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Investigation of the effect of guided inquiry approach supported by digital stories on attitude towards inquiry

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Abstract

This study aims to examine the effects of inquiry activities supported by digital storytelling on the attitudes of 6th-grade students towards inquiry, sub-dimensions of attitudes, and the change of attitudes depending on gender. The method of the study was determined as the embedded design, one of the mixed method research designs. The study was carried out with a total of 27 students, 12 female and 15 male. In the quantitative dimension of the study, one group pretest-posttest research design was used. Quantitative data were obtained through the Attitude Scale towards Research-Questioning. The qualitative dimension of the study was designed as a case study model. Qualitative data were obtained by using researcher diaries, student group diaries, and semi-structured weekly focus group interviews. As a result, a statistically significant difference was found between the students' ASTRQ pretest-posttest scores in favor of the posttest. Similarly, a statistically significant difference was found between the pre-test and post-test scores of the sub-factors of signification and avoiding, excluding the curiosity factor, in the attitude scale. These results were also supported by the findings obtained from qualitative measurement tools. The students' ASTRQ post-test scores differed statistically according to gender, which was in favor of female students.

1. Introduction

According to research, students' scientific inquiry skills are not static and are influenced by both cognitive and emotional aspects (Borovay et al., 2019; Kuhn et al., 2000; Miklíková, 2018). These can include scientific curiosity and motivation, as well as learning settings that are supported by inquiry activities (Sadeh & Zion, 2012). However, attitudes that develop in the process can also be effective. Attitude is a pre-reaction tendency in cognitive, emotional, and behavioral integrity. In this process, people organize everything that is animate-inanimate, abstract-concrete, has a psychological meaning for them or is based on their experiences and knowledge (Güney, 2014). Although teaching attitudes is much more difficult than acquiring skills, it is possible to create learning environments based on experiences and course contents that support the development of useful attitudes in lessons (Loxley et al., 2016). According to John Dewey (1916), students' scientific attitudes need to be developed to raise individuals who think and question (Huyugüzel Çavaş & Çavaş, 2014; Öztürk, 2008). According to Tuan et al. (2005), in a scientific inquiry environment, students have the opportunity to participate in creating research questions, conduct research, achieve individual results and share their findings with other

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students. According to instructors and students, the inquiry-based learning approach fosters higher-order thinking and leads to an in-depth comprehension. It also aids in the development of autonomous working abilities in terms of designing and executing scientific investigations, as well as the interpretation of results (Trautmann et al., 2004). In the process, they gain more than their previous learning in terms of increasing active learning strategies. Inquiry activity improves students' positive attitudes towards science learning (Gibson & Chase, 2002; Habelliaa & Suyantaa, 2019; Sangkala & Doorman, 2019). Studies report that students' attitudes and interests increase after participating in the inquiry activity draw attention (Toma, 2021; Tuan et al., 2005). Students who learn how it feels when a question completely occupies the mind in the classroom environment can carry the effect of this feeling to their daily lives (Bruner, 2014). Even if it is not possible for students to find the answers to all the questions with their own experiences, when the questions belong to them, curiosity and interest will increase, and they will be more willing to arrive at answers by using information sources through inquiry (Loxley et al., 2016). A thinker's most precious potentials are clever guesswork, creative hypotheses, and a step towards an imprecise conclusion (Bruner, 2014). The research-inquiry approach emerges in learning environments that will guide students to gain this skill. Inquiry learning is compatible with the constructivist approach, which emphasizes the active development of knowledge by the student (Zion & Mendelovici, 2012). It means that students develop various attitudes and skills in the process of acquiring knowledge (Tuan et al., 2005; Trautmann et al., 2004).

The inquiry approach has been adopted in the Science Course curriculum, which has been updated by the needs of the age and new approaches. With the inquiry-based learning strategy, it is aimed that students take an active part in both the "exploration and experiment" and "research and argument creation" processes (MEB, 2013). In the inquiry-based learning approach, the student assumes the role of actively participating in the lesson, being responsible for their learning and questioning. The teacher creates a democratic classroom environment in which students can develop their thinking and communication skills by expressing themselves in writing, verbally and visually, and encourages the student (MEB, 2018). Following teacher and student roles, related research in the literature place the most emphasis on the learning environment (Demirkan, 2016; Gül, 2011; Kaplan Parsa, 2016). The environment in which the lessons taught with the inquiry approach take place is a democratic and student-centered environment where it is easy to access the internet and computers, where resources other than textbooks are available, and desks are organized and suitable for group work. The most important thing in the inquiry approach is that students go through a process in which they actively use their research skills (Kaplan Parsa, 2016).

When students are taught with inquiry-based learning activities:

• They participate in the scientific questioning process,

• They give priority to evidence when answering questions,

• They make explanations based on evidence,

• They make connections between explanations and scientific knowledge,

• They share and present their explanations with others (Köseoğlu & Tümay, 2015).

Accordingly, students who actively participate in the inquiry process learn, step by step, how to address challenges they may face in the future (Senemoğlu, 2013). In the inquiry-based activity process, the stage of asking questions is of great importance (Karamustafaoğlu & Yaman, 2015). The teacher needs to ask questions of medium difficulty that will lead the students to a conclusion (Bruner, 2014). However, prospective teachers think that there may be difficulties in guiding students, attracting attention and arousing curiosity, and writing problem sentences (Bayram, 2015). "Asking questions", which is the basis of the inquiry approach, for some students, may be the most challenging aspect of the process. In this case, art, drama, poetry, and storytelling provide the necessary potential to engage students and make them ask more questions (Loxley et al., 2016).

This method is heard more and more as the variety of technologies and materials to support the inquiry learning experience as an educational tool increases and their use becomes more widespread. While there is some criticism, the majority of educators agree on the potential benefits of opportunities for students to engage in genuine inquiry (Kuhn et al., 2000). As a matter of fact, studies have revealed that science lessons suitable for the inquiry approach supported by various methods and techniques positively affect students' inquiry skills, inquiring thinking skills, attitudes towards inquiry, and their views and perceptions towards inquiry (Chen & Howard, 2010; Kaplan Parsa, 2016; Koyunlu Ünlü, 2015; Öz, 2015; Özer, 2019; Sağlamer Yazgan, 2013).

The integration of technology into teaching is now a necessity in this age. There is no standard way for technology integration in the literature (Yavuz Konokman & Yanpar Yelken, 2016). This situation may change according to some features such as the suitability of the technology to be used for the learning method and the level of the student, and the physical conditions arising from the learning environment. In the literature, it is emphasized that technology support is needed in the development of middle school students' inquiry skills (Koyunlu Ünlü, 2015; de Jong, 2006; van Joolingen et al., 2006). Since science concepts are difficult to understand for students at this level, supporting the process with visual and auditory tools will make learning meaningful and permanent. In particular, abstract concepts need to be embodied with appropriate technological tools (Gülen & Demirkuş, 2014; Uysal & Bostan Sarıoğlan, 2020). The best learning can be achieved with the simultaneous use of all senses. Technology-based educational materials, multimedia (multi-media) best serve this type of learning (Yanpar Yelken, 2015). Among the science subjects, it is recommended that astronomy subjects should be given with as many examples as possible, abstract concepts should be concretized with pictures and videos, and models should be used (Ekiz & Akbaş, 2005). In this way, it can be ensured that students visualize the concepts (Demirçalı, 2016). Uysal and Bostan Sarıoğlan (2020) taught the subject of solar eclipse with 6th grade students with the support of animation. Animation was used in the discovery step of the 5E learning model. They stated that they used the animation since the solar eclipse is not frequently encountered in daily life and it is not possible to observe the solar eclipse during the teaching process. One of the technological tool that can support inquiry activities in science lessons is the digital story method (Gıannakou & Klonarı, 2019; Yavuz Konokman & Yanpar Yelken, 2016).

The digital story method is about researching any subject, writing a script, creating an interesting story, bringing together and recording the story with multimedia tools such as appropriate sound, music, graphics in the computer environment (Robin, 2008). According to Barrett (2005), in the realm of education, digital stories are a synthesis of four student-centered learning strategies: student involvement, reflection for deep learning, technological integration, and project-based learning.

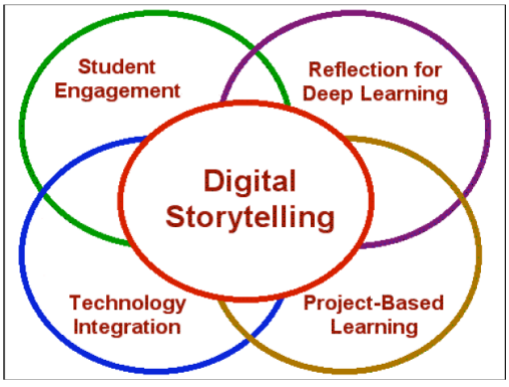

Fig. 1. Student-centered learning strategies convergence (Barrett, 2005)

It has been determined that digital stories prepared by students in constructivist learning environments support learning and increase students' participation and success in the lesson (Dorr, 2017; Francis, 2018; Hung et al., 2012). Studies in which digital stories are integrated into lessons are common, guided by the

technological possibilities of schools and the limitations of time management. The success of digital storytelling depends on several factors, including access to technology, appropriate user training and ongoing technical support. If this method is effectively integrated into the classroom, it has the potential to be a powerful teaching tool in K-12 education (Dogan & Robin, 2008). Digital stories used in the field of education have positive effects on various areas such as research, gaining technical knowledge and skills, supporting classroom discussions, providing motivation, providing permanent learning, and improving literacy skills (Campbell, 2012; Dogan & Robin, 2008; Robin, 2008). The use of digital stories in courses is helpful in grabbing students' attention and establishing a creative and open-ended learning environment, and it is regarded highly by educational scholars in terms of mixing technology with pedagogy (Kocaman Karaoğlu, 2015; Smilack, 2007).

According to Robin (2008), digital stories used in lessons i) enable students to participate in the course content, ii) facilitate discussion about the topics presented in the story, iii) make the abstract conceptual content more understandable, iv) increase students' attention and interest in discovering new ideas. In this context, it is thought that the visual and auditory concrete representation of the Solar System and Eclipses is important in preparing students for inquiry activities.

Considering all these explanations, one can deduce that digital stories can be used to attract students' attention at the introductory stage of inquiry-based courses, create a discussion environment in the classroom, and enable students to present a problem situation.

Aim

This study aims to examine the effects of inquiry activities supported by digital storytelling on the attitudes of 6th-grade students towards inquiry, sub-dimensions of attitudes, and the change of attitudes depending on gender and also to determine the thoughts of the students about the applications. In this regard, the following research questions were addressed in this study:

1.1. Do guided inquiry activities supported by digital stories have a statistically significant impact on 6th-grade students' attitudes towards inquiry?

1.2. What are the thoughts of the focus group students on the concepts of research and questioning before and after the application?

2.1. Is there a statistically significant difference between the Attitude Scale towards Research-Questioning sub-dimension pretest and posttest scores?

2.2. What are the feelings and thoughts of the students that affect the sub-dimensions of attitudes about the knowledge and activities they learn?

3. Is the difference between the pretest and posttest scores obtained from the Attitude Scale towards Research-Questioning depending on gender statistically significant?

2. Methodology

2.1. Model of the Research

In this study, the embedded mixed approach was considered. The mixed method, under the pragmatist philosophy, aims to examine the research question in a multidimensional and in-depth manner, as defined by Yıldırım and Şimşek (2016). The embedded design is based on the support of data collected by one of the qualitative or quantitative methods with the other. For this reason, while the research questions are mostly related to qualitative or quantitative methods, the information received from the other approach is used to support and explain the data obtained (Yıldırım & Şimşek, 2016). In the studies, one of the methods is more dominant than the other and the other is carried out by embedding in the dominant method (Çepni, 2014). A large part of this study was constructed quantitatively and qualitative data were embedded in the quantitative method. As a means of quantitative dimension, single group pretest-posttest

research design, which is one of the pre-experimental research designs, was used. As for the qualitative dimension, the research was designed following the case study model. Case studies are based on "how" and "why" questions and allow the researcher to examine an event in depth (Yıldırım & Şimşek, 2016).

2.2. Participating Students

The research was carried out in October of the 2019-2020 academic year. The convenience sampling method was used to determine the student attendees. The convenience sample includes people available for the study. Researchers who have administrative difficulties in randomly selecting participants generally use the convenience sample (Best & Khan, 2017). The research began with the involvement of 30 sixth-grade pupils from a rural public school, on a voluntary basis, after obtaining the necessary permission from the school administration and parents. However, during the data analysis, the data from three students with poor attendance were omitted. The data collected on the demographic characteristics of the students, which are thought to affect the study, are given in Table 1 for a total of 27 students, 12 female, and 15 male.

Table 1.

Students' demographic characteristics

	Computer Access Status				**Internet Access Status**			
Gender	**Available**	**(%)**	**Unavailable**	**(%)**	**Available**	**(%)**	**Unavailable**	**(%)**
Female	9	75	3	25	8	66.66	4	33.33
Male	8	53.33	7	46.66	10	66.66	5	33.33
Total	17	62.96	10	37.03	18	66.66	9	33.33

As depicted in Table 1, 37% of the participants do not have computer access and 33% do not have internet access. Also, 25% of female students and 47% of male do not have computer access in their daily lives. In their daily life, 33% of male and female students do not have access to the internet.

In addition, ASTRQ pre-test scores were taken into account in the selection of students for the focus group interview. According to this, 27 students participating in the research were divided into three groups as lower, middle and upper groups by the method of determining the group interval coefficient stated below according to their ASTRQ pre-test scores (Güler, 2011). As a result of the analysis, student groups were determined as lower (n=7), medium (n=9) and upper (n=11). Two students from each groups (n=6) were selected by random method for the focus group interviews in which 3 of them are female and 3 are male.

$$\frac{\text{Highest Score on the Test - Lowest Score on the Test}}{\text{Number of Groups to be Created}}$$

2.3. Pilot Study

Pilot investigations were carried out with 24 pupils from various branches of the same school, five months before starting the actual studies. In the pilot study, the unit "Sound and Its Features" was covered with open-ended inquiry approach activities, in which students prepared digital stories during the evaluation phase. It was observed that open-ended questioning takes a longer time. In addition, during the preparation of the digital stories by the students, there were difficulties in the creation of sound recordings in a quiet environment. With the pilot study, the difficulties that can be experienced in the process due to the physical impossibilities of the school and the living environment were better seen. In the light of this information, the main applications were designed by the guided inquiry approach in which digital stories prepared by the teacher were used in the introductory phase of the lessons.

2.4. Implementation Process

Before starting to prepare activities suitable for the inquiry approach, national and international studies on this subject in the last five years were examined. Before starting the application, guided inquiry lesson plans supported by digital stories were prepared at the introductory stage following the 5E teaching model developed by Roger Bybee considering the stages of the constructivist education philosophy in the science course. There are more studies in the literature that employ the inquiry technique in conjunction with the 5E teaching model (Akben & Köseoğlu, 2015; Bezen, 2019; Demirkan, 2016; Gülhan & Yurdatapan, 2014; Uysal & Bostan Sarıoğlan, 2020; Xin & Enshan, 2016). The steps of the 5E teaching model are: "Engagement, Exploration, Explanation, Elaboration, and Evaluation".

Within the scope of this study, 6 lesson plans following the stages of the 5E teaching model were prepared for 6 different activities, each of which lasted two hours, and were used in the lessons after the opinion of a science teacher who completed the fifth year in the profession. In a heterogeneous structure, 6 groups of four and five were formed, and after this stage, activities were carried out under the direction of the researcher teacher for 4 weeks.

The lesson plan of the "Wise Owl and Rabbit Long Ear" activity related to the solar eclipse of the application process is shared as an example below.

Engagement: The digital story named "Wise Owl and Rabbit Long Ear" is displayed on the smart board and watched by the class. Students write down the information they heard in the story under the pictures on the storyboard.

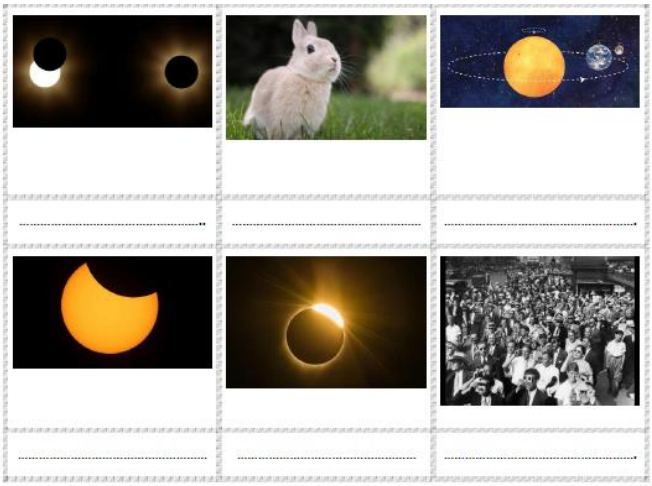

Fig. 2. Storyboard view of the wise owl and rabbit long ear activity

The following questions are answered through classroom discussions.

1. What is the Rabbit Long Ear like?

2. What does the Rabbit Long Ear not believe in?

3. Is the Wise Owl right in what he tells?

4. Why does the eclipse frighten Earthlings?

5. What are you curious about?

Exploration: With the question "What are you curious about?", the whole class is directed to the research question "How does a solar eclipse occur?". The groups test their predictions about the problem situation using the materials at hand. They record their findings with drawings. They record the situations that they are curious about and incomprehensible to investigate.

Explanation: Groups are allowed to research so they can explain what they've discovered. Students use books and computers in the classroom while doing research. They should be able to make explanatory sentences such as "Solar eclipse occurs when the Moon is between the Earth and the Sun". Designs where the Moon is in the middle and the Sun, Earth and Moon are aligned are considered successful.

Fig. 3. Students who prepared a solar eclipse model during the explanation phase

Elaboration: Students must be able to clarify the questions "What phase is the Moon in during a solar eclipse?" and "Why doesn't a solar eclipse occur at every new moon phase?" using the information they learned in this course and previous years, through experimentation and observation, based on research data.

Evaluation: The activity ends with the groups presenting the information they learned in the classroom and filling out the student diaries.

2.5. Tools of Collecting Data

The "Attitude Scale towards Research-Questioning (ASTRQ)" and demographic questions were used to collect quantitative data for the study. Demographic questions include questions to determine students' access to information and communication technology tools. Researchers' diaries, student group diaries, and focus group interview questions were used to collect qualitative data.

2.5.1. Attitude Scale towards Research-Questioning (ASTRQ)

ASTRQ was developed by Ebren Ozan et al. in 2016 for secondary school students. There are 13 items on a 5-point Likert scale, six of which are negative and seven of which are positive, and 3 sub-factors: "Curiosity", "Signification" and "Avoiding". The items on the scale were graded as "Completely Agree: 5", "Agree: 4", "Undetermined: 3", "Do not agree: 2", "Do not agree at all: 1", and reverse scoring was made for 7 negative items in the test. The greatest possible score on the test is 65, while the lowest possible score is 13 (Ebren Ozan et al., 2016).

If the answers to the test items are three or more, the Cronbach Alpha (α) coefficient is used. Özdamar (1999) stated that the Cronbach Alpha coefficient between 0.60 and 0.90 is quite reliable (as cited by Tavşancıl, 2006, p.29). Cronbach Alpha (α) reliability gives a measure of consistency between items, that is, the measure of the internal consistency of the test. High reliability indicates that the correlations of the test items are high (Güler, 2011). The Cronbach Alpha reliability coefficient of the overall scale was calculated as 0.756 by Ebren Ozan et al. (2016). On the other hand, Cronbach Alpha reliability coefficient values calculated for the sub-dimensions of the scale; 0.649 for curiosity, 0.644 for signification, and 0.701 for avoiding. The Cronbach Alpha coefficients was calculated for this study for sub-dimensions and overall scale of the scale are presented in Table 2.

Table 2.

ASTRQ sub-dimensions and overall reliability analysis scale statistics values

Sub-Dimensions	Number of Items	Arithmetic Mean	Variance	Standard Deviation	Cronbach Alpha (α)
Curiosity	4	16.214	11.881	3.446	0.650
Signification	4	14.842	13.497	3.673	0.635
Avoiding	5	18.185	19.371	4.401	0.623
Overall scale	13	49.242	89.926	9.482	0.808

When Table 2 is examined, Cronbach's Alpha values for the ASTRQ sub-dimensions and the overall scale were calculated as curiosity α=0.650, signification α=0.635, avoiding α=0.623 and for the overall scale α=0.808. According to these values, it can be accepted that each sub-dimension of the scale and the overall scale are reliable.

2.5.2. Teacher's Diaries and Student Group Diaries

Students wrote group diaries at the end of the lessons. The students were asked to give information in their diaries about the work done that day and their participation in these studies, the information they learned, and their feelings and thoughts about the activities. Group diaries were written in the last part of the activity papers. The diaries kept by the researcher, who is also the teacher of the course, were written right after the lesson, taking into account the whole process and the students, in a way to include sections from in-class dialogues.

2.5.3. Focus Group Interview Questions

Weekly focus group interview questions were prepared in order to examine the changes in students' attitudes in depth and to determine their views on the practices. In order to ensure the validity of the questions, they were examined by four researchers who are experts in the field of science education. The form was finalized by taking into account the opinions of experts in order to comply with the level of the student, to use an understandable language, and to obtain data that serve the purpose of the study.

Cautions were taken to include students from lower, middle and upper groups and to be heterogeneous in the student groups that will work together during the activity. Focus group students were distributed to each group, and the interviews with these students were carried out in pairs separately. The interviews were held in the school's guidance service, and the notes taken by the researcher during the question-answer were supported by audio recordings. Each group's interviews lasted an average of 20 minutes, with interviews lasting between 15 and 25 minutes. The interviews were taped and processed in order to be analyzed. While analyzing the data, the students were given codes as L1, L2, M1, M2, U1, U2.

2.6. Validity-Reliability Check

The reliability of a study is supported by making the qualitative measurement tools clear, precise, and understandable, considering the readiness and motivation of the students for the interviews, and adjusting the interview time to the optimum level (Güler, 2011). For this study, reliability was controlled with a similar approach.

It is important to collect data by more than one method and use that data obtained to confirm the validity and consistency (Yıldırım & Şimşek, 2016). Within current research, the data collected by quantitative methods were supported by data collected by qualitative methods. To ensure the reliability of the findings related to group interviews, the researcher read researcher diaries, student group diaries, and the research data repeatedly.

2.7. Analysis and Interpretation of Data

Making use of SPSS 22 statistical package application, quantitative data were analyzed using descriptive statistical approaches. The skewness and kurtosis coefficients were calculated to see if the ASTRQ pre-test and post-test scores of the students who participated in the applications displayed a normal

distribution. Because the scores were normally distributed, the t-Test was used to evaluate whether there was a statistically significant difference between the linked samples and between independent samples. The acquired data were interpreted using the .05 level of significance.

Content analysis approaches was used to assess qualitative data. The following steps were followed in the content analysis. After the interview question and the raw data in the group diaries were read several times by the two researcher at different times, the codes were created and it was determined whether there were any differences between the codes. Frequency values were written according to the frequencies of the codes. Consistency between codes According to Miles and Huberman (1994) consistency reliability analysis, "Consensus / (Agreement + Disagreement) x 100" was made. Accordingly, the compliance reliability was determined as .88 for the focus group interview question and .84 for the whole theme of group diaries. According to Yıldırım and Şimşek (2016), reaching a reliability percentage of at least 70% indicates that the codes are reliable. It can be said that the analyzes are reliable since the compliance reliability values of both the focus group interview question and the group diary themes are over 70%. At the same time, as a result of checking the invariance (reliability) of the data, that is, whether the same results can be achieved (Yıldırım & Şimşek, 2016), it was determined that the codes of the interviews and group diaries were mostly consistent and compliant.

3. Findings and Interpretation

The data analysis performed in line with the sub-problems, as well as the results collected, are provided below.

1.1. By comparing the ASTRQ pre-test and post-test scores, quantitative conclusions about the attitudes of sixth-grade students toward inquiry-questioning of the applied technique were obtained. First, the skewness-kurtosis coefficients were calculated to see if the ASTRQ pre-test-post-test scores had a normal distribution. Table 3 displays the obtained results.

Table 3.

ASTRQ pre-test and post-test descriptive statistics results

	Measurement	N	Min.	Mak.	$\bar{X}$	Sd	Variance	Skewness	Kurtosis
ASTRQ	Pre-test	27	30	61	46.740	9.653	93.199	-0.117	-0.984
	Post-test	27	36	65	51.555	8.087	63.872	-0.322	-0.797

The scores in the normality analysis of test results must not stray considerably from normal. The fact that the skewness and kurtosis coefficients are in the range of ±1 can be attributed to the fact that the scores do not stray significantly from normal (Büyüköztürk, 2017). Table 3 shows that the ASTRQ pretest-posttest skewness and kurtosis values are within the normal distribution bounds.

The Paired Samples t-Test findings for identifying a statistically significant difference between the ASTRQ pretest-posttest scores are shown in Table 4.

Table 4.

ASTRQ pre-test and post-test scores Paired Samples t-Test results

Measurement	N	$\bar{X}$	Sd	df	t	p
Pre-test	27	46.740	9.653	26	3.444	0.002*
Post-test	27	51.555	8.087			

*p<0.05

As one checks Table 4, a significant increase in the attitude scores of the students after they participated in research inquiry activities supported by digital stories ($t_{(26)}$=3.444, p<0.05) is observable. While the average of the students' attitude scores before the application was $\bar{X}$=46.740, this score increased to $\bar{X}$=51.555 after the application. As a result, the applied strategy has a considerable influence on enhancing students' attitudes toward inquiry.

1.2. Questions were asked of the focus group students (n=6) before and after the application to disclose their perspectives on inquiry, and the codes acquired from the students' replies are shown in Table 5.

Table 5.

Codes of focus group students' opinions on inquiry

Question	Students' Answers	BA	AA
		f	f
"What comes to mind when you think of research and questioning?"	Books and Library	2	3
	Phone, Tablet, Computer, Internet	3	5
	Research homework	3	2
	Research question	1	1
	Inventing, Examination, Exploring, and Experiment	1	2
	Information	1	2
	Sharing thoughts	-	1
	Consult someone who knows	-	2

BA: Before Application, AA: After Application

According to Table 5, the students explained the research before the application with concepts such as books, libraries, phones, tablets, computers, the internet, research homework, research questions, and information. Furthermore, they explained it with the concepts of inventing, examining, exploring, and experimenting. After the application, concepts like sharing thoughts, consult someone who knows are also revealed.

A sample of the answers given to the question "What comes to mind when you think of doing research and questioning" in the last week's interview is given below:

> *U1: "When I think of research, I think of searching from information sources, looking at search engines, and when I say querying, questioning our information comes to mind. When we research on the internet, some information may be wrong, so we need to do research from encyclopedias and other sites. We can also investigate the research question by experiment."*

The following is reflected in the group diaries where the students did research to gain information in the course of teaching through inquiry-based activities:

> *"Today, we learned about asteroids and meteorites, we did research, we got good information and learned whether they were similar or not." (23.10.2019)*

The knowledge that the groups used the technological tools available in the classroom environment suitable for research and inquiry while conducting these research were reflected in the teacher diaries.

> *"The group Blues learned through computer research that all gaseous planets have rings. Following this group, the Whites group obtained the same information as a result of research they have done with their phones." (16.10.20219)*

2.1. The skewness-kurtosis coefficients were analyzed to see if the students' pretest-posttest scores for curiosity, meaning, and avoidance sub-dimensions had a normal distribution. Table 6 displays the acquired results.

Table 6.

Sub-dimensions of ASTRQ results of pre-test and post-test descriptive statistics

Sub-Dimensions	Measurement	N	Min.	Mak.	$\bar{X}$	Sd	Variance	Skewness	Kurtosis
Curiosity	Pre-test	27	7	20	15.703	0.709	13.60	-0.660	-0.307
	Post-test	27	10	20	15.888	0.560	8.48	-0.375	-0.766
Signification	Pre-test	27	6	20	13.703	0.648	11.37	-0.068	-0.354
	Post-test	27	9	20	15.481	0.652	11.49	-0.462	-0.525
Avoiding	Pre-test	27	9	24	17.481	0.729	20.10	-0.183	-1.445
	Post-test	27	12	25	20.000	0.862	14.38	-0.302	-1.106

The fact that the skewness and kurtosis coefficients are in the range of ±2 can be explained by the fact that the scores do not deviate excessively from normal (Cited from George & Mallery, 2010, Ekinci et al., 2017). According to Table 6, the pretest-posttest skewness and kurtosis values of the attitude sub-dimensions are within the normal distribution limits.

Table 7 shows the results of the Paired Samples t-Test which was used to see if there was a statistically meaningful difference between the pre-test and post-test scores of the students' curiosity, signification, and avoiding attitude sub-dimensions.

Table 7.

ASTRQ sub-dimensions pretest-posttest scores Paired Samples t-Test results

Sub-Dimensions	Measurement	N	$\bar{X}$	Sd	df	t	p
Curiosity	Pre-test	27	15.703	3	26	2.875	0.751
	Post-test	27	15.888				
Signification	Pre-test	27	13.703	3.59	26	0.321	0.016*
	Post-test	27	15.481				
Avoiding	Pre-test	27	17.481	4.55	26	2.567	0.008*
	Post-test	27	20.000				

*p<0.05

As Table 7 suggests, there is no statistically significant difference between the pre-test and post-test scores of the curiosity sub-dimension ($t_{(26)}$=2.875, p>0.05). However, the pre-test and post-test scores in the sub-dimensions of signification and avoiding show a statistically significant difference ($t_{(26)}$=0.321, p<0.05; $t_{(26)}$=2.567, p<0.05).

2.2. The content analysis of the group diaries produced by the students at the end of each activity yielded qualitative data on the attitude sub-dimensions. For this purpose, the statements in the student group diaries were analyzed under the themes of curiosity, signification, and avoiding, which are the sub-dimensions of ASTRQ. Table 8 shows the results obtained.

Table 8.

Codes and themes related to attitude sub-dimensions in group diaries

Themes	Codes	f	Total
Curiosity	We got caught up in challenging adventures	1	
	We wanted to see the planets up close	1	4
	We recognized the planets more intimately	2	
Signification	We had a great time	6	
	We got good information	7	
	It was fantastic	4	
	We were brightened	12	34
	We managed to be a group	5	
Avoiding	The activity did not go well	1	
	We couldn't get along with our group-mates	3	
	We had a hard time understanding	2	6

As revealed by Table 8, the students expressed their opinions in the group diaries in the sub-dimensions of curiosity the least (f=4) and gave the highest signification (f=34). Accordingly, the research results obtained by qualitative and quantitative methods related to the sub-dimensions of attitude support each other. In the theme of signification in the student group diaries, we mostly encounter with the explanations: we had a great time, we got good information, we managed to be a group, and we were brightened. Examples of what has been written about them are presented below.

> *"We had a lot of fun today with our teacher, our friends, and our group mates and we were very happy. We did research on how the lunar eclipse happens with our group friends and were informed."*
>
> *"Today, we got to know the planets more closely and the planets we knew were so beautiful that it was as if we saw them all the time. This work we did was very good."*
>
> *"Today was a very fun day, we learned Saturn Jupiter Uranus Neptune in this study. We had a lot of fun and we are very happy to learn about the planets and we got along very well with our group mates. We love our group mates very much."*
>
> *"Today this work has been very nice and useful. Without this study, we would not have been able to recognize planets in such a short time."*

On the other hand, the statements of "we recognized the planets more intimately" in the theme of curiosity and "we couldn't get along with our group-mates" in the theme of avoiding are in the majority. An example of what has been written about them is presented below.

> *"Without this work we would not be able to recognize or understand planets. This study has been beneficial for us."*
>
> *"Today was a very busy day for us because we can say that we made some mistakes. If you are asking why, we cannot say that we are a good team today. We failed to be a team."*

As a result, it can be said that the students mostly have a positive attitude, except for a few negative situations such as difficulties and disagreements with their groupmates.

3. The skewness-kurtosis coefficients were examined in order to determine whether the ASTRQ pretest-posttest scores of female and male students showed a normal distribution. The obtained results are given in Table 9.

Table 9.

ASTRQ pre-test and post-test descriptive statistics results of female and male students

Measurement	Gender	N	Min.	Mak.	$\bar{X}$	Sd	Variance	Skewness	Kurtosis
Pre-test	Female	12	30	61	50.000	9.390	88.182	-0.794	0.429
	Male	15	30	60	44.133	9.349	87.410	0.346	-0.750
Post-test	Female	12	45	65	55.750	5.642	31.841	-0.534	0.292
	Male	15	36	65	48.200	8.325	69.314	0.475	-0.601

When Table 9 is examined, it is seen that the pretest-posttest skewness and kurtosis values of the female and male students are within the normal distribution limits.

Table 10 shows the Independent Samples t-Test results of whether there is a statistically significant difference between the ASTRQ pretest-posttest scores of female and male students.

Table 10.

ASTRQ pre-test and post-test scores Independent Samples t-Test results by gender

Measurement	Gender	N	$\bar{X}$	Sd	df	t	p
Pre-test	Female	12	50.000	9.390	25	1.617	0.118
	Male	15	44.133	9.349			
Post-test	Female	12	55.750	5.642	25	2.682	0.013*
	Male	15	48.200	8.325			

*p<0.05

According to Table 10, no statistically significant difference was found in the attitude scores of female and male students before the application ($t_{(25)}$=1.617, p>0.05). Following the application, there was a substantial difference in ASTRQ scores between female and male students in favor of females ($t_{(25)}$=2.682, p<0.05). Accordingly, we can deduce that the method applied positively affects the attitude scores of male and female students towards inquiry in favor of females.

4. Discussion

In this study, research-inquiry activities supported by digital storytelling increased the 6th-grade students' attitude scores towards inquiry statistically significantly ($t_{(26)}$=3.444, p<0.05). As a result, the strategy used had a considerable impact on improving students' attitudes toward inquiry. According to the literature, research-inquiry based learning environments affect student attitudes (Akgül, 2018; Büyükcengiz, 2017; Ebren Ozan & Karamustafaoğlu, 2020; Kaplan Parsa, 2016; Sadeh & Zion, 2012; Tuan et al., 2005). On the other hand, studies assessing the efficiency of the research-inquiry technique assisted by technology applications can be found (Çamlıbel, 2018; Koyunlu Ünlü, 2015; Özer, 2019; Şentürk, 2018; Uysal & Bostan Sarıoğlan, 2020; van Joolingen et al., 2006; Waight & Abd-El-Khalick, 2007). According to van Joolingen et al. (2006), inquiry learning needs support for effective learning environments. Computer-assisted inquiry learning is important in that it includes the tools and methods that an inquiry-based learning environment will need, because computers allow the creation of computer-based inquiry environments in which students can interact. Thus, students can perform real inquiry tasks. Koyunlu Ünlü (2015) reported that secondary school students developed a positive attitude towards the lesson thanks to technology-supported inquiry-based science lessons.

Özer (2019) studied Light and Sound unit with 6th-grade students with educational technologies such as Socrative, Kahoot, Google Drive, Google Classroom, and Algodoo. However, no significant difference was found between pre-test-post-test scores in student attitudes towards inquiry-questioning. In this study, the authors concluded that the digital story technological course materials used in the introductory phase of the courses are effective in making a difference in attitude scores because the students asked questions using the digital story course materials and started their research on the situations described in the digital stories.

When the students were asked for their opinions about doing research and research inquiry before and after the application, an increase in the answers given in most of the codes (Table 5) was observed. While students associated inquiry with more technology, exploration, experimentation, and consult someone who knows, there was a decrease in the answers given about doing homework. During the implementation process, the students made research a part of their lives, told their friends and teachers about their research at school, spent their free time such as lunch break by doing research, and attempted to find solutions to the problems that remained unanswered when they returned home. In some studies where digital stories were prepared by students, students continued their research outside of school (Çiçek, 2018; Niemi et al., 2018). However, as some studies in the literature suggest, students stop working after leaving the classroom, so they have to adapt to the application process each time (Karakoyun, 2014).

Another finding obtained in the study was that there was no statistically significant difference in the curiosity sub-dimension scores of the attitude scale ($t_{(26)}$=2.875, p>0.05), and a statistically significant difference was detected in the signification and avoiding sub-dimensions ($t_{(26)}$=0.321, p<0.05; $t_{(26)}$=2.567, p<0.05). Among the qualitative findings related to the sub-dimensions, the codes most frequently expressed under the theme of signification attract attention. These are as follows: 'we had a great time', 'we got good information', 'it was fantastic', 'we were brightened', and 'we managed to be a group'. This situation supports the paired samples' t-Test results. Ebren Ozan and Karamustafaoğlu (2020) reached similar findings in their studies. They explained the lack of change in the curiosity factor by asking questions that arouse students' curiosity about the items and being willing to do research. At the same time, it was emphasized that affective skills such as attitude can not change in a short time.

Inquiry-based learning activities supported by digital stories created a statistically significant difference in favor of females in terms of gender variable ($t_{(25)}$=2.682, p<0.05). As a result, the applied strategy might be viewed as having a greater impact on female students' attitudes toward inquiry than on male students. This finding can be evaluated as that the digital stories used in the process have a positive effect on female students. Cheng et al. (2021) stated in their study that female students displayed more ability compared to males in creating research questions. According to the study conducted by Kim (2011) with 8th grade female students using a guided inquiry method supported by technology, students' attitudes towards science improved significantly after the applications. At the same time, female students expressed that technology makes science teaching interesting, provides more accurate and more scientific information, and makes difficult science concepts understandable by visualizing them. As the study of Çiçek (2018) revealed, male students studying in the 6th-grade work more irregularly and reluctantly than females in the digital story preparation process, as a result of which their attitude scores decrease, and only the groups consisting of females prepare more successful digital stories. In the literature, the opposite results have been observed for younger age groups. For example, Valkonova and Watts (2007) observed that 7-8-year old male students make more creative products and work more willingly than female students. In fact, this situation manifests itself more clearly in the studies of groups consisting of only men. The findings of the study suggest that inquiry-based learning does not make a significant difference in the attitudes of female and male students towards science (Saylan Kırmızıgül, 2019; Tatar, 2006; Toma, 2021). As a result, doing a study on how inquiry-based learning settings backed by various instructional technologies might result in a large improvement in men's attitudes is deemed crucial.

5. Conclusion and Suggestions

There was a statistically significant difference in the students' ASTRQ pretest-posttest scores in favor of the post-test. It was observed that during the application process, students made research a part of their lives, told their friends and teachers about their research at school, and attempted to find solutions to the problems that remained unanswered when they returned home and did research during their spare time like lunch breaks.

Similarly, a statistically significant difference was found between the pre-test and post-test scores of the sub-factors of signification and avoiding, excluding the curiosity factor, in the attitude scale. These results are also supported by the findings obtained from qualitative measurement tools. The interviews made after the application revealed that the students explained inquiry with the concepts of inventing, examining, exploring, and experimenting. Thanks to the digital stories used in the introductory phase of the research-inquiry process, it became easier for students to ask questions, answer questions, and be curious about the subject.

There was no statistically significant difference in the ASTRQ pre-test scores of female and male students prior to the application, however, there was a statistically significant difference in favor of females after the application, depending on gender. Accordingly, it can be said that research-inquiry activities supported by digital stories are more effective in the attitudes of female students than male students.

In line with the results obtained from the study, the following recommendations can be made:

- In this study, the guided inquiry approach was supported by the digital story method. Studies can be conducted in which digital stories are employed in conjunction with various methodologies, or where the research-inquiry methodology is supplemented with various methods.
- The difficulties and advantages of the applied method in terms of teachers and students can be investigated. Studies with prospective teachers from relevant university departments might be conducted for this aim.
- Digital stories prepared by teachers and students can be used as effective course materials to enrich educational platforms such as EBA. For this purpose, in-service training can be provided to teachers.
- Since this study was carried out in a secondary school in a rural area without a science and computer laboratory, sufficient technological equipment could not be provided. For this reason, digital stories were used by the teacher to draw attention to the lesson and initiate questioning. In schools where such limitations do not exist, digital stories can be prepared by students and the effectiveness of using digital stories at different stages of the lessons can be investigated.

Notes

This study is produced from the Master's thesis in which the first author is student and the second one is supervisor.

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