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Students' Opinions on the Use of Virtual Museums in Science Teaching

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Abstract

This study aims to present secondary school students' opinions on a science learning process supported by virtual museum activities. The study was conducted with 29 5th grade students studying at a public school during the academic year 2021-2022. During the study, the science lessons were enriched with virtual museum activities in addition to the activities presented in line with the curriculum and the content of the textbook. As the virtual environment, researchers used the virtual museum of Smithsonian National Museum of Natural History in the USA. After the lessons, semi-structured interviews were held to identify the participants' opinions on the virtual museum activity. It was observed that all the students had a positive impression and were satisfied with the process even though they addressed the virtual museum experience from different aspects. The students stated that they enjoyed both seeing the remains of creatures that lived in the past and getting information about the creatures they were familiar with. In addition, it was observed that they felt as if they had made a physical visit to the museum and related their learning with the achievements of the course. In the light of the findings, it is thought that virtual museums can be given more place in science lessons.

Key Words

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Since there are too many abstract concepts in science, all kinds of components that can support classroom learning in science lessons are researched. One such component is out-of-school learning environments. Various studies have revealed that activities carried out in these environments at different grade levels increase students' academic achievement (Çığrık & Özkan, 2016; Marth & Bogner, 2018; Mertoğlu, 2019), attitudes towards science lesson (Mertoğlu, 2019), motivations (Çığrık & Özkan, 2016; Dönel Akgül & Arabacı, 2020; Marth & Bogner, 2018; Uitto et al., 2006), permanent learning (Çiçek & Saraç, 2017; Dönel Akgül & Arabacı, 2020; Özcan & Yılmaz, 2018), interest in out-of-school learning environments (Bozdoğan, 2008) and sense of responsibility (Sujarwo & Tristanti, 2017). Museums, which are frequently encountered among out-of-school learning environments and placed on top in the "Handbook for Out-of-School Learning Environments" in Türkiye, are essential learning environments that the Ministry of National Education recommends schools to cooperate with. Museums, which aim that many artifacts are examined using the necessary scientific techniques and displayed to the public, continue their work in many fields from science to art, from history to geography. The principal objective of contemporary museology is that museums are acknowledged as places where knowledge is acquired as well as places where valuable historical items are kept and observed by visitors (Okan, 2018). Therefore, museums are not places for passive exhibitions and tours, but active learning environments where many kinds of formal and informal learning take place. It is indicated in some studies that the use of museums in science lessons strengthens communication (Yener et al., 2018) and increases students' academic achievement (Bolat et al., 2020), permanent learning (Bozkurt, 2022), and interest in science (Conway, 2014; Kartal & Şeyihoğlu, 2020). In addition, it is considered important that these experiences in museums are examined in detail for high quality learning. In their study on the museum experiences of 5th grade students, Çil and Yanmaz (2016) identified that the students had little experience with museum activities throughout their school life and hardly ever participated in educational activities in museums. It was also observed that the students were interested in museums and activities with scientific content, but they were not active especially in trips to natural history museums. This is an important finding as it shows that the level of effectiveness of museum visits in promoting learning in science lessons may change. It is also emphasized in the same study that teachers should include museum activities in their science teaching.

With the increase in the interaction of museums with technology, the concept of a virtual museum has emerged. Virtual museums, also known as museums without walls, are defined as digital platforms that present all the content that traditional museums have (Schweibenz, 2004). With the emergence of this concept, museums have become available to larger masses and more widely used (Ustaoğlu, 2012). Virtual museums enable visitors to open up to a different world smoothly by using technology instead of visiting a place. These new environments can bring in the potential for direct interaction by acting as a natural museum so that visitors become eager participants rather than passive viewers (Margetis et al., 2021).

Virtual museums provide the opportunity to experience art and culture for those who cannot make time for museum trips or who live in geographically remote locations, and offer different alternatives for those who cannot follow museum hours or lack the time to visit. Virtual museums offer the chance for interactive participation, especially for visitors who reside at a distance from museums (Barlas Bozkuş, 2014). Besides, they increase students' creativity as well as improve their learning (Ismaeel & Al-Abdullatif, 2016). It is stated that students'

socioeconomic differences make it difficult to carry out activities including physical museum visits (Dilli, 2017). In this respect, the availability of virtual museums in the home or school environments is important for students with limited economic opportunities to benefit from museum activities (Uslu, 2008).

In the last twenty years, there has been a rising generation who masters especially in the digital environment. This generation, who has been familiar with the virtual world due to computer games from an early age, feels more confident and comfortable in virtual environments. Çetin (2021) evaluated 8th grade students' reading behaviors in virtual environments and observed that students did not use virtual environments to learn, but they enjoyed these platforms, and activities carried out there enhanced their reading skills. Demirbağ (2020) aimed to investigate three-dimensional virtual environments and evaluate how convenient it was to use them for educational purposes, based on the examples in the literature, and conducted studies on Second Life activities. As a result of the overall literature review, it was identified that Second Life and alternative virtual environments provided a contemporary educational environment for students. It was also emphasized that Second Life activities offered an enjoyable learning environment, enhanced students' creative thinking skills, and shed light on the principle of learning by doing. Moreover, it was considered an advantage that lessons learned in virtual environments could promote students' foreign language learning, and time and costs of education could be saved. In a different study, the data obtained from 89 secondary school students revealed that most of the students spent time in virtual environments for games or social network platforms, and that they felt happier in such environments (Bulut Özek, 2018). Such strong and effective ties of students with virtual environments have made it possible to include these environments in the learning process.

Many studies have been conducted on the use of virtual museums in education. In a study by Uslu (2008), it was observed that CD-supported museum education provided for 7th grade students in visual arts class increased student achievement. Similarly, Ermiş (2010), who investigated 6th grade students' opinions on virtual museum activities using the example of Ankara State Art and Sculpture Museum, concluded that in-class virtual museum visits were useful for visual arts lesson. Gılıç (2020) carried out similar studies regarding the English learning process and emphasized the positive effects of virtual museums on students. Moreover, Ismaeel and Al-Abdullatif (2016) noted that concepts learned in social studies course became more permanent with the help of virtual museum and provided the students with the sense of protecting their cultural heritage. It was also observed in various research findings that virtual museums increased students' interest in biology lesson (Donaldson, 2005), contributed to students' science learning (Campos et al., 2016), and increased their knowledge of zoology (Castro et al., 2021). Furthermore, at university level, it was identified that the use of virtual museums positively changed students' attitudes towards museum activities (Çalışkan et al., 2014), increased their interest in physical visits to museums (D'Alba, 2012), made learning permanent (Islek & Danju, 2019) and improved creativity and questioning skills (Bidyuk et al., 2021). Virtual museums have shown their effects not only on students but also on teachers. It was discovered that virtual museum experience increased teachers' creativity, supported classroom activities with effective materials (Salar et al., 2013) and offered teachers various experiences that they did not have in their undergraduate education (Sungur & Bülbül, 2019), and that teachers had a favorable opinion of using virtual museums in lessons (Canlı, 2016; Karataş et al., 2016).

As it can be observed in the studies conducted, the use of museums in the field of education has become increasingly widespread. For this reason, museums are considered as an important tool that supports teaching processes with their positive effects. Furthermore, virtual museum environments, which significantly facilitate access to museums and popularize museum culture, provide teachers not only with rich course materials, but also with the opportunity to take many more students to museums at a much lower cost, and these opportunities promote the enrichment of course content accordingly. Nevertheless, there are very few studies on the use of virtual museums in science education (Ünal et al., 2022). In the light of this information, this study aims to examine secondary school students' opinions on a science learning process supported by virtual museum activities. The research question of the study is as follows:

- What are the opinions of 5th grade students on virtual museum activities in science lesson?

Method

Research Design

The study was a qualitative descriptive research. Such research examine individuals'experiences or thoughts and make a description. These studies can be seen as a more basic and less interpretive version of phenomenological studies (Sandelowski, 2010). In this study, it was aimed to identify the opinions of the students attending the virtual museum-supported science lessons regarding the process and the activity.

Participants

The participants were 29 5th grade students studying at a public school during the 2021-2022 academic year. As one of the researchers was science teacher at a public school, and it was not possible to take students for dividing in different groups, a 5th grade class (n=29) was chosen as study group. There were 16 male and 13 female students in the class. They all had one of tablet PCs or PC at home and they could actively use those for lessons or individual research. The science lesson within the scope of the study was delivered by one of the researchers, and all the students in the class involved in the activities.

Implementation Process

During the study, the science lessons were enriched with virtual museum activity in addition to the activities presented in line with the curriculum and the content of the textbook. The additional activity aimed to use the museums, which were selected in accordance with the relevant subjects and learning outcomes, in the lessons. The activity was developed for the learning outcome *"Students will be able to question the importance of Biodiversity for natural life"* in the Human and Environment Unit. As the learning environment, researchers chose the virtual museum of Smithsonian National Museum of Natural History in the USA. After planning the details about lessons and learning environment, two academician from science education reviewed the lesson plan in terms of content compliance with outcome, applicability and duration of the activity. In line with experts' feedback, some steps of the activity were revised and the activity became more useful for the lesson duration.

In the activity, the virtual museum exploration form was first distributed to the students. Before the Smithsonian National Museum of Natural History virtual tour, the students were given plenty of time to check the worksheet and ask their questions about it. After the students' questions were answered by teacher, the virtual museum tour was started. As there was a smartboard in the class and it was used as an important component of science lessons, there was no need for students to explain how to use the board. But, as all virtual museums, this museum had its own platform and buttons to use during the tour. Therefore, the teacher explained how to use these buttons actively, what do they mean in Turkish (because the main language of menu is English) and how to use information in the museum. After that, the museum plan was shown on the virtual museum map. In line with the requests and comments of the students, the teacher led a virtual museum tour. During the tour, students checked the questions on the worksheet and noted their new questions in addition to answers. The teacher asked for volunteers for leading the tour and allowed them to take a tour themselves. Although students filled their worksheets individually, they worked in groups during the tour on the board. They chose their group mates according to their common questions. Naturally, groups reshaped dynamically according to questions. The activity was performed in a classroom setting for a total of 2 lesson hours. Virtual tour was ready for students to continue and try during these lessons. Both during and after the tour, teacher asked questions about what they see and what are the differences between those. Students were encouraged to think and question about our planet, animals, human, other livings and their interaction with each other. They explained some questions using the information that they had from the museum. Some students argued the features of extinct animals with each other experiencing the tour. After students' all questions were answered by other students or the teacher, they completed to fill their worksheet. Sample images from the implementation process of the activity are presented in Figure 1 and 2.

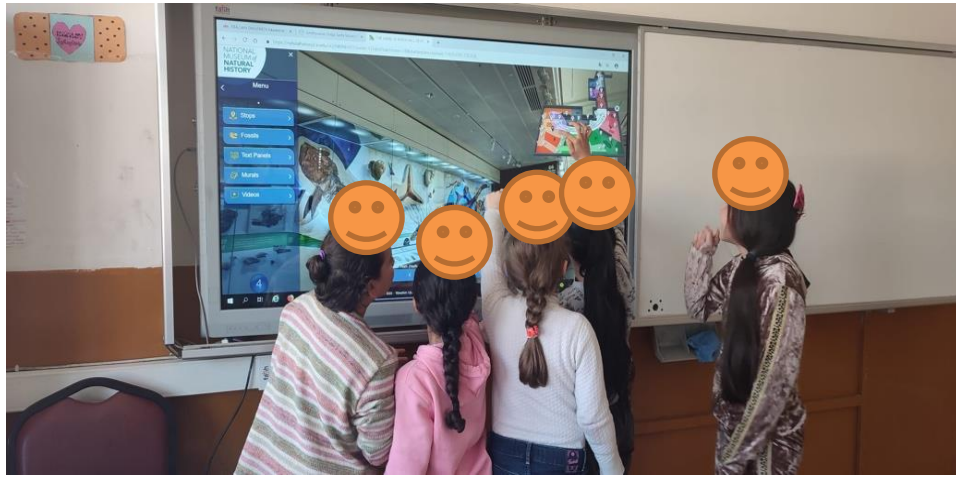**Figure 1.** Students Leading The Tour to Find Answers of Their Questions

Figure 2. Students Experiencing How to Use The Platform and to Start the Tour

Data Collection Tool and Data Analysis

In the study, semi-structured interviews were held to identify the participants' opinions on the virtual museum activity. Semi-structured interviews serve as an advantageous technique in that they enable both to progress by receiving answers to predetermined questions and to seek in-depth answers when necessary (Büyüköztürk et al., 2020). For the interviews in this study, the questions developed by Kaya and Okumuş (2018) on the use of virtual museums were utilized in line with the level of students and the course content. The interviews that consisted of a total of 8 questions were held individually with all participants following the activity.

The interviews were analyzed using content analysis, in which the data are examined in detail, and codes, categories and themes are created to identify participants' opinions on a given subject (Creswell, 2021). Number and frequency values, which indicate how often the codes are used, are also presented (Büyüköztürk et al., 2020). The responses of the participants in the study were examined thoroughly by the researchers, and the codes and categories were created. To ensure the reliability of the findings obtained, the analyses were performed by two researchers working independently of each other. Following the analyses, percent agreement between the codes of the researchers was calculated using the formula by Miles and Huberman (1994) (Reliability=Agreement/Agreement+Disagreement). The intercoder agreement was estimated as 94.7%, it can thus be stated that the codes were reliable (Miles & Huberman., 1994)

Results

The answers of the students to the questions asked for their opinions following the virtual museum-supported science lesson are presented in detail below. Table 1 presents the findings regarding the question "What are your opinions after your virtual visit to the American National Museum of Natural History?".

Table 1

Opinions on the Virtual Museum Experience

Category	Code	n
Content experience	I saw extinct animals	13
	I saw animals that I had never seen	9
Feelings	It was as if I went there	9
	I had a lot of fun	6
Learning process	I learned better	14
	I learned more easily	1

In Table 1, it is observed that the students mostly focused on extinct creatures in the virtual museum. They also stated that they felt like they physically visited the museum and that they learned better. Considering these responses, all the opinions of the students were positive. Some sample statements are as follows:

S4: "It was as if we were there, we learned better."

S12: "Yes I liked it, it is better."

S21: "We learned better."

S22: "We learned very well; we saw the history."

S18: "We saw the history, I liked it. It was more fun."

Table 2 presents the findings regarding the question "How did the virtual museum activity change your interest in the science lesson?".

Table 2

Opinions on the Change of Interest in the Lesson

Category	Code	n
Content-based effects	It was more interesting	28
	We saw many animals	10
Process-based effects	The time passed quickly	9
	We learned better	3

In Table 2, it is observed that almost all the students found the lesson more interesting. In addition, they stated that animal diversity attracted their attention and that they had a more enjoyable learning process. It is also an important finding that all the responses were positive. Some sample statements are as follows:

S5: "We became more interested."

S6: "We saw many animals."

S9: "It was more enjoyable. The time passed very quickly. I saw animals that I had barely seen."

S13: "We got more interested in science, and it was fun. The time passed quickly."

Table 3 presents the findings regarding the question of "What do you think about the usefulness of virtual museums?".

Table 3

Opinions on the Usefulness of Virtual Museums

Category	Code	n
Usefulness	I found it very useful	27
	I understood very well	15
Teaching	Like America was in the village	14
	We saw many animals	15

All the students expressed positive opinions about the usefulness of the virtual museum, with two different categories presented in the table. Most of them emphasized that they found virtual museums useful. In addition to these statements there were some other statements about especially the instructional aspect of them. Some sample statements are as follows:

S1: "I found it useful, I understood the subject very well. We had a better lesson. I saw many paintings. America was here."

S10: "I found it useful, we went to America."

S11: "I found it more useful, we understood the lesson better. It was more fun. We saw many paintings. America was here in X village."

S16: "I found it more useful, we learned the lesson better. We saw many animals."

Table 4 presents the findings regarding the question of "What attracted your attention the most in the virtual museum?".

Table 4

Content that Attracted the Participants' Attention the Most

Category	Code	n
Extinct creatures	Fossils	25
	Mammoth	15
	Dinosaur	11
Living creatures	Giraffe	11
	Octopus	6
	Human bones	2
	Marine animals	2
	Monkey	2
	Lion	2
	Tiger	1
	Chamois	1
	Snake	1
Other	The whole museum	4

Considering the sections that attracted students' attention, the answers were categorized by the period in which the creatures lived. In Table 4, it is observed that most of the students were interested in the extinct creatures. On the other hand, other sections of interest included creatures that they were less likely to observe in their immediate surroundings. In the category labeled as "other", the participants stated that they found every part of the museum interesting and gave an answer inclusive of other participants' responses. Some sample statements are as follows:

S18: "Mammoth, giraffe, fossil."

S21: "Fossil, octopus."

S24: "Fossil, mammoth, giraffe, monkey, octopus."

S26: "Fossil, giraffe, marine animals, mammoth, dinosaur, lion, octopus."

S28: "Fossil."

S14: "Fossils, dinosaurs, mammoths, marine animals."

Table 5 presents the findings regarding the question of "Which creatures did you find different?"

Table 5

Creatures that Participants Found Different

Category	Code	n
Extinct creatures	Mammoth	20
	Dinosaur	9
	Fossil	2
Living creatures	Octopus	14
	Giraffe	9
	Human	3
	Chamois	2
	Kangaroo	2
	Lion	2
	Zebra	1
	Snake	1
	Swordfish	1
	Monkey	1
	Hippopotamus	1
	Panda	1
	Marine Animals	1
	Elephant	1
Other	All	2

When the answers about the different creatures are examined, it is observed that mammoth is the most frequent answer. It is noteworthy that the creatures that attracted students' attention were also the most frequently stated creatures among those they found different. But the creatures that students found different were not limited with those. They stated some animals that they already know from TV or zoos (such as octopus, kangaroo, lion). Some sample statements are as follows:

S14: "Swordfish."

S13: "Mammoth because I saw it for the first time."

S9: "Mostly Dinosaur."

S6: "Octopus, Mammoth."

S2: "Octopus."

S19: "Mammoth, Octopus and Chamois."

S21: "I saw a Mammoth."

S25: "Mammoth, Dinosaur."

Table 6 presents the findings regarding the question of "What did you learn as a result of the virtual museum activity?".

Table 6

What is Learned as a Result of the Virtual Museum Activity

Category	Code	n
	Extinct animals	19
Science-related learning	Animals I have never seen	7
	Fossils	4
	Differences of ancient humans	3
Non-science learning	Museum concept	2

Considering the students' statements about their learning experiences, the responses are categorized into two as "science-related learning" and "non-science learning". In the science-related learning category, it is observed that learning about extinct animals stands out. Similarly, learning about animals never been seen and humans of previous periods is emphasized. Some sample statements are as follows:

S28: "I have learned what a museum is."

S26: "We saw fossils that we had never seen. We examined extinct fossils."

S10: "We learned about history and extinct animals."

S13: "We saw animals that we had never seen. We saw extinct animals. We saw fossils."

Table 7 presents the findings regarding the question of "Would you like to reexperience a lesson with virtual museums?".

Table 7

Opinions on Reexperiencing the Virtual Museum

	n
Yes	29

As it is observed in the table, all the students answered yes to this question. The absence of negative statements among the answers to the previous questions also presented findings consistent with this table.

Table 8 presents the findings regarding the question of "What do you think can be done to make virtual museums better and more effective?".

Table 8

Suggestions for Better Virtual Museums

Category	Code	n
Enrichment of museum content	Cartoons can be created	26
	Animal sounds can be included	10
	Animals can be animated	3
	An audio guide can be included	2
	Real life state of the fossils can be presented	2
Variety of museum components	A zoo can be included	3
	Statues can be included	1

Students' opinions on better and more effective virtual museums were divided into two categories as "Suggestions for the enrichment of museum content" and "Suggestions for the variety of museum components". Among the suggestions, the statements about supporting the content in the museum with various technological components stand out. In addition, suggestions were proposed regarding the inclusion of statues and a zoo in the museum. Most of the suggestions were for enriching the content with various components. Some sample statements are as follows:

S2: "I would like to see the pictures of fossils when they were alive."

S7: "The sounds of animals could be included."

S13: "There may be displays like cartoons. There may be statues. We can hear the sounds of animals."

S18: "It could be like a cartoon. Audio could be included. Animal sounds and movements could be included."

S19: "It could be like a cartoon. Dinosaurs could be displayed realistically."

S24: "It could be like a cartoon. I wish animal sounds were included."

S14: "There could be a display like a cartoon. Statues could be included. The animals could be animated, and we could hear their sounds."

Discussion, Conclusion & Suggestions

What is noteworthy in the findings is that all the statements were positive. It is observed that all the students had a positive impression and were satisfied with the process even though they addressed the virtual museum experience from different aspects. It is identified that what attracted the students' attention the most in the museum was the creatures that they had never seen before due to the difference in period or habitat. This is an expected situation as it is a reaction to any content encountered for the first time, yet it is also an important finding in increasing students' awareness of both other museum content and learning that takes place here. As a matter of fact, the students stated that they felt like they were in a museum and had a better and easier learning experience in the virtual museum activity. Besides, the number of students who emphasized learning constituted more than half of the participants. These results are consistent with those of other studies indicating that out-of-school learning activities support students in terms of academic achievement (Çığrık & Özkan, 2016; Marth & Bogner, 2018; Mertoğlu, 2019). The fact that students felt like they were in a museum indicates that one of the most important purposes of using virtual museums as an out-of-school learning environment could be achieved. By combining this achievement with the awareness of learning experiences, students' science-related learning can be enriched. It is believed that expanding the use of museum environments, which are relatively rarely used in science lessons, is important for the relevant awareness. At this point, the fact that the students had a real-like experience in an environment, which they did not have the opportunity to experience in their immediate surroundings, and had a learning experience in this way corresponded with the purpose of both the science lesson and the virtual museum integration in the study.

The creatures that attracted the students' attention the most include mammoth, octopus, dinosaur and giraffe. These animals may have attracted the students' attention because they differ in physical structure from the ones that the students frequently see. Moreover, since these are prominent characters in various movies, the students may have found them more intriguing. The fact that the students consider the creatures that are extinct or not available in their environment as interesting may stimulate them to be preoccupied with situations different from those they see as problems in daily life. It may be possible that they are triggered by this virtual tour and concern themselves about situations that they normally do not mind (for example, endangered animals and conservation methods). Therefore, it is likely that they turn to topics intended in the course content, and that their interest in science, history of science and history is triggered considerably. Presenting the living conditions of these creatures, the characteristics of their relatives that are still alive today, and the present ways to obtain relevant information today through a virtual museum can directly promote formal learning outcomes of science lessons. Evolution, extinct creatures, fossils are the first relevant examples that come to mind. Studies indicating that the use of museums in science lesson increases students' academic achievement (Bolat et al., 2020; Campos et al., 2016), communication skills (Yener et al., 2018) and permanent learning (Conway, 2014; Kartal & Şeyihoğlu, 2020) are also in line with these findings.

Considering the details of the content that attracted students' attention in the museum, it is observed that the emphasis on fossil stands out. The students highly enjoyed seeing and getting information from the remains of creatures that lived in previous periods. This learning supports the learning outcome of "Students will be able to question the importance of biodiversity for natural life" in the course content. Furthermore, a significant part of the students stated that they were also interested in seeing the creatures that they had the chance to observe in real life. These results indicate that the museum is considered interesting not only for being an environment where the students encounter creatures that they cannot see, but also for the knowledge that they acquire about the creatures that they are familiar with. The fact that students consider museums as an environment for acquiring knowledge is stated among the objectives of contemporary museology (Okan, 2018). Therefore, virtual museum experience not only allows students to experience a museum visit, but also contributes to the understanding of contemporary museology. It is also noted in different studies that virtual museums positively affect attitudes towards museums (Çalışkan et al., 2016; Peker, 2014). For this reason, it is believed that virtual museums, for example a natural history museum, can serve as an effective learning environment for learning about the life cycles and changes of creatures, and particularly evolution, in science lessons. Regarding their interest in the lesson, 28 students stated that they got more interested with the virtual museum-supported learning process. The high rate is an indication that inclusion of virtual museum activities in science lesson can be highly effective in motivating students. In addition, this result supports the studies indicating that similar activities increase students' interest (Bozdoğan, 2008) and motivation in the lesson (Dönel Akgül & Arabacı, 2020; Çığrık & Özkan, 2016; Marth & Bogner, 2018; Uitto et al., 2006).

With the help of different questions, the students' opinions on whether the virtual museum was effective and enjoyed were tested, and all their statements were consistently positive. All the students replied in the affirmative when asked about their willingness to have a similar experience again. These results indicate that virtual museums are out-of-school learning environments of which use is convenient in science lessons and which increase the quality of the lesson. The students participating in the study offered various suggestions about enriching their museum experiences. Among these suggestions, supporting the content with cartoons and including the sounds of animals were emphasized the most. What these suggestions had in common was that technological components should be added. Although this study was limited to the virtual museum experiences (in science lessons) of 29 students in a public school, these suggestions can contribute significantly to both teachers trying to identify museums to use in science lessons and researchers studying on the development of museum content. Besides, it also gives an idea about what other activities a teacher, who plans to use virtual museums to teach any science subject, can carry out as integrated with this process. For example, following the virtual tour in the study, a cartoon or short film with similar content can be selected and shown to the students. Consequently, it is possible to evaluate the expectations of students in science lessons and museums by making inferences from these suggestions.

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