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The effect of digital stories prepared according to realistic mathematics education on students' mathematical achievements, anxiety and attitudes[1]

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Abstract

This research examined the effects of digital stories prepared according to Realistic Mathematics Education (RME) on the mathematics achievement, anxiety and attitudes of 4th-grade students. A quasi-experimental design with the pretest-posttest control group, one of the quantitative research designs, was used in the research. The research was conducted with 69 fourth-grade students studying in a public primary school in the Tarsus district of Mersin province in the second term of the 2021-2022 academic year. In the experimental group, the teaching was carried out by the researcher using digital stories prepared according to RME, the researcher carried out the learning in one of the control groups according to the current curriculum, and the classroom teacher carried out the teaching in the other control group according to the current curriculum for seven weeks. Two-factor ANOVA (mixed ANOVA) was used for mixed measurements to analyse the data obtained from the study. As a result of the statistical analyses, it was determined that digital stories prepared according to RME made a significant difference in the increase of students' academic achievement and mathematics attitudes but did not create a substantial difference in mathematics anxiety.

Keywords: realistic mathematics education, digital storytelling, mathematics achievement, anxiety, attitude

Gerçekçi matematik eğitimine göre hazırlanmış dijital öykülerin öğrencilerin matematik başarılarına, kaygılarına ve tutumlarına etkisi

Özet (Türkçe)

Bu araştırma, Gerçekçi Matematik Eğitimine (GME) göre hazırlanmış dijital öykülerin 4. sınıf öğrencilerinin matematik başarılarına, kaygılarına ve tutumlarına etkisinin incelemesi amacıyla yapılmıştır. Araştırmada nicel araştırma desenlerinden öntest-sontest kontrol gruplu yarı deneysel desen kullanılmıştır. Araştırma 2021-2022 eğitim öğretim yılı ikinci döneminde, Mersin ili Tarsus ilçesindeki bir devlet ilkokulunda öğrenim görmekte olan 69 dördüncü sınıf öğrencisi ile gerçekleştirilmiştir. Deney grubunda öğretim, GME'ne göre hazırlanmış dijital öyküler kullanılarak araştırmacı tarafından, kontrol grubunun birinde öğretim mevcut öğretim programına göre araştırmacı tarafından ve diğer kontrol grubunda öğretim ise mevcut programa göre, sınıf öğretmeni tarafından 7 hafta boyunca yürütülmüştür. Araştırmadan elde edilen verilerin analizinde karışık ölçümler için iki faktörlü ANOVA (mixed ANOVA) kullanılmıştır. Yapılan istatistiksel analizler sonucunda GME'ne göre hazırlanmış dijital öykülerin öğrencilerin akademik başarılarının artmasında ve öğrencilerin matematik tutumunda anlamlı fark oluşturduğu, matematik kaygıları üzerinde ise anlamlı bir faklılık oluşturmadığı tespit edilmiştir.

Anahtar Kelimeler: gerçekçi matematik eğitimi, dijital öykü, matematik başarısı, kaygı, tutum

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Introduction

In technological terms, the world is experiencing a process in which today is not different from yesterday, but today is different from a little while ago. The information explosions that arise due to the unabated change in science and technology show their effects in every field with the increasing use of technology (Öğüt, 2003). Technology has become integral to life (Kaya, 2019; Ömrüuzun, 2019). The effect of technological developments on learning processes is increasing day by day. Countries focus on integrating their education policies with technology and develop policies in line with the developments in the world to use technological tools efficiently (Türel et al., 2020). In this direction, projects such as the Movement for Increasing Opportunities and Improving Technology in Education (FATİH) and the Education Information Network (EBA) have been implemented in Turkey (Kaya, 2019; Kolburan et al., 2020).

In this age where technology is encountered in every aspect of life, students are motivated to use advanced technology in the teaching process (Khazaal, 2015). The technology used in the field of education can offer different stimuli, teaching methods and teaching materials as options according to the interests and needs of each student. In addition, technology in education can play an influential role in realising the principle of "lifelong education-continuing education" (Alpar et al., 2007). This study examined the effects of digital materials in learning environments on learning outcomes.

As a requirement of our age, digital technologies in learning environments, materials, and multimedia tools that appeal to many senses simultaneously increase attractiveness. It is effective in ensuring retention in learning. In this direction, it is necessary to use digital materials in the learning environments of students who aim to have digital competence. It is thought that digital storytelling and digital stories will be compelling in teaching any subject through intuition and practice, not memorising rules. Digital storytelling is a new storytelling style and process in which traditional storytelling is transformed into a new and artistic structure by combining story scenarios with digital content consisting of pictures, sounds and videos (İnceelli, 2005), and stories are transferred to the online environment (Xu et al., 2011). Digital storytelling is one of the tools that allows technology integration with learning environments and covers most 21st-century skills.

When the literature is examined, it is seen that there are many studies conducted with digital stories. The results of the studies show that digital stories increase students' active participation in lessons (Barrett, 2006; Burmark, 2004; Ohler, 2008; Robin, 2006, 2008; Wang & Zhan, 2010; Yoon, 2013). In addition, digital stories contribute positively to students' academic achievement (Barrett, 2006; Doğan, 2007; Sadık, 2008; Hung et al., 2012; Yüksel et al., 2011; Demirer, 2013; Kahraman, 2013; Özpınar et al., 2017; Çiçek, 2018; Ulusoy, 2019). Digital stories facilitate learning

(Bromberg et al., 2013; Dupain & Maguire, 2005) and contribute positively to attitudes and motivation towards lessons (Demirer, 2013; Neimi et al., 2018; Dinçer, 2019; Ulusoy, 2019). Some studies show that students have better comprehension (Barret, 2006; Verdugo & Belmonte, 2007), creative problem-solving (Yılmaz, 2019), creative writing (Kulla Abbot, 2006; Xu et al., 2011; Green, 2011; Uslu, 2019; Demirbaş, 2019) and active collaboration skills (Neimi et al., 2018) in lessons with digital stories.

Students of primary school age lack experience compared to adults. According to Strang (1960), the most crucial factor preventing students from learning is that students do not have enough experience (Doğan, 2007). Students' lack of knowledge can be overcome with lessons that put the student at the centre and use real problem situations. Realistic Mathematics Education (RE) is one of the teaching theories that can increase students' mathematical achievement and reduce their mathematical anxiety. The basic idea of realistic mathematics education is to use practical problem situations at the starting point of mathematics teaching. Freudenthal, the father of the concept of GME, stated that mathematics is a human activity connected with real situations (Zulkardi, 2002). According to this approach, students should associate mathematical concepts with real-life experiences. Firstly, the necessary mathematical structure for the solution is created using diagrams, figures, number tables, etc., of the information in the problem. Then, it is translated into mathematical structures in their minds, such as formulas, theorems, generalisations, etc. The main idea of the approach is that the things intended to be learnt about mathematics are shaped and formed in the students' minds (Alacacı, 2016). No foreign and ready information is given from outside. The aim is to make mathematical information "realistic" and plausible in the student's mind and experience, like the initial problem situations.

When the literature is examined, the results of the studies on GME show that GME is effective in increasing academic achievement (Lee, 2006; Özdemir & Üzel, 2011; Çakır, 2013; Nama Aydın, 2014; Kaylak, 2014; Özçelik, 2015; Cansız, 2015; Çilingir, 2015; Özkaya, 2015; Demir, 2017; Yetim et al., 2017; Korkmaz & Tutak, 2017; Zakaria & Syamaun, 2017; Erdoğan, 2018; Özkürkçüler, 2019), increased retention (Özçelik, 2015; Demir, 2017; Özkürkçüler, 2018), improved students' problem-solving skills (Verschaffel & De Corte, 1997; Fauzan, 2002; Bonotto, 2005; Çilingir, 2015), improved their attitude towards mathematics (Özkaya, 2015; Özçelik, 2015; Özkürkçüler, 2019) and increased their motivation (Çakır, 2013). In addition, studies are showing that GME has a positive effect on reducing students' mathematical anxiety (Demir, 2017), improves their estimation skills (Bonotto, 2005), eliminates the disconnect between theory and practice (Korthagen & Russel, 1999), provides easy learning (Yorulmaz & Doğan, 2019), improves concept understanding ability (Hadi, 2002; Barnes, 2004; Lestari & Surya, 2017) and communication skills (Cansız, 2015).

Materials are instrumental for students to learn by doing and experiencing (Sönmez, 1997). The use of digital technologies in learning environments and

materials and the use of multimedia tools that appeal to many senses simultaneously increase interest and effectively ensure retention. As a result of the literature review, it is thought that this study will complete an essential gap in the field because there is no study on mathematics teaching supported by digital stories prepared according to GME, the sub-learning areas of "Multiplication with Natural Numbers" and "Division with Natural Numbers" are among the essential topics in primary school mathematics teaching. According to GME, no digital stories can be used as digital materials related to these topics in the field. In addition, it is thought that digital stories designed according to GME will facilitate students' learning. Accordingly, the problem statement of this study is "Do digital stories prepared according to the Realistic Mathematics Education Approach for the 4th-grade mathematics course "Multiplication with Natural Numbers" and "Division with Natural Numbers" sub-learning areas affect students' mathematics achievement, mathematics anxiety levels, mathematics attitudes and retention?".

Purpose of the Study

This study examined the effect of teaching with digital stories prepared according to GME on the mathematics achievement, mathematics anxiety and mathematics attitudes of 4th-grade primary school students in the sub-learning areas of "Multiplication with Natural Numbers" and "Division with Natural Numbers". In line with this purpose, answers to the following questions were sought.

1. Is there a significant difference between the experimental group's pre-test and post-test mathematics achievement scores in which digital stories prepared according to GME were applied and the control group in which the current teaching method was used?
2. Is there a significant difference between the mathematics attitudes of the experimental group of students taught with digital stories prepared according to GME and those of the control group students acquainted with the current method?
3. Is there a significant difference between the mathematics anxiety of the experimental group students taught with digital stories prepared according to GME and the control group students taught with the current method?

Method

Research Design

In this study, to examine the effects of digital stories created according to GME on students' mathematics achievement, attitudes and anxieties in the 4th grade "Numbers and Operations" learning domain, a quasi-experimental design was preferred and an "experimental model with pretest-posttest control group", one of the types of experimental design, was used. In the quasi-experimental design with

the pretest-posttest control group, the participants are subjected to measurements related to the dependent variable before and after the experimental research (Karasar, 2009). In the study, the Mathematics Achievement Test was applied to the fourth-grade classes in the primary school where the research would be conducted before the application. Three classes with close results were determined as a result of statistical analysis, and one experimental group (23 people) and two control groups (23+23) were determined by random assignment method. In the experimental group, teaching was carried out by the researcher using digital stories prepared according to GME; in one of the control groups, teaching according to the current curriculum was carried out by the researcher; and in the other control group, teaching according to the current curriculum was carried out by the class's teacher for seven weeks in order to eliminate researcher bias and increase the reliability of the research.

Working Group

The research study group consists of 69 fourth-grade students (23 students in each class) studying in a public primary school in the Tarsus district of Mersin province in the second semester of the 2021-2022 academic year. This study used typical case sampling to select the study group. Specific case sampling is the determination and selection of a regular, in other words, an ordinary and average situation among many situations that exist in the universe related to the research (Büyüköztürk et al., 2011).

Table 1 shows the number and gender of the students in the study group.

Table 1. The number and gender of the students in the study group

Grup		**Female**		**Male**	
	N	**f**	**%**	**f**	**%**
Experiment	23	13	56.52	10	43.48
Control 1	23	14	60.87	9	39.13
Control 2	23	12	52.17	11	47.83
Total	**69**	**39**	**56.52**	**30**	**43.48**

As seen in Table 1, the study was carried out with the participation of 69 students: 23 (F=13, M=10) in the experimental group, 23 (F=14, M=9) in the control 1 group and 23 (F=12, M=11) in the control 2 group. Female students constituted 56.52% of all students, and male students constituted 43.48%. According to Table 1, it can be said that the number of students in the experimental and control groups was equal to each other, and the gender distributions within the groups were close to each other.

Data Collection Tools

In this study, the "Mathematics Achievement Test", "Mathematics Anxiety Scale", and "Mathematics Attitude Scale" were used as data collection tools.

Mathematics Achievement Test

Creating the "Mathematics Achievement Test" used in this study, which aims to examine the effect of digital stories prepared according to GME for the sub-learning areas of "Multiplication with Natural Numbers" and "Division with Natural Numbers" in the learning area of "Numbers and Operations" in the 4th grade of primary school, on the mathematics achievement of 4th-grade students, the test development steps specified by Cronbach (1984) were followed. These steps are as follows:

1. Determining the purpose of the test
2. Determination of the characteristics to be measured by the test
3. Item writing and creation of the item pool
4. Technical supervision and examination of language clarity
5. Obtaining expert opinion, creating the pre-test form
6. Pre-application
7. Determining the psychometric properties of the test (Cited in Büyüköztürk et al., 2011).

Item analysis was performed using TAP for the items that formed the test form. The item discrimination index was analysed while selecting the items to create the final test. Item 41 has a discrimination power index below 0.20, so this item should either not be used or should be rearranged (Büyüköztürk et al., 2011). Except for item 41, the discrimination power indices of all other items are more significant than 0.30. According to these values, the items are successful questions distinguishing the students who know and those who do not.

First, the item discrimination index was examined to select the items to be included in the final test. In cases where the item discrimination indexes were equal or very close to each other, the items that could affect the thinking skills, where visuality was prioritised, were used from the question items created for the same acquisition.

After examining the item analyses obtained and following the reliability and validity studies, the 41st item was removed from the test. After the 41st item was removed from the test, the 28-item Achievement Test, obtained from the remaining 49 items, representing each outcome and including two items for each outcome, was made to be used as a pre-test post-test in the research.

According to the results obtained by item analysis, a final test with high reliability and validity was formed by taking the best of the items prepared to measure that behaviour for each of the behaviours to be tested in the test. The final 28-item achievement test had an average difficulty index of 0.58 and an average discrimination index of 0.65. The KR-20 value of the final achievement test was found to be 0.907, and a multiple-choice achievement test with high reliability was created at a satisfactory value.

Mathematics Anxiety Scale for Primary School 3rd and 4th Grade Children

The study, "Mathematics Anxiety Scale for Primary School 3rd and 4th Grade Children", developed by Mutlu and Söylemez (2018), measured students' anxiety about mathematics. The MSAS is a 13-item, 3-point Likert-type scale. The highest score that can be obtained from the scale is 39, and the lowest score is 13. A high score on the scale indicates that the student's anxiety is high, while a low score means that the student's anxiety is common.

Mutlu and Söylemez (2018) calculated the Cronbach Alpha coefficient, which is the internal consistency criterion of the scale and each factor, as 0.747 for the reliability of the mathematics anxiety scale. This study used the Cronbach Alpha, the internal consistency coefficient, to calculate the scale's reliability as 0.846. Therefore, the calculated result showed that the scale was reliable.

Mathematics Attitude Scale (MAT)

In the study, "Mathematics Attitude Scale" developed by Gülburnu and Yıldırım (2015) was used to measure students' attitudes towards mathematics. The scale consisted of 27 items in a 5-point Likert type.

According to their findings, Gülburnu and Yıldırım (2015) concluded that the Mathematics Attitude Scale is a scale that measures the attitudes of primary and secondary school students towards mathematics and has a reliable structure with measurement validity. The highest score that can be obtained from the scale is 135, and the lowest score is 27. The high score obtained from the scale indicates that the student's level of participation in the proposition is high, while the low score obtained from the scale indicates low participation.

Gülburnu and Yıldırım (2015) found the Cronbach Alpha coefficient, which is the internal consistency criterion of both the scale and each factor, as 0.880 for the reliability of the mathematics attitude scale. In this study, the Cronbach Alpha, the internal consistency coefficient used to calculate the scale's reliability, was 0.721. Therefore, the calculated result showed that the scale was reliable.

Collection of Research Data

Material Used in Application

The researcher prepared the digital stories for the experimental research process by following the steps of creating digital stories by GME. The drafted contents were evaluated by two experts who have the title of professor in the field of classroom education, three professors who are experts in the field of mathematics education, an expert who continues his doctoral education on mathematics teaching in classroom education, and an expert who has a doctorate in the field of digital stories by using the "Graded Rating Scale for Digital Stories" developed by Özcan, Kukul, and Karataş (2016) and were found suitable for use.

The steps Barret (2009) determined were followed in creating digital stories prepared according to the GME used in this study's experimental method. According to Barret (2009), digital stories are created by following five steps. These steps are

The text to be processed in the digital story is written: Firstly, the acquisition to be created in the digital story was determined. After determining the acquisition, the scenario to be processed in the digital story was written. While preparing the scenario, the characteristics of the students to whom the digital stories will be applied were considered, and appropriate scenarios were written to attract the students' attention.

1. Audio Recordings are Made: The scenarios were vocalised by the researcher using a voice recorder, paying attention to fiction, emotion, emphasis and intonation. The vocalisations were carried out in a quiet environment, and it was tried to prevent the sounds that may come from outside from being heard.

2. Visuals to be used in the digital story are collected: Visuals suitable for the topics covered in the scenario were collected.

3. The Digital Story is Created with a Suitable Programme: At this stage, the voices and visuals that will form the digital stories to be prepared according to GME were combined using the PowerPoint programme.

4. Digital Story is Published: The digital stories, which were finalised using the PowerPoint programme, were converted into videos using the video publishing feature of the PowerPoint program and used in this way.

Pilot Application Process

In the pilot study, the control group consisted of 13 male and 14 female students, while the experimental group consisted of 11 male and 14 female students. The researcher conducted the lessons in the experimental and control groups. In the experimental group, the lessons were carried out with digital stories prepared

according to GME. In contrast, in the control group, the lessons were carried out with teaching based on the current curriculum.

As a result of the pilot application, the problems were identified, and necessary corrections were made in line with the expert opinions before the actual application. After the corrections and precautions, the actual implementation was started.

Actual Implementation Process

The implementation started in November in the first semester of the 2021-2022 academic year and continued for eight weeks. In the first week, teachers and students were met, necessary information was given, and pre-test applications were carried out. The actual implementation process lasted seven weeks. The implementation process was completed in 35 hours, 5 class hours each week.

Analysing the Data

In the study, one-way ANOVA was used for unrelated samples. It was analysed whether there was a significant difference between the pre-test scores according to the groups. The significance level was accepted as .05. As a result of the analyses, it was observed that there was no significant difference between the three groups whose pre-test scores were examined according to their mathematics achievement pre-test, mathematics attitude scale pre-test scores and mathematics anxiety scale pre-test scores ($p>.05$). After this stage, whether the achievement test scores of the experimental and control group students and the scores obtained from the scales differed according to the groups (practical, control one and control 2), measurements (pre-test-post-test) and their common effect was analysed by performing two-factor ANOVA for mixed measurements (mixed ANOVA) from multivariate statistical methods. The reason for the two-factor ANOVA test for hybrid measures is that two different procedures were performed together by comparing the measurement results of the experimental and control groups and applying the pre-test and post-tests of these groups as repeated measurements. Therefore, it was deemed appropriate to use two-way analysis of variance for mixed measures for these research questions. Here, the first factor is groups, and the second is repeated measurements. In this case, since there were three different groups and two different measurements, a 3x2 mixed measures ANOVA test was applied. With the results of the analyses obtained, the effect of experimental and control groups, the impact of repeated measurements and the joint impact of group and measurement were examined.

Findings

Mathematics Achievement of the Students Who Were Taught with Digital Stories Prepared According to GME and Existing Method

A mixed measures ANOVA test was conducted to determine whether the changes observed in the mathematics achievement test results of the students in three different groups after the experimental procedure compared to the pre-experimental procedure showed a significant difference, and the results of the analysis are given in Table 2.

Table 2. ANOVA results for mixed measures for MBT pre-test and post-test

Source of Variance	Sum of Squares	Degrees of freedom	Mean Squares	F	p	Significant Difference (LSD)	Eta square ($\eta^{2)}$)
Between Subjects	1334.667	68	-			D>K1, D>K2	
Group (A)	165.754	2	82.8777	4.679	.013*		.124
Error	1168.913	66	17.711				
In-subjects	2220.5	69					-
Measurement (B)	1862.674	1	1862.674	566.755	.00*		.896
AXB	140.913	2	70.457	21.438	.00*		.394
Error	216.913	66	3.287				
Total	3197.341	137					

(D: Experimental group, P1: Control 1 group, P2: Control 2 group)

As seen in Table 2, it was found that the mathematics achievement of the students to whom two different teaching methods were applied differed significantly from before to after the experiment; that is, the joint effects of the repeated measures factors on mathematics achievement were significant, $F(2,66)=21.438$, $p<.001$). This finding shows that participating in ongoing instruction with digital stories prepared according to the GME approach and the current situation has different effects on increasing students' mathematics achievement. It is understood that the digital storytelling method prepared according to GME, which was taught in the experimental group, which obtained higher math achievement test scores than the pre-experiment group, was more effective in increasing students' math achievement than the course of lessons in the current plan taught in the control groups. When the eta-square values of the group and measurement common effect were examined, it was seen to have a high impact on math achievement ($\eta 2 =.394>.14$).

According to the results of the LSD test, when the difference between the groups of students whose pre-test - post-test mathematics mean achievement scores were determined, it was concluded that the experimental group in which the researcher conducted the lesson was significantly different from the control 1 group in which the researcher taught the lesson and the control 2 group in which another

teacher taught the lesson in favour of the experimental group. However, no significant difference was found between the control one and control two groups.

Mathematics Attitudes of Students Who Were Taught with Digital Stories Prepared According to GME and Existing Method

The results of the ANOVA analysis for mixed measures regarding whether the changes observed in the math attitude scores of the students in three different groups after the experimental procedure compared to the pre-experimental procedure showed a significant difference in Table 3.

Table 3. ANOVA results for mixed measures for ITS pre-test and post-test

Source of Variance	Sum of Squares	Degrees of freedom	Mean Squares	F	p	Significant Difference (LSD)	Eta square (η^2)
Between Subjects	9391.623	68				D>K1, D>K2	
Group (A)	781.058	2	390.529	2.993	.057		.083
Error	8610.565	66	130.463				
In-subjects	5100.435	69					-
Measurement (B)	524.355	1	524.355	13.226	.001		.167
AXB	717.580	2	358.790	9.050	.00*		.215
Error	2616.565	66	39.645				
Total	14492.058	137					

(D: Experimental group, P1: Control 1 group, P2: Control 2 group)

According to the results of the analysis in Table 3, it can be stated that the mathematics attitudes of the students in the experimental group where digital stories prepared according to GME were used and in control one and control two groups where the current method was used showed a significant difference from before to after the experiment. In other words, it can be said that the joint effects of being in different treatment groups and repeated measures factors on math attitudes are significant $F(2, 66)=9.050$, $p<.001$). When the eta-square values of the joint effect of group and measurement were examined, it was seen to have an effect of 21.5% on math attitudes ($\eta 2 =.215>.14$).

When the difference between the groups of students whose pre-test and post-test mathematics attitude scale scores were determined according to the results of the LSD test was examined, it was concluded that the experimental group in which the researcher conducted the course was significantly different from the control 1 group in which the researcher conducted the course and the control 2 group in which another teacher conducted the course in favour of the experimental group. However, no significant difference was found between control one and control two groups.

Mathematics Anxiety of Students Taught with Digital Stories Prepared According to GME and Existing Method

The results of the two-factor ANOVA analysis for mixed measures regarding whether the changes observed in the math anxiety scale results of the students in three groups showed a significant difference after the experimental procedure compared to before the testing procedure are given in Table 4.

Table 4. ANOVA results for mixed measures regarding MKÖ pre-test and post-test scores

Source of Variance	Sum of Squares	Degrees of freedom	Mean Squares	F	p	Significant Difference (LSD)
Between Subjects	1080.594	68				
Group (A)	26.841	2	13.420	0.841	.436	0.025
Error	1053.753	66	15.966			
In-subjects	777.5	69				-
Measurement (B)	341.225	1	341.225	13.226	.00*	0.167
AXB	9.797	2	4.899	9.050	.473	.022
Error	426.478	66	6.462			
Total	1858.094	137				

*p<.001

When Table 4 is examined, it was found that the mathematics anxiety of the students to whom two different teaching methods were applied did not differ significantly from before to after the experiment; that is, the expected effects of repeated measures factors on mathematics anxiety were not significant ($F(2,66)=9.050$, $p>.05$). In this case, it can be said that the lessons carried out with digital stories prepared according to GME did not affect the reduction of 4th-grade students' mathematics anxiety.

Conclusion and Discussion

GME Digital Stories and Mathematics Achievement

The first sub-problem of the study aimed to determine whether there was a significant difference between the mathematics achievement of the experimental group students taught with digital stories prepared according to GME and the control group students acquainted with the current method. As a result of the analyses made at the end of the application, it can be said that the mathematics achievement of the experimental group using digital stories prepared according to GME and the control one and control 2 group students using the current method showed a significant difference from before to after the experiment and that the application had a positive effect on students' mathematics achievement.

When the literature is examined, it is seen that there are studies examining the effect of GME on students' academic achievement at the primary school level. Can (2012) taught the 3rd-grade Measuring Liquids and Lengths topic based on GME. As a result of his study, Can (2012) determined that GME is effective in increasing students' academic achievement, similar to the results of this study. Çakır (2013) also stated in their study that GME positively affects students' achievement in teaching topics in the 4th-grade measurement learning area. Nama Aydın (2014) also taught the 3rd-grade fractions subject according to GME and revealed the positive effect of GME on students' achievement. The study conducted by Uça (2014) aimed to reveal how 4th-grade students follow a path in their comprehension processes regarding decimal fractions using GME.

As a result of the study, it was found that the students were able to reach from the part to the whole with the measurement processes they performed through the activities of weighing masses developed according to GME, reading decimal fractions intuitively, and establishing a relationship between the part and the whole, It was concluded that they expressed the pronunciations of decimal fractions based on the pronunciations of whole number fractions, made sense of whole number decimal fractions based on the connection of whole number fractions, and reached decimal fraction knowledge based on fraction and decimal fraction connections. In the study conducted by Kurt (2015), the effects of GME on students' achievement in teaching the 4th-grade topic of measuring lengths were examined.

The study results show that the GME-supported teaching method applied to the experimental group in teaching the subject "Measuring Lengths" increased students' achievement. Çilingir (2015) conducted a study to examine the effect of teaching with realistic mathematics education on the visual mathematics literacy and problem-solving skills of 4th-grade students and found that GME positively affected academic achievement. Sukri (2017) conducted a study to determine the effect of Realistic Mathematics Education through integrative thematic learning on the academic achievement of fourth-grade students and found that Realistic Mathematics Education had a significant effect on academic achievement in primary school compared to traditional conventional thematic learning. Herman, Arnawa, and Ardipal (2018) examined the effect of GME on the mathematics achievement of Islamic primary school students.

As a result of the study, they concluded that GME increased academic achievement. Özkürkçüler (2019) used the GME approach in teaching the sub-learning areas of "Measuring Time, Area and Length Measurement". The study aimed to determine the effects of the GME approach on the academic achievement of 4th-grade students. The results of the study show that GME has a positive effect on students' academic achievement. The result of Kan (2019), who examined the effect of GME on student achievement in teaching Fractions to 4th-grade students, is similar to the result of this study and reveals that GME has a positive effect on students'

academic achievement. The results of the study conducted by Astuti, Gunarhadi, and Mintasih (2020) to examine whether there are differences in mathematics learning outcomes between 2nd-grade students learning with the GME approach and 2nd-grade students learning with scientific models show that GME has a positive effect on academic achievement.

The results of the study conducted by Uskun Aytekin, Çil, and Kuzu (2021) to determine the effect of GME on the academic achievement of 4th-grade students reveal that GME increases students' academic achievement. The result of Sancu's (2022) study, which was conducted to determine the effect of GME on the academic achievement of 2nd-grade students in teaching addition and subtraction operations in natural numbers, reveals that GME is effective in increasing students' academic achievement. In the study by Çiftçi (2022), teaching the subject of money to 2nd-grade students was carried out with Scratch-supported GME activities. As a result of the study, it was determined that activities based on Scratch-supported GME had a positive effect on students' academic achievement. As a result of the study conducted by Akış (2022) to examine the effect of the GME approach supported by metacognitive strategies on the academic achievement of 3rd-grade primary school students, it was determined that the GME approach supported by metacognitive strategies had a positive effect on student's academic achievement, in the study conducted by Filiz (2022) aimed to examine the effect of teaching with GME on the academic achievement of 3rd-grade students with the risk of math learning disabilities. As a result of the study, it was seen that it contributed to the learning of students with the risk of math learning difficulties.

When the literature was examined, no study on using digital stories in mathematics lessons at the primary school level was found. It is seen that there are very few studies conducted at different levels. The results of the study conducted by Neimi and Niu (2019), which investigated the effect of digital stories on enhancing self-efficacy in mathematics learning among Chinese primary school students aged 11, are similar to this study, indicating that digital stories positively affect students' mathematics learning. Similar to the results of this study, Katipoğlu, Katipoğlu, and Sezer (2021) determined that stories were effective in increasing students' achievement due to their study on decimals in the 5th-grade mathematics course using the storytelling method. The result of the study by Özpinar, Gökçe, and Aydoğan Yenmez (2017), which aimed to examine the effect of teaching activities in mathematics lessons by associating them with digital stories on the academic achievement of 8th-grade students, was different from the result of this study, which was that digital stories were not compelling in mathematics achievement. Similarly, Dinçer (2019) taught 6th grade "Whole Numbers and Algebraic Expressions" topics with digital stories created based on a context-based learning approach and examined the effects on students' academic achievement. Unlike the results of this study, the results obtained from the study reveal that digital stories created

according to the context-based learning approach are ineffective in increasing students' mathematics achievement.

As a result, studies in the literature show that GME is more effective than the current teaching method in increasing students' mathematics achievement. However, some studies show that using digital stories in mathematics lessons positively affects students' mathematics achievement, while others show no effect. One of the reasons the results obtained from the studies are different from the results of this study is that the studies were conducted with students at different grade levels and age groups. In addition, digital stories prepared according to GME were used in this study. This situation can be shown as another reason for the difference in the results.

Digital Stories Prepared According to GME and Mathematics Attitudes

The second sub-problem of the study was aimed to determine whether there was a significant difference between the math anxiety of the experimental group students who were taught with digital stories prepared according to GME and the control group students who were taught with the current method. As a result of the analyses made at the end of the application, it can be said that the mathematics attitudes of the experimental group using digital stories prepared according to GME and the control one and control 2 group students using the current method showed a significant difference from before to after the experiment and that the application had a positive effect on students' mathematics attitudes.

When the literature is examined, it is seen that there are studies examining students' attitudes towards mathematics. The study conducted by Çakıcı (2018) to examine the effect of digital story-based mathematics teaching on 4th-grade students' academic achievement, motivation and attitudes towards mathematics activities shows that digital stories positively affect students' mathematics attitudes.

Similarly, Dinçer (2019) taught the 6th-grade mathematics course Integer Numbers and Algebraic Expressions with digital stories created by the context-based learning approach. As a result of his study, Dinçer (2019) revealed that digital stories were effective in helping students form positive attitudes towards mathematics. Kan (2019) taught the primary school 4th grade fractions sub-learning area according to GME. The study examined the effect of GME on students' attitudes towards mathematics. The study by Kan (2019) revealed that GME influenced students' attitudes towards mathematics. Üzel (2007), as a result of his study in which he taught the 7th-grade "Equations and Inequalities with One Unknown in the First Order" unit by GME, concluded that GME was influential in developing students' positive attitudes towards mathematics course, similar to this study. The results of the study conducted by Özkaya and Yetim Karaca (2017) to determine the effects of GME on 5th-grade students' mathematics achievement and attitudes reveal that GME positively contributes to students' mathematics attitudes. Again, Işık (2019)

conducted a study to examine the effects of teaching the 11th-grade sequences subject with GME activities on student achievement and student attitudes towards mathematics. The results of the study conducted by Işık (2019) are similar to the results of this study and show that GME positively affects students' attitudes towards mathematics.

Korkmaz and Tutak (2017) taught the 7th-grade Transformation Geometry topic through activities prepared by GME and examined the effects of GME on academic achievement and mathematics attitude. Unlike this study, the results revealed that GME did not affect students' attitudes toward mathematics. Again, Korkmaz and Korkmaz (2017) taught the 8th-grade "EBOB-EKOK" subject according to GME. Unlike the previous study, the results of this study revealed that GME did not affect students' attitudes towards mathematics. Zakaria and Syamaun (2017) conducted a study to determine the effect of GME on high school student's academic achievement and attitudes. They found that although GME contributed positively to achievement, it did not affect mathematics attitudes differently than the traditional method. Likewise, the results of Liona's (2021) study to determine the effect of GME on high school students' mathematics achievement and attitudes towards mathematics show that, unlike this study, GME does not affect students' attitudes towards mathematics.

As a result, there are studies in the literature that show that GME and digital stories have a positive effect on students' attitudes toward mathematics. In addition, there are studies in the literature that show that GME does not have any effect on students' attitudes toward mathematics. In this study, the reasons for the significant and higher positive change in the mathematics attitudes of the students in the experimental group compared to the students in the control group may be that the activities carried out during the implementation process enabled the students to experience a sense of success by actively participating in the lessons, the activities were based on situations that the students were familiar with, group work was carried out during the activities, digital materials made the lessons fun and enabled all students to learn by having fun, and as a result, the students liked the mathematics course and developed positive attitudes by moving away from their prejudices about the mathematics course.

Digital Stories Based on GME and Mathematics Anxiety

The third sub-problem of the study was aimed to determine whether there was a significant difference between the math anxiety of the experimental group students who were taught with digital stories prepared according to GME and the control group students who were taught with the current method. The results of the two-factor ANOVA analysis for mixed measures revealed that the mathematics anxiety of the experimental group and control group students did not differ significantly from before to after the experiment ($p>.05$). This finding can be interpreted as that the

math anxiety levels of the students in the experimental group, in which digital stories prepared according to GME were used, and in the control group, in which the current method was used, did not change according to the method applied.

The literature shows that the effects of GME on students' attitudes are mainly investigated (Kan, 2019; Üzel, 2007; Özkaya & Yetim Karaca, 2017; Zakaria & Syamaun, 2017). Only one study investigated the effects of GME on students' math anxiety. Demir (2017) examined the effects of GME on students' mathematics anxiety, self-efficacy perception, academic achievement and retention. At the end of the study, unlike the results of this study, it was found that GME had a positive effect on reducing students' math anxiety.

The fact that mathematics has a structure that seems difficult and complex may cause students to have prejudices and negative thoughts towards mathematics (Civelek et al., 2003; Umay, 1996). This situation may even hinder mathematics teaching (Tatar et al., 2008; Ma & Xu, 2004; Yenilmez, 2006). Reducing or eliminating students' math anxiety may take a long time. As a matter of fact, according to Aydoğmuş (2010) and Özsevgeç (2006), an extended implementation period may be needed for research examining affective change. The reason why there was no significant difference between the students in the experimental group and the control group in terms of students' mathematics anxiety in this study may be that the implementation period of this study was not sufficient to bring about an effective change in terms of students' mathematics anxiety and the age group of the students was small.

Recommendations

As a result of the research, it was determined that digital stories prepared according to GME positively affected students' mathematics achievement and attitudes. However, digital stories prepared according to GME did not positively affect students' mathematics anxiety. This may have been caused by the fact that the implementation period was not long enough to bring about effective change. It may reduce students' mathematics anxiety if practitioners keep the implementation period of the research they will conduct on digital stories prepared according to GME longer. The fact that the implementation was carried out with a teacher other than the classroom teacher caused students to exhibit behaviours that negatively affected classroom management from time to time due to their young age group. In order to prevent this situation from happening again, practitioners can attend classes with the class's teacher for a certain period before the implementation process.

References

Akış, A. (2022). *Üstbilişsel stratejilerle desteklenen gerçekçi matematik eğitiminin üçüncü sınıf öğrencilerinin akademik başarıları, matematik tutumları ve üstbilişsel becerilerine etkisinin incelenmesi.* Yayımlanmamış Yüksek Lisans Tezi. Çukurova Üniversitesi, Sosyal Bilimler Enstitüsü, Sınıf Eğitimi Ana Bilim Dalı, Adana.

Akyüz, M. F. (2010). *Gerçekçi Matematik Eğitimi (RME) yönteminin ortaöretim 12. sınıf matematik (integral ünitesi) öğretiminde öğrenci başarısına etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Yüzüncü Yıl Üniversitesi, Fen Bilimleri Enstitüsü, Van.

Alacacı, C. (2016). Gerçekçi Matematik Eğitimi, E. Bingölbali, S. Arslan ve İ. Ö. Zembat içinde, *Matematik Eğitiminde Teoriler* (s. 341-353), Ankara: Pegem Akademi.

Alpar, D., Batdal, G. & Avcı, Y. (2007). Öğrenci merkezli eğitimde eğitim teknolojileri uygulamaları. *Hasan Ali Yücel Eğitim Fakültesi Dergisi, 7*, 19-31.

Altıparmak, K., Aklar, M. A. & Dursun, G. (2017). Bir günlüğüne matematik öğretmeni olsaydım, neler yapardım/yapmazdım: Öğrenci görüşleri. *YYÜ Eğitim Fakültesi Dergisi (YYU Journal of EducationFaculty), 14*(1), 1117-1140.

Astuti,N.R., Gunarhadi & Mintasih (2020). The effect of RME on mathematics learning outcomes viewed mathematic communication skills. *International Journal of Educational Research Review,5*(1),43-53.

Aydoğmuş, E. (2010). Lise 1 fizik dersi iş- enerji konusunun öğretiminde 5e modelinin öğrenci başarısına ve tutumuna etkisinin araştırılması. *Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi, 29, 83-94.*

Barnes, H. (2004). Realistic mathematics education: eliciting alternative mathematical conceptions of learners. *African Journal of Research in SMT Education, 8*(1), 53–64.

Barrett, H. (2006). Researching and evaluating digital storytelling as a deep learning tool. *Technology and Teacher Education International*, pp. *1*, 647–654.

Barret, H. C. (2009). *How to create simple digital stories*. http://electronicportfolios.com/digistory/howto.html

Baykul, Y. (1999). *İlköğretimde etkili öğretme ve öğrenme el kitabı, ilköğretimde matematik öğretimi (Modül 6).* Ankara: Milli Eğitim Yayınları.

Bonotto, C. (2005). How informal out-of-school mathematics can help students make sense of formal in-school mathematics: The case of multiplying by decimal numbers. *Mathematical Thinking and Learning, 7*(4), 313–344.

Bromberg, N. R., Techatassanasoontorn, A. A. & Andrade, A. D. (2013). Engaging students: Digital Storytelling in information systems learning. *Pacific Asia Journal of the Association for Information Systems, 5*(1), 1-22.

Burmark, L. (2004). Visual presentations that prompt, flash, and transform. *Media and Methods,40*(6), 4–5.

Büyükcengiz, M. (2017*). Dijital öyküleme metodunun ortaokul öğrencilerinin fen bilimleri dersi akademik başarı, bilimsel süreç becerileri ve derse yönelik tutumlarına etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Akdeniz Üniversitesi, Eğitim Bilimleri Enstitüsü, İlköğretim Anabilim Dalı, Antalya.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2011). *Bilimsel araştırma yöntemleri*. Ankara: Pegem Akademi.

Can, M. (2012). *İlköğretim 3. sınıflarda ölçme konusunda gerçekçi matematik eğitimi yaklaşımının öğrenci başarısına ve öğrenmenin kalıcılığına etkisi,* Yayımlanmamış Yüksek Lisans Tezi. Abant İzzet Baysal Üniversitesi, Eğitim Bilimleri Enstitüsü, İlköğretim Anabilim Dalı, Sınıf Öğretmenliği Bilim Dalı, Bolu.

Cansız, Ş. (2015). *Gerçekçi matematik eğitimi yaklaşımının öğrencilerin matematik başarısına ve yaratıcı düşünme becerilerine etkisi,* Yayımlanmamış Doktora Tezi. Atatürk Üniversitesi, Eğitim Bilimleri Enstitüsü, Ortaöğretim Fen ve Matematik Alanları Eğitimi Anabilim Dalı, Erzurum.

Cengiz, S. & Eğmir, E. (2022). The effect of realistic mathematics education on academic achievement, motivation and retention of fifth-grade students. *Universal Journal of Educational Research 10*(3), 225-239.

Civelek, Ş., Meder, M., Tüzen, H. & Aycan, C. (2003). Matematik öğretiminde karşılaşılan aksaklıklar. http://www.matder.org.tr/Default.asp?id=10

Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches*. USA: SAGE Publications.

Çakır, P. (2013*). Gerçekçi matematik eğitimi yaklaşımının ilköğretim 4. Sınıf öğrencilerinin erişilerine ve motivasyonlarına etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, Sınıf Öğretmenliği Programı, İzmir.

Çiçek, M. (2018). *Dijital hikâyeleme yöntemini kullanmanın altıncı sınıf fen bilimleri dersindeki etkisinin incelenmesi: bir karma yöntem araştırması.* Yayımlanmamış Doktora Tezi. Ortadoğu Teknik Üniversitesi, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü, Ankara.

Çiftçi, K. (2022). *Scratch destekli gerçekçi matematik eğitiminin paralarımız alt öğrenme alanındaki akademik başarı ve kalıcılığa etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Erzincan Binali Yıldırım Üniversitesi, Sosyal Bilimler Enstitüsü, Erzincan.

Çilingir, E. (2015). *Gerçekçi matematik eğitimi yaklaşımının ilkokul öğrencilerinin görsel matematik okuryazarlığı düzeyine ve problem çözme becerilerine etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Çukurova Üniversitesi, Sosyal Bilimler Enstitüsü, Sınıf Öğretmenliği Anabilim Dalı, Adana.

Demir, G. (2017). *Gerçekçi matematik eğitimi yaklaşımının meslek lisesi öğrencilerinin matematik kaygısına, matematik özyeterlik algısına ve başarısına etkisi,* Yayımlanmamış Yüksek Lisans Tezi. Adnan Menderes Üniversitesi, Sosyal Bilimler Enstitüsü, Eğitim Bilimleri Anabilim Dalı, Eğitim Programları ve Öğretim Programı, Aydın.

Demirbaş, İ. (2019). *Dijital öykülerin ilkokul öğrencilerinin dinlediğini anlama ve yaratıcı yazma becerilerine etkisi.* Yayımlanmamış Doktora Tezi. Kırşehir Ahi Evran Üniversitesi Sosyal Bilimleri Enstitüsü, Temel Eğitim Ana Bilim Dalı, Sınıf Eğitimi Bilim Dalı, Kırşehir.

Demirer, V. (2013). *İlköğretimde e-öyküleme kullanımı ve etkileri.* Yayımlanmamış Doktora Tezi. Necmettin Erbakan Üniversitesi, Eğitim Bilimleri Enstitüsü, Konya.

Dinçer, B. (2019). *Dijital hikaye temelli matematik öğretiminin ortaokul öğrencilerinin kavram öğrenmeleri üzerine etkileri.* Yayımlamamış Doktora Tezi. Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, İlköğretim Anabilim Dalı, İlköğretim Matematik Öğretmenliği Programı, İzmir.

Doğan, B. (2007). *Implementation of digital storytelling in the classroom by teachers trained in a digital storytelling workshop*. Unpublished Doctoral Dissertation. University of Houston, Texas.

Doğan, Y. (2007). İlköğretim çağındaki 10-14 yaş grubu öğrencilerinin gelişim özellikleri. *U.Ü. Fen-Edebiyat Fakültesi Sosyal Bilimler Dergisi, 8*(13), 155-187.

Dupain, M. & Maguire, L. (2005). Digital Storybook Projects 101: How to create and implement digital storytelling into the curriculum, in *21st Annual Conference on Distance Teaching and Learning, p. 6*, 2014.

Erdoğan, H. (2018). *Gerçekçi matematik eğitimine dayalı matematik öğretiminin akademik başarı, kalıcılık ve yansıtıcı düşünme becerisine etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Pamukkale Üniversitesi, Eğitim Bilimleri Enstitüsü, Eğitim Bilimleri Anabilim Dalı, Eğitim Programları ve Öğretim Bilim Dalı, Denizli.

Fauzan, A. (2002). *Applyıng realistic mathematics education (RME) in teaching geometry in Indonesian primary schools.* Unpublished Doctoral Dissertation. University of Twente.

Filiz, T. (2022). *Matematik öğrenme güçlüğü riski olan öğrenciler için gerçekçi matematik eğitimi ile öğretim tasarım modeli geliştirme, uygulama ve değerlendirme.* Yayımlanmamış Doktora Tezi. Trabzon Üniversitesi, Temel Eğitim Anabilim Dalı, Sınıf Öğretmenliği Eğitimi Bilim Dalı, Trabzon.

Gravemeijer, K.P.E. (1999). Developmental research: Fostering a dialectic relation between theory and practice. In J. Anghileri (Ed.), *Principles and Practice in Arithmetic Teaching.* London: Open University Press.

Green, M.R. (2011). *Teaching the writing process through digital storytelling in pre-service education.* Unpublished Doctoral Dissertation, University of Texas A&M: USA.

Gülburnu, M. ve Yıldırım, K. (2015*).* İlkokul ve ortaokul öğrencilerine yönelik matematik tutum ölçeği geliştirilmesi ve uygulanması. *VI. Uluslararası Türkiye Eğitim Araştırmaları Kongresi,* Ankara.

Hadi, S. (2002). Effective teacher professional development for the implementation of realistic mathematics education in Indonesia. Enschede: Doctoral dissertation, University of Twente.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education, pp. 21*, 33–46.

Herman, M. Arnawa M. & Ardipal (2018). The effect of realistic mathematic education (RME) toward motivation and learning achievement of the fourth-grade elementary students. *Advances in Social Science, Education and Humanities Research, 178*, 508-511.

Hung, C.M., Hwang, G.J., & Huang, I. (2012). A project-based digital storytelling approach for improving students' learning motivation, problem-solving competence and learning achievement. *Educational Technology & Society, 15*(4), 368-379.

Işık, S. (2019). *Diziler konusunun gerçekçi matematik eğitimi etkinlikleriyle öğretiminin öğrenci başarısına matematik tutumuna etkisi ve öğrenci görüşlerinin incelenmesi.* Yayımlanmamış Doktora Tezi. İnönü Üniversitesi, Eğitim Bilimleri Enstitüsü, Matematik Eğitimi Bilim Dalı, Malatya.

Işıtan, H. & Doğan, M. (2018). Gerçekçi Matematik Eğitiminin tam sayılar konusundaki başarı ve kalıcılığa etkisi. *Medeniyet Eğitim Araştırmaları Dergisi, 1*(1), 1-9.

İnceelli, A. (2005). Dijital hikâye anlatımının bileşenleri. *The Turkish Online Journal of Educational Technology, 4*(3), 132–142.

Kahraman, Ö. (2013*). Dijital hikâyecilik metoduyla hazırlanan öğretim materyallerinin öğrenme döngüsü giriş aşamasında kullanılmasının fizik dersi başarısı ve motivasyonu düzeyine etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Balıkesir Üniversitesi, Fen Bilimleri Enstitüsü, Balıkesir.

Kan, A. (2019). *İlkokul 4. sınıf kesirler alt öğrenme alanı için gerçekçi matematik eğitimi yönteminin öğrenci başarısına etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Ege Üniversitesi, Sosyal Bilimler Enstitüsü. İzmir.

Karasar, N. (2009) *Bilimsel araştırma yöntemleri.* Nobel Yayınları, Ankara.

Katipoğlu, S. N., Katipoğlu, M. & Sezer, S. (2021). The effect of teaching maths through storytelling on students' math achievement. *Academy Journal of Educational Sciences, 5*(1), 15-26.

Kaya, M. F. (2019). İlkokul öğretim programlarının teknoloji entegrasyonu bakımından incelenmesi. *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi, 20*, 1063-1091.

Kaylak, S. (2014). *Gerçekçi matematik eğitimine dayalı ders etkinliklerinin öğrenci başarısına etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Necmettin Erbakan Üniversitesi, Eğitim Bilimleri Enstitüsü, İlköğretim Anabilim Dalı, Matematik Eğitimi Bilim Dalı, Konya.

Khazaal, H. F. (2015). Problem-solving method based on e-learning system for engineering education. *Journal of College Teaching & Learning, 12*(1), 1-12.

Korkmaz, E. & Tutak, T. (2017). Dönüşüm geometrisi konularının gerçekçi matematik eğitimi etkinlikleriyle işlenmesinin öğrenci başarısına ve matematik tutumuna etkisi. *Disiplinlerarası Eğitim Araştırmaları Dergisi, 1*(2), 30-42.

Korkmaz, E. & Korkmaz, C. (2017). Ebob-Ekok konusunun gerçekçi matematik eğitimi etkinlikleriyle öğretiminin başarı ve tutuma etkisi. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 14*(39), 504-523.

Korthagen, F. & Russell, T. (1999). *Building teacher education on what we know about teacher development. Annual Meeting of the American Educational Research Association (AERA)*, Montreal, Canada.

Kulla Abbott, T.M. (2006). *Developing literacy practices through digital storytelling.* Unpublished Doctoral Dissertation. University of Missouri, St. Louis.

Kurt, E. S. (2015). *Gerçekçi matematik eğitiminin uzunluk ölçme konusunda başarı ve kalıcılığa etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Ondokuz Mayıs Üniversitesi, Eğitim Bilimleri Enstitüsü, İlköğretim Eğitimi Ana Bilim Dalı, Samsun.

Le, T. A. (2006). *Applying Realistic Mathematics Education in Vietnam: Teaching middle school geometry.* Unpublished Doctoral Dissertation. Mathematisch-Naturwissenschaftlichen Fakultät der Universität Potsdam.

Lestari, L. & E. Surya, (2017). The effectiveness of realistic mathematics education approach on students' mathematical concept understanding ability. *International Journal of Sciences: Basic and Applied Research, 34*(1), 91-100.

Liona, P. S. G. (2021). The effect of RME curriculum materials in the achievement and attitude of low attainers multigrade class. *2019 MATHTED International Conference*, p. 24-26 October 2019.

Ma, X. & Xu, J. (2004). The causal ordering of mathematics anxiety and achievement: A longitudinal panel analysis. *Journal of Adolescence, 27*(2), 165-179.

Mutlu, Y. & Söylemez, İ. (2018). İlkokul 3. ve 4. sınıf çocukları için matematik kaygı ölçeği; Güvenirlik ve geçerlik çalışması. *EKEV Akademi Dergisi, 73*, 429-441.

Nama Aydın, G. (2014). *Gerçekçi matematik eğitiminin ilkokul 3. sınıf öğrencilerine kesirlerin öğretiminde başarıya kalıcılığa ve tutuma etkisi,* Yayımlanmamış Yüksek Lisans Tezi. Abant İzzet Baysal Üniversitesi, Eğitim Bilimler Enstitüsü, Eğitim Programları ve Öğretimi Anabilim Dalı, Bolu.

Neimi, H., Niu, S., Vivitsou, M. & Li, B. (2018). Digital storytelling for twenty-first-century competencies with math literacy and student engagement in China and Finland. *Contemporary Educatıonal Technology, 9*(4), 331-353.

Ohler, J. (2008). *Digital storytelling in the classroom: New media pathways to literacy, learning, and creativity*. Thousand Oaks, CA: Corwin Press.

Öğüt, A. (2003). *Bilgi çağında yönetim.* Ankara: Nobel Yayıncılık.

Ömrüuzun, I. (2019). *Okul öncesi öğretmenlerinin teknoloji kullanımlarını etkileyen faktörler: Bir yol analizi çalışması.* Yüksek Lisans Tezi. Eğitim Bilimleri Enstitüsü, Hacettepe Üniversitesi, Ankara.

Özcan, S., Kukul, V. & Karataş, S. (2016). Dijital hikâyeler için dereceli değerlendirme ölçeği. *10th International Computer and Instructional Technologies Symposium (ICITS),* 16-18 May 2016.

Özçelik, A. (2015). *7. sınıf yüzdeler ve faiz konusunun gerçekçi matematik eğitimine dayalı olarak işlenmesinin öğrencilerin başarı ve tutumlarına etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Fırat Üniversitesi, Eğitim Bilimleri Enstitüsü, İlköğretim Anabilim Dalı, Elazığ.

Özdemir, E., & Üzel, D. (2011). Gerçekçi matematik eğitiminin öğrenci başarısına etkisi ve öğretime yönelik öğrenci görüşleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *40*, 332-343.

Özkaya, A. (2015). *5. sınıf matematik dersinde gerçekçi matematik eğitimi destekli öğretimin öğrenci başarısına, tutumuna ve matematik öz bildirimine etkisi.* Yayımlanmamış Doktora Tezi. Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü. Ankara.

Özkaya, A. & Yetim Karaca S. (2017). The effects of Realistic Mathematics Education on students' achievements and attitudes in fifth grades mathematics courses. *International Online Journal of Education and Teaching (IOJET), 4*(2). 185-197.

Özkürkçüler, L. (2019). *Gerçekçi matematik eğitimine dayalı öğretimin 4. sınıf öğrencileri üzerindeki etkileri.* Yayımlanmamış Yüksek Lisans Tezi. Aydın Adnan Menderes Üniversitesi Sosyal Bilimler Enstitüsü Temel Eğitim Anabilim Dalı, Aydın.

Özpınar, İ., Gökçe, S ve Aydoğan Yenmez, A. (2017). Effects of digital storytelling in mathematics ınstruction on academic achievement and examination of teacher-student opinions on the process. *Journal of Education and Training Studies, 5*(10), 137-149.

Özsevgeç, T. (2006). Kuvvet ve hareket ünitesine yönelik 5E modeline göre geliştirilen öğrenci rehber materyalinin etkililiğinin değerlendirilmesi. *Journal of Turkish Science Education, 2(3), 36–48.*

Robin, B. (2006). The educational uses of digital storytelling. C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference, 2006* (pp. 709–716). Chesapeake, VA: AACE.

Sadık, A. (2008). Digital storytelling: A meaningful technology-integrated approach for engaged student learning. *Educational Technology Research and Development*, *56*(4), 487–506.

Sancu, A. (2022). *Gerçekçi matematik eğitimi (gme) destekli öğretimin ilkokul ikinci sınıf öğrencilerinin problem çözme ve kurma başarılarına, öğrenmenin kalıcılığına ve öz yeterlilik algılarına etkisi.* Yayımlanmamış Yüksek Lisans Tezi. İstanbul Medeniyet Üniversitesi, Temel Eğitim Anabilim Dalı, Sınıf Eğitimi Bilim Dalı, İstanbul.

Signes, C. G. (2010). *Practical uses of digital storytelling.* Researchgate, https://www.researchgate.net/publication/253907387_PRACTICAL_USES_OF_DIGITAL_STORYTELLING

Sönmez, V. (1997). *Program geliştirmede öğretmen el kitabı.* Ankara: Anı Yayıncılık.

Strang, R. (1960). *Helping your gifted child.* New York: E.P. Dutton & Company Incorporated.

Sukri, Y. F. (2017). The effects of RME approaches on motivation and learning achievement of students through thematic-integrative learning. *The First International Conference of the CRN Child Science Exchange Program in Asia is March 4 to 5 in Shanghai, China*.

Şahin, F. (2004). Ortaöğretim öğrencilerinin ve üniversite öğrencilerinin matematik korku düzeyleri. *Eğitim Bilimleri ve Uygulama, 3*(5), 57-74.

Tashakkori, A. & Creswell, J. W. (2007). The new era of mixed methods. *Journal of Mixed Methods, 1*(1), 2-8.

Tatar, E., Okur, M. ve Tuna, A. (2008). Ortaöğretim matematiğinde öğrenme güçlüklerinin saptanmasına yönelik bir çalışma. *Kastamonu Eğitim Dergisi, 16* (2), 507-516.

Tatlı, Z. & Bayramoğlu, A. (2015). Öğretmenlik uygulaması sürecinin dijital öyküler ile yansıtılması. *Journal of Instructional Technologies & Teacher Education, 4*(2), 16-28.

Uça, S. (2014). *Öğrencilerin ondalık kesirleri anlamlandırmasında gerçekçi matematik eğitimi kullanımı: bir tasarı araştırması.* Yayımlanmamış Doktora Tezi. Adnan Menderes Üniversitesi, Sosyal Bilimler Enstitüsü, Eğitim Bilimleri Anabilim Dalı. Aydın.

Ulusoy, S. (2019). *Dijital hikâye destekli örnek olaya dayalı öğrenme ortamlarının fen öğrenme üzerindeki etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Uşak Üniversitesi, Fen Bilimleri Enstitüsü, İlköğretim Anabilim Dalı, Fen Bilgisi Eğitimi Bilim Dalı, Uşak.

Umay, A. (1996). Matematik eğitimi ve ölçülmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 12*, 145-149.

Uskun Aytekin, K., Çil, O. ve Kuzu, O. (2021). Gerçekçi matematik eğitiminin dört işleme yönelik problem kurma ve çözme becerisi ile akademik başarıya etkisi. *Journal of Qualitative Research in Education, 28*, 22-50.

Uslu, A. (2019). *İşbirlikli dijital hikaye anlatımının ilkokul 4. Sınıf öğrencilerinin yaratıcı yazma ve sosyal duygusal öğrenme becerilerine etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Manisa Celal Bayar Üniversitesi, Sosyal Bilimler Enstitüsü, Manisa.

Üzel, D. (2007). *Gerçekçi matematik eğitimi (RME) destekli eğitimin ilköğretim 7. Sınıf matematik öğretiminde öğrenci başarısına etkisi.* Yayımlanmamış Doktora Tezi. Balıkesir Üniversitesi, Fen Bilimleri Enstitüsü, Balıkesir.

Üzel, D. & Uyangör, S. (2006). Attitudes of 7th class students toward mathematics in realistic mathematics education. *International Mathematical Forum, 1*(39), 1951-1959.

Verdugo, D. R. & Belmonte, I.A. (2007). Using digital stories to improve listening comprehension with young Spanish learners of English. *Language Learning & Technology, 11*(1), 87-101.

Verschaffel, L., & De Corte, E. (1997). Teaching realistic mathematical modelling in the elementary school: A teaching experiment with fifth graders. *Journal for Research in Mathematics Education, 28,* 577- 601.

Wang, S. & Zhan, H. (2010). Enhancing teaching and learning with digital storytelling. *International Journal of Information and Communication Technology Education (IJICTE), 6*(2), 76-87.

Xu, Y., Park, H., & Baek, Y. (2011). A new approach toward digital storytelling: An activity focused on writing self-efficacy in a virtual learning environment. *Educational Technology & Society, 14*(4), 181–191.

Yenilmez, K. (2006). Velilerin matematik eğitiminde çocuklarına sağladıkları katkı düzeyleri üzerine bir araştırma. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 6*(1), 13-29.

Yetim Karaca, S. & Karaca, A. (2017). The effects of realistic mathematics education on students' math self-reports in fifth grades mathematics course. *International Journal of Curriculum and Instruction 9*(1), 81–103.

Yıldırım, A., & Şimşek, H. (2011). *Sosyal bilimlerde nitel araştırma yöntemleri* (8. Baskı). Ankara: Seçkin Yayıncılık.

Yılmaz, M. (2019). *Program görselleştirme aracıyla gerçekleştirilen dijital öyküleme etkinliklerinin yaratıcı problem çözme becerisi ve bilgisayara yönelik tutum üzerindeki etkisi.* Yayımlanmamış Yüksek Lisans Tezi. Atatürk Üniversitesi, Eğitim Bilimleri Enstitüsü, Bilgisayar ve Öğretim Teknolojileri Eğitimi Ana Bilim Dalı, Erzurum.

Yoon, T. (2013). Are you digitised? Ways to motivate cells using digital storytelling. *International Journal of Research Studies in Educational Technology, 2*(1), 25–34.

Yorulmaz, A. & Doğan, M. C. (2019). İlkokul dördüncü sınıf öğrencilerinin gerçekçi matematik eğitimine ilişkin görüşlerinin incelenmesi. *Eğitim Kuram ve Uygulama Araştırmaları Dergisi, 5*(2), 153-162.

Yüksel, P., Robin, B. & McNeil, S. (2011). Educational uses of digital storytelling all around the world. In *Society for Information Technology and Teacher Education International Conference* (pp. 1264-1271). Association for the Advancement of Computing in Education (AACE).

Zakaria, E. & Syamaun, M. (2017). The effect of realistic mathematics education approach on students' achievement and attitudes towards mathematics. *Mathematics Education Trends and Research, 1*, 32-40.

Zulkardi, Z. (2002). *Developing a learning environment on realistic mathematics education for Indonesian student teachers.* Unpublished Doctoral Dissertation. Universiteit Twente, Enschede.

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This article is based on the first author's PhD thesis. The first author contributed to the data analyses and the writing of the research article. At the same time, the second author supervised the thesis, contributed his expertise in the field of evaluation and coordinated the research process.

Conflict of Interest

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