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Abstract

This study aims to examine the effects of activities prepared using the Actionbound application on students' academic achievement and mathematical attitude in the field measurement subject in the 6th-grade mathematics course. The study was designed using a quasi-experimental design with a control group from quantitative research methods. The study group of research consists of students studying in two different 6th grades of a secondary school in the central district of Elazığ province in the school year 2022-2023. The achievement averages of the branches in the previous semester were used in forming the experimental and control groups and in ensuring the equivalence of the branches. The research, which was conducted in parallel with the MoNE curriculum, was applied simultaneously to the experimental and control groups. The research, which used parametric testing procedures due to the normal distribution of the data, was analyzed using the SPSS package program. The results show that the digital learning game developed using Actionbound improves performance and attitude, but does not cause a significant difference between the groups. It is recommended to extend the application period of the study and continue the study for one semester.

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Research Article

The Effect of Actionbound Application on Academic Success and Attitude on 6th Grade Field Measurement *

Ebru KORKMAZ [1]

Abstract

This study aims to examine the effects of activities prepared using the Actionbound application on students' academic achievement and mathematical attitude in the field measurement subject in the 6th-grade mathematics course. The study was designed using a quasi-experimental design with a control group from quantitative research methods. The study group of research consists of students studying in two different 6th grades of a secondary school in the central district of Elazığ province in the school year 2022-2023. The achievement averages of the branches in the previous semester were used in forming the experimental and control groups and in ensuring the equivalence of the branches. The research, which was conducted in parallel with the MoNE curriculum, was applied simultaneously to the experimental and control groups. The research, which used parametric testing procedures due to the normal distribution of the data, was analyzed using the SPSS package program. The results show that the digital learning game developed using Actionbound improves performance and attitude, but does not cause a significant difference between the groups. It is recommended to extend the application period of the study and continue the study for one semester.

Keywords: Actionbound, educational digital game, attitude, academic achievement, field measurement

1. INTRODUCTION

Games, which have entered our lives since childhood, are expressed as an act of creativity that enables to achieve a solution within some unique and certain rules (Aytaş & Uysal, 2017). Thanks to games, which are among the most important tools that enable people to communicate with their environment, they can reflect their inner world to the outside world (Aldemir-Engin, 2023). Many emotionally experienced emotions are revealed with the help of games. It can be said that they also allow drawing conclusions about people's priorities or how to get rid of the difficulties they face in real situations.

With rapidly developing and advancing technology, digitalization has become a necessity in all fields. Education, which has a dynamic structure and an interdisciplinary character, has been and continues to be significantly affected by current developments. However, the trend of digitalization in education is increasing day by day, and there are many changes and developments in this direction. To keep up with the digitization initiative in education, students and parents are forced to turn to digital tools to continue their education (Livari, Sharma & Ventä-Olkkonen, 2020).

Digital games are games that can be played by one or more players in digital environments using various technical devices (Aslan, Turgut, & Karakuş-Yılmaz, 2019; Özer, 2020). Digital games are divided into PC games, console games, massive online games, mobile games, and social games. Mobile games in this class include games designed for portable mobile devices such as tablets or phones (Ilgaz-Büyükbaykal & Abay-Cansabuncu, 2020). Educational games, on the other hand, are

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games that aim to educate while providing fun for the person and offering fun and seriousness together (Anastasiadis, Lampropoulos & Siakas, 2018; Aslan et al., 2019). In this direction, we can say that digital learning games are games developed with the help of technology and based on both education and entertainment. Conventional resources, especially textbooks, used in education and training are not sufficient for teaching (Prensky, 2008). Thanks to the constantly evolving technological innovations, educational and training processes are also affected. It is well known that digital games have great importance in the development of mathematics education (Giannakos, 2013). Digital educational games represent an important part of the educational process. Educational computer games, which reflect the entertaining and motivational nature of computer games, are among the teaching materials used for educational purposes (Çankaya & Karamete, 2008). Moreover Fadda, Pellegrini, Vivanet and Zandonella-Callegher, (2022) stated that digital games are more effective tools compared to traditional teaching methods. Thanks to teaching tools called digital learning games, individual learning processes are facilitated, motivation (Aşıksoy, 2018), critical thinking (Hwang & Chen, 2017), and cognitive development (Issa, 2007) are positively influenced. Therefore, it can be said that it is effective in developing a positive attitude towards mathematics (Divjak & Tomić, 2011), gaining self-confidence in mathematics, increasing motivation to learn mathematics (Divjak & Tomić, 2011), promote the enjoyment of mathematics (Uğurel, 2003), and increase interest in the lessons (Tsai, Yu & Hsiao, 2012). Digital educational games, which can be designed differently for almost any level of learning, can be designed according to the purpose and duration of the topic to be taught or played individually or in groups. Digital games designed for educational purposes can be used to create opportunities to interact with individuals with different learning styles and behaviors. In addition, both individual and group instruction can be provided in all formal and informal learning environments (Turner, Johnston, Kebritchi, Evans & Heflich, 2018).

There are many educational digital games used today. One of them is Actionbound. Actionbound is an educational tool that can provide feedback based on digital multimedia content (images, audio, video, etc.) and it can be used to create instant exams. Developed in 2012 in Berlin for educational purposes, this educational tool offers possibilities such as designing tools and providing interactive educational programmes. It can also be used without an internet connection in external or internal areas. Students can become independent while playing the game. Students and teachers participating in this application, which requires simple technical skills to use, can access the game results at any time (Rosdiana, Busono & Yosita, 2020). Actionbound, which has several games, creates a digital space that can be played both individually and as a team with GPS locations, directions, maps, compass, pictures, tasks, videos, and multiple choice or true-false options (Kissi & Dreesmann, 2017). It is similar to a digital orientation application. With Actionbound, it is also possible to organize educational competitions at historical and archeological sites, large cities, and schools. The main achievements of this program, which has been implemented in a limited number in Turkey, include creating group awareness, contributing to teamwork, learning together, discovering together, and competing in cooperation toward the same goal.

Actionbound takes students into an exploration adventure. The tasks assigned by the teacher in an interactive manner are designed to be performed individually or as a group and are very entertaining and play-based educational practices. The logic of the practice is based on the correct and timely completion by the students of the tasks given by the teacher.

1.1. Aim of Study

The aim of this study is to examine the effect of the area measurement subject taught with the effects of educational digital games on academic achievement and attitudes towards the mathematics of 6th-grade students in a mathematics course. The research aims to associate the subject of area measurement with daily life and to make the lesson enjoyable for students.

The problem statement of the study was determined as "Does teaching with the help of educational digital games affect academic achievement and attitude in 6th-grade students?". In line with this main purpose, answers to the following questions were sought:

1. Is there a statistically significant difference between the pretest achievement scores of the experimental and control group students?
2. Is there a statistically significant difference between the pre-test and post-test achievement scores of the experimental group students?
3. Is there a statistically significant difference between the pre-test and post-test achievement scores of the control group?
4. Is there a significant difference between the post-test achievement scores of the experimental and control group students?
5. Is there a statistically significant difference between the pre-attitude scores of the experimental and control group students?
6. Is there a statistically significant difference between the pre-and post-attitudes of the experimental group?
7. Is there a statistically significant difference between the pre-and post-attitudes of the control group?
8. Is there a statistically significant difference between the final attitude scores of the experimental and control group students?

1.2. Importance of Research

With the development of technology, the education and training process has been affected by different fields and the use of technology has become widespread in this process. There are different approaches and ideas about the integration of technology into educational environments. Considering the research, the digital game sector, which is growing day by day, draws attention. In this direction, it can be said that the idea of using digital games for educational purposes is important as a result of the decrease in the age of playing digital games, the time allocated to digital games, and the player audience.

Existing studies in the literature that educational games increase mathematics achievement have led to the curiosity of examining their effects on achievement in mathematics teaching. Considering the benefits of educational digital games, it is thought that the studies to be conducted in this field can be guiding for those working in the field of mathematics, teachers, and students in terms of taking measures to increase achievement and providing the opportunity to try new approaches in educational environments. In addition, it is seen that there are few studies on educational digital games and mathematics teaching at the 6th-grade level in the literature. In this direction, it is thought that the study will contribute to the field

2. METHOD

In this study, in which the effect of the course supported by the educational digital game prepared with the help of Actionbound on academic achievement and attitude was examined, and a

quasi-experimental design with a control group, one of the quantitative research methods, was used. In the quasi-experimental design, which is used in cases where real experimental models cannot be realized, the amount of change and difference between two different groups can be measured with this method (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2013).

2.1. Working Group

The research was conducted at Mezre Secondary School in the center of Elazığ province after obtaining the necessary permissions. A total of 46 students from two different 6th-grade classes studying in the spring term of the 2022-2023 academic year were included in the study group. The school where the study will be implemented and the students selected as the sample were determined by convenience sampling method in terms of the accessibility of the sample and the ease of implementation. Convenient sampling is the method of selecting the sample from accessible, easily applicable units due to the limitations in terms of time, money, and labor force (Büyüköztürk et al., 2013). The equivalence of the groups in this study, in which the quasi-experimental design with an experimental control group was used, was determined by taking into account the students' grade point averages in the previous semester (Experimental Group=74.1; Control Group=73.8). In addition, the equivalence of the groups was also confirmed by the field measurement achievement test (pre-test). There were 25 students in the experimental group and 21 students in the control group.

2.2. Data Collection Tool

The data collection tools of the study are the "Area Measurement Achievement Test" prepared by the researcher and the "Mathematics Attitude Scale" developed by Gülburnu and Yıldırım (2015) for primary and secondary school students. The "Field Measurement Achievement Test" was prepared by the researcher by taking the test questions of the "Field Measurement" subject in the MoNE book. In order to ensure the content validity of the achievement test questions, the validity and reliability of which were carried out by the Ministry of National Education, the opinions of 3 expert mathematics teachers were consulted. The Field Measurement Achievement Test consisting of a total of 30 questions was applied to the classes as a pre-test and post-test before and after the application during 1 lesson hour. Grade 6 "Area Measurement" sub-learning area (after repeating the units, terms, and concepts of area and length measurement) has a total of 5 learning outcomes. These are;

1. Forms the area relation of the triangle, and solves related problems.
2. Forms the area relation of the parallelogram, and solves related problems.
3. Recognises the units of area measurement, and converts m^2-km^2, m^2-cm^2-mm^2 units to each other.
4. Recognises land surveying units and associates them with standard land surveying units.
5. Solves problems related to the field (MoNE, 2018).

In addition, in order to measure the students' attitudes towards the course, the Mathematics Attitude Scale was applied to the classes as pre-attitude and post-attitude for 1 class hour before and after the application. The Matehematics attitude scale consists of 27 items. It has a five-point Likert type. The item factor loadings of this scale are between 0.44-0.75. The Kaiser-Meyer Olkin (KMO) value was .89, and the internal consistency coefficient (Cronbach alpha) value calculated for the reliability study was found to be α=.88. Findings regarding validity and reliability studies show that the scale has a valid and reliable structure.

2.3. Implementation Process

In this study, an educational digital game was developed by the researcher with the help of Actionbound software in order to enrich the content of the mathematics course and to positively affect students' interest in mathematics. This game includes objectives such as connecting with what is already known, drawing conclusions, self-evaluation, data collection, and connecting with real life. In addition, information was obtained from the secondary school mathematics teacher about the student's prior knowledge and readiness levels. In this direction, an educational digital game activity was

prepared by adhering to the achievements of the field measurement. Finally, the learning environment for the experimental group students was determined according to the activity to be implemented.

Before the research, a pre-achievement test and a pre-attitude test were applied to the groups in order to determine whether there was a statistically significant difference between the groups in terms of academic achievement and attitudes towards mathematics courses. The experimental group students were told that the lesson would be taught in the garden. The 25 students in the experimental group were divided into groups of 5. Each group was provided with a smartphone. The actionbound application was installed on these phones and information about the application was given. It was explained that the students needed to find the correct answer in order to complete the tasks. The digital educational game activity named "Treasure Hunt" was started by reading the QR code of the bond prepared by the researcher. The students tried to reach the treasure by fulfilling the tasks given to them in order.

The steps of the “Treasure Hunt” activity prepared with the help of Actionbound are given below.

1. Find the area of the handrails on the sides of the school staircase in the form of parallel sides.
2. Write lyrics about the field.
3. Sing the lyrics you wrote under the video recording.
4. Go to the flagpole in the garden.
5. Imagine that you cut the square plate under the flagpole in half diagonally.
6. Calculate the area of one of the triangles.
7. Find and read the QR code hidden in the school garden.
8. Determine the furthest distance jumped after a jumping tournament.
9. Convert this distance to decimetres.
10. Finally, find the treasure.

A race against time was organized between previously formed student groups in the school building and garden. Students were encouraged to use basic measuring instruments in order to realize the conceptual learning of the acquisitions related to area measurement. It was aimed for students to learn actively by doing-living, game-based active learning.

The implementation phase of the research took place in two lesson hours in both groups. In the first lesson, the subject of measurement was explained to the experimental group by showing it through concrete materials. In the second lesson hour, the students were taken to the school garden to experience what they had learned. The control group students were taught the subject theoretically in their own classrooms, as they always did, with a smart board, slides, and some examples. In addition, it was noted that there was no variable that would affect the measured features positively or negatively. After the application, the effect of the independent variable (teaching method) on the dependent variable (academic achievement and attitude) was measured.

The presence of the researcher during the research process or the thought that the individual is being observed causes some changes in their behavior. The situation that affects the results of the study and creates expectations at the end of the study is called the Hawthorne effect. In addition, the application of experimental and control groups by different practitioners creates the John Henry effect. This effect is the subconscious feeling of competition of the classroom teacher who carries out the practices in the Control group (CG) against the experiment group (EG), and this situation manifests itself as an increase in performance (Kocakaya, 2012). In order to prevent all these effects, EG and CG's lessons were taught by their current teachers. Additionally, students in the CG were not informed that they would be involved in an experimental study and would be compared with a EG. Thus, precautions were taken against the John Henry effect that may occur on CG students.

2.4. Data Analyses

The data collected with the "Attitude Scale" and "Field Measurement Achievement Test" were analyzed with the SPSS package program. Skewness and Kurtosis values of the data obtained in the study were analyzed. In this direction, test techniques were determined. When Kurtosis and Skewness values are between -1.5 and +1.5, the normal distribution is accepted (Tabachnick & Fidell, 2013)

Table 1. Normality analysis of the data of the experimental group

Experiment Group	Pre-Test Success	Post-Test Success	Pre-Attitude	Post-Attitude
Skewness	.549	-.529	-.248	.254
Kurtosis	-.242	-.193	1.089	-.285

Table 2. Normality analysis of the data of the control group

Control Group	Pre-Test Success	Post-Test Success	Pre-Attitude	Post-Attitude
Skewness	-.112	-.053	-.255	-.152
Kurtosis	-.883	-.419	-.233	-.650

When Table 1 and Table 2 are examined, it can be said that the analyses to be made for the experimental and control groups should be selected from parametric test techniques.

3. FINDINGS

In this study, a statistically significant difference between the academic achievement and attitude towards mathematics levels between the groups before and after the application was investigated. The findings obtained from the data analyses are given below.

3.1. Findings Related to Field Measurement Achievement Test

Independent groups t-test was applied to determine whether there was a statistically significant difference between the test scores of the groups (EG - experiment group and CG – control group) before and after the application.

Table 3. Independent groups t-test of experimental and control groups (pre-test)

Groups	N	$\bar{X}$	S	sd	t	p
EG	25	6.88	2.65	44	-.608	.546
CG	21	7.33	2.35			

$p > .05$

In the independent groups t-test analysis, no statistically significant difference was found between the mathematics achievement of the two groups ($p = .546 > 0.05$). According to this analysis result, it is possible to say that the groups were equal to each other before the application. At the end of the application, the Independent Groups t-test was applied to determine whether there was a statistically significant difference between the post-test scores of the groups. The results obtained are given in Table 4.

Table 4. Post-test Independent groups t-test of experimental and control groups

Groups	N	$\bar{X}$	S	sd	t	p
EG	25	10.04	3.39	44	1.150	.256
CG	21	8.85	3.56			

$p > .05$

As a result of the independent groups t test analysis, $p = .256 > 0.05$ was found. Therefore, it is possible to say that there was no statistically significant difference between the groups in terms of academic achievement after the research. As seen in Table 4, academic achievement is in favour of the experimental group ($X=10.04$). Although the academic achievement of the experimental group was higher than that of the control group, there was no statistically significant difference between the post-test scores of the groups.

Dependent groups t test was performed to see whether the change in the pretest and posttest scores of EG and CG created a statistically significant difference. The results obtained are given in Table 5.

Table 5. Dependent groups t test results for the pretest-posttest achievement scores of the groups

Groups	Measurement	N	$\bar{X}$	S	sd	t	p
EG	Pre-test	25	6.88	2.65	24	12.97	.000
	Post-test	25	10.04	3.39			
CG	Pre-test	21	7.33	2.35	20	14.286	.000
	Post-test	21	8.85	3.56			

$p < .05$

According to the results of the dependent groups t-test analysis, there was a statistically significant difference between the pre-test and post-test achievement scores of the experimental group students whose pre-test mean score was (X = 6.88) and the post-test mean score was (X = 10.04) ($p = 0.000 < 0.01$).

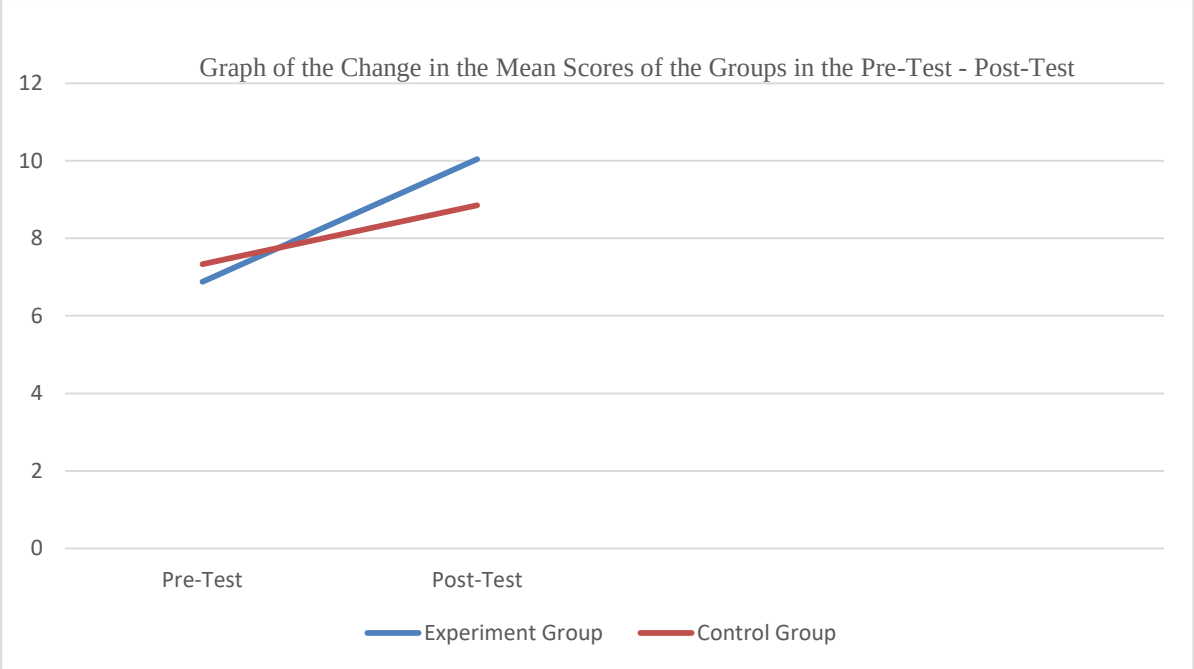

Figure 1. Graph of the change in the mean scores of the groups in the pre-test – post-test

This shows that the educational digital game used had a statistically significant effect on student achievement in favour of the post-test. In addition, the achievement test was applied to the control group, in which the lessons were taught with the traditional teaching method, before and after the research. the average score on the exam before the application was (X = 7.33); the average score on the exam after the application was (X = 8.85). When Table 5 was examined, a statistically significant difference was found in favour of the post-test in the control group ($p = 0.00 < 0.01$).

3.2. Findings on Attitudes towards Mathematics

Independent Groups t-test was applied to determine whether there was a statistically significant difference between the test scores of the groups before and after the application.

Table 6. Pre-attitude Independent groups t-test of experimental and control groups

Groups	N	$\bar{X}$	S	sd	t	p
EG	25	77.24	11.05	44	.015	.988
CG	21	77.19	11.90			

p > .05

In the independent groups t-test, p = .988 > 0.05 was found. This shows that there was no statistically significant difference between the experimental and control groups before the application. Therefore, it is possible to say that the attitude levels of the experimental and control groups in the mathematics course before the research were equal.

Table 7. Post-attitude Independent groups t-test of experimental and control groups

Groups	N	$\bar{X}$	S	sd	t	p
EG	25	77.64	8.64	44	-.008	.993
CG	21	77.66	13			

p > .05

In the independent groups t-test, p = .993 > 0.05 was found. This shows that there is no statistically significant difference between the attitude scores of the experimental and control groups after the application. Therefore, it is possible to say that the attitude levels of the groups were the same after the application. Dependent groups t-test was performed to see whether the change in the pre-attitude and post-attitude scores of EG and CG created a statistically significant difference. The results obtained are given in Table 8.

Table 8. Dependent groups t-test results for the pre-attitude-post-attitude achievement scores of the groups

Groups	Measurement	N	$\bar{X}$	S	sd	t	p
EG	Pre-test	25	77.24	11.05	24	34.92	.000
	Post-test	25	77.64	8.64			
CG	Pre-test	21	77.19	11.90	20	29.72	.000
	Post-test	21	77.66	13			

p < .05

In the dependent groups t test analysis, the mean attitude score before the application was (X=77.24) and the mean attitude score after the application was (X=77.64). It is also seen that p = .000 < 0.01.

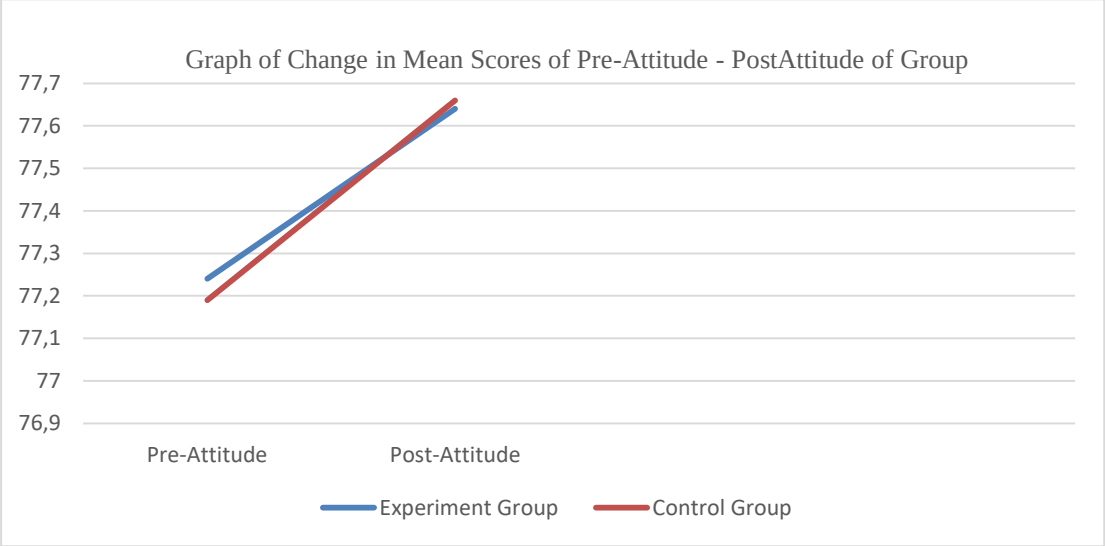

Figure 2. Graph of change in mean scores of pre-attitude - post-attitude of groups

In this case, it is possible to say that a statistically significant difference occurred in the attitude level in the experimental group after the application. In addition, an attitude test was applied to the control group, in which the lessons were taught with the traditional teaching method, before and after the research. In the dependent groups t-test analysis, there is a statistically significant difference between the mean attitude score (X=77.19) before the application and the mean attitude score (X=77.66) after the application ($p = .000 < 0.01$). The results of this analysis show that the subject covered was liked by the students and improved their attitudes towards the course.

4. DISCUSSION and CONCLUSION

Considering the results obtained, it was found that the experimental and control groups were equivalent in terms of performance. Statistically significant differences were found between the pretest-posttest results of the experimental group and the pretest-posttest results of the control group in terms of academic performance. In this case, it can be said that the instruction in the experimental and control groups significantly increased academic achievement. In other words, both the course supported by digital learning games and the course taught with traditional teaching methods were effective for students. However, it can be seen that there is no statistically significant difference between the performance levels of the experimental and control groups after the test. This means that the performance level of the students is the same again after teaching in both branches. Therefore, it can be said that there is no superiority between different teaching methods applied in different branches. The statistically significant difference between the pre-test and post-test in the experimental group in favor of the post-test supports that educational digital games increase achievement. However, the non-significant difference between the post-test achievement scores between the branches shows that the teaching method actually applied is equivalent to the traditional teaching method. In parallel with this result, Aslan Akın and Atıcı (2015); Şahin (2016) did not find a statistical difference between the groups in terms of academic achievement. In addition, Yıldız-Durak (2019) found in his study that educational digital games are not suitable for the exam system, not every subject can be taught with this method, the preparation process is long, and technical support needs, technological literacy competence (Kara, 2021), workload increase, problems that may be experienced in practice, and the perspective of the school administration. In addition, Avcu (2023) mentioned the contributions of educational digital games to the student and the teaching process, the limitations of digital games, and some issues that need to be considered. The limitations include classroom dominance, lack of technological knowledge, and access impossibilities. Jensen and Skott (2022), on the other hand, mentioned that digital games are not suitable for the course content and that a meaningful relationship cannot be established between all subjects. Similarly, Joung and Byun (2021) pointed out that digital games cannot be useful for the mathematics performance of all students at kindergarten, primary, middle, and high school levels, and that for a game to be effective, its content should be created by the course teacher and should be parallel to the course outcomes.

On the other hand, we can say that educational digital games are effective in increasing student achievement (Aksoy, 2014; Şahin, 2016; Yavuzkan, 2019) or a useful method in developing positive emotions (Aslan-Akın & Atıcı, 2015; Avcu, 2023; Kara, 2021; Meşe & Meşe, 2022; Yıldız-Durak, 2019). Similarly, the studies of Ağırgöl, Kara & Dönel-Akgül, (2022) with Yıldız and Zengin (2021) were encountered. In the study conducted for science courses, it was determined that educational digital games increased success. In addition, Günbaş and Öztürk (2022) examined the digital mathematics games in EBA content according to Bloom's taxonomy and mentioned that students can gain positive emotions such as group learning, struggle, and solving real-life problems from game mechanics. In studying the mathematical setting in accordance with the results, the analyses show that the experimental and control groups were equal to each other before the application. We can conclude that the groups are also equal after the application. This fact shows that the different teaching methods

did not cause any change in the students. Parallel to the literature review, it is found that digital learning games cannot change the attitude (Ağırgöl et al., 2022; Çankaya & Karamete, 2008; Şahin, 2016; Yavuzkan, 2019). The inability of digital learning games to change student attitudes may be based on short-term research. Changing a person's attitude is a phenomenon that can change over a very long process. Therefore, it is unlikely that a few hours of application can change people's attitudes (Yavuzkan, 2019). On the other hand, Aksoy (2014) found that digital educational games caused a statistically significant difference in favor of the experimental group in terms of attitude.

This study includes teaching the 6th-grade field measurement subject with an educational digital game prepared with the help of the Actionbound application. It is thought that the fact that the study was limited to only one subject and the application process was limited to only 2 lesson hours prevented the increase in attitude and achievement levels. In this direction, it is recommended to use educational digital games in different subjects and class levels. In addition, it is also recommended that the teaching method applied should be spread over a longer period of time.

Ethics Committee Decision

Ethical approval and written permission for this study were obtained from the Social and Human Sciences Research Ethics Committee of Fırat University with the decision dated 14/06/2023 and numbered 2023/12.

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Appendix
Pictures from the Implementation Process