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Online Science Teaching Supported by Web 2.0 Tool: Virtual Museum Event

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ABSTRACT **Research Article**

In this study, it is aimed to investigate the effect of the online science course, which is carried out by using the virtual museums created with the web 2.0 tool, on the academic achievement and science attitudes of the fifth-grade students. In addition, student opinions about the virtual museum were also taken within the scope of the study. The research was conducted based on mixed method research in which qualitative and quantitative research models were combined. Quasi-experimental design with pre-test and post-test control groups was used in the quantitative dimension. The study group consisted of a total of 100 fifth grade students studying at a public school in the academic year of 2020-2021. In the determination of the study group, the easily accessible case sampling method, which is one of the purposeful sampling methods, was used. The study group was divided into two, and science teaching was carried out in the experimental group with a virtual museum created with web 2.0 tools; in the control group, traditional science teaching was carried out by adhering to the activities in the textbook. In the qualitative aspect of the study, opinions about the virtual museum were taken from the students. In the study, the science lesson attitude scale and the academic achievement test prepared for the subject of human and environment were used as data collection tools. While the data obtained from the science lesson attitude scale and achievement test were analysed with the SPSS program; the interview data were analysed using descriptive analysis. As a result of the research, it was revealed that virtual museums, which are web 2.0 tools, have a positive effect on students' science lesson attitudes and academic achievement.

KeyWords: Science education, online education, Web 2.0 tools, virtual museum, academic achievement, attitude.

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Web 2.0 Aracı ile Desteklenen Çevrim İçi Fen Bilimleri Öğretimi: Sanal Müze Etkinliği

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ÖZ

Bu çalışmada, web 2.0 aracıyla oluşturulan sanal müzelerden yararlanılarak gerçekleştirilen çevrim içi fen bilimleri dersinin, beşinci sınıf öğrencilerinin akademik başarılarına ve fen tutumlarına olan etkisinin araştırılması amaçlanmıştır. Ayrıca sanal müze hakkında öğrenci görüşleri de çalışma kapsamında alınmıştır. Araştırma, nitel ve nicel araştırma modellerinin bir arada olduğu karma yöntem araştırmasına dayalı olarak yürütülmüştür. Nicel boyutunda ön test ve son test kontrol gruplu yarı deneysel desen kullanılmıştır. Çalışmanın nitel boyutunda ise öğrencilerden sanal müzeye yönelik görüşler alınmıştır. Çalışma grubunu ise 2020-2021 yılı eğitim-öğretim yılında bir devlet okulunda öğrenim görmekte olan toplam 100 kişilik, beşinci sınıf öğrencisi oluşturmuştur. Çalışma grubunun belirlenmesinde amaçlı örnekleme yöntemlerinden kolay ulaşılabilir durum örnekleme türüne başvurulmuştur. Çalışma grubu ikiye bölünmüş, deney grubunda web 2.0 araçlarıyla oluşturulan sanal müze ile fen öğretimi gerçekleştirilmiş; kontrol grubunda ise ders kitabındaki etkinliklere bağlı kalınarak geleneksel fen öğretimi yapılmıştır. Çalışmada veri toplama aracı olarak, fen dersi tutum ölçeği ve insan ve çevre konusunda yönelik hazırlanmış olan akademik başarı testi kullanılmıştır. Fen dersi tutum ölçeği ve başarı testinden elde edilen veriler SPSS programı ile analiz edilirken; görüşme verileri, betimsel analizden yararlanılarak analiz edilmiştir. Araştırma sonucunda, web 2.0 araçlarından olan sanal müzelerin, öğrencilerin fen dersi tutumlarına ve akademik başarılarına olumlu etkisinin olduğu ortaya konulmuştur.

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Introductıon

The new type of coronavirus, which emerged in the city of Wuhan, China in December 2019, has spread rapidly all over the world, exceeding the borders of China in a short time (Karadağ & Yücel, 2020). In our country, the Covid-19 pandemic officially started with the detection of the first positive case in March. The Covid-19 pandemic has turned the routine life flow upside down, causing a crisis in many areas. In order to counter the Covid-19 pandemic, which has affected many areas of life, it has become necessary for countries to make significant changes (Alpago & Alpago, 2020).The Covid-19 outbreak has caused disruptions in the field of education as well as in different fields, disrupting the routines of students and taking some precautions in the education process (Daniel, 2020; Kırmızıgül, 2020).At the beginning of these measures, face-to-face education was interrupted for a while and switched to online education. Carrillo and Flores (2020), stated that with the distance education that has come to the fore with the pandemic, education has started to be reshaped, and teachers and students have to adapt quickly to distance education. Suspending the face-to-face education process for a while made it necessary for many teachers to move the course content online and required a transformation from the traditional learning process to the digital learning process (Bozkurt, 2020).With this transformation, students and teachers needed to master using digital tools to participate in their education (Dennis, 2020; Livari, Sharma & Ventä-Olkkonen, 2020; Zheng, Khan & Hussain, 2020; Kırmızıgül, 2020). Özkılıç (2021), regarding this issue, states that there is a need to review and renew learning and teaching methods, teaching environments and assessment methods and integrate them with technology. Although it is still a problem for individuals to access online education; Resources and processes have been developed to focus students on the course and materials, to make communication effective, and to manage the process (Lockee, 2021).Mulenga and Marban (2020) state that the epidemic plays a catalyst role for more effective use of digital devices, online resources, technologies and e-learning activities. By pointing out the importance of using instructional technologies in overcoming this digitalization process (Agnoletto & Queiroz, 2020), it is thought that it will be very effective to reflect different technologies in this online education process. It is clear that there is a need to use digital technologies and different online resources to make the distance education process, which has gained momentum with the Covid-19 pandemic, effective. At this point, web 2.0 applications, one of the applications that emerged as a result of today's developing technologies and can be used in the teaching process, come to mind. Web 2.0 applications increase the numerous opportunities available in the distance education process with their online nature, the conveniences and opportunities they offer (Bower, Hedberg & Kuswara, 2010).Web 2.0 applications are explained by McLoughlin and Lee (2007) as follows; A secondary web platform that can develop content, enable individuals to work in groups, and provide information flow between individuals. In other words, they are second-generation web applications that aim to facilitate communication, share information, and work in cooperation, and are successfully integrated into the education system of developed societies (Faboya & Adam, 2017). Çelebi and Satırlı (2021), on the other hand, briefly describe the concept of web 2.0 as practices that facilitate mutual information sharing and working through the internet, both individually and in groups. They are internet-oriented technologies and can be used at any point of access (Avcı & Atik, 2020). Faizi (2018) explains that the functions of each of the web 2.0 applications overlap, but states that they can be basically classified into three categories:

A. Applications such as Facebook, LinkedIn, Twitter, Instagram that serve social communities where individuals interact with social networks.

B. Applications such as YouTube, Dailymotion, Dropbox, Slideshare that serve individuals to share and organize content
C. Applications such as Wiki, Blogger, Google Docs, WordPress that serve the content production and editing of individuals

Similarly, Korucu and Çakır (2015) explain web 2.0 applications as dynamic web technologies that provide opportunities to meet today's needs; It states that applications can be grouped as social networking sites, video sharing environments, instant messaging applications, virtual museums, googleearth, podcasting, wikis, weblogs and news providers (RSS). It is possible to classify web 2.0 tools that can be used in educational environments as follows; presentation, concept teaching tools, virtual reality tools, language education tools, classroom management tools, coding tools, blog preparation tools, photo and video preparation tools, game tools, alternative assessment tools, note taking, animation preparation tools, poster, journaling, story tools, cartoon tools, distance education and virtual classroom, coding and other tools, (Çelik, 2021; Tatlı, 2017; Yıldırım, 2020).Elmas and Geban (2012) determined their usage areas and selected web 2.0 tools that can be used in the education and training process and classified them into eight basic categories. With the determined classification, it can be easy to reach the appropriate program for teachers who aim to benefit from web 2.0 tools in the teaching process. The aforementioned classification is given in Figure 1.

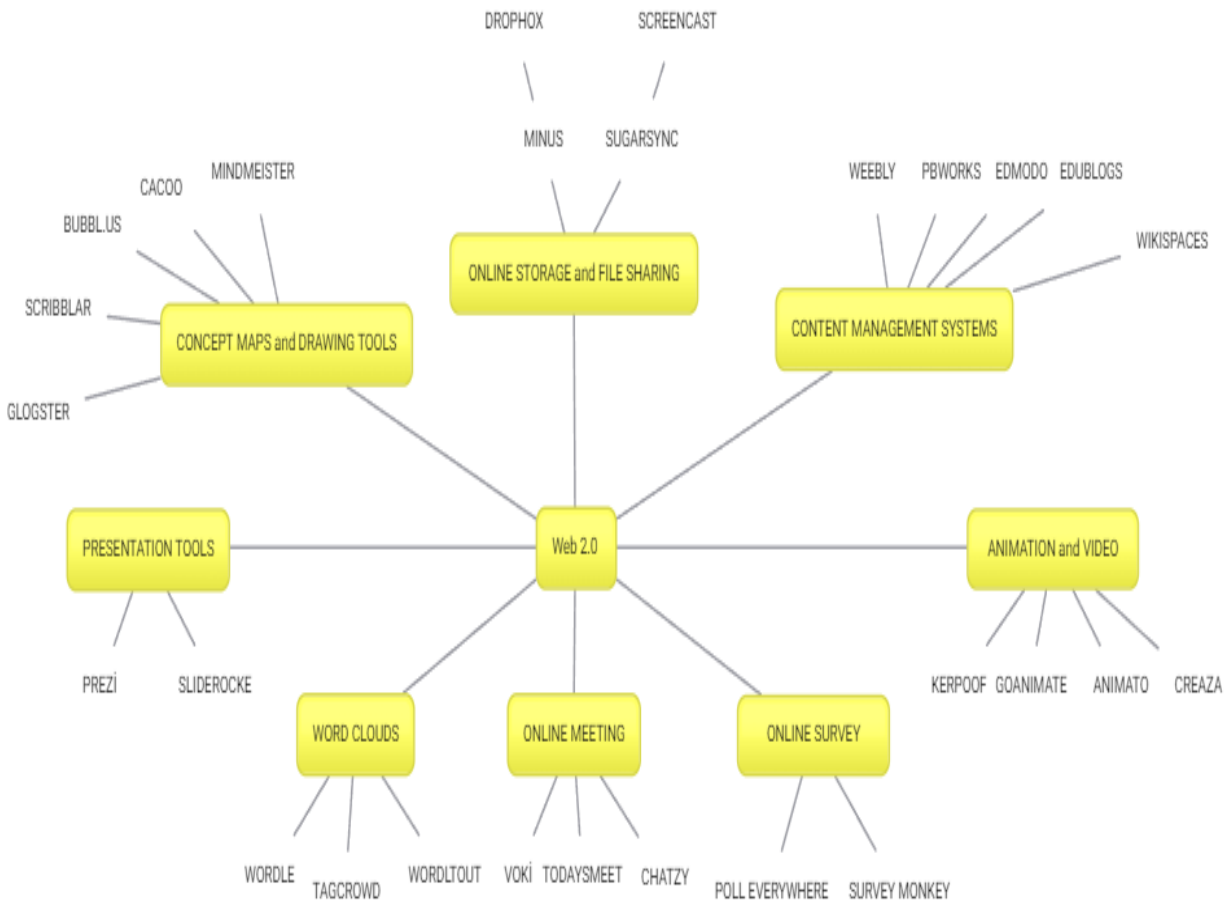

Figure 1. *Classification of Web 2.0 Tools That Can Be Used in the Teaching Process*

The potentials of creating opportunities during teaching and learning, providing information flow, having ease of use, supporting cooperation and communication are at a key point in education (Çelebi & Satırlı, 2021).Wang (2013) states that web 2.0 tools can fill the digital gap between teachers and students if they are developed in a way that can be integrated into teaching tools or included in teaching. On the other hand, Aytan and Başal (2015) state that web 2.0 tools are in an important position in reaching the targeted opportunities in learning environments. The types and possibilities offered by web 2.0 tools are increasing day by day (Uysal, 2020). It is predicted that the opportunities provided by web 2.0 tools to both teachers and students will increase in the distance education process. Web 2.0 tools provide a basic technology environment for teachers by moving individuals away from the traditional course format (Dibella & Williams, 2015).Web 2.0 tools take learning and teaching actions beyond traditional classroom environment (Phirangee, 2013).It is also stated in the literature that web 2.0 tools offer tremendous opportunities to change the nature of the teaching process and have a positive effect on teaching experiences (Konstantinidis, Theodosiadou & Pappos, 2013). It has been revealed that web 2.0 tools have significant effects on secondary school students' learning performance, collaborative learning, and self-regulation compared to traditional teaching (Jena, Bhattacharjee, Gupta, Das & Debnath, 2018). In a study conducted by Liu, Lu, Wu and Tsai (2016), it was determined that web 2.0 learning activities support the development of creative thinking skills. Web 2.0 tools contribute to the development of various skills by contributing to the creation of an active and participatory classroom environment (Uysal, 2020). The contributions of web 2.0 applications to educational environments are compiled in the literature: effective learning, high-level thinking skills, constructivist problem solving, individual development, and taking responsibility (Karaman, Yıldırım & Kaban, 2008).In addition to reading and understanding the information, it can provide important contributions to students by enabling them to develop content related to the subject (Elmas & Geban, 2012).On the other hand, it also plays a role in increasing students' science literacy levels and their potential to be technology users (Magbuson, 2013).In learning based on web 2.0 tools, it provides the opportunity to fully examine how students have understood and solved a concept, event or problem (Horzum, 2010). Web 2.0 tools create interactive educational environments with active and collaborative methods in different education formats (Rhoads, Berdan & Toven-Lindsey, 2013).It is stated that educational studies based on web 2.0 technologies contribute to the training of individuals who can adapt to the age of technology, use and process information effectively (Gürleroğlu, 2019).There are many studies showing that the use of web 2.0 tools in course environments positively affects student achievement (Akkaya, 2019; Azid et al., 2020; CinSeker, 2020; Gürleroğlu, 2019; Korkmaz, Vergili, Çakır & Erdoğmuş, 2019; Korucu, 2020; Malhiwsky, 2010; Hursen, 2020; Özenç, Dursun & Şahin, 2020; Sönmez & Çakır, 2021; Tuncer & Şimşek, 2019; Yıldırım, 2020). On the other hand, there are also studies in which web 2.0 tools have positive effects on motivation, conceptual understanding, critical thinking, self-efficacy and attitude (Akgün, Babur & Albayrak, 2016; Almalı & Yeşiltaş, 2020; Alp, 2109; Durusoy, 2011; Gömleksiz & Pullu, 2017). ;Gündoğdu, 2017; Mete & Batıbay, 2019). In his study, Onbaşılı (2020) states that web 2.0 tools affect the learning process positively and improve high-level thinking skills and imagination. Web 2.0 tools offer interactive learning opportunities, designing content independent of time and place, and actively participating in the learning process. Considering these possibilities, it is pointed out that teachers should have the competence to integrate and use web 2.0 tools in their own fields in their education processes (Çelik, 2021).Web 2.0 tools used in the teaching process; It is stated that it has strengths such as increasing student achievement, making students active, providing individuals with a productive learning environment, and increasing student interest (Arslan & Coştu, 2021). At this point, it is thought that web 2.0 tools can have a positive effect on students' course achievement and

attitudes in educational environments, especially in the online education process, and make significant contributions to the operation of the teaching process both for the teacher and the student. The positive opinions of students and teachers on the use of web 2.0 tools in the educational environment and their positive effectiveness in the teaching process has been found in many studies in the national and international literature (Altıok, Yükseltürk & Üçgül, 2017; Bolatlı & Korucu, 2018; Bünül, 2019; Çetin, 2020; Elmahdi, Al-Hattami & Fawzi, 2018; Fırat & Köksal, 2017; Gürleroğlu, 2019; Gürsoy & Göksun, 2019; Ibrahim & Alqahtani, 2018; Jena, Bhattacharjee, Devi & Barman, 2020; Kompen et al., 2019; Rachmawati & Purwati, 2021; Say & Yıldırım, 2020; Timur, Timur, Arcagök & Öztürk, 2020).

It is accepted that virtual museums emerged as a result of the development of web technologies. Elbay (2021) explains virtual museums as the opportunity to see objects exhibited in physical museums in the digital environment. Therefore, they are cited as examples of e-learning platforms. Virtual museums, which do not require time and space, are seen as the starting point in cases where real museum tours cannot be made in educational environments (Sungur & Bülbül, 2019). Karataş, Yılmaz, Kapanoğlu, and Meriçelli (2016) describe virtual museums as a result of innovations brought by technology to educational environments. Virtual museums that can be designed effectively can be used for educational purposes in the distance education process (Turgut, 2015).

Şahin and Yılmaz (2020) emphasize the necessity of strengthening science with technology on the grounds that science has a content that includes abstract concepts based on nature and natural phenomena. Similarly, Ateş (2018) points out the need to utilize different technologies in order to facilitate the process of science learning. Considering the content and teaching of science courses, the fact that the subjects require experimentation and observation supports the views of benefiting from technology. Timur, Timur, Arcagök and Öztürk (2020) stated that using web 2.0 tools in science; states that there are many benefits and conveniences that it will provide on the teacher, student and learning environment. Hainsworth (2017) states that shaping the future vision of science education and science curriculum and changing teaching and learning approaches in science can be possible with web 2.0 applications. The opinions that effective teaching activities planned with web 2.0 tools have a positive effect on students' knowledge acquisition (Laru, Näykki & Järvelä, 2012) and have a positive impact on students' learning (Lim & Newby, 2020) reveal the necessity of using web 2.0 tools in science teaching. These tools have the potential to transform the classroom environment from teacher-centred teaching to student-centred approaches (Rosen & Nelson, 2008). In this context, it can be stated that the science teaching objectives and the achievements of web 2.0 tools overlap in many points, and that educators use them as supportive practices for the science curriculum. It is clear that the use of web 2.0 tools in science lessons can be beneficial for students and teachers, but it can be even more valuable in the distance education process. Web 2.0 tools to be used in the distance science lesson; It is thought that there may be a way out for science teachers who can make students who are far from their teachers and the classroom context more active and focus on the lesson, who have to make a sudden transition to the distance education process and who are in search of new materials, to make their online lessons more effective.

Although there are many studies on the use of web 2.0 tools in the educational environment, it is striking that these studies are few in science education (Yıldırım, 2020). From this point of view, it would not be wrong to state that the literature needs science education studies for web 2.0 tools. It is seen that the studies carried out for the virtual museum are predominantly in the branches of social studies and visual arts (Karataş et al., 2016). At this point, it is expected that a study on the use of virtual museums in science education will meet a need in the literature. In the distance education process, it is thought

that virtual museums will provide the opportunity to provide the visuality and observation required by the science course and will support the positive learning of the students. Setting an example for students who will not be able to carry out museum tours for a certain period of time during the epidemic, in terms of showing that they can carry out museum activities in the online context, highlights the value of the study. Increasing the quality of teaching by supporting distance science teaching and improving the online science teaching process are among the expected research outputs. It is to encourage educators to develop an understanding of how virtual museums can be used in the classroom environment and to enable them to use them easily. It is expected to be an important study in terms of revealing the contributions of virtual museums to online education and their effectiveness in teaching, especially in science courses that require visual support. It is thought that it can be a source in terms of guiding educators who will benefit from virtual museums in their online courses and shaping their teaching in this process. The fact that virtual museums provide clues in terms of determining the advantages and disadvantages that can be created for students and teachers can make the study valuable. Based on all these approaches, in this research, it is aimed to investigate the effects of the virtual museum created with the web 2.0 supported Artsteps application on the academic achievement and science lesson attitudes of the students on the subject of "Human and Environment" at the fifth grade level, and to determine the students' opinions about the application.

Research Questions

In line with the purpose of the study, the question "Is there an effect of online science course supported by a web 2.0 tool on fifth grade students in terms of some variables?" was determined as the main research question. The sub-research questions based on the main research question are given below, respectively.

1. Is there a significant difference between the pre-test academic achievement scores of the students who receive science education supported by virtual museums in the online environment and those who receive education with traditional science education in the online environment?
2. Is there a significant difference between the post-test academic s achievement scores of the students who receive science education supported by virtual museums in an online environment and those who receive education with traditional science education in an online environment?
3. Is there a significant difference between the pre-test science lesson attitude scores of the students who receive science education supported by virtual museums in the online environment and the students who receive education with traditional science education in the online environment?
4. Is there a significant difference between the post-test science lesson attitude scores of the students who receive science education supported by a virtual museum in the online environment and the students who receive education with traditional science education in the online environment?
5. What are the opinions of the students who are taught science supported by the virtual museum about the virtual museum, which is one of the web 2.0 tools?

Method

Pattern

The study was carried out based on mixed method research in which qualitative and quantitative data were used together. Mixed design is preferred in studies where qualitative or quantitative studies cannot find answers only. In the current study, while the academic

achievement and attitude towards the science lesson were determined quantitatively, the study was supported by qualitative data by conducting interviews with the students. In this direction, the study was carried out by making use of the basic designs based on mixed methods research and the explanatory sequential design. Explanatory sequential patterns are defined by Creswell and Clark (2017) as collecting and analysing quantitative data and then collecting and analysing qualitative data to form a basis for quantitative data. Quasi-experimental design with pretest-posttest control group was used in the quantitative dimension of the explanatory design. Studies in which the quasi-experimental design is preferred are one of the scientific methods in which the most effective results can be obtained, in which comparable procedures are performed and the effects of the processes are examined (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz & Demirel, 2012). At this stage, the academic achievement and attitude test was applied in order to investigate the effect of science teaching with the virtual museum created by the web 2.0 tool on academic achievement and science lesson attitude. After the completion of the quantitative data collection stage, the qualitative data collection stage was started. Qualitative data were collected by conducting semi-structured interviews with students. The findings obtained from both quantitative and qualitative data were brought together and the data were interpreted.

Study Group

The study group of the research consists of a total of 100 fifth grade students studying at a public school in the 2020-2021 academic year. 57 of the fifth-grade students constituting the study group are male and 44 of them are female students. In the study, the easily accessible case sampling type, which is one of the purposeful sampling types, aiming to speed and practice the research, was preferred (Yıldırım & Şimşek, 2018).In the quantitative aspect of the study, half of the 100 participants (N=50) constituted the science teaching group with the virtual museum created with the web 2.0 tool, and the other half (N=50) constituted the traditional science teaching group. In the qualitative dimension, online interviews were conducted with 15 students from 50 people in the science teaching group conducted with the virtual museum.

Data Collection Tools

During the research process, the academic achievement test and science lesson attitude scale prepared for the subject of "Human and Environment" were used as quantitative data collection tools, while the student interview form was used as qualitative data collection tools.

Academic Achievement Test on Human and Environment Subject

In the study, the "Human and Environment Academic Achievement Test" developed by Ekinci (2019) regarding achievements was used. The achievement test was created to determine the academic achievement levels of the students and includes 25 multiple-choice questions. The highest score that students can get from the knowledge test is 26 and the lowest score is 0. The difficulty of the achievement test items used in the research process ranged from 0.33 to 0.73.The average discrimination power of the test ranges between 0.31 and 0.76, and the discrimination of the test is high. The KR-20 reliability of the academic achievement test is 0.83.Therefore, it can be stated that the achievement test used in the study consists of very reliable, moderately difficult, very good and good questions. Necessary permissions were obtained from the researcher via e-mail in order to use the current achievement test in the study. In addition, some of the questions in the test are given in Figure 2 below as an example.

18-) **"Substances that remain in nature for a long time without deterioration cause permanent pollution."**

Which of the following would not cause permanent pollution?
A) Wastes mixed with water from industrial facilities.
B) The plastic bottles we use for water.
C) The bags we use.
D) Residues from plants that shed their leaves.

19-) I. Plastic bottles and plastic bags can cause permanent pollution in nature.
II. If cleaning agents used in homes get into lakes and seas, they endanger the lives of living things.
III. Dirty water that mixes with the soil can pass to humans with food and cause diseases such as jaundice, cholera and typhoid.
Which of the above statements are true?
A) I and II
B) III only
C) II and III
D) I, II and III

Figure 2. *Sample Questions on the Academic Achievement Test*

Science Lesson Attitude Scale

The "Science Class Attitude Scale" developed by Şaşmaz-Ören (2005) was used in the study. The scale consists of 22 items. The Cronbach alpha reliability coefficient of the scale is 0.93.It is a 5-point Likert type scale as "I totally disagree", "I do not agree", "I am undecided", "I agree" and "I totally agree". The validity and reliability of the scale were ensured.13 of the items in the attitude scale are positive and 9 of them are negative. The minimum score that can be obtained from the scale is 22 and the maximum score is 110. Necessary permissions were obtained from the researcher via e-mail for the current attitude test to be used in the study. A few of the questions in the attitude test are given in Figure 3 below as an example.

- I feel bad when I hear a word about science.
- Science is a subject I like to study.
- Science lesson helps to better understand the natural phenomena around us.
- School would be more enjoyable for me without science lessons.
- I would like to have more science lesson hours.

Figure 3. *Sample Questions Regarding the Questions Included in the Science Lesson Attitude Scale*

Student Interview Form

In the study, semi-structured interview form was used in order to determine the opinions of the students about the virtual museum prepared with the web 2.0 tool Artsteps application. Patton (2018) states that interviews allow individuals to express their ideas about a particular topic with their sentences. The questions in the interview form were created by the researchers. The created interview form was forwarded to two experts in the field of science education, and their opinions on the questions were received. In the next stage, a preliminary application was made by giving an interview form to 10 fifth grade students who would represent the target audience, and it was understood that the form was suitable for the level of the student. The interview form, which was validated and piloted, was given its final form. In the interview form, there are 3 basic questions to determine the students' views on the

application used in the lesson. Interviews were conducted with 15 students in the study group, where science teaching was carried out with the virtual museum. While selecting the students, care was taken to have 5 students each from high, medium and low students with high academic achievement scores. Below are the questions asked during the interviews with the students.

1. What do you think are the positive aspects of the virtual museum prepared with the Artsteps application, which is a web 2.0 tool?
2. What do you think are the negative aspects of the virtual museum prepared with the Artsteps application, which is a web 2.0 tool?
3. Does a course prepared with the virtual museum content prepared with the web 2.0 tool Artsteps application contribute to the science course? Please explain.

Implementation Process

The implementation period covers 14 hours including each step. The implementation period and process are based on the curriculum. In the context of the study, experimental and control groups were determined. While the subject of human and environment was being studied in the experimental group, while making use of the virtual museum created with web 2.0 tools; In the control group, direct narration, question and answer approaches were used. For a better understanding of the implementation process, the implementation period of the experimental group is given in Table 1.

Table 1. *The Implementation Period Followed by the Experimental Group Students in the Research*

Lesson Hours	Implementation Process
1	Pre-test application of academic achievement test and Science Attitude Scale
1	Introducing Artsteps application, one of the web 2.0 tools
3	Teaching the lecture with the virtual museum created with the Artsteps application
2	Students preparing cartoons, pictures, videos, experimental studies and slides
4	Students create their own virtual museums
1	Post-test application of academic achievement test and Science Attitude Scale
2	Conducting interviews with students about the application

First of all, Human and Environment Academic Achievement Test and Science Lesson Attitude Scale, which were selected as data collection tools, were applied to the determined experimental and control groups as a pre-test in the online environment. In the next stage, traditional science teaching to the control group was carried out online. The subject gains in the current curriculum were transferred to the students by giving lectures in line with the textbook. On the other hand, the students who were determined as the experimental group were taught online, supported by a virtual museum prepared with the Artsteps application, one of the web 2.0 tools. Before the experimental process, the study group was given necessary information about the Artsteps application, and the application was introduced and its use was demonstrated. In the first stage, the lectures on the subject of human and environment were made with the videos, visuals, botanical gardens, national protection areas created with the Artsteps application. Afterwards, the students were divided into four groups, each sub-achievement in the curriculum was distributed to the groups, and they were asked to

prepare cartoons, pictures, videos, experimental studies and slides about the subject. Then, the students created a virtual museum in the Artsteps application, under the supervision of the teacher, based on the materials they had prepared during the lesson. The virtual museum created with the students was watched and the lecture was carried out by the students. With the virtual museum, an effort was made to make the students more active by making the students discuss. Finally, the academic achievement test and the attitude test, which were applied at the beginning, were administered to the students as a post-test. After the tests applied, short interviews were made with the students selected from the experimental group and their thoughts on the virtual museum prepared with the Artsteps application, which is a web 2.0 tool, were taken. The visuals of the virtual museum created with the students are given in Figure 3.

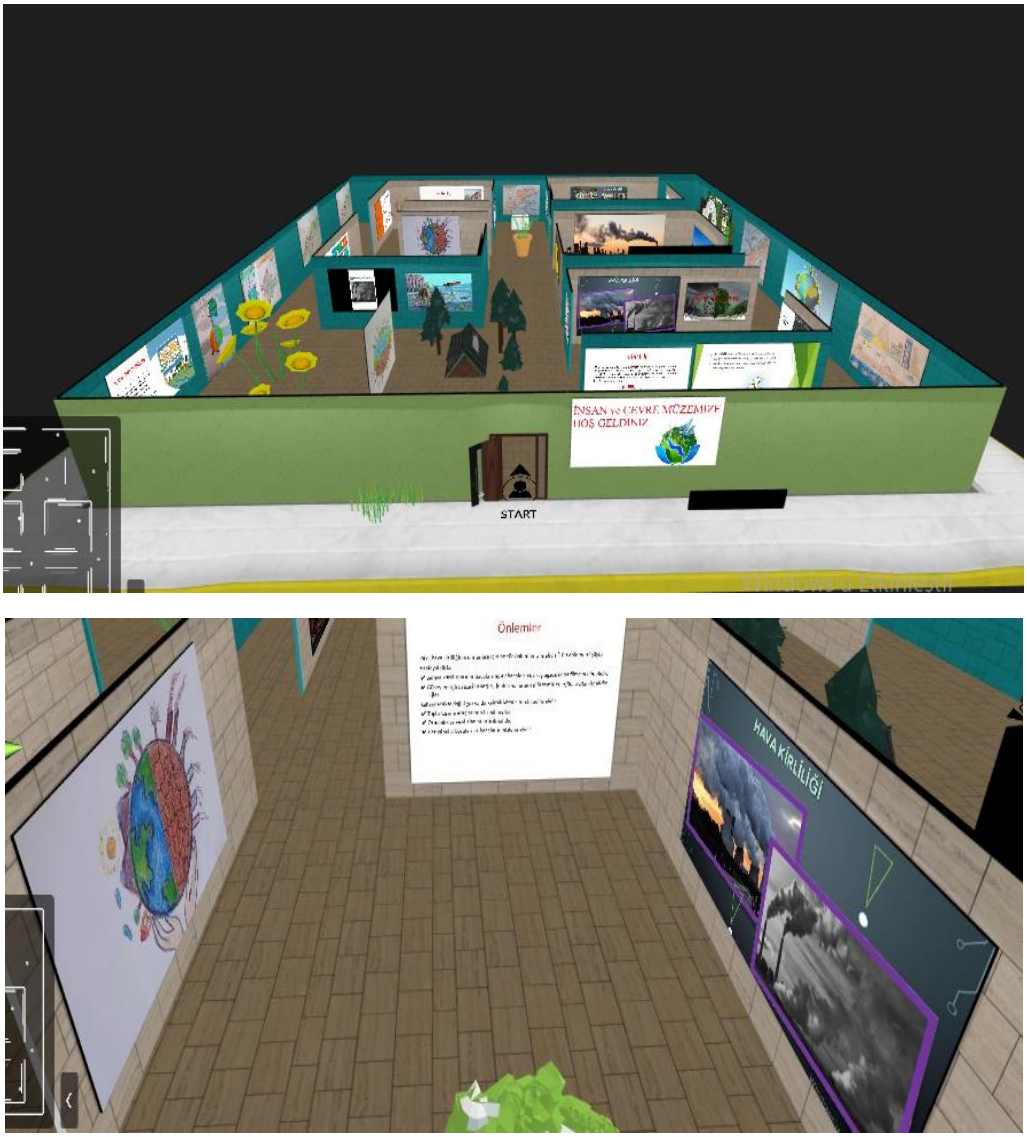

Figure 3. *Images of the Artsteps Virtual Museum Designed in the Study*

Data Analysis

The data obtained in line with the answers given by the students to the academic achievement test and the attitude test were analysed by transferring them to the SPSS statistical program. In the analysis phase of the achievement test, the correct answers of the students were coded as 1 point and the wrong answers as 0 points in the analysis program.

There was no question that the students left blank in the achievement test. Before the analysis of achievement test data, Kolmogrov-Smirnov test results were examined in order to examine the normality distribution. After it was understood that the data set obtained from the academic achievement test showed a normal distribution, parametric tests were used in the analysis process of the achievement test. In addition, the mean score and standard deviation values of the experimental and control groups were calculated. In order to compare the achievement scores of the experimental and control groups, the pre-test and post-test achievement scores were subjected to independent samples t-test.

After the data obtained from the attitude test were transferred to the SPSS program, reverse coding was applied to 9 negative items. Before the analysis of the attitude test data, Kolmogrov-Smirnov test results were examined in order to examine the normality distribution similarly. Parametric tests were used in the analysis process of the attitude test, which was understood to have a normal distribution. The mean attitude score values and standard deviation values of the experimental and control groups were calculated. In order to compare the science lesson attitude scores of the experimental and control groups, the pre-test and post-test achievement scores were subjected to the independent samples t-test.

The data obtained from the semi-structured interviews with the students were analysed using descriptive analysis. Each student interviewed was coded as S1, S2 ..., S15. Direct quotations from the views of the participant students are also included. Opinions of each participant were examined and similar views were determined. Similar views were gathered, codes were created, and categories to cover the codes were determined. The frequency values of the codes created in the next step are written. While determining the frequency values, the case of a student's response matching more than one code was considered.

Ethical Processes of Research

The students participating in the research were informed that the data to be obtained through the research will be used for scientific purposes, not for any other purpose, and that the confidentiality of the data will be protected and evaluated within the scope of scientific ethical rules. In addition, a voluntary participation form has been added to the appendix of the prepared data collection forms. Ethical permission was obtained from the Yıldız Technical University Ethics Committee before the scale was administered to the participants.

Findings

The data obtained within the scope of the study were analysed and presented in this section.

Findings on Quantitative Data

Before the analysis of achievement test data, Kolmogrov-Smirnov test results were examined in order to examine the normality distribution. The values obtained from the results of the normality distribution test applied to the academic achievement test scores of the students in the study group are given in Table 2.

Table 2. *Normality Distribution Test ResultsRegarding the AcademicAchievement Test*

Score	Groups	Kolmogorov-Smirnov		
		Statistics	Sd	ρ
Pre-test	Experiment	.118	50	.080
	Control	.119	50	.074
Post-test	Experiment	.120	50	.070
	Control	.119	50	.073

When Table 2 is examined, the fact that the data set obtained from the academic achievement test is found as ρ> 0.05 indicates that it has a normal distribution.

Before the analysis of the attitude test data, Kolmogrov-Smirnov test results were examined in order to examine the normality distribution similarly. The values obtained from the results of the normality distribution test applied to the attitude test scores are given in Table 3.

Table 3. *Normality Distribution Test Results Regarding the Attitude Test*

Score	Groups	Kolmogorov-Smirnov		
		Statistics	**Sd**	**ρ**
Pre-Test	Experiment	.087	50	.200*
	Control	.107	50	.200*
Post-Test	Experiment	.121	50	.063
	Control	.120	50	.070

When Table 3 is examined, the data set obtained from the attitude test applied as ρ > 0.05 indicates a normal distribution.

An answer was sought for the first sub-research question of the study. The question is as follows: “Is there a significant difference between the pre-test academic achievement scores of students who receive science education supported by virtual museums in the online environment and those who receive education with traditional science education in the online environment?”.Accordingly, the pre-test scores obtained from the experimental and control groups were analysed using the independent samples t-test. The values of the independent t-test results of the pre-test academic achievement scores are given in Table 4.

Table 4*. Independent t-Test Results of Academic Achievement Test, Pre-Test Scores*

	Groups	N	X	SS	Sd	t	ρ
Score	Experiment	50	10.1600	4.16673	98	.523	.0602
	Control	50	9.7200	4.24764			

When Table 4 is examined, it was found that the academic achievement test pre-test mean score of the experimental group students was X=10.16 and the standard deviation was 4.16. The academic achievement test pre-test mean score of the control group students was found to be X=9.72, and the standard deviation was 4.24. When the pre-test achievement score values are examined, it is understood that there is no significant difference between the scores of the experimental and control groups (t=.523; ρ>.05).

An answer was sought for the second sub-research question of the study. The question is as follows: "Is there a significant difference between the post-test academic achievement scores of the students who receive science education supported by virtual museums in the online environment and those who receive education with traditional science education in the online environment?". Accordingly, the post-test scores obtained from the experimental and control groups were analysed using the independent samples t-test. The values of post-test academic achievement scores and t-test results are given in Table 5.

Table 5. *Academic Achievement Test, Independent t-Test Results on Post-Test Scores*

Groups	N	X	SS	Sd	t	ρ

Score	Experiment	50	18.9800	4.01777	98	8.414	.000
	Control	50	11.6200	4.70297			

When Table 5 is examined, it was found that the academic achievement test and post-test mean score of the experimental group students was X=18.98, and the standard deviation was 4.017. The academic achievement test post-test mean score of the control group students was found to be X=11.62 and the standard deviation was 4.702. When the post-test achievement score values are examined, it is understood that there is a significant difference between the scores of the experimental and control groups (t=8.414; ρ<.05) and this significant difference is in favour of the experimental group.

An answer was sought for the third sub-research question of the study. The question is as follows: "Is there a significant difference between the pre-test science lesson attitude scores of the students who receive science education supported by virtual museums in the online environment and those who receive education with traditional science education in the online environment?". In this direction, the attitude test pre-test scores obtained from the experimental group students were analysed using the independent samples t-test. The values of the t-test results of the pre-test attitude scores are given in Table 6.

Table 6. *Science Lesson Attitude Scale, Independent t-Test Results of Pre-test Scores*

	Groups	**N**	**X**	**SS**	**Sd**	**t**	**ρ**
Score	Experiment	50	67.3756	6.82850	98	.370	.712
	Control	50	66.8976	6.07326			

When Table 6 is examined, the pre-test mean score of the experimental group students' answers to the science lesson attitude scale was found to be X=67.37 with a standard deviation of 6.82. The pre-test mean score of the control group students was found as X=66.89 standard deviation 6.07. When the pre-test achievement score values are examined, it is understood that there is no significant difference between the scores of the experimental and control groups (t=.370; ρ>.05).

An answer to the fourth sub-research question of the study was sought. The question is as follows: "Is there a significant difference between the post-test science course attitude scores of the students who receive science education supported by virtual museums in the online environment and those who receive education with traditional science education in the online environment?". In this direction, the post-test scores obtained from the experimental group students were analysed using the independent samples t-test. The values of the t-test results of the post-test attitude scores are given in Table 7.

Table 7. *Science Lesson Attitude Scale, Independent t-Test Results on Post-Test Scores*

	Groups	**N**	**X**	**SS**	**Sd**	**t**	**ρ**
Score	Experiment	50	86,8780	11.92782	98	7.101	.000
	Control	50	69,2604	12.86482			

When Table 7 is examined, the post-test mean score of the answers given by the experimental group students to the science lesson attitude scale was found to be X=86.88 standard deviation 11.93. The post-test mean score of the control group students was found to be X=69.26, and the standard deviation was 12.86. When the post-test achievement score

values are examined, it is understood that there is a significant difference between the scores of the experimental and control groups (t=7.101; ρ<.05) and this significant difference is in favour of the experimental group.

Findings Related to Qualitative Data

An answer to the fifth sub-research question of the study was sought. The question is as follows: "What are the opinions of the students who are taught science supported by the virtual museum about the virtual museum, which is one of the web 2.0 tools?". In this direction, the interview data obtained from the experimental group students were evaluated with descriptive analysis. The data obtained from the students are given in Table 8.

Table 8.*Students' Views on the Virtual Museum Prepared with Web 2.0 Tool*

Theme	Category	Code	Frequency
Student Opinions on the Virtual Museum Prepared with the Web 2.0 Tool	Positive aspects	Being Interesting	15
		Having Fun	12
		Adding Visibility	11
		Being Fluent	9
		Being Realistic	9
		Working in Groups	8
		Content Design	6
		Being Technological	6
	Negative aspects	Being Boring	4
		Being Time-consuming	4
		Difficult to use	2
		Unsuitable for the Course	1
	Contribution to Science Course	Being Instructive	15
		Increasing Achievement	15
		Lesson Encouragement	12
		Lessons Become Easier	11
		Making the Class Enjoyable	9
		Creativity Enhancement	5
		IncreasingActive Participation	5
		Making it Easy to Focus	4

*While calculating the frequency values, the case of a student having more than one answer was taken into account.

When Table 8 is examined, the opinions of the students in the experimental group towards Artsteps application, which is one of the web 2.0 tools, can be seen. The first question asked in the interview was "What do you think are the positive aspects of the virtual museum prepared with the Artsteps application, which is a web 2.0 tool?" The answers given to the question are presented under the heading of positive aspects. According to this, about the virtual museum, 15 of the students are interesting, 12 are fun, 11 are able to add visuals, 9 are fluent, 9 are realistic, 8 can work in groups, 6 are content design and again. 6 of them mentioned that it is technological. A few quotes from student interviews regarding the aforementioned question are given below.

Student coded S2 said, *"…It was a lot of fun to prepare a virtual museum. Our teacher used to take us to the museum. But I never knew there was such a museum. I had never built a museum with my friends and my teacher. It turned out very interesting. We were very surprised all together…*".

The student coded S4 said, "*Science lesson has never been so fun and interesting before. I didn't like science class very much, but now I do. Science class was very enjoyable.*

He explained his opinion as "I got a lot of points even from the test where I got a low score...".

The student coded S6 said, "*... The museum that my teacher showed us around in the science class was amazing. We have never used such a tool in any class before. It was very interesting to me. I wish we could do it in every science class*." expressed itself.

The student with the code S8 said "*... It was very interesting to design a museum. It's great to see all we've done together. We could do it the way we wanted. Our teacher always asked us when we were building the museum. We were able to use a lot of visuals related to our subject…*" He explained his idea.

Student coded S10 "…The virtual museum is very different and interesting. It is very nice that we have a museum because we do it ourselves. I want to learn from my teacher and do it myself at home." he stated his opinion.

Student coded S12 "*...It was very realistic, as if you were walking in a museum. I'm looking forward to completing our next science class, our museum. It was very enjoyable to attend the class, I didn't want it to end. I learned about the environment very well thanks to the museum. Our lesson was very entertaining and enjoyable*".

The second question asked in the interview, "What do you think are the negative aspects of the virtual museum prepared with the Artsteps application, which is a web 2.0 tool?" The answers given to the question are presented under the heading of negative aspects. According to this, about the virtual museum, 4 of the students mentioned that it was boring, 4 of them was time-consuming, 2 of them were used hard and 1 of them was not suitable for the lesson. A few quotes from student interviews regarding the aforementioned question are given below.

Student coded S7 said "… I think it is difficult to prepare a museum. Sometimes it was difficult for me to place things on the museum walls and move them wherever we wanted. We have used a similar technological application before. I think they waste the time of the lesson too much…"

Student coded S9 said, "*The virtual museum is not bad, but I think it is very difficult to do. Because we always placed one by one. We even made the things we would put in it ourselves. I think it took a lot of our time. If we're going to do it again, let's do it on a shorter topic.*" expressed his opinion.

Student coded S11 said "*...Preparing a museum is a good thing. But I think we'd better not use it in class. It got a little boring to me. We could not solve the question because we wasted our lesson on this. I like solving questions more. Let's make a museum, but not in the classroom…*".

The student with the code S13 said, "*It was exciting to visit the museum we prepared, but I think it was quite boring to do it. We were too tired to do it. If we ever build a museum again, let's choose another topic.*" expressed his opinion.

The student with the code S15 said, "*I was a little bored in the lesson. I wish my teacher had told me again. If only we had a question. I think we shouldn't use a museum in the lesson from now on...*".

The third question asked in the interview was "Does a course prepared with the virtual museum content prepared with the Artsteps application, which is a web 2.0 tool, contribute to the science course?" The answers given to the question are presented under the title of contribution to science course. According to this, about the virtual museum, 15 of the students are instructive, 15 of them increase achievement, 12 of them make the lesson love, 11 of them make the lesson easier, 9 of them make the lesson enjoyable, 5 of them improve creativity, 5 of them increase active participation and 4 of them mentioned that it makes it easier to focus. A few quotes from student interviews regarding the aforementioned question are given below.

Student coded S4 said, "*I loved making the museum. I understood the subject of science lesson more easily. I even got a high score on my teacher's test. I learned a lot about the environment. It was very enjoyable to make a museum with my friends. I wish my teacher would make us a museum in every science lesson, I think it is an application that definitely facilitates the learning of science lessons…*" expressed his opinion.

The student with the code S7 said, "*Me and my friends' scores increased with the virtual museum we made in the lesson. I think we all understood the environmental issue in this way. Even my friends who didn't make a sound in class took the floor in science class. I think the environmental issue came easy to everyone with the virtual museum*." expressed his opinion.

The student coded S9 said, "*I liked the science lesson, but it was difficult, as if I had a museum, I liked it more and found it easier. While doing the museum, the lesson was even more enjoyable. The teacher always asked us and our museum turned out to be what we had in mind. I learned a lot more in class. In this way, I think I will be more successful in science class and be more creative.*" expressed itself.

The student with code S13 said "*...Science lesson was very easy and I attended the lesson more than normal times. It's like we talked all the time. It was like I was inside the museum. I even answered questions easily. I have never learned the lesson so well…*"

Student coded S14 said, "*We all made a different material as a group, accompanied by our teacher, before preparing the museum. Thus, we have a better understanding of the environmental issue. And because we prepared it the way we wanted, our creativity increased. I think the science lesson we did with the museum was very easy and enjoyable…*".

Result and Discussion

Along with the distance education process, technology has served as a tool to move the online education process to a more effective and more qualified point. It is known that web 2.0 tools are the leading technological applications that can be used in this process. In this direction, in this study, it is aimed to reveal the effect of virtual museums created with the Artsteps application, one of the web 2.0 tools, on the academic achievement and science lesson attitude of the students and to determine the opinions of the students about the virtual museum used.

In order to find an answer to the first sub-research question of the study, the academic achievement pre-test data applied to the experimental and control groups were analyzed using the independent t-test. When the findings were examined, it was revealed that the pre-test achievement scores of both study groups were statistically equivalent to each other. Therefore, it can be stated that the experimental and control groups determined within the scope of the study have equal knowledge about the subject of "Human and Environment".

In order to find an answer to the second sub-research question of the study, the academic achievement post-test data applied to the experimental and control groups were analysed using the independent samples t-test. When the findings were examined, it was determined that there was a statistically significant difference in the achievement levels of the study groups. Although there was an increase in the achievement scores of all students, it was determined that the virtual museum prepared with the web 2.0 tool was a achievement in favor of the group to which it was applied. In this context, it has been seen that science teaching based on the virtual museum application prepared with the web 2.0 tool has a positive effect on academic achievement compared to traditional teaching. When the studies carried out in the literature are examined, no other study can be found that directly uses virtual museums based on web 2.0 applications in science courses. However, there are many studies in which

the use of virtual museums in the teaching process in other branch courses increases the achievement of the course (Ambusaidi & Al-Rabaani, 2019; Doğanlı, 2019; Gılıç, 2020; Özer, 2016; Taylor, 2001; Ustaoğlu, 2012). In the study carried out by Teker and Özer (2016), the positive effect of the use of the contextual model of learning in the virtual museum on the academic achievement and student views of the students can form a basis for the current study. As a result of a bibliographic review conducted by Franceschi and Miguel (2021), it has been determined that a virtual museum provides indications that it is an effective tool both in the field of consolidation and reinforcement of learning. Islek (2021), in his study, found that an active teaching process can be created and learning can be embodied more easily with virtual museum applications, from the opinions of pre-service teachers. In a study conducted by Bulut and Uzun (2021), it was revealed that virtual museums are applications that can provide a museum environment to students without going from one place to another and enrich the teaching process. It is also stated that virtual museums can be used in science courses that require observation and appropriate workshops can be designed. In the study carried out by Türkmen, Zengin and Kahraman (2018) with museum experts in the field of science, it was determined that the number of museums where experiments were conducted within the framework of science course was not sufficient. The contribution of the virtual museum to science teaching in the current research can be shown as evidence that a virtual museum that can be created by teachers can fill the museum gap in the field of science. Considering the existing value of virtual museums in education, it is possible to state that teachers' use of virtual museum applications in their planned teaching will make significant contributions (Zouboula, Fokides, Tsolakidis & Vratsalis, 2008). Tatlı, Altınışık, Şen and Çakıroğlu (2021) found that students who participated in the virtual museum were able to retain more events and objects in their minds than the students who participated in the real museum. In the current study, web 2.0 tools were used in the creation of the virtual museum. In this sense, on the one hand, the positive effect of web 2.0 tools on science achievement was revealed in the study. There are studies that will support our study at this point, in which the positive effect of web 2.0 tools on science achievement has been determined (Gürleroğlu, 2019; Gömleksiz, 2017; Korucu, 2020: Keçeci, 2018; Uysal, 2020; Yıldırım, 2020).

In order to find an answer to the third sub-research question of the study, the science lesson attitude pre-test data applied to the experimental and control groups were analyzed using the independent samples t-test. When the findings were examined, it was revealed that the science attitude scores of both study groups were equivalent to each other. It can be stated that it is an expected result in terms of clearly determining the effect of virtual museum applications used in our study on student science lesson attitude.

In order to find an answer to the fourth sub-research question of the study, the science lesson attitude post-test data applied to the experimental and control groups were analyzed using the independent samples t-test. The analysis results can be explained by the fact that the research groups differed after the experimental process. The fact that this differentiation is in favor of the experimental group reveals the effect of virtual museums used in the application phase on the process. Therefore, it can be deduced that Artsteps application, which is one of the web 2.0 tools, has a positive effect on science lesson attitudes. When the literature is examined, there are studies showing that virtual museum applications increase the course attitude (Peker, 2014; Yıldırım & Tahiroğlu, 2012). In the study carried out by Liu et al. (2021), it was revealed that students had a positive attitude towards the virtual museumand they believed that the virtual museum could support meaningful learning. Similarly, encountering studies that reveal the effect of web 2.0 tools on course attitude (Almalı & Yeşiltaş, 2020; Akbaba, 2019; Yıldırım, 2020) supports the contribution of the web 2.0 tool used in our study.

In the interviews with the students, they stated that virtual museums have an effect on increasing the academic achievement of science courses. In this sense, it is clear that the findings obtained with quantitative data are also supported by student thoughts. Virtual museums; As a result of the interviews, it was determined that it made the science lesson interesting, made the lesson easier, increased the focus on the lesson, and acted as a tool to activate the student in the lesson. It has been stated that virtual museums are an application that is fun, interesting, can create the desired content, offers a technological environment and can offer visuality.Kampouropoulou et al., (2015) and Tengku, Ashaari and Rahim (2016), evaluating the efficiency of virtual museums in line with the opinions of students shows parallelism with the existing study. It is stated that virtual museums make lessons more enjoyable, create an active environment, and the importance of virtual museums has emerged in most studies (Islek & Asiksoy, 2019).Similarly, Okumuş and Vurgan (2021) state that one of the technology-based applications is the transfer of virtual museums to the classroom environment, which contributes significantly to making the lesson more concrete and understandable. In another study, in which students' opinions are discussed, the educational dimensions of virtual museums are evaluated and it is pointed out that virtual museums are a cognitive tool that has become a popular and attractive learning environment (Kampouropoulou et al., 2015). At this point, it would not be wrong to say that the studies found in the literature and the current study overlap. On the other hand, when the negative aspects of the application are examined, it is also mentioned that it is a boring, time-saving and somewhat difficult tool to use. The opinions of teachers and teacher candidates who reveal that virtual museums provide permanent learning, create an active participation environment and are visually rich are also included in the literature (Aladağ, Akkaya, & Şengöz, 2014; Çalışkan, Önal & Yazıcı, 2016; Kaya & Okumuş, 2018; Sungur & Bulbul, 2019). In this context, it can be stated that the positive teacher views about the virtual museum reached in the literature overlap with our current study. Ulusoy (2010) found in his study that students approached virtual museums positively, that museums were effective and increased students' motivation in the teaching process.It has been determined that teachers create positive thoughts about virtual museums and recommend their colleagues to use them in the teaching process in order to enrich the lessons (Karataş et al., 2016). The contributions of virtual museums to the science teaching process are also revealed in the present study. On the other hand, the current study provides a starting point for the situations in which a field trip cannot be made due to the current classroom conditions in the subject areas of the science course that require a museum visit. In support of this idea, Eguz (2020) states that virtual museum applications allow access to museums that are located in distant regions and cannot be visited for various reasons, regardless of time and space. Yıldırım and Tahiroğlu (2012) emphasize the need to support real museums in the learning process with computer-assisted virtual museums and excursions in the classroom environment. With museum applications created with web 2.0 tools, students will be able to create virtual museums and a more active learning process framework will be drawn.

Suggestions

In line with the results of the study, a positive effect of the Artsteps virtual museum application, which is one of the web 2.0 tools, on the academic achievement and science lesson attitude of the students was determined. In addition, students' views on the virtual museum application were also determined. In this direction, it is suggested that virtual museum applications, which are web 2.0 tools, should be used as a tool that can be used by science teachers and that they should be created together with students in the context of the

classroom, as well as to show students directly in the virtual museum. Considering the benefits of web 2.0 tools for the field of science, it is recommended to be used by educators in science teaching. In the study, it can be stated that some situations are not used frequently by teachers on the grounds that they are seen as boring and waste of time. In addition, the fact that teachers can assign most of the museum as homework instead of doing it in class can eliminate boringness. On the other hand, this situation can be eliminated by ensuring that students who may be in the background can be included in the course flow. Artsteps virtual museum application was used in the study. In other studies, different web 2.0 tools can be used to provide diversity. In the study, the effect on students' achievement and attitudes was revealed. In other studies, the effect on anxiety, motivation, digital or technology literacy can be determined. In the research, the subject area of Human and Environment was studied at secondary school level. Virtual museums can be used for subjects where other visuals are intense in the field of science. Other web 2.0 tools, especially virtual museum applications, can be used at different secondary school levels or high school education. In the current study, its effect on the science course was investigated. In other studies, the effect on different branch courses can be revealed. The teaching process can be shaped in a different way by supporting other web 2.0 tools together with virtual museum. The reflections of the developing technology are seen rapidly in education day by day and the need to satisfy the students in terms of technology emerges in the future. At this point, it is suggested that courses related to this should be given in the undergraduate period on the grounds that the science teachers who will grow up gain the necessary competence in web technologies.

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