had positive views about the approach. The students whose initial opinions were positive, gave the following statements:

> *"Our teacher giving the lessons via videos and asking us questions on these videos seemed like a different approach and I thought it would be fun. I mean, even if we just practised with simulations, I assumed that we wouldn't get bored in the lessons." (S4)*
>
> *"Physics lessons are always boring, I thought it couldn't be worse than the book or listening to the teacher. I thought it had to be fun if we were going to use computers, the Internet and simulations." (S11)*

Qualitative data gathered from student interviews showed that the students' initial opinions of using the flipped classroom approach were predominantly negative.

Table 6 shows the codes related to the theme "opinions regarding the success of the application". According to this, after experiencing physics education incorporating the flipped classroom approach, students described the method as "better than the older approach" (f=15), "a fun approach" (f=9) but also as "an unnecessary approach" (f=2). These results show that the majority of the students' final opinions about the approach were positive. Below are some statements made by the students after experiencing the flipped classroom approach:

> *"I thought we would go back to our old way of teaching-learning after a few weeks. But, in time, I realised that I had actually started to like it. In-class discussions were really enjoyable." (S20)*
>
> *"I thought this approach could not be applied; I was definitely pessimistic about it. But now I think it is the best approach. As a matter of fact, using your phone or tablet to watch video lessons was enough on its own to make this a better approach than the old one." (S6)*
>
> *"The first day frightened me a little, but with time, I realised that my fears were unfounded. I have a totally different opinion of the approach now. It was a lot better than the traditional method; there is no comparison between the two." (S14)*

However, even after the process, there were several students who still maintained negative opinions about the flipped classroom approach. These students expressed their thoughts about the flipped classroom approach as "an unnecessary approach" (f=2). Below are the statements provided by the students' whose final opinions on the flipped classroom approach were negative:

> *"I haven't really thought about the approach, I didn't like it anyway. It would have been better if we had done the lessons using the old method." (S8)*
>
> *"When I heard about the approach, I was scared. Changing the approach of a lesson like physics is a risk. I still think it was unnecessary." (S15)*

The qualitative data gathered from student interviews prove that many of the students who had negative thoughts about the approach prior to the process, overcame their prejudice over time and developed positive opinions.

Student Views on the Flipped Classroom Approach Based on the 5E Learning Cycle Model in Physics Education

The experimental group students were asked: "How has the 5ELFA affected your learning of physics? Explain."

The qualitative data gathered from student answers were analysed under two different themes: "effective" and "ineffective". The codes and frequencies under these two themes are presented in Table 8.

Table 8
Student views on the effect of the flipped classroom approach on physics education

Themes	Codes	Frequency (f)
Effective	Creating connections between real-life and physics principles	21
	Ensuring meaningful learning	20
	Making abstract concepts concrete	12
	Making physics a fun subject	9
Ineffective	There was no difference compared to the old method	2

As can be seen from the "effective" theme in Table 8, according to student views, using the flipped classroom approach in the physics course proved to be beneficial in the following aspects: "creating connections between real-life and physics principles", "ensuring meaningful learning", "making abstract concepts concrete" and "making physics a fun subject".

A significant majority of students stated that using the flipped classroom approach in the physics course had a powerful effect on "creating connections between real-life and physics principles" (f=21). Examples of student statements supporting this idea are given below:

> *"In fact, the exercises done in class helped making connections between daily life and physics. Now, even when bowling, physics involuntarily comes to my mind." (S1)*
> *"With this approach, I realised that the physics I so feared was intertwined with life itself." (S14)*

Some of the students said that the approach helped them by "ensuring meaningful learning" (f=20). These students' sample statements are given below;

> *"I now know that physics, which I used to believe only consisted of mathematical terms, is a subject that can be understood. Besides, we came to class already knowing the topics because of the video lessons. In class, problem-solving tasks*

> *and discussions helped us grasp the theoretical information." (S5)*
> *"In physics lessons, rather than trying to understand the phenomenon and answer the question, I used to directly focus on the formulas. Whereas, making connections with real events, finding out the reasons and solutions to the problems is a lot easier." (S19)*

Under the "effective" theme, students claimed that using the flipped classroom approach in the physics course helped "making abstract concepts concrete" (f=12). Sample student statements supporting this view are given below:

> *"Physics is not a subject in which you can just understand the theory. This approach helped us enormously, making abstract concepts concrete, as lessons were spent on practice rather than theories." (S9)*
> *"I could not envision some topics. And I could not learn the topics I could not envision. This approach, with the in-class activities and the real-life events in the videos shared by our teacher, really made it easy to envision the phenomenon." (S3)*

Under the "effective" theme, a benefit of using the flipped classroom approach in the physics course was "making physics a fun subject" (f=9), but that was the statement least used by students. Some sample sentences used by students, which can constitute this idea, are presented below:

> *"In this system, the way the subject was explained, the interesting videos, the vigorous in-class discussions made the physics lessons fun." (S11)*
> *"We were freed from the boredom of physics lessons. I enjoyed studying because I could understand the subject matter, not memorise it." (S29)*

Under the "ineffective" theme, only two students (f=2) stated their opinions as "there was no difference compared to the old method". A statement made by one of the students who gave this opinion is provided below:

> *"When compared to the old system, not much changed for me. Physics lessons were still very difficult." (S15)*

Consequently, it was determined that the opinions of the students who thought that the flipped classroom method was effective in physics teaching outweighed the opinions of the students that perceived it to be ineffective.

Discussion and Conclusion

This research was conducted in order to study the effect of the 5ELFA in physics education on students' achievement in physics and to determine the students' views on the the flipped classroom approach.

The pre-test, which was administered to the experimental and control groups before the process, identified that the students in the two groups had the same achievement scores in physics.

After the experimental process, it was determined that the experimental group students who used the 5ELFA to learn physics, had a higher achievement score than the students in the control group who only used the 5E learning model. It can be said that this is due to the reduction of class time spent on the explanation of the lesson content, transferring the focus to discussions, problem-solving activities, and the use of simulations to practice theoretical knowledge in the flipped classroom approach. Furthermore, students coming to class prepared and having already learnt the lesson content, ensured their participation in active learning exercises and facilited the use of advanced level cognitive skills, which in turn resulted in increased student achievement. In parallel with our findings, there have been previous studies which have claimed that the flipped classroom approach increases student achievement. For instance, Chao, Chen, and Chuang (2015), reached the conclusion that the flipped classroom approach had a positive impact on students in engineering education. Similarly, mirroring our findings, other studies in the literature have suggested that the flipped classroom approach increases student achievement (Deslauriers, Schelew, & Wieman, 2011; Mason, Shuman, & Cook, 2013; Moffett & Mill, 2014; Zownorega, 2013).

However, there are also studies whose findings conflict with our results, suggesting that the flipped classroom approach does not increase achievement. Winter (2013) compared the use of the flipped classroom approach to the traditional approach in General Physics-I. The achievement test administered to the two groups after the five-week experimental process signified that there was no statistical difference between the scores. Similarly, Willis (2014), Bishop (2013), and Johnson and Renner (2012) stated that the flipped classroom approach had no positive effect on the students' achievement in lessons. As can be observed, there are some studies in the literature that state that the flipped classroom approach has a positive impact on student achievement and some that claim that it has no positive influence compared to the traditional approach. This discrepancy regarding whether the flipped classroom approach has a positive impact on student achievement or not can be said to result from the manner in which the approach is applied and the quality of the materials used. Moreover, the instructor's knowledge of the approach being applied is another factor which could influence the results. In this study, it can be said that the flipped classroom approach had a positive effect on physics achievement because it was adapted to the 5E learning model.

When the experimental group students were informed that they were going to use the flipped classroom approach at the beginning of the semester, it was identified that their initial perceptions were negative. At this point, students may have had negative thoughts about the flipped classroom approach because they were accustomed to a more traditional approach. In parallel with this, there are studies in the literature which claim that students' initial opinions on the flipped classroom approach are negative (Tune, Sturek, & Basile; 2013; Turan & Göktaş, 2015).

In time, most of the students who had had negative thoughts about the approach before it was applied, overcame their prejudice and formed more positive opinions.

This change in perception may have been induced because, in the flipped classroom approach, more time was allocated to the in-class component, and teacher-student relationships became stronger. Moreover, because technological education environment is more convenient to modern students (Halili & Zainuddin, 2015), watching video lessons and using technology for in-class advanced level learning activities may have had a positive impact on students' opinions. In parallel with this finding, Mason, Shuman, and Cook (2013) found in their studies that when students were first introduced to the flipped classroom approach, they were resistant towards it; however, in time, students stated that they were satisfied with the approach. Similarly, Talbert (2012) emphasised that students may have prejudice against the flipped classroom approach, but this should be resolved through teacher-student communication as well as reviewing and clarifying any points that students did not understand or are lacking through in-class discussions. At this point, it can be interpreted that, after experiencing the flipped classroom approach, students formed positive views about the concept.

In order to determine student opinions on the flipped classroom approach in physics teaching, students were asked: "How has the flipped classroom approach affected your learning of physics?" The results showed that the majority of students believed that the flipped classroom approach had a positive influence on physics lessons. Students said that using the flipped classroom approach in physics lessons helped "create connections between real-life and physics principles", "ensure meaningful learning", "make abstract concepts concrete" and "make physics a fun subject". According to student feedback, it can be said that the usage of the approach provided meaningful learning. This outcome coincides with other research findings (Bates & Galloway, 2012; Deslauriers, Schelew, & Wieman, 2011; Zownorega, 2013)

It was identified that only two students claimed that using the flipped classroom approach in physics education had no effect on their learning. This result may be because these students were not able to break their learning habits, which had been formed by the traditional method, and because they could not overcome their prejudice against the new approach. This finding overlaps with Johnson and Renner's (2012) research findings. In their research, Jonson and Renner (2012) compared the flipped classroom approach with the traditional method and found that students had negative views about the new approach. They stated that these negative views were derived from students' attachment to the traditional method.

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Nastavni pristup *obrnute* učionice utemeljen na 5E modelu ciklusa učenja

Sažetak

Cilj ovog istraživanje bio je odrediti utjecaj nastavnog pristupa obrnute učionice koji se temelji na 5E modelu ciklusa učenja, nazvan 5ELFA, na postignuća studenata u kolegiju Fizike. Cilj je također bio i utvrditi mišljenja učenika o takvom pristupu. Ovo istraživanje, koje je provedeno primjenom mješovitih metoda, obuhvatilo je 94 studenta tehničkih znanosti koji su upisali kolegij Fizika 101. U istraživanju u kojem se koristio dizajn s predtestom i posttestom za kontrolnu skupinu studenti su bili nasumično raspodijeljeni u eksperimentalnu i u kontrolnu skupinu. Dok se u radu sa studentima u eksperimentalnoj skupini na nastavi iz kolegija Fizike koristio pristup obrnute učionice utemeljen na 5E modelu ciklusa učenja tijekom 10 tjedana, u kontrolnoj se skupini koristio samo 5E model ciklusa učenja. Kvantitativni podaci prikupljeni su s pomoću testa postignuća iz Fizike, a kvalitativni su podaci prikupljeni putem polustrukturiranih intervjua. Rezultati su pokazali da je uspjeh studenata iz eksperimentalne skupine na posttestu postignuća iz Fizike bio znatno veći od uspjeha studenata iz kontrolne skupine. Intervjui s dobrovoljcima iz eksperimentalne skupine otkrili su da je većina studenata imala pozitivno mišljenje o pristupu obrnute učionice i da su smatrali kako je on imao pozitivan utjecaj na kolegij Fizike.

Ključne riječi: *5E model učenja; obrazovanje u području Fizike; obrnuta učionica; visoko obrazovanje.*

Uvod

Otkrića u polju fizike, temeljne grane prirodnih znanosti, ne samo da imaju važan utjecaj na ostale grane prirodnih znanosti, poput kemije, biologije i astronomije, nego i na primijenjene znanosti, poput medicine i tehničkih znanosti (Çalışkan, 2007). Otkrića u fizici u 21. stoljeću ubrzala su tehnološki napredak (Gök i Sılay, 2008). Stoga se ne može poreći da je fizika ključna znanost koja omogućava tehnološki razvoj i utječe na razvoj društva (Çalışkan, 2007; Fishbane, Gasiorowicz, i Thornton, 2003). S ciljem održavanja tehnološke konkurentnosti na svjetskoj sceni, države se sve više usmjeravaju na obrazovanje kvalificiranih pojedinaca koji imaju široko obrazovanje u području primarnih znanosti, koji su sposobni provoditi istraživanja i svoje znanje prenijeti na tehnologiju (Bodur, 2006). Rezultat toga je da je važnost uspješne i učinkovite znanstvene tehnologije za znanstveni razvoj neke zemlje, pogotovo u području fizike, svakim danom sve veća (Mistades, 2007; Öztürk, 2009).

Iako je Fizika važan predmet, velika je većina srednjoškolaca i studenata smatra dosadnim predmetom koji je teško razumjeti i koji ima puno apstraktnih formula koje zahtijevaju učenje napamet (Levrini i Fantini, 2013). Glavni razlog zbog kojega učenici i studenti imaju poteškoća s razumijevanjem fizike u školi jest tradicionalni pristup koji imaju i prakticiraju nastavnici Fizike (Abe i Watanabe, 2012; Karam i Krey, 2015; Korsacılar i Çalışkan, 2015). Primjena tradicionalnog pristupa u nastavi Fizike vodi stvaranju skupine pasivnih učenika koji ne posjeduju znanstveni intelekt, koji nisu sposobni konkretizirati znanstvene pojmove i koji ne mogu stvarati veze između tzv. naučenog znanja i stvarnog svijeta. Stoga takvi studenti ne mogu položiti ispite iz tog kolegija i imaju negativno mišljenje o fizici općenito (Satterthwait, 2010; Tekbıyık i Akdeniz, 2010).

Zbog toga bi trebalo provesti temeljne promjene u nastavnom procesu i procesu učenja kako bi se nadišli problemi koje je stvorio tradicionalni pristup učenju i poučavanju i kako bi se obrazovali kvalificirani pojedinci koji su sposobni odgovoriti na potrebe modernog vremena (Karakuş i Öztürk, 2016).

Inovacije u područjima tehnologije i interneta i njihova primjena u obrazovanju stvorili su potrebu za suvremenim pristupima i njihovom primjenom u nastavi kako bi se omogućilo uspješno i učinkovito obrazovanje (Bodur, 2006). U posljednjih nekoliko godina pristup obrnute učionice postao je najpopularnijim konstruktivnim pristupom, što je rezultat tehnoloških, a time i pedagoških dostignuća (Bergman i Sams, 2014; Chen, Wang, Kinshuk, i Chen, 2014; Fautch, 2015). U literaturi su taj pristup, s pojmovima postavljenima naopako i obrnuto, prvi primijenili nastavnici kemije Jonathan Bergmann i Aaron Sams 2007. godine (Bergmann i Sams, 2014). U pristupu obrnute učionice nastavnik dijeli s učenicima nastavni sadržaj određenog nastavnog sata izvan učionice, putem tehnologije, pa se tako učenje o pojmovima odvija izvan učionice, u različito vrijeme. Na taj se način učionice pretvaraju u okruženje za vježbanje, u kojemu se učenike potiče na aktivno sudjelovanje u nastavnim aktivnostima, poput rješavanja problemskih zadataka, rasprava i laboratorijskih eksperiemenata (Butt, 2014; Letina, 2015; Ogan i Williams 2015). Drugim riječima, zadatke vezane uz prethodno učenje o sadržaju (razumijevanje, shvaćanje, fokusiranje itd.) odrađuju učenik prije dolaska na nastavu, a na nastavnom se satu odvijaju usustavljivanje znanja, izgradnja znanja i odrađuju se smisleni zadaci (Bristol, 2014; Findlay-Thompson i Mombourquette, 2014; Milman, 2012). Pristup obrnute učionice privlačan je suvremenim učenicima, pripadnicima tzv. internetske generacije, koji su skloni upotrebi interneta kako bi zadovoljili svoje potrebe (Alsancak Sırakaya, 2015).

Pregled literature otkriva kako istraživanja provedena o pristupu obrnute učionice pokazuju da on ima mnoge prednosti. Jedna od najvažnijih prednosti koja iz njega proizilazi jest povećana interakcija između nastavnika i učenika i učenika i učenika (Springen, 2013). Videolekcije smanjuju količinu vremena potrebnog nastavniku kako bi objasnio i ponovio nastavni sadržaj te mu omogućavaju efikasno korištenje vremena za aktivne zadatke; na taj način učenike se potiče na preuzimanje aktivnije uloge u svojem učenju (Seaman i Gaines, 2013). On nastavniku ne omogućava samo više vremena za fokusiranje na intelektualne i emocionalne potrebe učenika nego također daje podršku učenicima tako što ih uključuje u zadatke koji zahtijevaju napredni stupanj kognitivnih vještina (Goodwin i Mille, 2013; Sarawagi, 2013). Štoviše, suprotno tradicionalnim pristupima, u obrnutoj učionici učenici imaju više prilike za raspravu sa svojim nastavnikom, kao i jedni s drugima (Bergmann i Waddell, 2012). Prema Milmanu (2012), glavna prednost pristupa obrnute učionice jest promicanje timskog rada na nastavi. Prednosti koje je naveo Fulton (2012) jesu da učenici mogu imati pristup videolekcijama kada god i gdje god to žele te imaju priliku učiti vlastitim tempom. Kada se primjenjuje taj pristup, učenike se potiče na razmišljanje, i u učionici i izvan nje (Kellinger, 2012). Drugi pozitivan aspekt tog pristupa jest njegova prikladnost za primjenu u različitim nastavnim strategijama. Dodatna prednost jest ta što navedeni pristup omogućava roditeljima praćenje lekcija čime im omogućava da bolje i točnije pomognu svojoj djeci (Love, Hodge, Grandgenett, i Swift, 2013).

U literaturi se nalazi i nekoliko studija provedenih o nastavi Fizike u kojoj se primjenjuje pristup obrnute učioinice u usporedbi s tradicionalnim metodama (Bates i Galloway, 2012; Deslauriers, Schelew, i Wieman, 2011; Zownorega, 2013). Kako bi pristup obrnute nastave bio učinkovit, preporučuje se usvajanje odgovarajućih modela nastave (Marlowe, 2012). Stoga se u ovom istraživanju koristio pristup obrnute učionice prilagođen modelu 5E ciklusa učenja, za koji je poznato da je podigao stupanj učinkovitosti nastave, pogotovo u nastavi prirodnih znanosti. 5E model ciklusa učenja razvio je Roger Bybee na temelju rezultata istraživanja koje navode Nacionalni standardi znanstvenog obrazovanja (Trowbridge, Bybee i Powell, 2004). 5E model učenja njeguje aktivne istraživačke vještine i aktivnosti neophodne za učenje i razumijevanje, pa on tako ispunjava očekivanja učenika. U toj metodi učenje se odvija u pet faza: angažiranje, istraživanje, objašnjavanje, razrada i evaluacija (Martin, 2006). Daljnje analize literature pokazale su da 5E model učenja ima pozitivan utjecaj i na nastavu Fizike (Bıyıklı i Yağcı, 2015; Budprom, Suksringham, i Singsriwo, 2010; Kapartzianis i Kriek, 2014; Lye i sur., 2014).

Cilj je ovoga istraživanja utvrditi učinak nastavnog pristupa obrnute učionice koji se temelji na 5E modelu ciklusa učenja (5ELFA) na postignuća studenata u kolegiju Fizike i dobiti povratnu informaciju od studenata o pristupu obrnute učionice. Kako bi se odredio utjecaj i došlo do mišljenja studenata, tražili su se odgovori na sljedeća pitanja:

1) Ima li 5ELFA značajan utjecaj na postignuća studenata u fizici?
2) Kakva su mišljena studenata o pristupu 5ELFA?

Metode

Dizajn istraživanja

U ovom istraživanju, koje se sastoji od kvantitativnih i kvalitativnih podataka, koristio se dizajn istraživanja s mješovitim metodama, a koji je obuhvatio predtest i posttest u kontrolnoj i u eksperimentalnoj skupini. Dizajn istraživanja prikazan je u Tablici 1.

Tablica 1

Sudionici

Istraživanje je provedeno na 94 ispitanika, studenata prve godine Fakulteta tehničkih znanosti Sveučilišta Near East, koji su upisali kolegij Fizika 101 tijekom jesenskog semestra akademske godine 2015./2016. Studenti su nasumično raspodijeljeni u eksperimentalnu i kontrolnu skupinu. Nakon razvrstavanja studenata u skupine, i eksperimentalna skupina, u kojoj je primijenjen pristup 5ELFA, sastojala se od 47 studenata, kao i kontrolna skupina, u kojoj se primjenjivao 5E model učenja.

Alati za prikupljanje podataka

Test postignuća iz Fizike koristio se kako bi se prikupili kvantitativni podaci u istraživanju. Kvalitativni podaci prikupljeni su snimanjem intervjua polustrukturiranog oblika.

Test postignuća iz Fizike

Kolegij Fizika 101 obuhvaća sljedeće pojmove: kretanje u jednoj dimenziji, vektore, kretanje u dvije dimenzije, zakone gibanja, energiju sustava, konzerviranje energije, linearni moment i sudar, angularni moment i mehaniku fluida. Test postignuća iz Fizike bio je izrađen od istraživača i obuhvatio je sljedeće pojmove: kretanje u jednoj dimenziji, vektore, kretanje u dvije dimenzije, zakone gibanja i energiju sustava. Cilj testa bio je procijeniti postignuća studenata u kolegiju Fizika 101. Test postignuća proveden je kao predtest prije eksperimentalnog procesa kako bi se odredilo je li postojeće znanje studenata u dvije različite skupine jednako, i kao posttest nakon provedenog procesa kako bi se procijenila postignuća studenata u fizici. Proces pisanja testa postignuća iz Fizike koji se sastojao od pitanja višestrukog izbora objašnjen je u daljnjem tekstu.

Prije izrade testa najprije su analizirani udžbenici koji se koriste u nastavi na Fakultetu tehničkih znanosti u kolegiju Opća fizika 101. Izrađen je popis od tvrdnji o tome što studenti mogu, uzevši u obzir ishode učenja, ovisno o predmetima. Izrađen je skup od 50 pitanja kojima se procjenjuju vještine studenata na svakom stupnju. Dok se izrađivao skup pitanja, posebna je pažnja posvećena tome da se uključe tvrdnje koje su izražavale složenije vještine poput analize, sinteze i evaluacije. Tako je izrađen test s 36 pitanja višestrukog izbora utemeljen na nižim stupnjevima kognitivne domene

Bloomove taksonomije, a nadgledalo ga je pet nastavnika Fizike kako bi se osigurala valjanost njegova sadržaja. Valjanost sadržaja osigurana je i procjenom stručnog mišljenja i unošenjem potrebnih promjena. U skladu s povratnom informacijom nastavnika, tvrdnje u testu stavljene su u poredak od lakših prema težim pitanjima. U testu se nisu koristile negativne tvrdnje.

Prepravljen test pilotiran je kako bi se osigurala analiza valjanosti i pouzdanosti prije njegove primjene u istraživanju. Pilotiranje je provedeno na 115 studenata druge godine koji su već pohađali kolegij Fizika 101. Kako bi se nakon pilotiranja poboljšala valjanost testa postignuća, za svaku tvrdnju u testu izračunati su indeksi težine (p) i diskriminacije (r). Nakon analize tvrdnji, ona pitanja čiji je indeks težine (p) bio između 0,82 i 0,85 uklonjena su iz testa postignuća. Indeks težine tvrdnji u testu bio je između 0,20 i 0,80, iako je bilo razlike u stupnju težine svake tvrdnje, a srednja težina testa bila je otprilike 0,50, što je važno za pouzdanost testa (Büyüköztürk, Çokluk i Köklü, 2013). Uklanjanjem tih dvaju pitanja test postignuća iz Fizike, koji je sadržavao 34 pitanja višestrukog izbora, bio je finaliziran. Izračunat minimalni indeks diskriminacije tvrdnji u testu postignuća iz Fizike bio je 0,32, maksimalni indeks diskriminacije bio je 0,80, a srednji indeks diskriminacije bio je 0,54. Minimalni indeks težine pitanja bio je 0,38, maksimalni indeks težine pitanja bio je 0,67, a srednji indeks težine pitanja bio je 0,49.

Izračunat je i Kuder-Richardson-20 (KR-20) koeficijent pouzdanosti testa postignuća iz Fizike od 0,943. Koeficijent pouzdanosti iznad 0,70 pokazuje da je test pouzdan (Field, 2009). Tako je utvrđeno da je test postignuća iz Fizike, koji je obuhvaćao 34 pitanja, bio i valjan i pouzdan. Točni odgovori donosili su po 1 bod, a netočni su odgovori nosili 0 bodova. Pri evaluaciji testa postignuća iz Fizike ukupan rezultat za svakog studenta pretvoren je u sustav od 100 bodova. Tablica 2 pokazuje distribuciju tvrdnji/pitanja u testu postignuća iz Fizike prema provjeravanim pojmovima.

Tablica 2

Primjeri nekih pitanja iz testa postignuća iz Fizike mogu se vidjeti na Slici 1.

Slika 1

Oblik polustrukturiranog intervjua

Kako bi se od studenata iz eksperimentalne skupine prikupile povratne informacije o pristupu obrnute učionice, istraživači su izradili polustrukturirani intervju. Za vrijeme pripreme pitanja za intervju, proučavanjem literature osigurana je valjanost sadržaja. Pitanja su zatim pregledali stručanjaci kako bi se osigurala jasnoća pitanja i kako bi ona poslužila planiranoj svrsi. Napravljene su potrebne izmjene, a pitanja su finalizirana na temelju povratne informacije petero stručnjaka. Primjer kako su sugestije stručnjaka provedene u praksi može se vidjeti kod promjene napravljene u pitanju koje je postavljeno studentima: „Kakvo je vaše opće stajalište o 5ELFA pristupu?", koje je zamijenjeno ovim pitanjima: „Kakvo je bilo vaše stajalište o 5ELFA pristupu prije eksperimentalnog procesa?" i „Kakvo je vaše stajalište o 5ELFA pristupu nakon provedbe eksperimentalnog procesa?" Na kraju eksperimentalnog procesa provedeni su usmeni intervjui s 23 studenta koji su se dobrovoljno javili. Intervjui su snimani i poslije transkribirani, kako bi se spriječio gubitak podataka.

Analiza podataka

Podaci prikupljeni testom postignuća koji je bio primijenjen prije eksperimentalnog procesa kako bi se odredila ujednačenost postignuća studenata u fizici u eksperimentalnoj i u kontrolnoj skupini primijenjeni su u nezavisnim skupinama kao t-test. Primijenjena je analiza kovarijance (ANOVA) kako bi se odredile eventualne razlike između postignuća studenata iz eksperimentalne i kontrolne skupine nakon eksperimenta. K tomu, za svaku analizu izračunat je indeks veličine učinka ili eta-square (η^2). Veličina učinka omogućava interpretaciju toga koliko varijanca rezultata testa ovisi o nezavisnoj varijabli, a koliko o grupnoj varijabli. Štoviše, ona pojednostavljuje interpretaciju toga koja varijacija ima veći učinak kada se razlike između prosječnih bodova ne mogu objasniti standardnim jedinicama. Eta-square (η^2) vrijednosti koje su bile 0,01, 0,06 i 0,14 pokazuju da postoji mali, srednji i veliki utjecaj, za svaku od njih pojedinačno (Büyüköztürk, Çokluk, i Köklü, 2013).

Kvalitativni podaci prikupljeni polustrukturiranim intervjuima analizirani su s pomoću programa NVivo 10 i metode analize sadržaja, s podacima prikazanim u tablicama prema njihovoj frekvenciji.

Ispitivanje ujednačenosti postojećeg znanja iz Fizike studenata iz obiju skupina prije provedbe eksperimentalnog procesa

Prije provedbe eskperimentalnog procesa analizirani su rezultati testa postignuća iz Fizike studenata iz eksperimentalne i iz kontrolne skupine. Test postignuća iz Fizike koristio se kao predtest i primijenjen je prije početka eksperimenta kako bi se utvrdio stupanj spremnosti studenata iz kontrolne i iz eksperimentalne skupine. Srednje vrijednosti rezultata studenata iz obje skupine uspoređene su nezavisnim t-testom. Tablica 3 pokazuje srednje vrijednosti predtesta studenata iz eksperimentalne i kontrolne skupine, kao i njihovu komparativnu analizu.

Kako se može vidjeti u Tablici 3, srednji rezultat predtesta eksperimentalne skupine bio je 63,55, a srednji je rezultat kontrolne skupine bio 58,89. Rezultati pokazuju da ne postoji značajna razlika između postignuća kontrolne i eksperimentalne skupine ($t_{(92)}$=3,179, p>0,05). Taj rezultat pokazuje da su sudionici iz obje skupine imali isti stupanj akademskog znanja prije provedbe eksperimenta.

Tablica 3

Priprema materijala za eksperimentalni proces

Videolekcije

Videolekcije koje su studenti iz eksperimentalne skupine trebali pogledati prije dolaska na nastavu pripremili su istraživači prema stupnjevima 5E modela učenja, a oni su: angažiranje, istraživanje i objašnjavanje (Slika 2).

Slika 2

S pomoću videa koji se koristio u fazi angažiranja u sklopu 5E modela učenja realiziran je nastavni sadržaj na temelju stvarnih situacija iz svakodnevnog života. Video, koji je imao za cilj iznenaditi, zabaviti ili zaintrigirati studente, trajao je manje od tri minute.

Video koji je pripremljen za fazu istraživanja 5E modela učenja dodan je na kraj videa iz faze angažiranja. Faza istraživanja uključuje pitanja otvorenog tipa koja su izrađena kako bi pomogla studentima kod propitivanja i istraživanja veze između stvarnih događaja prikazanih u videu i nastavne teme. Ta faza traje otprilike 2 minute i uključuje sliku istraživača i njegov glas.

Video koji je pripremljen za fazu objašnjavanja 5E modela učenja dodan je na kraj videa iz faze istraživanja. Video koji sadrži objašnjenje teme nije dulji od 14 minuta i uključuje pitanja otvorenog tipa, višestrukog izbora, kao i pitanja točno/netočno, kako bi se potaknula interakcija. Video iz faze objašnjavanja također uključuje sliku istraživača i njegov glas.

Kratke videosnimke pripremljene za faze angažiranja, istraživanja i objašnjavanja spojene su primjenom programa Camtasia Studio 8 u jedan video. Te videosnimke, izrađene za eksperimentalnu skupinu, trajale su otprilike 19 minuta. U literaturi se navodi da videolekcije snimljene sa svrhom primjene pristupa obrnute učionice u visokom obrazovanju ne bi trebale trajati dulje od 20 minuta, jer u protivnom studenti postaju dekoncentrirani, nezainteresirani ili izgube motivaciju (Moraros i sur., 2015; Phillips i Trainor, 2014).

Interaktivne videolekcije izrađene su s pomoću Wacom Graphic tablet računala, programa Camtasia Studio 8 i Smooth Draw 3.2 računalnog programa za crtanje. Videolekcije su pripremane svaki tjedan, zatim su bile objavljene na mrežnoj stranici Screencast.com, a poveznica se dijelila putem Moodla. Tako su studenti mogli gledati videolekcije koristeći se poveznicom na Moodle MLS nakon što su unijeli svoja imena, prezimena i e-mail adrese. Studenti iz eksperimentalne skupine imali su pristup videolekcijama, koje su objavljene dva dana prije nastave Fizike svakoga tjedna, preko svojih pametnih telefona, tablet računala ili osobnih računala. Snimka zaslona videokanala može se vidjeti na slici 3.

Slika 3

Eksperimentalni proces

Tijekom orijentacijskog tjedna, prije samog početka eksperimentalnog procesa, studenti su pisali predtest. Tijekom sljedećeg tjedna studenti su nasumičnim izborom smješteni u eksperimentalnu ili kontrolnu skupinu. Studenti iz eksperimentalne skupine dobili su objašnjenje o tome kako će se nastava odvijati i pružena im je pomoć pri prijavi na domenu Fizika 101 koju su na Moodle-u otvorili istraživači. Eksperimentalni proces odvijao se 10 tjedana, a svakog tjedna i eksperimentalna i kontrolna skupina imala je tri sata nastave. U obje skupine nastavu kolegija Fizika 101 izvodio je jedan od istraživača, koji je također i nastavnik Fizike. Teme koje su obrađivane tijekom implementacije eksperimentalnog procesa bile su iste i u eksperimentalnoj i u kontrolnoj skupini, a odabrane su iz udžbenika iz Fizike koji se koristi na Fakultetu tehničkih znanosti. Posttest je proveden i u eksperimentalnoj i u kontrolnoj skupini u 11. tjednu. Poslije su provedeni polustrukturirani intervjui sa studentima iz eksperimentalne skupine koji su se dobrovoljno javili.

Videolekcije bile su dostupne studentima iz eksperimentalne skupine putem Moodle MLS-a svakoga tjedna dva dana prije održavanja nastave Fizike. Te videolekcije sastojale su se od prve tri faze (angažiranje, istraživanje, objašnjavanje) 5E modela učenja. Posljednje dvije faze 5E modela učenja, razrada i evaluacija, odvijale su se u učionici. S druge strane, u kontrolnoj skupini nastava Fizike izvodila se samo prema 5E modelu učenja, a svih pet faza toga modela odvijalo se u učionici, licem u lice. Ilustracija izvođenja nastave u u eksperimentalnoj i u kontrolnoj skupini dana je na slici 4.

Slika 4

Rezultati

Usporedba postignuća iz Fizike studenata iz eksperimentalne i studenata iz kontrolne skupine nakon provedbe eksperimentalnog procesa

Nakon provedbe eksperimentalnog procesa ispitivalo se postoji li razlika u postignućima iz Fizike kod studenata iz eksperimentalne skupine (koji su se koristili pristupom 5ELFA) i studenata iz kontrolne skupine (kod kojih se primjenjivao samo 5E model učenja). Kako bi se neutralizirao bilo kakav utjecaj rezultata predtesta na rezultate posttesta i u eksperimentalnoj i u kontrolnoj skupini, grupni rezultati predtesta su kontrolirani, a rezultati posttesta predani su na analizu kovarijance kako bi se utvrdile razlike. Kako bi se to postiglo, za obje skupine izračunata je aritmetička sredina i standardna devijacija testa postignuća iz Fizike, koji je bio proveden kao predtest i posttest. Izračuni su prikazani u Tablici 4.

Tablica 4

Kako se može vidjeti u Tablici 4, srednji rezultat eksperimentalne skupine na posttestu ($\bar{X}$=81,40; S=12,02) bio je bolji nego njihov srednji rezultat na predtestu ($\bar{X}$=63,55; S=7,19). Slično tome, srednji rezultat kontrolne skupine na posttestu ($\bar{X}$=66,53; S=8,45) bio je bolji od srednjeg rezultata na predtestu ($\bar{X}$=58,89; S=7,01). Štoviše, nakon eksperimentalnog procesa, srednji rezultat na posttestu u eksperimentalnoj skupini bio je bolji od srednjeg rezultata na posttestu u kontrolnoj skupini.

Kako bi se utvrdilo je li razlika u srednjim vrijednostima na posttestu u eksperimentalnoj i u kontrolnoj skupini statistički značajna, provedena je analiza kovarijance (ANCOVA) na posttestu. Rezultati predtesta poslužili su kao kovarijat.

Za provedbu ANCOVA-e na rezultatima posttesta postignuća iz Fizike, ispitana je interakcija s „rezultatima na predtestu testa postignuća skupine x" i utvrđeno je da ona nije značajna ($p>0,05$). To pokazuje da su varijable statističke kontrole koje ovise o procijenjenom nagibu regresijske krivulje postignuća iz Fizike u eksperimentalnoj i u kontrolnoj skupini iste. Nagibi regresijske krivulje moraju biti isti kako bi se provela ANCOVA. Kako bi se omogućila komparacija rezultata na predtestu i posttestu testa postignuća iz Fizike u eksperimentalnoj i u kontrolnoj skupini, najprije su određene prilagođene srednje vrijednosti prema srednjim vrijednostima na predtestu testa postignuća iz Fizike, a koje su prikazane u Tablici 5.

Tablica 5

Iz Tablice 5, koja prikazuje rezultate koje su studenti ostvarili na testu postignuća iz Fizike, može se vidjeti da je srednja vrijednost na posttestu u eksperimentalnoj skupini 81,40, a da je srednja vrijednost na tom testu u kontrolnoj skupini 66,53. Prilagođena srednja vrijednost za eksperimentalnu skupinu je 78,94, a za kontrolnu skupinu 68,99. Prema prilagođenim srednjim vrijednostima može se zaključiti da je srednja vrijednost u eksperimentalnoj skupini veća od srednje vrijednosti kontrolne skupine. Rezultati ANCOVA testa, koji je proveden kako bi se utvrdilo postoji li značajna razlika između prilagođenih srednjih vrijednosti eksperimentalne i kontrolne skupine, prikazani su u Tablici 6.

Tablica 6

Prema rezultatima kovarijacijske analize prikazanima u Tablici 6, kada se kontroliraju rezultati predtesta u eksperimentalnoj i u kontrolnoj skupini, može se uočiti značajna razlika ($F_{(1,91)}= 40,183$, $p<0,05$) u prilagođenoj srednjoj vrijednosti posttesta u obje skupine. Ovisno o rezultatima Bonferronijeva testa, koji je proveden na prilagođenim rezultatima posttesta obiju skupina, može se utvrditi da je srednja vrijednost na posttestu u eksperimentalnoj skupini (78,94) bila viša od one u kontrolnoj skupini (68,99). S ciljem određivanja utjecaja te razlike, koja ide u prilog eksperimentalnoj skupini, izračunata je vrijednost eta kvadrata (η^2) koja je iznosila 0,306. Budući da je vrijednost viša od 0,14, to pokazuje da postoji značajan utjecaj. Taj rezultat otkriva da su rezultati testa postignuća iz Fizike u eksperimentalnoj skupini pokazali značajan porast u usporedbi s rezultatima testa postignuća iz Fizike u kontrolnoj skupini ($F_{(1,91)}=$ 40,183, $p<0,05$).

Mišljenja studenata o pristupu obrnute učionice utemeljenog na 5E modelu ciklusa učenja

Početna i završna mišljenja o pristupu

Studente iz eksperimentalne skupine pitali smo sljedeće: „Što ste najprije mislili na početku semestra kada vam je rečeno da će se nastava Fizike izvoditi s pomoću

5ELFA pristupa, a što mislite o tom pristupu na kraju semestra? Objasnite." Kodovi i frekvencije određeni nakon kvalitativne analize podataka provedene na odgovorima studenata prikazani su u Tablici 7.

Tablica 7

U Tablici 7 mogu se vidjeti kodovi koji su povezani s temom „mišljenja prije primjene". U vezi s tim studenti su kazali „da su mislili da to neće funkcionirati" (f=9), „da su bili iznenađeni" (f=6), „da su bili zabrinuti" (f=5), „da nisu puno razmišljali o tome" (f=4) i „da su bili uplašeni" (f=4) kada su saznali da će se nastava Fizike izvoditi primjenom pristupa obrnute učionice. Ti rezultati pokazuju da je većina studenata imala negativno mišljenje o pristupu obrnute učionice kada su bili obaviješteni o njegovoj primjeni. Ovo su neki primjeri početnih negativnih stavova studenata o pristupu obrnute učionice:

> *„Kada nam je naš profesor objasnio pristup i rekao da ćemo se njime koristiti u nastavi Fizike, nisam zapravo smatrao da će to biti išta drugačije. I nisam uopće puno razmišljao o tome." (S8)*
>
> *„Zapravo sam već čuo za taj pristup, ali nisam znao puno o njemu. Čim nam je profesor rekao da ćemo se njime koristiti u nastavi Fizike, zabrinuo sam se." (S17)*

Iz prikupljenih podataka utvrđeno je da je samo dvoje studenata imalo pozitivno mišljenje o pristupu. Studenti čiji je početni stav bio pozitivan rekli su sljedeće:

> *„Mogućnost da nam profesor drži nastavu putem videosnimke i da nam u njoj postavlja pitanja činila se drugačijim pristupom i mislio sam da će biti zabavno. Mislim, čak i da samo vježbamo na simulacijama, na nastavi nam ne bi bilo dosadno." (S4)*
>
> *„Nastava Fizike je uvijek dosadna, pa sam mislio da ovo ne može biti gore od udžbenika ili slušanja profesora. Mislio sam da će sigurno biti zabavno ako se budemo koristili računalima, internetom i simulacijama." (S11)*

Kvalitativni podaci prikupljeni iz intervjua sa studentima pokazali su da su njihova početna mišljenja o primjeni pristupa obrnute učionice pretežno bila negativna.

Tablica 6 pokazuje kodove povezane s temom „mišljenja o uspješnosti primjene". Prema njima, nakon što su iskusili nastavu Fizike koja je uključivala pristup obrnute učionice, studenti su opisali metodu kao „bolju od starog pristupa" (f=15), „zabavan pristup" (f=9), ali i kao „nepotreban pristup" (f=2). Takvi odgovori pokazuju da su mišljenja većine studenata na kraju eksperimenta bila pozitivna. U daljnjem tekstu navode se mišljenja studenata nakon primjene pristupa obrnute učionice:

> *„Mislio sam da ćemo se nakon nekoliko tjedana vratiti na stari način izvođenja nastave. No, s vremenom sam shvatio da mi se taj način čak počeo i sviđati. Rasprave na nastavi zaista su bile ugodne." (S20)*
>
> *„Mislio sam da se taj pristup neće moći primijeniti; bio sam definitivno pesimističan. No sada mislim da je to najbolji pristup. Zapravo, moći se koristiti*

mobitelom ili tabletom kako bismo odgledali videolekcije bilo je sasvim dovoljno kako bi taj pristup bio puno bolji od staroga." (S6)
„Prvi dan me malo uplašio, ali kako je vrijeme odmicalo, shvatio sam da je moj strah nepotreban. Sada imam sasvim drugačije mišljenje o tom pristupu. Puno je bolji od tradicionalne metode; ta dva pristupa uopće se ne mogu usporediti." (S14)

Međutim, čak i nakon provedbe procesa, bilo je nekoliko studenata koji su još uvijek imali negativno mišljenje o pristupu obrnute učionice. Ti su studenti smatrali da je takav pristup „nepotreban" (f=2). U daljnjem tekstu mogu se pročitati mišljenja studenata čija su zazavršna mišljenja o pristupu obrnute učionice bila nagativna:

„Nisam baš puno razmišljao o tom pristupu, ionako mi se nije sviđao. Bilo bi bolje da se nastava izvodila s pomoću stare metode." (S8)
„Kada sam čuo za pristup, bilo me je strah. Promijeniti pristup nastavi Fizike je riskantno. Još uvijek mislim da je to bilo nepotrebno." (S15)

Kvalitativni podaci prikupljeni od studenata putem intervjua pokazuju da su mnogi studenti koji su prije primjene novog pristupa imali negativno mišljenje o njemu s vremenom nadišli svoje predrasude i razvili pozitivan stav.

Mišljenja studenata o pristupu obrnute učionice utemeljenom na 5E modelu ciklusa učenja u nastavi Fizike

Studentima iz eksperimentalne skupine postavljeno je sljedeće pitanje: „Kako je pristup 5ELFA utjecao na način na koji učiš fiziku? Objasni."

Kvalitativni podaci prikupljeni iz odgovora studenata analizirani su u dvije različite kategorije: „učinkovit" i „neučinkovit". Kodovi i frekvencije u tim kategorijama prikazani su u Tablici 8.

Tablica 8

Kako se može vidjeti iz kategorije „učinkovit" u Tablici 8, prema mišljenjima studenata, primjena pristupa obrnute učionice u nastavi Fizike pokazala se korisnom u sljedećim aspektima: „stvaranju veza između stvarnoga života i principa fizike", „omogućavanju smislenog učenja", „pretvaranju apstraktnih pojmova u konkretne" i „pretvaranju Fizike u zabavan predmet".

Značajna većina studenata navela je da je primjena pristupa obrnute učionice u nastavi Fizike imala velik utjecaj na „stvaranje vaza između stvarnoga života i principa fizike" (f=21). Ovo su neki primjeri komentara studenata koji to potvrđuju:

„U stvari, zadaci koje smo radili u učionici pomogli su nam da uočimo veze između svakodnevnog života i fizike. Sada, čak i kada sam na kuglanju, fizika mi nehotice pada na pamet." (S1)
„Uz taj pristup sam shvatio da je fizika, koje sam se toliko pribojavao, isprepletena sa samim životom." (S14)

Neki su studenti rekli da im je pristup pomogao tako što im je „omogućio smisleno učenje" (f=20). Ovo su neki primjeri takvih izjava studenata:

> *„Sada znam da je fizika, za koju sam nekada smatrao da se sastoji samo od matematičkih formula, predmet koji je moguće razumjeti. Osim toga, dolazili smo na nastavu već znajući o kojoj će temi biti riječi jer smo gledali videolekcije. U razredu su nam problemski zadaci i rasprave pomogli da shvatimo teorijske podatke." (S5)*
>
> *„Na nastavi Fizike, radije nego da pokušam shvatiti fenomen i odgovoriti na pitanja, prije sam se izravno fokusirao na formule. Međutim, povezivanje fizike sa stvarnim događajima, pronalaženje razlog*a i rješenja za neke probleme puno je lakše." (S19)

Pod kategorijom „učinkovito" studenti su tvrdili da je primjena pristupa obrnute učionice u nastavi Fizike pomogla „učiniti apstraktne pojmove konkretnima" (f=12). Slijede primjeri izjava studenata koji tu tvrdnju mogu potkrijepiti:

> *„Fizika nije predmet u kojem možete samo razumjeti teoriju. Ovaj pristup jako nam je pomogao, čineći apstraktne pojmove konkretnima, jer su nastavni sati potrošeni na praktične zadatke, a ne na teoriju." (S9)*
>
> *„Nisam si mogao predočiti neke teme. A ne mogu učiti o stvarima koje si ne mogu predočiti. Ovaj pristup, s aktivnostima koje se provode u učionici i događajima iz stvarnog života prikazanim u videolekcijama koje je s nama podijelio naš profesor, zaista su mi olakšali predodžbu fenomena." (S3)*

Pod kategorijom „učinkovit" dodatna prednost primjene pristupa obrnute učionice u nastavi fizike bila je ta što je on „činio fiziku zabavnim predmetom" (f=9), no tu su tvrdnju studenti najmanje spominjali. Ovo su neki od primjera izjava studenata koji idu u prilog toj tvrdnji:

> *„U ovom su sustavu način na koji su teme objašnjene, zanimljive videolekcije, živahne rasprave u učionici nastavu fizike učinili zabavnom." (S11)*
>
> *„Bili smo oslobođeni dosade na nastavi Fizike. Uživao sam u učenju jer sam mogao razumjeti gradivo*, a ne samo ga učiti napamet." (S29)

Pod kategorijom „neučinkovit" samo je dvoje studenata imalo negativno mišljenje jer su smatrali da „ne postoji razlika u usporedbi sa starom metodom." Ovo je izjava koju je dao jedan od studenata koji je imao takvo mišljenje:

> *„U usporedbi sa starim sustavom, za mene se nije puno toga promijenilo. Nastava fizike i dalje je bila jako teška." (S15)*

Na kraju, utvrđeno je da su mišljenja studenata koji su smatrali da je metoda obrnute učionice učinkovita u nastavi fizike brojčano nadvladala mišljenja studenata koji su smatrali da je ona neučinkovita.

Rasprava i zaključak

Ovo istraživanje provedeno je kako bi se proučio utjecaj modela 5ELFA u nastavi fizike na postignuća studenata u fizici i kako bi se utvrdila mišljenja studenata o pristupu obrnute učionice.

S pomoću predtesta koji je proveden i u eksperimentalnoj i u kontrolnoj skupini prije provedbe eskperimentalnog procesa utvrđeno je da su studenti u obje skupine imali ista postignuća u fizici.

Nakon provedbe eksperimentalnog procesa, utvrđeno je da su studenti iz eksperimentalne skupine, koji su se u učenju fizike služili modelom 5ELFA, imali bolja postignuća od studenata iz kontrolne skupine, koji su se koristili samo 5E modelom učenja. Može se reći da je razlog tomu smanjena količina vremena koje se troši na objašnjavanje nastavnog sadržaja, a naglasak se u pristupu obrnute učionice prenosi na rasprave, zadatke u kojima se rješavaju problemi, kao i na simulacije za praktičnu primjenu teorijskog znanja. Nadalje, studenti koji su dolazili na nastavu spremni i koji su već naučili nastavni sadržaj o kojemu će biti riječi, osigurali su svoje sudjelovanje u aktivnim zadacima i služili se kognitivnim vještinama višeg reda, što je na kraju rezultiralo većim postignućima studenata. U skladu s našim rezultatima, postoje i prijašnja istraživanja u kojima se tvrdi da pristup obrnute učionice povećava postignuća učenika. Na primjer, Chao, Chen, i Chuang (2015) došli su do zaključka da je pristup obrnute učionice imao pozitivan utjecaj na studente na tehničkim fakultetima. Slično tome i našim rezultatima, druga istraživanja o kojima se u literaturi može čitati također su pokazala da pristup obrnute učionice povećava postignuća studenata (Deslauriers, Schelew, i Wieman, 2011; Mason, Shuman, i Cook, 2013; Zownorega, 2013; Moffett i Mill, 2014).

Međutim, postoje također istraživanja čiji su rezultati suprotni našima, tj. u kojima se tvrdi da pristup obrnute učionice ne povećava postignuća. Winter (2013) je usporedio primjenu pristupa obrnute učionice s tradicionalnim pristupom u Općoj fizici – I. Test postignuća proveden u dvije skupine nakon eksperimentalnog procesa koji je trajao pet tjedana ukazao je na to da ne postoji statistička razlika u rezultatima. Slično tomu, Willis (2014), Bishop (2013) i Johnson i Renner (2012) tvrdili su da pristup obrnute učionice nema pozitivnog utjecaja na postignuća studenata u nastavi. Kako se može primijetiti, postoje neka istraživanja u literaturi u kojima se navodi da pristup obrnute učionice ima pozitivan utjecaj na postignuća studenata, kao i neka u kojima se navodi da takav pristup nema pozitivan utjecaj na postignuća studenata u usporedbi s tradicionalnim pristupom. Moglo bi se reći da taj nesrazmjer u mišljenjima ima li pristup obrnute učionice pozitivan ili negativan utjecaj na postignuća studenata proizlazi iz načina na koji se pristup primjenjuje, kao i iz kvalitetete materijala koji se u nastavi koriste. Štoviše, znanje koje nastavnik ima o pristupu koji primjenjuje još je jedan faktor koji bi na to mogao utjecati. U ovom se istraživanju može reći da je pristup obrnute učionice imao pozitivan utjecaj na postignuća iz fizike jer je bio prilagođen 5E modelu učenja.

Kada su na početku semestra studenti iz eksperimentalne skupine obaviješteni da će se koristiti pristup obrnute učionice, utvrđeno je da su njihovi početni stavovi bili negativni. Tada su možda studenti imali negativna mišljenja o tom pristupu jer su bili naviknuti na tradicionalniji pristup. U skladu s tim i u literaturi se spominju istraživanja u kojima se vidi da su početna mišljenja studenata o pristupu obrnute učionice bila negativna (Tune, Sturek, i Basile; 2013; Turan i Göktaş, 2015).

S vremenom je većina studenata koji su imali negativno mišljenje o pristupu prije nego je on primijenjen nadišla svoje predrasude i razvila pozitivnija mišljenja. Do te je promjene možda došlo i zato što je u pristupu obrnute učionice više vremena rezervirano za aktivnosti u učionici, a odnos između profesora i studenata postaje jačim. Nadalje, zato što je tehnološko okruženje u kojemu se obrazovni proces odvija prilagođeno modernim studentima (Halili i Zainuddin, 2015), gledanje videolekcija i primjena tehnologije u učionici za aktivnosti učenja višeg reda možda je imalo pozitivan utjecaj na mišljenja studenata. U skladu s tim, Mason, Shuman, i Cook (2013) su u svojim istraživanjima došli do spoznaja da su, kada se studentima prvi put objasnio pristup obrnute učionice, oni prema njemu imali otpor. Međutim, poslije su naveli da su bili zadovoljni tim pristupom. Talbert (2012) je također naglasio da studenti možda imaju predrasude prema pristupu obrnute učionice, no taj bi se problem trebao riješiti komunikacijom između profesora i studenta, kao i razjašnjavanjem svih nejasnoća ako studenti nešto ne razumiju ili im rasprave u učionici nisu dovoljne. U ovoj se fazi može protumačiti da, nakon što studenti isprobaju pristup obrnute učionice, prema njemu izgrađuju pozitivan stav.

Kako bi se utvrdila mišljenja studenata o pristupu obrnute učionice u nastavi fizike, postavljeno im je pitanje: „Kako je pristup obrnute učionice utjecao na način na koji ti učiš fiziku?" Rezultati su pokazali da je većina studenata vjerovala da je pristup obrnute učionice imao pozitivan utjecaj na nastavu fizike. Studenti su izjavili da im je pristup obrnute učionice u nastavi fizike pomogao „stvoriti veze između stvarnoga života i principa fizike", „učiniti učenje smislenim", „učiniti apstraktne pojmove konkretnima" i „učinio fiziku zabavnim predmetom". Prema povratnoj informaciji studenata, može se reći da je primjena pristupa obrnute učionice osigurala smisleno učenje. Taj ishod podudara se s rezultatima prije provedenih istraživanja (Bates i Galloway, 2012; Deslauriers, Schelew, i Wieman, 2011; Zownorega, 2013).

Uočeno je da je samo dvoje studenata izjavilo da primjena pristupa obrnute učionice u nastavi fizike nije imala nikakvog utjecaja na način na koji uče. Razlog tomu je možda činjenica da studenti nisu mogli nadvladati svoje navike učenja, koje su izgradili prema tradicionalnoj metodi nastave, pa zbog toga nisu mogli nadići svoje predrasude prema novom pristupu. Taj se rezultat preklapa s rezultatima istraživanja koje su proveli Johnson i Renner (2012), u kojemu su uspoređivali pristup obrnute učionice s tradicionalnom metodom i došli do spoznaje da su studenti imali negativno mišljenje o novom pristupu. Smatraju da takvi negativni stavovi proizlaze iz privrženosti studenata tradicionalnoj metodi.

Napomena

U pisanju ovoga rada koristili su se rezultati dobiveni za potrebe izrade doktorske disertacije Gülsüma Aşıksoya.