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Investigating the Effectiveness of Activities Supported by Digital Learning Tools in Different Learning Environments

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Abstract: This study was conducted to determine the effects of learning activities carried out in different environments supported by digital learning tools (computer and mobile applications) on students' academic achievement and attitudes towards science. The present study employed a pretest-posttest control group quasi-experimental design to examine the effects of a curriculum intervention on the understanding of "Reproduction, Growth, and Development in Plants and Animals" among a sample of 45 seventh-grade students enrolled in a public school during the 2020-2021 academic year. In the study, blended learning was applied to the control group, the enriched face-to-face learning dimension of blended learning was applied to the experimental-1 group, and the enriched e-learning dimension of blended learning was applied to the experimental-2 group. In all groups, the activities were designed in accordance with the 5E learning model. Quantitative data obtained using the "Academic Achievement Test" and the "Science Attitude Scale" were analyzed with the SPSS software package. As a consequence, a statistically significant difference was found between the experimental-2 group and the control group in terms of academic achievement, and between the experimental-1 group and the control group in terms of attitude.

Keywords: Science education, web-based teaching, out-of-school learning, blended learning methods

Farklı Öğrenme Ortamlarında Kullanılan Bilgisayar ve Mobil Uygulama Destekli Etkinliklerin Etkililiğinin Araştırılması

Öz: Bu araştırmanın amacı, farklı ortamlarda gerçekleştirilen bilgisayar ve mobil uygulama destekli etkinliklerin öğrencilerin akademik başarı ve fen bilimlerine yönelik tutumlarına etkisini incelemektir. 2020–2021 eğitim öğretim yılında bir devlet okulunun 7. Sınıfında öğrenim gören 45 öğrenci ile "Bitki ve Hayvanlarda Üreme Büyüme ve Gelişme" ünitesinde gerçekleştirilen araştırmada ön test son test, kontrol gruplu, yarı deneysel desen kullanılmıştır. Araştırma kontrol grubuna harmanlanmış öğrenme, deney grubu – 1'e harmanlanmış öğrenmeye zenginleştirilmiş yüz yüze öğrenme uygulamaları eklenerek, deney grubu – 2'ye ise harmanlanmış öğrenmeye zenginleştirilmiş e-öğrenme uygulamaları eklenerek yürütülmüştür. Her üç grupta da etkinlikler 5E öğrenme modeline uygun tasarlanmıştır. Veriler "Akademik Başarı Testi" ve "Fen Bilimleri Tutum Ölçeği" olmak üzere iki ölçek kullanılarak toplanmış ve SPSS 22 paket programı ile analiz edilmiştir. Araştırmanın sonuçlarına göre akademik başarı yönünden deney grubu – 2 ile kontrol grubu arasında deney grubu – 2 lehine, fen bilimlerine yönelik tutum açısından deney grubu – 1 ile kontrol grubu arasında, deney grubu – 1 lehine istatistiksel olarak anlamlı düzeyde farklılık tespit edilmiştir.

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Anahtar kelimeler: Fen öğretimi, bilgisayar ve mobil uygulama destekli öğretim, okul dışı öğrenme ortamları, harmanlanmış öğrenme

Introduction

The era that we are currently living in is one in which the changes that occur as a result of developments in the field of technology have the potential to trigger changes in the field of education as well as in other areas of life. New circumstances, including the generation, interrogation, and dissemination of information, have arisen as a direct result of the changes that have taken place. The increasing need for knowledge and the continuous changes in the structure of knowledge call for innovative ways to its pursuit. (Akınoğlu, 2002; Jones et al., 2010). New learning activities to be constructed as a synthesis of old and new information are required because of circumstances such as the development of prior knowledge, the stability of the information learned, and the application of the information to real life or to various academic fields (Ministry of National Education [MoNE], 2018a). Blended learning is one of these educational approaches. The blended learning model integrates the advantages of online education and face-to-face education, facilitating the establishment of connections across diverse learning environments (Osguthorpe & Graham, 2003). Blended learning refers to an educational approach that combines traditional face-to-face classroom instruction with online learning resources, allowing for simultaneous utilisation of both methods. It integrates a diverse range of instructional strategies and techniques, while actively using the internet. Blended learning is also referred to as hybrid or hybridized learning. Driscoll (2002), Graham (2006), and Osguthorpe and Graham (2003) all came to the same conclusion.

The increasing prevalence of technology and widespread internet access in the field of education has led to a gradual elevation of the role of computers and mobile devices in various learning environments. Based on a multitude of research studies, computer and mobile-assisted instructional activities exhibit a range of advantages and disadvantages (Bulun et al., 2004; Khan, 1997; Litchfield et al., 2007; Üçışık & Tuna, 2004). Osguthorpe and Graham (2003) argue that blended learning offers a pedagogical richness that can mitigate the limitations associated with traditional teaching methods that solely rely on either face-to-face instruction or digital content. Specifically, this richness will reduce the likelihood that students will fail to learn the material. Furthermore, students will have the opportunity to access the prearranged recorded activities in virtual settings, irrespective of their physical location, be it at school, home, or elsewhere. This will enable them to carry out learning activities at their own pace and within the time period that they determine. As a consequence of this, in order to realise an effective learning, it will be necessary to overcome the barriers that arise as a result of individual differences, as well as limitations of time or space.

According to Jagušt et al. (2018), individuals continue to learn throughout their lives, regardless of whether or not they are enrolled in formal educational programs. Therefore, it is not accurate to state that a student's education in a subject is solely comprised of predetermined instructional activities that take place at school. Out-of-school learning environments refer to educational approaches or strategies that involve conducting activities and practises in natural settings outside the traditional classroom. These environments aim to engage learners in educationally and achievement-oriented activities, allowing them to actively participate in their

learning process. By integrating daily life experiences with science lessons, children in these environments can establish meaningful connections and gain a deeper understanding of the phenomena they encounter. Out-of-school learning environments are defined as an educational method or strategy in which activities and practices that involve learning by doing and reinforcing what has been learned are both facilitated when students take the concepts they have acquired in science classes and apply them in real-world settings (Falk & Dierking, 2010; Falk & Needham, 2016; Laçin Şimşek et al., 2011). At the same time, these environments allow students to construct knowledge in accordance with their own capacities and to learn according to different learning speeds and different learning styles that arise from individual differences (Melber & Abraham, 1999).

The importance of affective states such as values, beliefs, motivation, attitudes, self-efficacy, self-control, etc., as well as cognitive states such as learning and academic achievement that emerge by using different methods and techniques in science education has been emphasized (MoNE, 2018b). Bloom (2012, p. 146) stated that the affective dimension is important for learning at every stage of education and that it is difficult to both explain a subject to a student with a negative attitude and to achieve success in that subject. Although the importance of developing positive attitudes for learning situations is known, it is evident that there are deficiencies in terms of how to ensure that students develop positive attitudes towards a lesson or subject and how to integrate this with the models, methods and techniques applied, and therefore, more research is needed.

When the literature is analyzed, it is seen that studies have been conducted at different grade levels in the field of science related to out-of-school learning environments (Gu & Xu, 2019; Krombaβ & Harms, 2008; Kubat, 2018; Saraç, 2017; Sontay et al., 2016; Ürey, 2018; von Albedyll et al., 2017; Yavuz, 2012; Zeren Özer & Güngör, 2019). In addition to studies in which many methods and techniques are tested in face-to-face learning environments, there are also studies on the effectiveness of face-to-face learning activities defined as blended learning and teaching activities using applications in digital environments, which have increased in number in recent years, although they are not yet very common in Turkey (Akgündüz & Akınoğlu, 2017; Bağci & Yalin, 2018; Çırak Kurt et al., 2017; Gürdoğan & Bağ, 2019; Meri-Yılan, 2021; Poçan et al., 2021; Sarıtepeci &Yıldız, 2014).

Apart from blended learning applications in digital environments and face-to-face learning activities, this study distinguishes itself by incorporating learning activities specifically designed for use in out-of-school learning environments. Therefore, it is thought that this study will add innovation to science education, and that the findings and the method followed will bring a different perspective for new studies. For these reasons, the aim of this study was to test experimentally the effect of learning activities supported by digital learning tools used in and out of school environments in the teaching of the "Reproduction, Growth, and Development in Plants and Animals" unit of the science course on students' academic achievement and attitudes toward science.

In light of this, the following questions were investigated:

1 - Is there a significant difference between the students in the control group (blended learning applied), the experimental-1 group (enriched face-to-face learning component of blended learning applied), and the experimental-2 group (enriched e-learning component of blended learning applied) with regard to their mean academic achievement pretest and posttest scores?

2 - Is there a significant difference between the mean scores obtained on the pretest and the posttest by students in the control group (blended learning applied), experimental-1 group (enriched face-to-face learning component of blended learning applied), and experimental-2 group (enriched e-learning component of blended learning applied) regarding their attitudes toward the science course?

Method

The method of the study is presented under the following headings:

Study Model

This study, a quantitative research design, employed a quasi-experimental design with a pretest posttest control group to examine the impact of learning activities conducted in and out of school settings and supported by digital learning tools (computer and mobile applications) in science education on students' academic achievement and attitudes towards science. The research design known as a quasi-experimental design is one in which the control and experimental groups are not assigned through random selection (Robson, 2015). The pretests and posttests were conducted to both the control group and the experimental groups, and then comparisons were made between the study groups with the data obtained.

Sample Selection

The study group consisted of a total of 45 students, all of whom were enrolled in the 7th grade at a public school located in Orhangazi (Bursa) during the 2020-2021 academic year. The selection of the grade was determined by the inclusion of the study subject matter pertaining to "reproduction, growth, and development in plants and animals" within the curriculum designed for students in the seventh grade. The selection of the study topic ("reproduction, growth, and development in plants and animals") is based on its alignment with the planned activities within the context of blended learning, because data pertaining to living organisms can be readily obtained from various sources, including physical contexts such as parks, schoolyards, and natural habitats, as well as digital platforms. This provides the potential for an objective observation and analysis. It is also particularly well-suited for blended learning, an approach that combines both face-to-face instruction and digital learning methods, due to its ability to facilitate the organization of both in-person and online learning events. The participants taking part in the study, in which the convenience sampling method was preferred, were not randomly assigned, but were selected from suitable groups that were easy to reach (Fraenkel et al., 2012). There were one control and two experimental groups in the study. In the process of determining the classes participating in the study as experimental and control groups, data such as having a computer or mobile device, internet access and usage possibilities were also taken into consideration. The class with more of these facilities was determined as the experimental-2 group. Within the framework of the quasi-experimental design principles, it was assumed that the experimental and control groups were similarly affected by factors other than the variables. The distribution of the students participating in the study is shown in Table 1.

Table 1.

Distribution of Study Groups

Gender	Control Group	Experimental-1 Group	Experimental-2 Group	Total
Female	-	15	-	15
Male	11	-	19	30
Total	11	15	19	45

As seen in Table 1, the study was conducted with 45 students, including 11 students in the control group, 15 students in the experimental-1 group and 19 students in the experimental-2 group. The total number of students consisted of 15 females and 30 males.

Data Collection Tools

Two scales were used in this study.

Academic Achievement Test (AAT)

The academic achievement test to measure student achievement within the scope of this study consists of multiple-choice questions developed by the researcher. The test was conducted as a pretest and posttest to all students. In the process of developing the academic achievement test, firstly, a question pool of 35 questions was created by the researcher in accordance with the learning outcomes. The questions were selected from previous academic studies, different exams prepared by the Ministry of National Education (MoNE), and screening tests used in the Education Information Network (EBA). The questions were carefully designed to ensure content validity, aiming to encompass the various objectives related to reproduction, growth, and development in both plants and animals to a reasonable degree. An academician working in the field of science education at a state university, along with two science teachers with five and fifteen years of experience reviewed the questions included in the test. Following these studies, it was decided that there would be a total of 25 questions on the examination. Prior to conducting the academic achievement test to the students in seventh grade taking part in the study project, a pilot study was carried out with a total of 36 students in eighth grade studying this topic in the previous academic year. The academic achievement test that the students took was graded, and their responses to the questions were evaluated. In this context, 0 points were given for each incorrect answer and unanswered question, and 1 point was given for each correct answer. The questions were evaluated in such a way that a student could receive a minimum score of 0 and a maximum score of 25. The reliability of the test (Cronbach's alpha) was calculated as 0.75. According to this result, it can be stated that the test will produce quite consistent results (Özçelik, 2013, p. 123). After the pilot study, the item analyses and difficulty and discrimination indices of the test were revealed. Accordingly, the average difficulty index of the AAT was found to be 0.59 and the average discrimination index was found to be 0.53. It is stated that the discrimination of the items in a scientific achievement test is quite good if it is greater than 0.40, and in addition, in terms of item difficulty, it is stated that the test is easy as the index approaches 1.00, item difficulty increases as

the index approaches 0.00, and the test will be of medium difficulty if the index is around 0.50 (Özçelik, 2013).

Science Attitude Scale (SAS)

The SAS that was used in this study was developed by Akınoğlu (2001). It has a reliability of 0.89 (Cronbach's alpha) and consists of 20 statements including both negative and positive sentences. The scale is a Likert-type scale with five points and consists of statements revealing whether or not students like the science course as well as whether or not they like the activities included in the science course. As a result of the pilot study, the Cronbach's alpha value of the scale in this study was found to be 0.88. The science attitude scale was applied to the students participating in the study as a pretest and posttest.

Implementation Process

This study was carried out with the approval of Bursa Uludağ University Scientific Research and Publication Ethics Committee (25.02.2020, no: 2020-02). The unit of "Reproduction, Growth and Development in Plants and Animals" was preferred in the study because it was included in the academic year in which the implementation would be made and it was suitable for the blended teaching method. The practices in all groups were carried out for 12 class hours (3 weeks), 4 class hours per week, considering the periods recommended in the annual plan. Both the AAT and the SAS were conducted to all study groups, and they were completed in two class hours. The term "pretest" is used to define tests given before the implementation and the term "posttest" is used to define tests given after the implementation. The implementation duration of the tests was determined by subtracting the study's implementation period. The control group was exposed to blended learning, whereas the experimental-1 group received the enriched face-to-face learning component of blended learning and the experimental-2 group was exposed to the enriched e-learning component of blended learning.

Control Group (Blended Learning) Activities

These activities were developed by taking into consideration the objectives for the subject. These objectives were carried out in the form of distance education activities and face-to-face learning activities in the form of live lessons in accordance with the science program and the 5E model. The lectures were presented in the form of two class hours of face-to-face and two class hours of remote live lectures each week. These lectures included methods such as question-and-answer sessions, group work, and discussions. As resources, we utilized things like textbooks, laboratory materials, posters, and interactive e-books, as well as computers, tablets, and smart phones. Face-to-face instruction included the use of textbooks and laboratory materials that were appropriate for the topic throughout the stages of arousing curiosity, exploring, explaining, and extending the topic. Interactive e-books and electronic content were utilized during live instruction. During the phase devoted to evaluation, the questions found in the student book as well as the activities found on the Education Information Network (EBA) were utilized. During the in-person classes, the assignments were reviewed and appropriate comments and suggestions were provided.

Experimental-1 Group (Enriched Face-to-face Learning Dimension of Blended Learning) Activities

These activities were designed for the students in this group, taking into account the objectives related to the subject, and were carried out in accordance with the science program and the 5E model. The activities took the form of two class hours of distance education activities in the

form of live lectures and two class hours of face-to-face learning activities in environments outside of the traditional school setting. In addition to textbooks, laboratory materials, posters, real objects, and living things in environments outside of the classroom, as well as e-content in live lessons, interactive e-books were utilized as resources. In order to arouse the students' curiosity, we made use of the chapter concepts presented in the textbook in addition to the topic review questions. During the exploration phase, students were given animal and plant observation forms to fill out, and together, they observed and analyzed the plants that were located in and around the school garden. Regarding the students' animal observations, the forms were distributed to them, granting them permission to complete the forms through the process of viewing animals either in their natural habitats or in their immediate surroundings. During live and face-to-face lessons, the students' forms were inspected, and volunteers were asked to present their findings. During the extension phase, students were asked to report on the growth and care processes of a plant or animal that they had been caring for and had either taken care of or had been given to them. During the live lessons, the volunteer students spoke to their peers about the animal they had been caring for and answered their friends' questions about it. During the phase of evaluation, we used the student observation forms, the activities that were contained within the textbook, as well as the activities that were contained within the Education Information Network (EBA) unit.

Experimental-2 Group (Enriched e-Learning Dimension of Blended Learning) Activities

These activities were carried out in accordance with the science program and the 5E model, and they consisted of 2 class hours of distance education activities in the form of live lectures and 2 class hours of face-to-face learning activities supported by digital learning tools (computer and mobile applications) in out-of-school environments, while taking into account the knowledge acquired on the subject. Textbooks, laboratory materials, posters, tablets, phones, computers, computer programs and mobile apps as well as real objects and living things in out-of-school learning environments were used as resources. The researchers created accounts for Nearpod and Flipgrid applications that students could use free of charge, and usernames and passwords were distributed to students. Students logged in to these applications with the usernames and passwords determined for them and used these applications in face-to-face and distance live lessons. In the curiosity arousal phase, a matching game consisting of plant and animal pictures and open-ended questions that students could answer using computers and smart devices were used. In the exploring phase, students used the Nearpod application to make live virtual tours in botanical gardens and zoos in different parts of the world and asked questions about the observed creatures. In the explanation phase, students logged in to the Nearpod application from computers or smart devices using the usernames and passwords previously given to them, and then the subject content and activities designed by the researcher were processed in a way to be controlled from the researcher's computer. In the extension phase, students were asked to take care of a plant or animal and report on the developmental processes of their chosen creature. In the evaluation phase, students were asked to shoot and share videos about plants and animals at school and outside the school in line with the given instructions by using the Flipgrid application to adapt the information they learned to daily life. In the Education Information Network (EBA), screening tests and questions related to the subject were sent to the students and their participation and answering percentages were monitored, and those who could not complete them were encouraged to complete them. Outside of the lessons, students entered the Flipgrid application and made comments and evaluations under each other's videos and had the opportunity to question their own learning. Among the comments and evaluations made, only those approved by the researcher were made available for others to see.

Data Analysis

The quantitative data obtained from the scales and tests were analyzed with the SPSS-22 software package, and a significance level of 0.05 was taken into consideration when evaluating the results. To determine whether or not there was a statistically significant difference between the pretest and posttest score distributions of the AAT and the SAS for all groups, a one-way ANOVA was carried out. According to the variance status, pairwise comparisons were made using the Tukey HSD and Games-Howell post hoc techniques.

Findings

The findings of the analyses of the data obtained from the two scales, which were conducted to investigate the effect of digital learning tool-supported activity designs on students' academic achievement and attitudes towards the science course in different environments, are presented below.

To investigate the first question of this study, the mean academic achievement pretest and posttest scores of the students in the control group, experimental-1 group and experimental-2 group were compared to see whether or not there was a significant difference. Table 2 presents the results of the arithmetic mean and standard deviation calculations for the AAT pretest and posttest scores obtained by each of the study groups.

Table 2.

AAT Scores of Control and Experimental Groups - Analysis Results

		Pretest		Posttest	
Groups	N	X	Sd	X	Sd
Control	11	7.09	3.47	11.90	3.64
Experimental-1	15	8.26	4.07	14.26	5.24
Experimental-2	19	9.42	4.47	17.21	3.50
Total	45	8.46	4.13	14.63	4.63

When Table 2 is examined, it is discovered that the mean score on the pretest for the control group was 7.09, while the mean score on the posttest for that group was 11.90. The mean score on the pretest for the experimental-1 group was 8.26, while the mean score on the posttest for that group was 14.26. The mean score on the pretest for the experimental-2 group was 9.42, while the mean score on the posttest for that group was 17.21. According to these findings, the score increase seen in the experimental-1 group and experimental-2 group was higher than the score increase seen in the control group. The experimental-2 group of students demonstrated an exceptionally large improvement in their AAT scores. Table 3 displays the findings of one-way ANOVA for the pretest scores on the AAT for the groups.

Table 3.

AAT Pretest Scores of Control and Experimental Groups - One-way ANOVA Results

Source of Variance	Sum of Squares	DF	Mean Squares	F	p
Between Groups	38.726	2	19,363	1,138	.330
Within Groups	714,474	42	17,011		
Total	753,200	44			

According to Table 3, there is no significant difference between the groups regarding their AAT pretest scores (p>0.05). As a consequence of this, it was decided that the prior knowledge possessed by the groups was comparable in regard to the AAT, and that the outcomes were not influenced by the variable of gender. The posttest scores of the groups were statistically analyzed using one-way ANOVA and the results are shown in Table 4.

Table 4.

AAT Posttest Scores of Control and Experimental Groups - One-way ANOVA Results

Source of Variance	Sum of Squares	DF	Mean Squares	F	p
Between Groups	205,800	2	102,900	5,848	.006
Within Groups	739,000	42	17,595		
Total	944,800	44			

It can be seen from looking at Table 4 that there is a statistically significant gap between the posttest scores of the groups (p<0.05). Based on the findings of one-way analysis of variance (ANOVA), it was first determined whether or not the variances were homogeneous. This was done in order to identify between which groups the difference was found. Following the completion of the analysis, it was discovered that the variables possessed identical characteristics (Levene value = 2.065, and p>0.05). Pairwise comparisons were conducted using the Tukey HSD test, which is one of the post hoc techniques. The results of these comparisons can be found in Table 5, which was created because the variances were the same.

Table 5.

AAT Posttest Scores of Control and Experimental Group Students - Tukey HSD Test Results

Groups		Differences Between Means	P
Control	Experimental-1	-2,357	.342
	Experimental-2	-5,301	.005

Experimental-1	Control	2,357	.342
	Experimental-2	-2,943	.117
Experimental-2	Control	5,301	.005
	Experimental-1	2,943	.117

When we analyze Table 5, we notice that the results of the Tukey HSD test, in which pairwise comparisons of the academic achievement test scores of the students taking courses with different activity designs were made, show that there is a significant difference between the experimental-2 group and the control group, and that this difference is in favor of the experimental-2 group. The results of this test were based on the fact that the experimental-2 group scored significantly different on the academic achievement test than the control group did ($p<0.05$). It was determined that there was no significant difference between the academic achievement posttest scores of the control group and the scores of the experimental-1 group ($p>0.05$). In addition, the academic achievement posttest scores of experimental-1 group and experimental-2 group did not differ significantly from one another ($p>0.05$).

To determine whether or not there is a significant difference between the pretest and posttest mean scores of the group students' attitudes towards the science course is the second question of the study. The arithmetic mean and standard deviation results of the pretest and posttest scores of the science attitude scale of the control and experimental groups are shown in Table 6.

Table 6.

SAS Scores of Control and Experimental Groups - Analysis Results

		Pretest		Posttest	
Groups	N	X	Sd	X	Sd
Control	11	73.54	8.95	70.00	15.27
Experimental-1	15	72.13	5.38	85.26	13.09
Experimental-2	19	75.21	11.28	78.78	9.35
Total	45	73.77	9.01	78.80	13.30

Examining Table 6 reveals that the mean SAS pretest score for the control group is 73.54, while the mean posttest score is 70.00; the mean SAS pretest score of the experimental-1 group is 72.13 and the mean posttest score is 85.26; the mean SAS pretest score of the experimental-2 group is 75.21 and the mean posttest score is 78.78. According to the data presented in the table, while the scores of the students who were part of the control group decreased slightly, the scores of the students who were part of the experimental groups 1 and 2 increased. The results of one-way ANOVA for the SAS pretest scores of the groups are shown in Table 7.

Table 7.

SAS Pretest Scores of Control and Experimental Groups - One-way ANOVA Results

Source of Variance	Sum of Squares	DF	Mean Squares	F	p
Between Groups	80.159	2	40,080	.481	.622
Within Groups	3499.619	42	83.32		
Total	3579.778	44			

There is no significant difference (p>0.05) between the SAS pretest scores of the groups, as shown in Table 7. One-way ANOVA results of the SAS posttest scores of the groups are shown in Table 8.

Table 8.

SAS Posttest Scores of Control and Experimental Groups - One-way ANOVA Results

Source of Variance	Sum of Squares	DF	Mean Squares	F	p
Between Groups	1479.109	2	739,554	4,922	.012
Within Groups	6310.091	42	150,240		
Total	7789.200	44			

The results of the SAS posttest for the groups are presented in Table 8, and it can be seen that there is a statistically significant difference between the groups (p<0.05). Based on the findings of the one-way variance analysis, it was determined whether or not the variances were homogeneous in order to find out which groups were different from one another and what the nature of this difference between the groups was. It was determined that the variances were homogeneous as a result of the analysis (the Levene value was 2.348, and the p-value was greater than 0.05). One of the post hoc methods that was utilized is the Tukey HSD test, and it was used to conduct pairwise comparisons because the variances were the same. Table 9 presents the findings of the Tukey HSD Test, which involved making paired comparisons of the students' scores on the science attitude scale. These students were divided into three groups: the control group, the experimental-1 group and the experimental-2 group.

Table 9.

SAS Posttest Scores of Control and Experimental Group Students - Tukey HSD Test Results

Groups		Differences Between Means	P
	Experimental-1	-15,266	.009

Control	Experimental-2	-8,789	.153
Experimental-1	Control	15,266	.009
	Experimental-2	-6,477	.287
Experimental-2	Control	8,789	.153
	Experimental-1	-6,477	.287

Table 9 shows that there is a statistically significant difference between the scores on the science attitude scale obtained by the experimental-1 group and those obtained by the control group, with the experimental-1 group coming out on top (p-value is less than 0.05). There is no significant difference (p>0.05) between the scores on the science attitude scale obtained by the control group and those obtained by the experimental-2 group. In addition, it can be seen that the scores on the science attitude scale for the experimental-1 group and the experimental-2 group do not differ significantly from one another (p>0.05).

Discussion and Conclusion

From the analysis of the data obtained from the study, it was seen that blended learning enriched with e-learning activities significantly increased academic achievement and blended learning enriched with face-to-face learning activities significantly improved attitudes towards science compared to blended learning alone. In addition, it was revealed that there was no significant difference, in terms of academic achievement and attitude, between blended learning enriched with face-to-face learning activities and blended learning enriched with e-learning activities.

It is seen that in studies examining the effect of blended learning on academic achievement in Turkey or in different countries of the world, results are published revealing that blended learning activities increase academic achievement (Akgündüz & Akınoğlu, 2017; Alsalhi et al., 2021; Çırak Kurt et al., 2017; Gürdoğan & Bağ, 2019; Watson et al., 2020). Furthermore, studies conducted in out-of-school environments and research on learning supported by digital learning tools (computer and mobile applications) also report results revealing that academic achievement is increased (Akçay et al., 2008; Bağci and Yalin, 2018; Elçiçek & Bahçeci, 2017; Krombaβ & Harms, 2008; Palavan & Sungur, 2017; Pekel & Matyar, 2016; Teyfur, 2010; Wünschmann et al., 2017; Yavuz, 2012). This shows that blended learning is an effective method to increase the academic achievement of students based on the richness of content, the advantages of face-to-face and digital activities and the idea that it appeals to more students. Using the aspect of blended learning enriched with digital activities supported by computer or mobile applications for learning activities designed for in- or out-of-school learning environments makes academic achievement more effective than blended learning alone. It can be said that learning activities that allow students to have the opportunity to interact with real objects or living beings in out-of-school environments and to have the experience of combining theory and real life contribute positively to academic achievement.

Çırak Kurt et al. (2017) conducted a meta-analysis of experimental studies on the effect of blended learning on academic achievement in Turkey and found that blended learning enriched in different ways had a greater effect on achievement than blended learning alone. Similarly, this study supports the use of blended learning enriched by different dimensions of blended learning in terms of academic achievement. In addition, it can be stated that the realization of learning activities carried out in out-of-school environments using paper and pencil and the realization of digital activities through computers or mobile devices have a similar effect on academic achievement.

In a content analysis study on blended learning conducted in the field of science education covering the years 2003-2018, it was reported that blended learning had a positive effect on the attitude variable, although the majority of studies reported that blended learning had no effect on attitude (neutral) (Kahraman and Kaya, 2021). In this study, while blended learning alone had a neutral effect on attitude towards the science course, it was found that blended learning had a positive effect on attitude when it was used together with enriched face-to-face learning activities. Therefore, it is thought that it would be appropriate to use blended learning with the dimension of enriched face-to-face learning activities in forming attitudes towards a course.

During the time period in which the study was carried out, extraordinary practices resulting from the pandemic were observed to have an impact not only on the education and training process but also on other fields. The activities in our study were restricted due to taking place under these circumstances. It is presumed that the uncontrollable variables influenced each group in a comparable and similar manner, that the students participating in the study provided answers that were honest and objective, and that the difference between the study groups was the result of differences in the teaching practices that were used. Those are the three assumptions. The study conducted at the seventh grade level regarding reproduction, growth, and development in plants and animals possesses the potential to be carried out at higher grade levels encompassing analogous or dissimilar subject matters. Altering the amount of time spent on face-to-face and online learning as well as the content that is covered in blended learning courses is one way to add variety to future academic pursuits.

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Geniş Özet

Giriş

İçinde bulunduğumuz çağda teknoloji alanındaki gelişmelere bağlı olarak ortaya çıkan değişimler hayatın diğer alanlarında olduğu gibi eğitim alanında da yeni durumları beraberinde getirmekte, bilgiye olan ihtiyaç ve bilginin yapısındaki değişimler onun öğrenilmesinde de bir takım yenilikler yapılmasını zorunlu kılmaktadır(Akınoğlu, 2002; Jones vd., 2010). Ön bilgilerin oluşması, öğrenilen bilgilerin kalıcılığı, bilgilerin hayata veya farklı disiplinlere transfer edilmesi gibi durumlar düşünüldüğünde eski ve yeninin sentezi şeklinde inşa edilecek yeni öğrenme etkinliklerine ihtiyaç duyulmaktadır(Milli Eğitim Bakanlığı [MEB], 2018a). Bu öğrenme modellerinden biri olan harmanlanmış öğrenme modelinde dijital içerikler aracılığıyla gerçekleştirilen çevrim içi eğitim ve yüz yüze eğitimin güçlü yönleri birlikte kullanılarak farklı öğrenme ortamları arasında bir bağ oluşturulabilmektedir (Osguthorpe & Graham, 2003).Araştırmalar bilgisayar ve mobil destekli öğretim uygulamalarının avantajları yanında bazı dezavantajlar barındırdığını da göstermektedir (Bulun vd., 2004; Khan, 1997;Litchfield vd., 2007; Üçışık & Tuna, 2004).Osguthorpe ve Graham'a göre (2003)harmanlanmış öğrenme, yüz yüze öğrenme ve dijital içeriklerin tek başına kullanılmasıyla oluşan öğretim uygulamalarının dezavantajlarını azaltacak pedagojik zenginlik içermektedir.

Öğrenme, okulda veya okul dışında olmalarına bakılmaksızın bireylerin yaşamı boyunca devam etmektedir (Jagušt vd., 2018). Bu yüzden öğrencinin bir konuyu öğrenmesi sadece okuldaki planlı öğretim faaliyetlerinden ibaret olduğu düşünülemez. Fen dersinde öğrenilen konuların okul dışı ortamlarda deneyimlenmesi, yaparak yaşayarak öğrenme ve öğrenilenlerin pekiştirilmesine olanak tanır (Falk & Dierking, 2010; Falk & Needham, 2016;Laçin Şimşek vd., 2011).Aynı zamanda bu ortamlar öğrenenlerin bireysel farklılıklardan kaynaklanan farklı öğrenme hızlarına ve farklı öğrenme şekillerine göre öğrenmelerini ve kendi kapasiteleri doğrultusunda bilgiyi yapılandırmalarını sağlar (Melber & Abraham, 1999).

Fen eğitiminde öğrenme ve akademik başarı gibi bilişsel durumlar yanında değer, inanç, motivasyon, tutum, öz yeterlilik, öz denetim vb. duyuşsal durumların da önemine vurgu yapılmıştır (MEB, 2018b). Bloom (2012, s. 146), duyuşsal boyutun eğitimin her evresinde öğrenme için önemli olduğunu, olumsuz tutuma sahip bir öğrenciye hem bir konuyu anlatmanın hem de o konuda başarı sağlamanın zor dolduğunu belirtmiştir. Öğrenme durumları için olumlu tutum geliştirmenin önemi bilinmekle birlikte öğrencilerin bir derse ya da konuya karşı olumlu tutum geliştirmesinin; nasıl sağlanacağı uygulanan model, yöntem ve tekniklerle nasıl entegre edileceği noktasında eksiklerin olduğu ve daha çok araştırmaya ihtiyaç duyulduğu aşikardır.

Bu çalışmada harmanlanmış öğrenmenin yüz yüze öğrenme faaliyetleri ve dijital ortamlardaki uygulamalar ile okul dışı öğrenme ortamlarını da kapsayacak şekilde tasarlanan öğrenme etkinlikleri bütüncül olarak ele alınmıştır. Araştırmada, bilgisayar ve mobil uygulama destekli etkinlikler yoluyla okul içi ve okul dışı ortamlarda (formal ve informal ortamlarda)

yürütülen öğrenme faaliyetlerinin öğrencilerin akademik başarı ve fen bilimlerine karşı tutumlarına etkisinin deneysel olarak sınanması amaçlanmıştır.

Yöntem

Araştırma modeli olarak ön test son test, kontrol gruplu, yarı deneysel desen kullanılmıştır. Çalışma grubunda yer alan katılımcılar rastgele olarak atanmamış, ulaşması kolay olan uygun gruplardan (Fraenkel vd., 2012)uygunluk örneklemi yöntemi ile seçilmiştir.

Çalışma 2020-2021 eğitim öğretim yılında bir devlet okulunun 7. Sınıfına devam eden 45 öğrenci ile fen bilimleri dersinin "Bitki ve Hayvanlarda Üreme Büyüme ve Gelişme" konusunda gerçekleştirilmiştir.

Araştırmada bir kontrol ve iki deney grubu yer almaktadır. Çalışma gruplarından kontrol grubuna harmanlanmış öğrenme uygulanmış ve dersler 2 saat yüz yüze, 2 saat uzaktan canlı dersler şeklinde işlenmiştir. Deney grubu – 1'e harmanlanmış öğrenmenin zenginleştirilmiş yüz yüze öğrenme boyutu 2 saat canlı dersler şeklinde uzaktan eğitim etkinlikleri ve 2 saat okul dışı ortamlarda yüz yüze öğrenme etkinlikleri şeklinde gerçekleştirilmiştir. Deney grubu – 2'ye ise harmanlanmış öğrenmenin zenginleştirilmiş e-öğrenme boyutu uygulanmış ve dersler 2 saat canlı dersler şeklinde uzaktan eğitim etkinlikleri ile 2 saat okul dışı ortamlarda bilgisayar ve mobil uygulama destekli yüz yüze öğrenme etkinlikleri şeklinde gerçekleşmiştir. Bütün gruplarda yapılan uygulamalar yıllık planda önerilen süreler dikkate alınarak haftada 4 saat olacak şekilde toplam 12 saat (3 hafta) olarak yürütülmüştür. Her üç grupta da etkinlikler 5E öğrenme modeline uygun tasarlanmıştır.

Veri toplama aracı olarak Akademik Başarı Testi (ABT) ve Fen Bilgisi Tutum Ölçeği (FBTÖ) kullanılmıştır. Bu araçlar uygulama öncesinde tüm gruplara; ön test olarak, uygulama tamamlandıktan sonra da son test olarak ikişer ders saatinde uygulanmıştır. Testlerin uygulanma süreleri çalışmanın uygulama süresi dışında değerlendirilmiştir. Araştırmada elde edilen nicel veriler SPSS 22 paket programı ile analiz edilmiştir.

Sonuçlar ve Tartışma

Araştırmanın sonuçlarına göre akademik başarı açısından deney-2 grubu ile kontrol grubu arasında, tutum açısından deney-1 grubu ile kontrol grubu arasında istatistiksel olarak anlamlı bir fark bulunmuştur. Bu sonuçlara göre harmanlanmış öğrenmenin zenginleştirilmiş e-öğrenme uygulamaları akademik başarıyı, harmanlanmış öğrenmenin zenginleştirilmiş yüz yüze öğrenme uygulamaları ise fen bilimlerine karşı tutumu harmanlanmış öğrenmeye göre anlamlı düzeyde artırdığı tespit edilmiştir. Öte yandan harmanlanmış öğrenmenin zenginleştirilmiş yüz yüze öğrenme uygulamaları ile zenginleştirilmiş e-öğrenme uygulamaları arasında akademik başarı ve tutum açısından anlamlı fark oluşmadığı ortaya çıkmıştır.

Çırak Kurt ve diğerleri (2017) tarafından ülkemizde harmanlanmış öğrenmenin akademik başarıya etkisini konu alan deneysel çalışmaların meta-analizi yapılmış ve farklı şekillerde zenginleştirilmiş harmanlanmış öğrenmenin kullanılagelen harmanlanmış öğrenmeye göre başarı üzerinde daha iyi bir etkiye sahip olduğu tespit edilmiştir. Bu araştırma da benzer şekilde akademik başarı açısından harmanlanmış öğrenmenin farklı boyutlarının zenginleştirilerek kullanılmasını desteklemektedir.

2003 – 2018 yıllarını kapsayan ve fen eğitimi alanında yapılmış harmanlanmış öğrenmeye dair içerik analizi çalışmasında harmanlanmış öğrenmenin tutum değişkeni üzerinde olumlu etki

oluşturduğuna dair çalışmalar çoğunlukta olsa da harmanlanmış öğrenmenin tutum üzerinde herhangi bir etkisinin olmadığı (nötr kaldığı) çalışmalar da rapor edilmiştir (Kahraman ve Kaya2021). Bu araştırmada ise yalnızca harmanlanmış öğrenme fen bilimleri dersine yönelik tutum oluşturmada nötr etkiye sahipken harmanlanmış öğrenme zenginleştirilmiş yüz yüze öğrenme etkinlikleri ile birlikte kullanıldığında tutum üzerinde olumlu bir etki oluşturduğu tespit edilmiştir. Bu yüzden de bir derse karşı tutum oluşturmada harmanlanmış öğrenme zenginleştirilmiş yüz yüze öğrenme etkinlikleri boyutu ile kullanılmasının uygun olacağı önerilmektedir.