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Research Article

The Impact of Khan Academy Learning Platform on Mathematics Achievement in Primary School Fourth Grade Students

Hakan ULUM

Necmettin Erbakan University, Ereğli Faculty of Education, Konya,
hakanulum@gmail.com, https://orcid.org/0000-0002-1398-6935

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Abstract – This study aims to examine the effect of the Khan Academy learning platform on students' achievement in mathematics lessons. In the study, the difference between the achievement levels of the experimental and control groups was tested using a pre-test post-test control group design. The study group consists of primary school fourth grade students attending the support and training course. The study was conducted with a total of 60 students. The students in the experimental group were provided with mathematics course contents via the Khan Academy learning platform, and teaching was carried out using these contents. The students in the control group were taught mathematics with the Education Information Network (EBA). Firstly, a pre-test was applied to both groups, and the achievement levels of the students were recorded. Then, the Khan Academy learning platform was introduced to the students in the experimental group, and this platform was used in mathematics lessons. The students in the control group were introduced to EBA, and this platform was used in mathematics lessons. After a certain period of time, the post-test was applied to both groups, and the achievement levels of the students were measured again. The difference between the achievement levels of the experimental and control groups was statistically analyzed using the data obtained. As a result of this analysis, it was concluded that the Khan Academy learning platform had a greater effect on students' achievement in mathematics.

Key words: Khan Academy, Education Information Network (EBA), primary school, mathematics, achievement.

Corresponding author: Hakan ULUM, Necmettin Erbakan University

Introduction

Mathematics education is vital to the cognitive development of pupils and is considered an essential skill. Enhancing students' mathematical abilities and achieving success in mathematics classes are crucial factors that not only impact their academic achievements but

also influence their future career choices. However, mathematics instruction presents a challenge as it requires considering the differences among students, such as their learning pace, prior knowledge levels, and learning styles (Güler & Basım, 2016; Kaya et al., 2013; Ulus et al., 2015).

In recent years, technological advancements have provided new opportunities in mathematics education. Online learning platforms like Khan Academy, in particular, have revolutionized mathematics learning. Khan Academy is known as a platform that provides millions of students worldwide with free access to a comprehensive mathematics learning experience. The platform offers interactive lessons, practice questions, personalized feedback, and progress tracking, providing students with a personalized and interactive learning experience (Altun, 2006; DiSalvo & Morrison, 2013; Morrison & DiSalvo, 2014).

In this context, it is important to examine the impact of the Khan Academy learning platform on enhancing mathematics achievement and enriching the learning experience of fourth-grade elementary school students. Research in the literature demonstrates the positive effects of online learning platforms on mathematics achievement. These platforms assist students in improving their mathematical skills while enabling teachers to track individual learning progress and provide tailored support to students (Çoruk & Çakır, 2017; Tabuk, 2019).

Online platforms like Khan Academy, which allow students to experience self-directed learning, play a significant role in terms of accessibility to mathematics education and student motivation (Sürmeli & Ünver, 2017). The significance of this study lies in evaluating the use of Khan Academy as an effective instructional strategy to enhance the mathematics achievement of fourth-grade students. By filling gaps in the literature and expanding existing knowledge, this research can make a valuable contribution to enriching and improving pedagogical practices focused on mathematics education. Additionally, this study can provide teachers and education policymakers with a better understanding of the effects and potential impacts of online learning platforms in mathematics instruction.

An important contribution of this study is the evidence-based examination of the impact of Khan Academy in mathematics classes. This research will provide a stronger understanding of the effectiveness of Khan Academy based on existing scientific evidence, assisting in making strategic decisions regarding mathematics education. Specifically, by examining its

impact on fourth-grade students, it can play a significant role in shaping policies and practices focusing on early-stage mathematics instruction.

Furthermore, this study enhances the prevalence of online learning platforms in mathematics education (Gürsul, 2008), increasing the potential for improving students' mathematical skills. Encouraging the use of technological innovations in mathematics education can help students strengthen their mathematical thinking skills and establish a solid foundation for their future achievements.

In conclusion, evaluating the use of online learning platforms such as Khan Academy to enhance the mathematics achievement and learning experience of fourth-grade students is of great importance. This study can reinforce pedagogical strategies by exploring innovative approaches in mathematics education to support students' mathematical skills and prepare them for a successful future.

Khan Academy

The use of technology in mathematics education has gained significant importance in recent years. In particular, online learning platforms have become effective tools for enhancing mathematical skills (Dickinson, 2016; Kaya et al., 2013; Kelly, 2018; Ulus et al., 2015). One of these platforms, Khan Academy, provides extensive usage and interaction in mathematics instruction.

Khan Academy's personalized learning experience allows students to develop their mathematical skills according to their individual learning needs. Studies have demonstrated the positive effects of personalized learning experience on student achievement and mathematical skills. Khan Academy offers students the opportunity to receive instant feedback and track their progress. Research in the literature has shown that feedback and progress tracking enhance student motivation and support mathematical achievement (da Silva & Coutinho, 2020; Kelly & Rutherford, 2017; Lawless et al., 2013).

As an online platform, Khan Academy provides broad access to mathematics education. Therefore, it offers a significant advantage for students living in economically or geographically restricted areas. Numerous studies have highlighted the positive effects of online learning platforms on mathematics learning and achievement with the proliferation of online learning platforms. Platforms like Khan Academy serve as indicators of the future use of educational technologies. Advancements in technology and digital resources present new opportunities in mathematics instruction. Such online platforms can be used as an additional

resource for students to enhance their mathematical skills, alongside traditional classroom environments. Research shows that technology-based mathematics instruction improves student achievement and contributes to the development of mathematical skills (Kelly & Rutherford, 2017; Lawless et al., 2013).

The learning materials offered by Khan Academy contain topics, examples, and practice questions presented in a clear and understandable manner. These materials provide students with a learning experience supported by visual and auditory elements to better understand mathematical concepts. It is noted that the use of this platform enables students to improve their understanding of mathematical topics, enhance problem-solving skills, and increase their confidence in mathematics (Light & Pierson, 2014; Otobelli et al., 2018).

In conclusion, online learning platforms such as Khan Academy have positive effects on mathematics learning and achievement. These platforms enable students to experience self-directed, personalized, and technology-based learning. Due to their accessibility and widespread availability, these platforms can play an even more significant role in mathematics education in the future. Therefore, examining the impact of Khan Academy on mathematics instruction based on the literature is of great importance for educators to identify best practices in mathematics teaching and develop technology-based learning approaches (da Silva & Coutinho, 2020; Lawless et al., 2013; Otobelli et al., 2018).

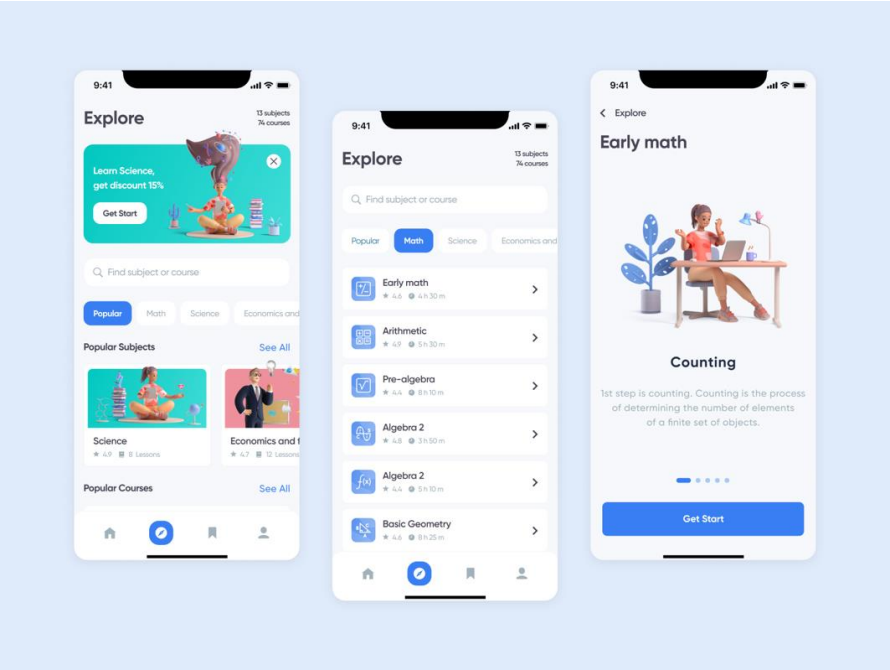

Figure 1 Khan Academy mathematical interface

Education Informatics Network (EBA- Eğitim Bilişim Ağı)

Education Informatics Network (EBA) is a digital platform provided free of charge to all students and teachers in Turkey. The platform is accessible through a website and mobile applications. EBA offers a rich content archive for students at every level. This content includes lecture notes, interactive teaching materials, video lessons, interactive games, and more. Additionally, teachers can assign homework, conduct exams, and track student progress through EBA. The Education Informatics Network (EBA) is a project aimed at improving the quality of the educational process and ensuring equal opportunities in education in Turkey. By providing teachers, students, and parents with rich content, educational materials, and digital tools, EBA aims to make the educational process more interactive and accessible (Atasoy & Nayir, 2019; Coşkunserçe & İşçitürk, 2019; Kılcan & Üçarkuş, 2018).

EBA stands out as a platform frequently used by teachers in Mathematics classes. It hosts mathematics content for almost every level. Research has been conducted on mathematics education and EBA in Turkey (Atasoy & Nayir, 2019; Bertiz, 2017).

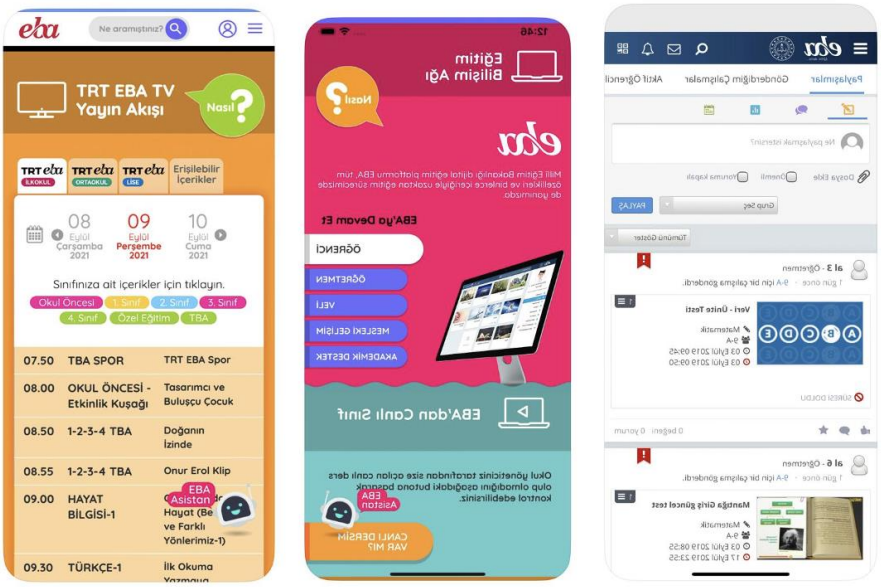

Figure 2 EBA interface

Mathematics Curriculum and Technology

The Primary School Mathematics 2018 Curriculum of the Ministry of National Education in Turkey emphasizes the importance of using technology in mathematics education. Among the objectives of the curriculum are to enhance students' mathematical thinking skills, enable them to use mathematical concepts in concrete and abstract situations,

and enable them to effectively use technology in mathematics instruction. One of the general principles of the curriculum is to encourage students to learn effectively by using technology in mathematics education. The curriculum recommends the use of technological tools that allow students to explore mathematical concepts, visualize them, and engage in interactive mathematical experiences. These tools help students enhance their mathematical thinking skills, concretize abstract concepts, and understand mathematical connections (Ministry of National Education [MoNE], 2018).

Furthermore, diversifying the activities and providing students with different learning experiences within the curriculum is also crucial. The use of technology is considered a means to achieve this diversity and to stimulate students' interest in mathematics education. The aim is to strengthen students' mathematical thinking skills, improve their problem-solving abilities, and enable them to use mathematical concepts meaningfully (Bütüner, 2006; Ersoy, 2006; MoNE, 2018).

The emphasis on the importance of technology use in the 2018 Primary School Mathematics Curriculum of the Republic of Turkey Ministry of National Education indicates our recognition of the potential and impact of technology in mathematics instruction. Therefore, exploring and evaluating the use of technology-based mathematics learning tools is an important step for educators to plan and implement mathematics instruction in line with the curriculum's objectives (Ersoy, 2006). Online learning platforms such as Khan Academy can also be considered effective resources that contribute to students' mathematics learning in this context.

Since the 2000s, the field of distance education, especially internet technology and digital space, has gained full function. Educational opportunities have been offered to millions of people, including domestic and international education (Gürer et al., 2016). However, with the effect of the pandemic in Turkey, education has developed with the help of distance education platforms. EBA is at the forefront of these platforms. EBA, which is used in various courses, has become a widespread and effective teaching platform (Bakırcı et al., 2021; Yangil & Özdoğan, 2022). However, interest in international non-formal education platforms has also increased considerably. Khan Academy (Noer, 2012), which has become the world's largest school with 10 million students in a short time, is now used as a platform to support learning in many countries around the world. Turkey is one of these countries. Numerous studies on the use of Khan Academy in Turkey, especially in the field of mathematics (San &

Aykaç, 2020), can be seen as an indicator of this use. Comparing the impact of these learning platforms on learning can be useful from various perspectives, especially in the context of mathematics education. It is thought that comparing digital platforms, which have an important place in mathematics education, will contribute to teachers and parents in practice, students in learning activities, and practitioners in creating an effective curriculum.

Aim of the Study

The aim of the study is to determine the impact of the Khan Academy learning platform on the academic achievement in mathematics of fourth grade primary school students. In line with this objective, the following research questions have been addressed:

Research Questions: What is the effect of the Khan Academy learning platform on the academic achievement of fourth grade primary school students taking mathematics lessons?

1. Is there a statistically significant difference between the pre-test scores of the experimental and control groups?

2. Has the use of Khan Academy in the experimental group resulted in a significant difference in favor of the post-test?

3. Have the interventions in the control group resulted in a significant difference in favor of the post-test?

4. Has the use of Khan Academy in the experimental group affected student achievement compared to the interventions in the control group?

By examining the impact of the Khan Academy learning platform on the academic achievement in mathematics of fourth grade primary school students, this research aims to make a significant contribution to improving students' mathematical skills and enhancing their learning experiences. One of the distinguishing factors of this research is the absence of a comparison with traditional methods (Akbaş, 2019; Ferman et al., 2019; Kelly & Rutherford, 2017).

Method

This study employs an experimental design aiming to determine the impact of the Khan Academy learning platform on the academic achievement in mathematics of fourth grade primary school students. The quasi-experimental design is an ideal method to determine the impact of the independent variable, the Khan Academy learning platform, on the dependent variable, students' mathematics achievement. This design allows for comparison between two

groups to ascertain their effectiveness (Büyüköztürk, 2007). The experimental group consists of students utilizing the Khan Academy learning platform, while the control group comprises students who receive instruction using the Educational Informatics Network (EBA). During the research process, both groups undergo a pre-test. Subsequently, the experimental group receives mathematics instruction through the Khan Academy learning platform, while the control group is taught using EBA. Afterward, both groups are administered a post-test, and the collected data are compared. In this manner, the impact of Khan Academy on mathematics achievement is statistically determined. This experimental design facilitates the data collection and inference process in a controlled environment aligned with the research objective. The pre-test post-test control group design aims to contribute to educational practices by enabling a clearer understanding of the effect on mathematics achievement.

Table 1 Research Design: The Impact of Khan Academy on Mathematics Achievement

Groups	Pre-test	Experiment Process	Post-test
Experimental	Attainment test	The carried-out exercises and courses in the Khan Academy Platform	Attainment test
Control	Attainment test	The carried-out exercises and courses by EBA	Attainment test

The procedures implemented in the experimental group of the study involved students engaging in mathematics exercises and lessons on the Khan Academy platform. In the control group, instructional activities utilizing the Educational Informatics Network (EBA) were used. Pre-test and post-test assessments were conducted to measure mathematics achievement. At the beginning of the research, students were evaluated with a pre-test, and then relevant procedures were applied according to the experimental and control groups. Finally, students in both groups were assessed with a post-test. A total of 18 hours of instructional time were allocated for both groups throughout the implementation period.

Participants

The research was conducted with fourth grade students attending a remedial and enrichment course at a primary school located in the Seyhan district of Adana province during the 2022–2023 academic year. The selection of the school and the study group took into consideration the voluntary participation of school administrators and classroom teachers. One of the two branches in the school was designated as the experimental group, while the other branch served as the control group. Descriptive statistics regarding the students in the experimental and control groups are provided in Table 2.

Table 2 Number and Percentages of Students in the Experimental and Control Groups

Groups	Gender				Total
	Female		Male		
	frequency	%	frequency	%	
Experimental group	15	50	15	50	30
Control group	14	47	16	53	30

In a quasi-experimental design, the "matched sampling" method can be used as the most reliable and least discrepant sample selection method for the experimental and control groups. Matched sampling involves pairing participants in the experimental and control groups based on specific characteristics to minimize the initial differences observed between the groups. In this method, matching is done based on similar demographic characteristics, pre-measured variables, or other important factors between the experimental and control groups (Büyüköztürk et al., 2012). In my study, to examine the impact of the Khan Academy learning platform on mathematics achievement among fourth grade primary school students, I could have matched students from each pre-determined branch as experimental and control groups. Considering factors such as students' gender, age, and mathematics achievement level, I selected a similar control group student for each experimental group student. In this way, I obtained a more homogeneous and balanced sample that included students with similar characteristics between the experimental and control groups. This will result in more reliable findings and allow for a more accurate attribution of the differences between the experimental and control groups to the effect of Khan Academy.

This study aims to investigate the impact of the Khan Academy learning platform on mathematics education among fourth grade elementary school students. This age group is in the developmental stage of fundamental mathematical skills. Additionally, their familiarity with technology and similar characteristics make them suitable for better matching experimental and control groups. Given that mathematics education is a fundamental component, enhancing the achievement of students in this age group can positively contribute to their future learning. Lastly, due to their inclination towards using online learning platforms, students in this age group can be considered a suitable choice in line with the research objectives.

Material

The data for the study were obtained from the "Achievement Test" results related to the "Data Collection and Evaluation" unit of the students. This test was administered to both groups of students, and their achievement scores were recorded. The achievement test was used to measure the level of understanding of the topics covered in the relevant unit.

The preparation of the "Achievement Test," which is where the quantitative data of the study were collected, was conducted through the following procedures: Firstly, the learning outcomes of the "Data Collection and Evaluation" unit, which the study focused on, were determined. These learning outcomes were based on the relevant unit in the Ministry of Education's mathematics curriculum. Upon determining the learning outcomes, a specification table encompassing the content and outcomes was created. The created specification table was presented to experts for their opinions, and necessary adjustments were made before proceeding to the question-writing process. In accordance with the learning outcomes and the number of questions specified in the specification table, a total of 35 items were created. This specification table and the developed items were presented to an assessment expert, a mathematics teacher, and a classroom teacher for their opinions. Based on the expert opinions, aspects such as technical suitability, language use, and content validity of the questions were evaluated, and it was decided to include 25 items in the pilot test. The pilot test was administered to 245 fifth grade students who had covered the same curriculum in the previous year. The results of the pilot test were analyzed for validity and reliability, and the number of questions was determined to be 25, ensuring content validity. The internal consistency coefficient of the pilot test was calculated at 0.78, and the final test's internal consistency coefficient was determined at 0.82. In the study, a final test consisting of 20 items was used as the pre-test and post-test.

Data Collection

The data were collected by the researcher from the experimental and control groups. Prior to the experimental procedures, the achievement test was administered to both the experimental and control groups by the researcher. At the end of the study, the achievement test was administered to both groups.

Data Analyses

In the initial phase of this study, the descriptive statistics of the quantitative data obtained from the "Achievement Test" related to the "Data Collection and Evaluation"

learning domain in the fourth grade mathematics course were calculated. These statistics include measures such as arithmetic means and standard deviations. Before proceeding with data analysis, it was examined whether the collected data were within predetermined boundaries and whether they contained errors; subsequent procedures were conducted thereafter. In the analyses, students' demographic characteristics and groups were considered as independent variables, whereas achievement test scores were treated as the dependent variable. The students' mean and standard deviations of pre-test, post-test, and retention test scores were computed. The normal distribution of pre-test, post-test, and retention test scores of both the experimental and control groups was investigated using the Kolmogorov-Smirnov test. In comparing the obtained mean values, the "t-test" method was used for both related and unrelated samples. The dependent (related) t-test was used for comparisons within the experimental and control groups, while the independent (unrelated) t-test was used for comparisons between the groups.

Experimental Implementation Process

Within the scope of this study, the aim was to investigate the impact of the Khan Academy learning platform on the mathematics achievement of fourth-grade primary school students. The study employed a pre-test post-test control group design to assess the difference in achievement levels between experimental and control groups. The experimental group consisted of a total of 60 students attending remedial and enrichment courses at the fourth-grade level. Students in the experimental group were provided with mathematics course content through the Khan Academy learning platform, and instruction was conducted using this content. Students in the control group, on the other hand, received mathematics instruction through the Education Informatics Network (EBA). Initially, a pre-test was administered to both groups, and their achievement levels were recorded. Subsequently, students in the experimental group were introduced to the Khan Academy learning platform, and they were guided to use this platform for their mathematics lessons. Meanwhile, students in the control group were introduced to EBA and used that platform for their lessons. At the end of the designated period, a post-test was administered to both groups, and students' achievement levels were measured once again. The collected data were used for the statistical analysis of the difference in achievement levels between the experimental and control groups.

Findings

In this research, the independent "t-test" was employed to compare the scores obtained from the achievement test in order to answer the research question, "Is there a statistically

significant difference between the pre-test scores of the experimental and control groups?" The results of the analysis are presented in Table 3.

Table 3 Descriptive Statistics of the Achievement Test for the Experimental and Control Groups

Tests	(n)	Pre-test		Post-test		Score (post-pre)	
		x	Ss	x	Ss	x	Ss
Experimental	30	22.60	4.22	40.30	4.32	15.00	3.96
Control	30	21.10	3.63	28.20	4.91	7.72	3.82

The above table contains the achievement test data and relevant descriptive statistics for the experimental and control groups in the "Data Collection and Evaluation" unit of the fourth grade mathematics class. The number of students in each group was determined to be 30. In the experimental group, the mean of the pre-test scores is 22.60 with a standard deviation of 4.22. The mean of the post-test scores is 40.30 with a standard deviation of 4.32. In the control group, the mean of the pre-test scores is 21.10 with a standard deviation of 3.63. The mean of the post-test scores is 28.20 with a standard deviation of 4.91. The mean of the gain test scores is 15.00 with a standard deviation of 3.96 for the experimental group. The mean of the gain test scores is 7.72 with a standard deviation of 3.82 for the control group.

Table 4 Comparison of Pre-Test Scores between the Experimental and Control Groups

Groups	n	x	s	sd	t	p
Experimental	30	22.60	4.22	58	0.763	0.462
Control	30	21.10	3.63			

The above table presents the comparison of pre-test scores between the experimental and control groups. In the experimental group, the mean of the pre-test scores was determined to be 22.60 with a standard deviation of 4.22. In the control group, the mean of the pre-test scores is reported as 21.10 with a standard deviation of 3.63. The t-test results indicate that with a p-value of 0.462, there is no statistically significant difference at the 0.05 level. It can be concluded that there is no significant difference between the groups in terms of the scores obtained from the achievement test.

Table 5 Comparison of Pre-Test and Post-Test Scores in the Experimental Group

Groups	n	x	s	sd	t	p
Experimental	30	22.60	4.22	29	7.611	0.000
Control	30	40.30	4.32			

As observed in Table 5, the mathematics activities conducted with Khan Academy in the experimental group have significantly improved students' achievements (t = 7.611, p = 0.000). This result demonstrates a statistically significant difference between the pre-test and post-test scores of students in the experimental group. Thus, it indicates that the mathematics activities conducted with Khan Academy are effective in enhancing students' academic performance. Therefore, the answer to the question "Did the mathematics activities conducted with Khan Academy in the experimental group result in a significant difference in favor of the post-test?" is affirmative. Students in the experimental group have obtained higher scores in the post-test as a result of the influence of the mathematics activities conducted with Khan Academy. This finding highlights that mathematics activities with Khan Academy are an effective method for improving students' achievements.

Table 6 Comparison of Pre-Test and Post-Test Scores in the Control Group

Groups	n	x	s	sd	t	p
Experimental	30	21.10	3.63	29	3.938	0.000
Control	30	28.20	4.91			

As shown in Table 6, it has been determined that the activities conducted using the EBA platform in the control group have significantly increased students' achievements (t = 3.938, p = 0.000). In other words, the activities carried out in the control group have significantly improved students' scores in favor of the post-test at the 0.05 level.

The fourth sub-question of the research is formulated as "Did the mathematics activities conducted with Khan Academy in the experimental group influence student achievement compared to the activities conducted in the control group?" In this study, an independent (unrelated) t-test was used to compare the gain scores of the experimental and control groups, and the findings are presented in Table 7.

Table 7 Comparison of Gain Scores between the Experimental and Control Groups

Groups	n	x	s	sd	t	p
Experimental	30	15.00	3.96	58	3.715	0.001
Control	30	7.72	3.82			

Table 7 reveals that at the end of the study, the experimental group showed an average increase of 15.00, while the control group showed an average increase of 7.72. By comparing these results, it has been determined that the mathematics activities conducted with Khan

Academy in the experimental group are more effective in improving students' achievements compared to the activities in the control group. The difference between the two groups is statistically significant in favor of the experimental group at the 0.05 level. It has been observed that the mathematics activities with Khan Academy particularly enhance students' achievements in the "Data Collection and Evaluation" unit of the mathematics course.

Result, Discussion and Suggestions

The t-test results indicated that there was no statistically significant difference between the pre-test scores of the experimental and control groups. Upon examining the pre- and post-test scores of the experimental group, it was found that the mathematics activities conducted with Khan Academy significantly increased students' achievement levels. The students in the experimental group achieved higher scores in the post-test as a result of their engagement with Khan Academy activities. Likewise, upon analyzing the pre- and post-test scores of the control group, it was determined that the activities utilizing EBA educational platforms significantly enhanced students' achievement levels. The students in the control group obtained higher scores in the post-test due to different activities.

Upon examining the achievement scores of the experimental and control groups, it was determined that the experimental group's achievement test scores were significantly higher than those of the control group. The mathematics activities conducted with Khan Academy significantly enhanced students' accessibility to the "Data Collection and Evaluation" unit in the mathematics lesson.

Based on these findings, the research compared the achievement levels of the experimental and control groups, focusing on the "Data Collection and Evaluation" unit in the mathematics lesson. The results demonstrate that the mathematics activities conducted with Khan Academy significantly increased the achievements of students in the experimental group. This finding indicates that Khan Academy is an effective tool for mathematics learning and enhances students' success. The difference in scores between the pre-test and post-test was higher for the students in the experimental group compared to the control group. In the control group, where EBA was utilized, it was observed that the activities contributed to student achievement. This indicates the impact of using EBA. However, the increase in achievement for the students in the experimental group was more pronounced compared to the control group. When examining the achievement test results, it was observed that students in the experimental group reached a higher level of accessibility as a result of the activities

conducted with Khan Academy. This indicates that Khan Academy facilitates students' access to the subject matter and enhances their understanding level.

In conclusion, this research demonstrates that mathematics activities conducted with Khan Academy enhance student achievement, particularly in relation to the topics covered in the "Data Collection and Evaluation" unit. These findings encourage educators and curriculum designers to further explore the use of digital resources in mathematics instruction and increase student success. When reviewing the literature, we can observe that the results of various studies support the findings of this research. However, many studies have compared an experimental group utilizing digital learning resources with a control group using traditional instructional methods (Akbaş, 2019; Ferman et al., 2019; Kelly & Rutherford, 2017). The results have shown that students in the experimental group achieve significantly higher mathematics scores than those in the control group. The results indicating that traditional teaching methods or tools have less impact compared to contemporary ones are not surprising. Therefore, it is believed that comparing current tools, platforms, methods, etc. (such as Khan Academy and EBA) in research studies would contribute more to the field.

Akbaş (2019) conducted a study investigating the impact of teaching fractions through animation-based content on student achievement using EBA (Educational Informatics Network) and traditional instructional methods. The results of the study showed that the experimental group (supported by EBA) significantly increased students' mathematics performance and motivation. Taking these findings into consideration, both studies demonstrate that digital learning platforms enhance student achievement. While this research indicates that the use of Khan Academy is more effective in improving mathematics performance, the second study suggests that EBA usage is more effective in developing fraction knowledge compared to traditional methods. In conclusion, both studies highlight the positive effects of digital learning platforms on student achievement. However, it is important to note that in our study, the EBA-supported group served as the control group, whereas in Akbaş (2019), it was the experimental group. Indirect inferences can be drawn from this distinction.

Furthermore, according to the findings of the study conducted by Özbey and Koparan (2020), EBA-supported education positively influenced the mathematics achievement and motivation of seventh grade students in the "Equality and Equation" topic. This research, along with the aforementioned study, demonstrates the positive effects of digital learning platforms on student achievement in various subjects and grade levels. These results suggest

that digital learning platforms can be effective tools in mathematics instruction and contribute to increased student success. However, considering the different characteristics of both studies and the variation in the platforms used, making direct comparisons may be challenging. Therefore, further research, incorporating different platforms as control groups, can help us better understand the effects of various digital platforms.

According to Zengin's (2017) research, the use of Khan Academy significantly increased mathematics achievement and improved access levels for students in the experimental group. Similarly, the results of the second study indicated that the flipped classroom approach, designed using Khan Academy and mathematics software, enhanced student achievement. Both studies demonstrate the potential of digital learning platforms to improve mathematics performance. The first study observed a significant increase in students' achievement levels and improved access levels. The second study highlighted the effectiveness of the flipped classroom approach in enhancing student achievement and understanding. However, there are some differences between the studies. While the first study utilized EBA as the control group, the second study employed traditional methods as the control group. Additionally, there were variations in the research groups and student levels. In conclusion, both studies indicate the positive effects of digital learning platforms on mathematics achievement. However, due to the differences in the studies, direct comparisons may be challenging. Further research incorporating different parameters can help us better understand the impact of digital learning platforms.

Kelly and Rutherford (2017) examined the use of Khan Academy as a mathematics intervention for seventh-grade students in a control group over a period of 4 weeks. In contrast to our study, Kelly and Rutherford's (2017) study did not find a statistically significant difference in student test scores between the experimental and control groups. However, the study did find significant relationships between the internal measurements used to monitor student performance and the usage of Khan Academy and student test scores. We can say that both studies show the positive effects of Khan Academy on mathematics learning. Comparisons between the studies are challenging due to the use of different parameters and methods, but this challenge provides opportunities for different research findings. Further research incorporating different controls can help us better understand the impact of Khan Academy.

Kelly's (2018) study found no difference between students receiving regular education with Khan Academy and students receiving only regular education. These different results may stem from variations in the research context, characteristics of the study groups, the tests used, and the analysis methods. Additionally, there may be differences in the instructional programmes and other variables used.

Different results may require further research and more in-depth analyses to understand the effects of different factors. Many studies aiming to enhance the effectiveness of instruction using the Khan Academy platform have shown positive results (Chu et al., 2018; Dickinson, 2016; Leon & Koosed, 2018; Makinde & Yusuf, 2017; Muir, 2014; Rueda-Gómez et al., 2023). It is important to interpret the results considering the methodology, sample size and characteristics, measurement tools used, and other factors. While interpretations in different contexts can shed light on future research, digital learning platforms have the potential to enhance effectiveness in practical applications.

The limitations of this research should also be taken into consideration. For instance, the number of students is limited to 60, which restricts the generalizability of the findings. Additionally, only one unit was focused on, and other mathematical topics were not considered. These are issues that need to be addressed in future research.

Based on the findings of this research, the following suggestions can be made:

Educators and curriculum designers should consider effectively using digital resources in mathematics classes. Online platforms such as Khan Academy can help students improve their mathematical skills. The use of such resources can enhance student achievement and support mathematics learning.

Teaching methods and materials should be carefully selected to enhance student achievement in specific topics like "Data Collection and Evaluation." This study found that activities conducted with Khan Academy increased the success of students in the experimental group. Therefore, it is recommended to incorporate similar activities in relevant topics.

Teachers can focus more on digital learning platforms to increase students' access levels. The results of the accessibility test indicate that students in the experimental group achieved higher levels of access through activities conducted with Khan Academy. This means that students can have better access to mathematical topics and improve their understanding.

Future research should conduct more comprehensive studies on different mathematical topics. This study focused only on the "Data Collection and Evaluation" unit. Similar research conducted on different topics can help us better understand the impact of digital learning resources in various areas of mathematics.

Research conducted on larger samples can enhance the generalizability of the results. In this study, the number of students was limited to 60. Research conducted on larger sample groups can provide more reliable interpretations of the results.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

No conflict of interest.

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CRediT author statement

The study was single authored and the whole process was carried out by the corresponding author.

Research involving Human Participants and/or Animals

The study involves human participants. Ethics committee permission (Date: 18.08.2023, Number: E-23688910-050.01.04-2300084605) was obtained from Bartın University, Social and Human Sciences Research Ethics Committee.

Khan Academy Öğrenme Platformunun İlkokul 4. Sınıf Öğrencilerinin Matematik Başarısı Üzerindeki Etkisi

Özet:

Bu araştırma, Khan Academy öğrenme platformunun öğrencilerin matematik dersindeki başarısına etkisini incelemeyi amaçlamaktadır. Araştırmada ön test-son test kontrol gruplu desen kullanılarak deney ve kontrol gruplarının başarı düzeyleri arasındaki farklılık test edilmiştir. Çalışma grubu, destekleme ve yetiştirme kursuna devam eden ilkokul dördüncü sınıf öğrencilerden oluşmaktadır. Çalışma 60 öğrenciyle gerçekleştirilmiştir. Deney grubunda yer alan öğrencilere Khan Academy öğrenme platformu üzerinden matematik dersi içerikleri sunulmuş ve bu içerikleri kullanarak öğretim gerçekleştirilmiştir. Kontrol grubundaki öğrencilere ise Eğitim Bilişim Ağı (EBA) ile matematik dersi işlenmiştir. Öncelikle her iki gruba da ön test uygulanmış ve öğrencilerin başarı düzeyleri kaydedilmiştir. Ardından deney grubundaki öğrencilere Khan Academy öğrenme platformu tanıtılmış ve matematik derslerinde bu platformu kullanılmıştır. Kontrol grubundaki öğrenciler ise EBA tanıtılmış ve derslerde bu platform kullanılmıştır. Belirli bir süre sonra her iki gruba da son test uygulanmış ve öğrencilerin başarı düzeyleri tekrar ölçülmüştür. Elde edilen veriler kullanılarak deney ve kontrol gruplarının başarı düzeyleri arasındaki farklılık istatistiksel olarak analiz edilmiştir. Bu analiz sonucunda Khan Academy öğrenme platformunun öğrencilerin matematik dersindeki başarısına etkisinin daha fazla olduğu sonucuna ulaşılmıştır.

Anahtar kelimeler: Khan Akademi, Eğitim Bilişim Ağı (EBA), ilkokul, matematik, başarı.

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