MersinÜniversitesiEğitimFakültesiDergisi - MersinUniversity Journal of the Faculty of Education

"Mersin Üniversitesi Eğitim Fakültesi Dergisi, 2020; 16(3): 573-586"
Araştırma Makalesi / DOI: 10.17860/mersinefd.750957

The Effect of Learning Activities Based on 5E Learning Model on 4thGrade Science Teaching*

5E Öğrenme Modeline Uygun Etkinliklerin İlkokul 4. Sınıf Fen Bilimleri Dersi Öğretimine Etkisi

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Abstract: This study aims to investigate the effects of the 5E learning model on students' academic achievement, basic process skills, attitude towards science, and the overcoming of misconceptions. The study was carried out by means of semi-experimental research design. The participants consisted of 41 fourth grade students. They were randomly selected and assigned to the control and the experimental groups. The activities in the force and motion and the properties of matter topics in the fourth grade science curriculum were designed based on the 5E learning model. The implementation lasted six weeks and three hours per week. In order to collect data, four different questionnaires were used: academic achievement test, basic process skills questionnaire, attitude towards science questionnaire, and misconception identification test. The data were collected at the beginning and the end of the implementation from both groups. The results revealed that after the implementation, the experimental group had higher scores comparing with the control group in terms of academic achievement, attitude towards science, and misconceptions. However, these differences were not statistically significant. In terms of basic process skills, the experimental group had significantly higher score than the control group. Therefore, it is concluded that the 5E learning model has a positive effect on students' academic achievement, basic process skills, attitude towards science, and misconceptions. The implications for future research and practice and the limitations of the study are discussed.
Keywords: Academic achievement, 5E learning model, basic process skills, attitude towards science course, misconceptions

Öz: Bu çalışmada Fen Bilimleri dersi 4. sınıf öğretim programındaki "Kuvvetin Etkileri" ve "Maddeyi Tanıyalım" ünitesindeki bazı konuların öğretilmesinde 5E öğrenme modelinin öğrencilerin akademik başarılarına, bilimsel süreç becerilerine, kavram yanılgılarına ve fen dersine yönelik tutumlarına olan etkisi araştırılmıştır.Araştırma ön test son test kontrol gruplu yarı deneysel desen modelinde tasarlanmıştır.Çalışma grubu Milli Eğitim Bakanlığına bağlı Elazığ ili Merkez ilçesine bağlı bir ilkokulda öğrenim gören iki farklı şubedeki toplam 41 öğrenciden oluşmaktadır. Araştırmanın uygulama süreci haftada üç ders saati olmak üzere toplamda 6 hafta sürmüş ve elde edilen sonuçlar SPSS 22.0 programında analiz edilmiştir. Verilerin analizi için bağımsız gruplar t testi, Mann Whitney U testi ile aritmetik ortalama, standart sapma, frekans ve yüzde analizleri kullanılmıştır. Elde edilen verilerin yorumlanmasında .05 anlamlılık düzeyi kabul edilmiştir. Araştırma sonuçları incelendiğinde deney ve kontrol gruplarında elde edilen son test ortalamalarında gruplar arasında akademik başarı, kavram yanılgıları ve fen dersine yönelik tutum bakımından deney grubu lehine bir fark oluşmakla birlikte bu farkın anlamlı düzeyde olmadığı sonucuna varılmıştır. Bununla birlikte bilimsel süreç becerileri bakımından deney grubu lehine anlamlı fark bulunmuştur. Bu sonuçlara göre, 5E öğrenme modeli ilkokul 4.sınıf seviyesinde öğrencilerin akademik başarıları, kavram yanılgıları ve fen dersine yönelik tutumlarına olumlu etki yaptığı görülmektedir. Bununla birlikte bilimsel süreç becerilerine ilişkin deney grubu lehine anlamlı düzeyde fark oluşturduğu görülmektedir.
Anahtar Kelimeler:Akademik başarı, 5E öğrenme modeli, bilimsel süreç becerileri, fene yönelik tutum, kavram yanılgıları

*Birinci yazarın hazırladığı "5E Öğrenme Modeline Uygun Etkinliklerin İlkokul 4. Sınıf Fen Bilimleri Dersi Öğretimine Etkisi" başlıklı yüksek lisans tezinden üretilmiştir.

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Gönderi Tarihi: 10.06.2020 - Kabul Tarihi: 13.11.2020

Introduction

Considering the purpose of the science curriculum, there is a need for learning environments suitable for constructivist approach that will motivate students, increase their success, and provide meaningful and real life learning experiences (Anıl & Kücüközer, 2017; Erdoğdu, 2011). The constructivist approach enables students to create their own knowledge, which results in students to be raised as individuals who question and criticize information, are open to innovations, and use scientific methods at every stage of life (Bahar, 2006; Önder, 2011). In order to reach all these achievements in science education, the 5E learning model is one of the suitable models (Coşkun, 2011). This model includes a process in which a student reaches new information based on the mental imbalances he/she experienced (Kaya and Zengin, 2012). The model consists of engage, explore, explain, elaborate, and evaluate phases and, as a model for learning new concepts or providing a deeper understanding of a known concept, aims to develop research curiosity and active research skills in students (Ayvacı &Bakırcı, 2012; Ergin, Ünsal & Tan, 2006; Suwarno, Suyatna & Manurung, 2019). This allows students to discover new concepts and to create their own knowledge (Bıyıklı & Yağcı, 2014) and to become more competent in cognitive, affective, and psychomotor learning activities (Faizin & Jamaluddin, 2018). In addition, since the learning model gives importance to real-life experiences, it also contributes to the development of students' critical thinking skills (Putra, Nurkholifah, Subali & Rusilawot, 2018).

In the first phase of the 5E learning model, the engagement phase, teachers attract students' attention in different ways including asking questions, presenting a scenario or starting a discussion, which enables teachers to identify students' prior knowledge and any misconceptions (Arioder, Arioder, Quintana & Dagamac, 2020; Saraç & Bayrak, 2017). In the exploration phase, students work together in groups and conduct experiments or activities under the guidance of a teacher (Mercan, 2012). In the explain phase, the experiences and the results obtained by the students from the explore phase are gathered together under the teacher's guidance and new concepts are reached (AggulYalcin & Bayrakceken, 2010). The elaboration phase allows teachers to improve students' understandings through questions, suggestions, and feedbacks (Türker, 2009). In the evaluation phase, the concepts that students fail to understand are identified and teachers conduct activities to match the knowledge that is just learned with the knowledge already learned, which determines how much learning takes place (Feyzioğlu and Demirci, 2013).

Ergin (2012) states that meaningful learning occurs when students actively involve in learning activities in science courses. While lesson plans that are organized based on the 5E learning model provide effective results in achieving the goals of a lesson and ensuring meaningful learning, they also show positive results in solving many problems in the teaching and learning process (Temiz, 2010). Many studies revealed that the 5E learning model increase students' academic achievement, provides meaningful conceptual changes in students thinking, and positively change students' attitudes towards science (Özsevgeç, 2007; Öztürk, 2008; Sağlam, 2006). Ezberci Çevik and Öner Armağan (2018) reviewed the Turkish literature on the 5E learning model and concluded that while related studies mainly focused on students' academic achievement, a limited number of studies focused also on the effects of 5E learning model on students' attitudes. In addition, there is only a few studies that examine the effects of the model on students' misconceptions and basic process skills (Açışlı & Turgut, 2016; Caner, 2008; Geren & Dökme, 2015). In terms of the participants, studies on the 5E learning model generally focus on middle or high school science curriculum (Campell, 2006; Cornelius, 2012; Erdoğdu, 2011; Kürkçü, 2016; Temiz, 2010). Indeed, there are only a few studies conducted in Turkey with the participation of 3rd and 4th grade students (Bıyıklı & Yağcı, 2014; Ergin, 2012; Saraç, 2018). Therefore, there is a need to conduct similar studies on elementary school science curriculum. In order to fill the gap in the literature, this study aims to evaluate the effects of 5E learning model for the 4th grade science curriculum on students' academic achievement, basic process skills, misconceptions, and attitudes towards science courses. To this end, the following research questions were addressed in this study:

1. Is there any statistically significant difference between the experimental and the control groups' pre-test scores in terms of following variables:
    a. Academic achievement
    b. Basic process skills
    c. Attitudes towards science
    d. The identification of misconceptions
2. Is there any statistically significant difference between the experimental and the control groups' post-test scores in terms of following variables:
    a. Academic achievement
    b. Basic process skills
    c. Attitudes towards science
    d. The identification of misconceptions
3. Is there any statistically significant difference between the pre- and post-test scores of the experimental and the control groups in terms of following variables:
    a. Academic achievement
    b. Basic process skills
    c. Attitudes towards science
    d. The identification of misconceptions

Method

Research model

In order to evaluate the effects of science activities designed based on the 5E learning model on 4th grade students' academic achievement, basic process skills, misconceptions, and attitudes towards science courses, the present study was carried out by means of semi-experimental research design. Semi-experimental models that come after true experimental design models are used in cases where the criteria required by true experimental design models are not provided or sufficient (Çepni, 2011). In the semi-experimental studies, both pre- and post-tests are administered to both groups, but experiment is employed only in the experimental group (Creswell, 2003). Despite its limitations, semi-experimental design is a usable model with high validity (Karasar, 2002). The experimental design of the study is explained in Table 1 below.

Table 1.
Research Model

Groups	Pre-tests	Teaching method	Post-tests
Experimental group	*Academic achievement test* BPSS Attitude scale Misconception identification test	(5E Learning model)	*Academic achievement test* BPSS Attitude scale Misconception identification test
Control group	*Academic achievement test* BSBT Attitude scale Misconception identification test	(Regular program)	*Academic achievement test* BSBT Attitude scale Misconception identification test

Participants

The participants of the current study is consisted of randomly selected 41 4th grade students from two classrooms (4/A and 4/H) enrolled in a school located in the eastern part of Turkey in 2017-

2018 academic year. Among the participants, 21 of them (8 male and 13 female) in 4/A classroom was identified as the experimental group. The control group consisted of 20 students (10 male and 10 female) was in 4/H classroom. The participants did not have any experience in terms of the 5E model learning.

Data collection process

The research was carried out in a six-week period between November 27, 2017 and January 3, 2018. The topics were the force and motion and the properties of matter. The selected data collection tools were administered as pre- and post-test to the participants. While in the control group regular lessons suggested by the Ministry of National Education were followed, in the experimental group worksheets that were designed based on the 5E learning model were used to teach the concepts. After the draft version of the activities was prepared by the researchers, they were reviewed by three elementary school teachers and three faculty members in the Department of Elementary Education. Based on the feedback received from the experts, necessary modifications were made and the final version of 5E-model activities was obtained.

Data collection tools

There are four data collection tools used in the current study. Below, they are explained in detail.

Academic Achievement Test: In order to determine the academic achievement levels of the participants, the researchers developed a test based on the literature. The questions in the test were about the force and motion and the properties of matter. First of all, 35 multiple choice questions were identified by the researchers. After obtaining the expert views and calculation of item difficulty and discrimination indices, five items were dropped out, which left 30 questions. While 13 questions were related to the effect of force on items, 10 of them were about gravitational force of the magnet, and 12 were about the properties of matter. Based on students' answers, the items were coded as either zero (0 - wrong answer) or one (1 - right answer).

The Basic Process Skills Test: In order to identify participants' basic process skills, a questionnaire developed by Padilla, Cronin and Twiest (1985) was used. The questionnaire was translated into Turkish by Aydoğdu and Karakuş (2015). It consists of 31 items with six factors: observation (5 items), categorization (5 items), inference (5 items), measurement (5 items) estimation (6 items), and communication (5 items). The reliability of the scale (KR-20) and the average difficulty level of the scale were calculated as .83 and .55, respectively.

Attitudes towards Science Courses: In order to identify participants' attitudes towards science courses, a questionnaire developed by Geban, Ertepınar, Yılmaz, Altın and Şahbaz (1994) was used. The questionnaire is in a five-point Likert type ranging from strongly disagrees to strongly agree and contains 15 items with only one factor. The reliability coefficient value of the scale was calculated as .83.

Misconception Identification Test: In order to identify students' misconceptions, the researchers reviewed the literature and designed a list of items related to misconceptions. There were a total of 27 items. After the calculation of item difficulty and discrimination indices, six items were deleted, which left 21 items in the test.

Data analysis

At the beginning of data analysis, the Shapiro-Wilk test was used to define whether data was normally distributed. In addition, kurtosis and skewness values were calculated and Q-Q graph, stem-and-leaf plots, and box plot graphs were drawn. For the normally distributed data, an independent samples t test and a paired samples t test were employed. For the other data, Mann Whitney U test was used. The p value was accepted as being meaningful if $p < .05$. Also,

arithmetic mean (x), standard deviation (s), and frequencies (f) were calculated. For data analysis, IBM SPSS version 22.0 was used.

Findings

Findings regarding the pre-test scores of the experimental group and the control

In order to identify any possible difference in the pre-test scores of the experimental and the control groups, an independent samples t test was used for normally distributed data and Mann Whitney U test was used for non-normally distributed data. The results are provided in Table 2 and 3.

Table 2.
Independent Samples T- Test Results: the Pre-Test Scores of the Experimental Group And The Control Group

	Groups	N	$\bar{X}$	sd	t	p	η2
Academic achievement	Control	20	16,65	6,17	,607	,547	0,009
	Experimental	21	17,71	5,02			
Basic process skills	Control	20	15,55	3,97	1,417	,161	0,04
	Experimental	21	17,04	2,63			
Attitudes towards science	Control	20	32,70	3,31	,667	,509	0,01
	Experimental	21	32,00	3,40			

No significant difference was observed between the experimental and the control groups in terms of their pre-test of academic achievement, basic process skills and attitude towards science ($p>.05$; Table 2). The average pre-test scores of the control and the experimental groups were calculated as 16,65 and 17,71 for academic achievement; 15,55 and 17,04 for the basic process skills and 32,70 and 32,00 for attitudes towards science, respectively (Table 2).

Table 3.
Mann Whitney U Test Results: Comparison of the Pre-Test Scores For Misconception Identification Test

Groups	N	Mean ranks	Sum of ranks	U	p	r
Control	20	20,65	413,00	203,00	,854	0.02
Experimental	21	21,33	448,00			

Pre-test scores for misconception identification found that no significant difference was observed between control and experimental groups ($p>.05$; Table 3).

Findings regarding the post-test scores of the experimental group and the control

In order to identify any possible differences in the post-test scores of the experimental and the control groups, an independent samples t test was used for normally distributed data and Mann Whitney U test was used for non-normally distributed data (see Table 4 and 5). Although no significant difference was observed between the experimental and the control groups in terms of their pre-tests academic achievement, misconceptions and attitude towards science, a significant difference was observed in their post-test basic process skills scores.

There was no found significant difference between the control and the experimental groups in terms of academic achievement, attitude towards science, and the misconception identification' post-test scores ($p>.05$; Table 4). The post-test scores of the control and the experimental groups were calculated as 19,45 and 21,95 for academic achievement; 33,40 and 34,00 for the attitudes towards science and 14,25 and 15,57 for misconceptions' identification, respectively. However, all of results obtained post-test scores showed that the average scores of experimental group higher than control group (Table 4).

Table 4.
Independent Samples T- Test Results: The Post-Test Scores Of The Experimental Group And The Control Group

	Groups	N	X̄	sd	t	p	η2
Academic achievement	Control	20	19,45	7,33	1,242	,222	0.03
	Experimental	21	21,95	5,48			
Attitudes towards science	Control	20	33,40	3,03	,737	,466	0.01
	Experimental	21	34,00	2,12			
Misconceptions	Control	20	14,25	3,1	1,215	,232	0.03
	Experimental	21	15,57	3,8			

Table 5.
Mann Whitney U Test Results: Comparison Of The Post-Test Scores For The Basic Process Skills Test

Groups	N	Mean ranks	Sum of ranks	U	p	r
Control	20	16,58	331,5	121,5	,02*	0.36
Experimental	21	25,21	529,5			

*p<.05

Post-test scores of basic process skills found that there was significant difference between control and experimental groups (p.<05; Table 5).

Findings regarding the comparison of the pre- and post-test scores of the control group
In order to compare the pre- and post-test scores of the control group, a paired samples t test was used. The results are given in Table 6.

Table 6.
Paired Samples T Test Results For The Control Group

		N	X̄	sd	t	p	η2
Academic achievement	Pre-test	20	16,65	6,17	2,679	,015*	0,15
	Post-test	20	19,45	7,33			
Basic process skills	Pre-test	20	15,55	3,97	,387	,703	0,003
	Post-test	20	16,00	5,74			
Attitudes towards science	Pre-test	20	32,70	3,31	,666	,514	0,01
	Post-test	20	33,40	3,03			
Misconceptions	Pre-test	20	12,25	3,83	1,921	,07	0,08
	Post-test	20	14,25	3,1			

*p<.05

Paired samples t test results showed that only significant difference was observed in the control group's academic achievement scores (p<.05). While their pre-test average score was 16.65, it increased to 19.45 in the post-test. However, there was no found significant differences between pre-test and post test scores of basic process skills, attitudes towards science and misconception identification of control group (p>.05, Table 6).

Findings regarding the comparison of the pre- and post-test scores of the experimental group
In order to compare the pre- and post-test scores of the experimental group, a paired samples t test was used. The results are given in Table 7. The results revealed that the experimental group had significantly higher scores in all post-tests, comparing with their scores in the pre-tests.

Table 7.
Paired Samples T Test Results For The Experimental Group

	Groups	N	X̄	sd	t	p	η2
Academic achievement	Pre-test	21	17,71	5,02	3,81	,001*	0,27
	Post-test	21	21,95	5,48			
Basic process skills	Pre-test	21	17,04	1,65	4,39	,000*	0,33
	Post-test	21	19,38	3,85			
Attitudes towards science	Pre-test	21	32,00	3,4	2,60	,017*	0,14
	Post-test	21	34,00	2,12	3		
Misconceptions	Pre-test	21	12,66	3,71	2,74	,012*	0,16
	Post-test	21	15,57	3,8	6		

p*<.05

Paired samples t test results showed that there was significant differences between pre-test and post test scores of academic achievement, basic process skills, attitudes towards science and misconceptions identification of experimental group (p<.05, Table 7).

Conclusion and Discussion

The participants' average scores in academic achievement test was compared and no significant difference was observed between the experimental and the control groups, which implies that the preliminary knowledge of the students about the force and motion and the properties of matter was equivalent. After the six-week experiment, although there is a difference in terms of academic achievement scores in favor of the experimental group, the difference was not statistically significant. Also, the partial eta square value between groups was calculated as a value between small and medium (η2= 0,03). According to these results, it is concluded that despite the increase in students' academic achievement in the experimental group due to 5E learning model, this increase was not at a desired level due to several factors including students' age group, the time limitation in applying the 5E learning model, and students' inexperience to use the model. A similar study with 5th grade students was conducted by Özsevgeç (2007), who found that the materials developed according to the 5E learning model were effective in increasing the academic success of the students. In another experimental study with 8th grade students, Tiryaki (2009) combined both the 5E learning model and cooperative learning and found significant difference in favor of the experimental group in terms of academic achievement. Similar results were obtained in other studies conducted by Uzezi Jack (2017), Ong, Govindasay, Salleh, Tajuddin, Rahman and Borhan (2018) and Bunkure (2019). However, one common feature of these studies mentioned above is that the 5E learning model was applied in 5th or higher grades. Kozcu and Güven (2019) conducted a meta-analysis on studies focusing on the 5E learning model and found that although the model greatly increased students' academic achievement in middle schools, high schools, and universities, it has a little but positive effect on elementary school students' academic achievement. Therefore, more studies is needed to determine the effectiveness of the 5E learning model in younger groups and the factors that affect its effectiveness.

The comparison of the pre-test average scores of the basic process skills of the students in the experimental and control groups revealed no significant difference between the groups, which implies the equivalence of the groups. However, a significant difference was obtained in the post-test scores in favor of the experimental group and medium effect size was calculated (r = 0.36). The 5E learning model requires students to activate their research skills while developing research curiosity (Ayvacı & Bakırcı, 2012; Ergin, Ünsal & Tan, 2006; Suwarno, Suyatna & Manurung, 2019), which is directly related to the basic process skills. Considering that these skills that mediate the development of students' scientific thinking structure contain the necessary tools and methods to reach scientific knowledge, the 5E learning model must take an important place in curriculum. Specifically in the explore phase of the 5E learning model, students were provided

activities that increased the basic process skill levels, which is also proved by Polyiem, Nuangchalerm and Wongchantra (2011). In other studies focused on the 5E learning model applications in science courses, also a significant increase in students' basic process skills were observed (Ercan Özaydın, 2010; Öztürk, 2013; Sole & Wilujeng, 2013). Since the basic process skills contribute significantly to the understanding of science subjects with the 5E learning model (Akar, 2005), it is critical to employ the model that requires students to actively observe and conduct research to build concepts in their minds (Ramalawati, Adam, Rusli & Mun'in, 2018). This helps students to reach and prove real knowledge thorough scientific activities.

When students' attitudes towards science scores in the pre-test were compared, there was no significant difference between the experimental and the control groups, which means that the groups were equivalent. On the other hand, although non-significant, a difference was observed in favor of the experimental group based on the post-test scores and the partial eta square value between the groups was calculated as small effect size ($\eta 2 = 0{,}01$). This means that the 5E learning model positively affected students' attitudes towards science courses. A similar study was conducted by Bıyıklı and Yağcı (2014). They employed the 5E learning model to 4th grade science curriculum and found positive change in the experimental group's attitude towards the course. Other studies also found similar results in terms of the change in favor of experimental groups (Balcı, 2005; Cornelius, 2012; Hokkanken, 2011; Özsevgeç, 2007; Sağlam, 2006). Kozcu Çakır (2017) conducted a meta-analysis and found that the 5E learning model had positive effect on students' academic achievement, basic process skills, and their attitude towards science. Similarly, in their meta-analysis, Kozcu and Güven (2019) found that students who learned science through the 5E learning model had higher positive attitude towards science, comparing with the other students who were exposed to a regular teaching methods.

The pre-test scores of the experimental and the control groups were compared and the results revealed that there was no significant difference between the groups, which implies that the groups were equivalent in terms of misconceptions before the implementation. The analysis of the post-test scores was conducted and, although non-significant, a difference was observed between the groups in favor of the experimental group and the partial eta square value between the groups was calculated as a value with small effect size ($\eta 2 = 0{,}03$). Altınay (2009) and Şahin and Çepni (2012) examined the effects of the 5E learning model on 8thgrade students' misconceptions and found positive effects. In another study with 11th grade students, a similar result was found (Pabuçcu & Geban, 2015). Specifically, in the engage phase of the model, students may be provided a discussion about a scientific topic. As students discuss about it, their misconceptions may arise and they become aware of their misconceptions (Yıldız, Ergin & Kocakulah, 2012; McWright, 2017). Based on the findings of the current study, there might be factors that affect the effectiveness of the 5E learning model. These factors may be the age group of the participants and the duration of the implementation. Therefore, more research is needed to ensure its effectiveness in younger age groups.

Implications for future research

The overall results of the study revealed that teaching with the 5E learning model had a positive effect on students' academic achievement, basic process skills, misconceptions, and attitudes towards science in 4th grade science curriculum. Based on the findings, there are several implications for future research. The first implication is related to the classroom size. The classrooms in which the experimental and the control groups were chosen had about 20 students. More research is needed to investigate the effectiveness of the 5E learning model in more crowded classrooms. The second one is related to the grade level in which the study was conducted. The study was carried out at the 4th grade level. In the literature, the studies were mainly conducted in higher grade levels and found positive effects on students' academic achievement, basic process skills, attitude towards science, and misconceptions. In order to better determine the effects of the 5E learning model, more research is needed in all grade levels, especially in younger age groups. Finally, there is a gap in the literature in terms of the effects of technology on the implementation

of the model. Therefore, the effects of the 5E learning model can also be explored in classrooms enriched with technology.

Implications for Practice

Based on the results of the study, it is observed that the 5E learning model had a positive effect on student achievement in 4th grade science curriculum. Therefore, as long as the phases are followed in an effective way, it is suggested that teachers choose this model in teaching 4th grade science curriculum. In addition, in the study, classroom environment in the experimental group was arranged in accordance with the model, which allowed students to carry out the activities in accordance with the purpose. Therefore, in order to implement the model effectively teachers/researchers should be cautious about the arrangement of the classrooms. Also, for teachers to implement all phases of the model in an appropriate way, they must seek professional development trainings to improve their knowledge about the model.

Limitations of the Study

There exist three critical limitations of the current study. The first one is the duration of the implementation. The study was carried out in a six-week time period and each week students were exposed to the model for only three hours. Therefore, in order to ensure about the effectiveness of the model, it is suggested that the implementation is spread over a wider time period. The second limitation is about the topics chosen for the implementation. In the study, the 5E learning model was applied to two subjects in 4th grade science curriculum: force and motion and the properties of matter. Different topics may be chosen to implement the model. The last limitation is related to the research model. The current study utilized qualitative research method. However, it is critical to collect data not only through questionnaires but also observations, interviews, and the other methods that are included in quantitative research methods, which is critical for reliability and validity of the study.

Ethic Committee Approval Information

The permission of the Ethics Committee for this study was obtained with the permission of Firat University Non-Interventional Research Ethics Committee, dated 16-11-2017, number 15/3.

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Uzun Öz

Giriş

21. yüzyılda öğrenmedeki temel amaç bilginin doğrudan aktarılması değil bilgiye ulaşma becerilerinin öğrencilere kazandırılmasıdır. Bu sayede öğrenciler okulda öğrendikleri bilgileri gerçek yaşama da transfer edebileceklerdir. Fen Bilimleri dersinde bu amaca ulaşabilmek için yapılandırmacı yaklaşıma uygun modellere ve öğrenme ortamlarına ihtiyaç duyulmaktadır. Yapılandırmacı yaklaşım ile öğrenciler bilgiye kendileri ulaşabilmekte ve böylece sorgulayan, bilimsel çalışma yöntemlerini yaşamın her aşamasında kullanabilen öğrenciler yetişmektedirler (Bahar, 2006; Önder, 2011). Bu amaca katkı sunan modellerden biri de son yıllarda farklı eğitim kademelerinde kullanılmaya başlanan 5E öğrenme modelidir. Yeni bir kavram öğrenilirken ya da ya da mevcut bilinen kavrama derinlik katılmasını amçlayan 5E öğrenme modeli girme, keşfetme, açıklama, derinleştirme-genişletme ve değerlendirme aşamalarından oluşmaktadır (Ayvacı ve Bakırcı, 2012; Ergin, Ünsal ve Tan, 2006; Suwarno, Suyatna ve Manurung, 2019). Anlamlı ve kalıcı öğrenmenin gerçekleşmesini sağlayan 5E öğrenme modeli ile ilkokul 4.sınıf fen bilimleri dersi konularının öğretimindeki etkilerinin görülmesi ve bu öğrenme modelinin öğrencilerin akademik başarıları, bilimsel süreç becerileri, kavram yanılgıları ve fen bilimleri dersine yönelik tutumları gibi farklı değişkenler üzerindeki etkisini araştırmak önem arz etmektedir.

Araştırmanın amacı

Bu çalışmanın amacı; ilkokul 4.sınıf Fen Bilimleri dersinin "Kuvvetin Etkileri" ve "Maddeyi Tanıyalım" ünitesinin öğretiminde uygulanacak olan 5E öğrenme modelinin öğrencilerin

akademik başarıları, bilimsel süreç becerileri, kavram yanılgıları ve fen bilimleri dersi tutumları üzerindeki etkilerini ortaya çıkarmaktır.

Araştırmanın problemi

Araştırmada aşağıda verilen probleme cevap aranmıştır.

- İlkokul 4.sınıf düzeyinde Kuvvetin Etkileri ve Maddeyi Tanıyalım ünitesi kapsamında; 5E öğrenme modelinin öğrencilerin akademik başarılarına, bilimsel süreç becerilerine, kavram yanılgılarına ve fen bilimleri dersi tutumlarına ilişkin etkisi nedir?

Yöntem

İlkokul 4.sınıf öğrencilerinin "Kuvvetin Etkileri" ve "Maddeyi Tanıyalım" ünitesi kapsamında akademik başarılarını, bilimsel süreç becerilerini, fen bilimleri dersine yönelik tutumlarını ve kavram yanılgılarını karşılaştırmak amacıyla yarı deneysel model kullanılmıştır.

Çalışma grubu

Çalışma grubunu 2017-2018 eğitim ve öğretim yılında Elazığ ili Merkez ilçeye bağlı bir ilkokuldaki random belirlenen 4-A ve 4-H şubelerinde eğitim gören 41 ilkokul öğrencisi oluşturmaktadır. Seçilen bu şubelerden 21 öğrenciden (8 erkek, 13 kız) oluşan 4-A şubesi 5E öğrenme modeli fen öğretiminin uygulandığı deney grubu, aynı şekilde 20 öğrenciden (10 erkek, 10 kız) oluşan 4-H şubesi ise mevcut öğretim programlarının uygulandığı kontrol grubu olarak belirlenmiştir.

Veri toplama araçları

Araştırmada, kontrol ve deney gruplarının akademik başarılarını belirlemek amacıyla 35 çoktan seçmeli sorudan oluşan akademik başarı testi kullanılmıştır. Öğrencilerin bilimsel süreç becerilerini belirlemek amacıyla Padilla, Cronin ve Twiest (1985) tarafından geliştirilen ve Türkçe 'ye uyarlaması Aydoğdu ve Karakuş (2015) tarafından yapılan 31 maddelik "Temel Beceri Ölçeği- TBÖ" kullanılmıştır. Ölçeğin güvenirlik katsayısı (KR-20) 0.83, ölçeğin ortalama güçlüğü ise 0.55 olarak bulunmuştur. Ayrıca araştırmada, kontrol ve deney gruplarının Fen bilimleri dersine yönelik tutumlarını ölçmek amacıyla Geban, Ertepınar, Yılmaz, Altın ve Sahbaz (1994) tarafından hazırlanmış olan 5'li Likert tipindeki 15 maddelik "Fen bilimleri dersine yönelik tutum ölçeği" kullanılmıştır. Ölçeğin güvenirliği 0.83 olarak bulunmuştur. Öğrencilerin sahip oldukları kavram yanılgılarını belirlemek amacıyla uzman görüşleri ve literatürler incelenerek 21 sorudan oluşan Kavram Yanılgısı Belirleme Testi hazırlanmıştır.

Veri toplanması ve analizi

Araştırma ilkokul 4.sınıf Fen bilimleri dersi "Kuvvetin Etkileri" ve "Maddeyi Tanıyalım" ünitesi kapsamında 6 haftalık süreçte yürütülmüştür. Kontrol ve deney gruplarına akademik başarı testi, bilimsel süreç becerileri testi, kavram yanılgılarını belirleme testi ve fen bilimleri dersine yönelik tutum ölçeği ön test ve son test olarak uygulanmıştır. Kontrol grubunda Milli Eğitim Bakanlığı Talim Terbiye Kurulu tarafından hazırlanan ilkokul 4.sınıf Fen bilimleri dersi programının ön gördüğü etkinliklere göre konular öğretilirken deneysel grupta araştırmacılar tarafından 5E öğrenme modeline göre hazırlanmış çalışma yapraklarına göre konular öğretilmiştir. Verilerin analizi için bağımsız gruplar t testi, bağımlı gruplar t testi, aritmetik ortalama ($\bar{x}$), standart sapma (s) ve frekans (f) kullanılmıştır. Ayrıca dağılımın homojen olmadığı durumlarda ise Mann Whitney U testi kullanılmıştır.

Bulgular

Bu bölümde araştırmanın amacı doğrultusunda 5E öğrenme modelinin öğrencilerin akademik başarıları, bilimsel süreç becerileri, fen derslerine yönelik tutumları ve kavram yanılgılarına ilişkin etkisinin belirlenmesi amacıyla çalışmada elde edilen verilerin analizi yapılmıştır

Deney ve kontrol grubunun akademik başarı düzeylerine baktığımızda deney grubu öğrencilerinin ortalamalarının ($\bar{x}$ =21,95) kontrol grubu öğrencilerinden ($\bar{x}$ =19,45) daha yüksek olduğu görülmektedir. Ancak gruplar arasında oluşan farkın istatiksel olarak anlamlı düzeyde olmadığı ($p>.05$) tespit edilmiştir.

Deney grubu ile kontrol grubunun bilimsel süreç becerileri bakımından son test sonuçlarına bakıldığında gruplar arasında istatiksel olarak anlamlı bir farkın ($p<.05$) olduğu görülmektedir

Deney ve kontrol grubunun fen bilimleri dersine yönelik tutumlarına ilişkin sonuçlara bakıldığında deney grubu öğrencilerinin ortalamalarının ($\bar{x}$ =34,00) kontrol grubu öğrencilerin ortalamalarından ($\bar{x}$=33,40) daha yüksek olduğu görülmektedir. Ancak gruplar arasında oluşan farkın istatiksel olarak anlamlı düzeyde olmadığı ($p>.05$) tespit edilmiştir.

Deney ve kontrol grubunun kavram yanılgılarına ilişkin sonuçlara bakıldığında deney grubu öğrencilerinin ortalamalarının ($\bar{x}$ =15,57) kontrol grubu öğrencilerin ortalamalarından ($\bar{x}$ =14,25) olduğu görülmektedir. Bununla birlikte gruplar arasında oluşan farkın istatiksel olarak anlamlı düzeyde olmadığı ($p>.05$) tespit edilmiştir.

Tartışma ve Sonuç

Bu araştırma 5E öğrenme modeline uygun etkinliklerin ilkokul 4.sınıf Fen Bilimleri dersi öğretimine etkisinin incelenmesi amacıyla gerçekleştirilmiştir. Araştırma sonuçları incelendiğinde deney ve kontrol gruplarında elde edilen son test ortalamalarında gruplar arasında akademik başarı, kavram yanılgıları ve fen dersine yönelik tutum bakımından deney grubu lehine bir fark oluşmakla birlikte bu farkın anlamlı düzeyde olmadığı sonucuna varılmıştır. Bununla birlikte bilimsel süreç becerileri bakımından deney grubu lehine anlamlı fark bulunmuştur. Bu sonuçlara göre, 5E öğrenme modeli ilkokul 4.sınıf seviyesinde öğrencilerin akademik başarıları, kavram yanılgıları ve fen dersine yönelik tutumlarına olumlu etki yaptığı görülmektedir. Yapılan bu çalışma ile 5E öğrenme modelinin ilkokul seviyesinde de uygulanabilir olduğu ve dersi daha zevkli hale getirdiği söylenebilir. Ancak bu modele dair sonuçların ilkokul seviyesinde daha net biçimde anlaşılabilmesi açısından daha fazla çalışmaya greksinim vardır.