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Using QR codes in the science and technology center [1]

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Highlights

- QR code; it is a two-dimensional, quickly responsive, barcode system.
- The QR code was used in the brochure of the science and technology center.
- Before the science and technology center trip, the students stated that the QR code brochure had remarkable and lively elements.
- The students stated that the science and technology center trip was of better quality with the QR code brochure.
- According to the students, the QR code brochure was very helpful in guiding the person.

Article Info: Research Article

Keywords: *QR code, brochure, science and technology center, secondary education*

Abstract

The aim of this study was to determine the high school students' views about the trip to the science and technology center with QR code brochure. In the study, the design and development research method was used. The study group consisted of a total of 21 students studying in the 11th and 12th grades of the Technical Anatolian High School in the Marmara region in Turkey. In the study, an information brochure of the science and technology center located in the Marmara region was re-designed by enriched with QR code. Afterwards, a day trip to the STC was organized. Data were collected with semi-structured interview forms and analyzed according to the content analysis technique. According to the results of the study, before the trip the students stated that the QR code brochure had different, remarkable, informative, and lively elements. The students emphasized that the QR code brochure increased their interest and curiosity about the trip. The students indicated that they had a better quality of the trip thanks to the QR code brochure, they could visit many places in a short time, and the brochure guided them. After the trip, the students asserted that their favorite parts of the science and technology center were the Simulator and Planetarium. Most of the students confirmed that the science and technology center trip contributed to the lessons, that they applied and tried what they learned in the lesson. Therefore, QR codes can be used in teaching materials and outdoor activities since QR codes increase students' motivation to lessons.

1. Introduction

QR code, known as square code, is used as the equivalent of the term data matrix. A QR code consists of intertwined squares in 3 corners of a square box. QR codes can contain links to an internet address, pdf file, video, text, photo, etc. It is the name of the two-dimensional barcode technology in which information is encoded. A QR code capacity can be increased from 20 to 7000 characters (Acartürk, 2012). Thanks to the feature of the QR code, with the program installed on smart mobile devices as an application tool, the data, images, videos, etc. can be reached.

QR code is one of the tools that can be used easily in many fields, especially in health, banking, transportation, auditing, and education. For example, a QR code application is used to verify documents

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downloaded from the e-pulse system (Karekodla e-Nabız'da [With QR code on e-Nabız], 2019). The sterilization process and sterile use of surgical instruments can be followed with a QR code. In addition, with the use of QR codes, forgetting materials in the patient's body after surgery can be prevented (Cerrahi Aletler "Kare Kod" Takibinde [Surgical Instruments Tracked by "QR Code"], 2020). A pilot application was made for transportation with QR code in metrobuses in Istanbul (Pilot Uygulama Mart'ta Başlıyor! Toplu Taşımada Yeni Dönem... [Pilot Application Starts in March! A New Era in Public Transportation...], 2020).

In a design study, importance was given to the use of colors and QR codes in a poster prepared for touristic purposes in public transportation in Egypt. One of the most important results of the research was that the poster was remarkable with the use of the QR code (Agag, 2022). In a study investigating the use of mobile tools for learning words in English language education and the acceptance level of students for these applications, a QR code was used to download the program (Aygül, 2019). They thought that with the practical use of QR code technology, they eliminated the confusion that might occur in the installation of a new program.

The use of QR codes in education is becoming more common day by day. For example, QR code is used in biology textbooks (Kabaoğlu et al., 2017). QR code was used in the Plickers application in a middle school quiz. Students answered the questions they saw in the Plickers application in the form of QR code printout papers (Plickers Uygulaması ile Bilgi Yarışması Çiftlikköy Şehit Abdülhamit Kaya İHO [Knowledge Competition with Plickers Application Ciftlikkoy Martyr Abdulhamit Kaya Imam Hatip Secondary School], 2017). In the Squareküt project, which was prepared by an 11th grade student in a high school, the era of smart school libraries began using the QR code application (Tekirdağ Namık Kemal Lisesi'nin Kareküt Uygulaması ile Akıllı Okul Kütüphaneleri Oldu [Tekirdağ Namık Kemal High School Became Smart School Libraries with the Squareküt Application], 2017). In a primary school in Ankara, the project named Playroom won the first prize in the integration plan category in the e-transformation project competition. In this project, the games are embedded in the QR code (Oyun Odası Adlı Projemiz Ödüle Layık Görüldü [Our Project titled Game Room was Awarded], 2016). In the Literature Street project prepared in a Vocational and Technical Anatolian High School, QR code application was used to direct information about the lives and works of literary figures, foreign poets, and writers to the site they prepared (Şairlerin hayatını okul koridorundaki karekodlarla öğreniyorlar [They learn about the lives of poets through QR codes in the school corridor], (2020). Activity papers enriched with QR code were developed in the Plant Morphology and Anatomy Laboratory course sheet (Kösal, 2019).

2. Literature

In the related literature, there were some studies on the use of QR codes in education, the design of brochures with QR codes, and field trips. For example, Cruse and Brereton (2017) in their study with teachers mentioned that they could make changes to the materials even by using very simple operations (such as creating only the QR codes with links). However, it was determined that some teachers approached the use of QR code with suspicion due to the reluctance of teachers who were not accustomed to technology. The use of the QR code might divert the attention of students from outside the classroom and caused an undesirable confusion. In the study, seven principles that would guide in designing QR code material for teachers who were open to improvement were mentioned: QR code should not contain unnecessary and distracting content and should be meaningful, ensure student participation, reflect student freedom, facilitate the course flow, facilitate the preparation of materials, add value to learning materials and encourage the use of original materials. The studies of Çakır et al. (2015) concluded that the presence of QR codes in the materials used in teaching English vocabulary increased the motivation of the student towards the material. Thus, they proved that the use of QR code had a positive effect on student success in teaching English vocabulary.

In the studies of Pehlevan et al. (2017), they prepared two Green Crescent Week Boards for primary school students with and without QR code applications. In the study, the students found the QR code board to be more remarkable and intriguing. QR code board encouraged students to use mobile devices more efficiently

outside of class or during rest periods such as recess. In the study of Akın (2014) there was no significant difference found in terms of success and permanence between the students in the experimental group who were given the QR code supported learning material and the control group students who were not distributed with the QR code supported education material. Octavia et al. (2019) developed an interactive fun museum education application. QR codes were placed in a part of the artifacts in the museum. These QR codes provided more information, photos, audio, video, etc. about the work. In the study, it was mentioned that this situation removed the limited information barrier in museums. 165 young museum visitors aged 6-17, and 75.9% of the participants clarified that this application was very interesting as a learning environment and museum tours. Özcan and Yılmaz (2018) in their study conducted a study that took students' opinions on the out-of-school learning environment (Planetarium), the knowledge levels of teacher candidates about the institution to visit, and the contribution of the trip to education. In the study, there were positive differences in the achievements of the astronomy course in the students with the making of the trip. Apart from these studies, QR code applications can be used in many other fields and studies. For instance, to create 21st-century resumes, check answers and reflect on students' assignments, grade appropriate websites for students to visit when they finish their assignments, give tutorial help for homework, provide websites with information about each type of plant or specimen, prepare image galleries related to a topic of study, extend activities corner, etc. (How to Use QR Codes in the Classroom - 17 Great Ideas for Teachers, 2023).

In a pilot school trip application where the mobile application was used, students who used the application that guided the route specified that they were very satisfied with this application (Silva et al., 2019). In a study that aimed to improve the language skills of Chinese students studying Turcology, to enable students to understand Turkish culture well, to ensure active learning of students with city trips and activities, and to enable students to apply what they learned during this period, QR code was used in the materials prepared to guide the city tours (Işık & Işık, 2021). The opinions of the students were taken before and after the city tour. To get more detailed information on the city tour, videos giving detailed information about the places to visit and the activities to be done have been added to the activity papers. The website with an English explanation and the QR code of the location have been added in case anyone cannot understand the Turkish explanation.

In his study, Amos (2023) described the planning of a science teaching field trip preparation and implementation phases. He mentioned that teachers may not be very willing to organize field trips due to these difficulties in planning them. Teachers who had not received postgraduate education and the teachers working in public schools, did not favor them because of their lack of knowledge about planning and organizing out-of-school trips (Soysal, 2018). One of the reasons affecting this situation can be shown as the fact that in the traditional education of science teachers and that pre-service teachers do not get training about the planning and implementation of out-of-school trips (Behrendt & Franklin, 2014). It was also found that preparing before the trip and conducting the follow-up after the trip had a positive effect on the students (Lee et al., 2020). Nature education and science center trips had positive effects on learning science lessons and talking about these subjects, and the attitudes and skills gained during the trip continue after the trip (Topaloğlu & Balçın, 2021). Accordingly, it could be said that the nature education or science center trips could rise the students' attitudes toward the lesson and the desire to learn, and there were many studies showed that the desire of the teachers to carry out out-of-school trips increases with the trips made with a proper preparation process (Başar et al., 2021; Bozdoğan et al., 2015; Çebi & Arslan, 2019; Doldur, 2019; Durmaz et al., 2017; Özyıldırım & Durmaz, 2022; Yıldırım & Şensoy, 2016).

Field trips are divided it into actual field trips, and alternative field trips such as virtual field trips, broadcast, electronic media formats, and print. For instance, in a subject like biology, a teacher can provide the learners with a picture or video of a botanical park to show endemic plants (Science Field Trips: Advantages and Critique -| Research Paper Example, ivypanda.com, 2024). Although field trips are divided into two as real and virtual, their common purpose is to ensure that students learn by supporting their understanding of science, to provide reliable information to students and to improve the learning process of students. Virtual science trips such as nature, journey to Mars, national aquarium, etc. which can be an alternative solution

to the difficulties of out-of-school trips, offer many kinds of virtual trips that can be done in the classroom, which is a safe environment, with the use of technology, saving time and without the need for logistics. Additionally, virtual field trips national like National Geographic, Field Trip Zoom, NationalParks.org, Museum of Science Virtual Trips, etc. are The Coolest Digital Field Trips that Boost Student Learning, 2024; 8 virtual field trips for STEM engagement, 2024.

According to the related literature, there were few studies related to organizing an out-of-school learning environment with a QR code brochure. For instance, Çetin (2020) examined the prospective biology teachers' views about the field trip to Manyas National Park by brochure with QR code including some additional information about national park, such as animals, specifically bird varieties, plants etc. This field trip was efficient outdoor activity for the students. The students' expectations were largely met, especially related to birds and social activity and the field trip was to contribute theory that the students learnt in their courses in the faculty.

Field trips, which are not organized too much for reasons such as time, intensive program content, permission, budget etc. can be made more efficient with QR code. Thanks to the ease and portability of QR code technology, students can use QR codes outside of the classroom in addition to inside the classroom. It is assumed that this current study will contribute to the relevant literature of the findings related to determining the opinions of students about the science and technology center (STC) trip with a brochure enriched with QR codes. This study addressed eight research questions about the STC trip:

1. Did the students attend any science-based trip or Science and Technology Center (STC) trips before?
2. What were the students' connotations and definitions about the STC before and after the trip?
3. What were the students' purposes and expectations of participating in the STC trip?
4. What was the most curious and impressive part of the STC before and after the trip?
5. What were the students' views on the contributions of the STC trip to them and lessons?
6. What were the students' suggestions about the STC trip?
7. What were the students' recommendations about the QR code brochure?

3. Methodology

3.1. Research Model/Design

This study was carried out according to the design and development research method, which was one of the quantitative research types, and here the development and evaluation of a product was made (Büyüköztürk et al., 2017).

3.2. Data Collecting Tools

The data were collected with semi-structured interview form developed by the researchers. Firstly, the draft semi-structured interview form included total 14 open-ended questions. It had two sections: Before trip (5 open-ended questions) and after trip (9 open-ended questions). Then, the draft interview form was sent to expert opinions. Expert opinions were obtained from two Computer and Instructional Technologies educators, one Mathematics educator, one Biology teacher, and one Biology education graduate student. After expert opinion, some changes were made to the draft form. After expert opinion, one question was asked as a probe and a few questions were changed. For example, "To what extent did the QR code brochure help you during your STC trip?" While the question was ranked 5th, it was ranked 3rd after expert opinion.

Finally, interview form consisted of three sections and a total of 13 open-ended questions. These sections and questions were as follows: 1. The pre-interview form contained 3 questions. 2. The before-trip interview form included 2 questions about the brochure distributed before the trip. 3. The after-trip interview form had 8 questions including questions about the trip with QR code brochure).

Preliminary interviews were held with the participants before the trip and with each student in about two minutes. The participants were asked whether they had gone on a science-based trip before, if they did, whether they were given information before the trip or whether brochures were distributed, to describe the science and technology center and the purpose of participating in the trip. After the preliminary interview, the STC brochures with QR codes were distributed to all students and they were asked to examine these brochures at home and participate in the trip with these brochures. On the day of the trip, students went to the STC. Before the trip interviews were performed with each student about the QR code brochure in approximately two minutes. After the trip was completed, the after-trip interviews were held with each student for approximately 10 minutes. A voice recorder was used in all interviews.

3.3. Study Group

Sometimes students with lower average success choose Technical and Vocational High Schools. However, since these types of high schools are types of schools that provide expertise in the vocational field, students who have mastered the basic academic knowledge of the profession can graduate from this school.

The study was carried out with a total of 21 students studying in the 11th and 12th grades of a Technical Anatolian High School in the Marmara region in Turkey. These students received training in the fields of "Electricity and Electronics" and "Informatics". These departments took many courses based on physics, mathematics, and algorithms.

3.4. Data Analysis

Interview data of students were transcribed for data analysis. Content analysis technique was used in data analysis (Yıldırım & Şimşek, 2011). After listing the answers given by the students to each interview question, they were divided into themes and sub-themes. The latest findings were tabulated, and their frequencies were calculated. In this study, sub-theme expressions or sentences with two or more frequencies in the tables are included. In addition, some examples of the interesting answers of the students in the article were provided by giving the students numbers and quoting them exactly like S15. Before trip or After trip. For example, "quotation of S15 Before trip" means that the views of S15 related interview before trip.

3.5. Validity and Reliability

The reliability of the study was calculated as 80% according to the formula [Agreement / (Agreement + Disagreement) X 100]. In addition, since the answers given by the participants (21) to each question could sometimes be included in more than one sub-theme, sub-theme frequencies could exceed the number of participants. This value, which showed the internal consistency for the coding, should be at least 0.80 (Miles & Huberman, 1994). Accordingly, it could be assumed that the survey results are reliable.

3.6. Brochure Design with QR Code

In the study, the first information brochure of the science and technology center was requested from the center. Later, it was enriched with a QR code. Then, a trip to a science and technology center was organized with the students.

While developing a QR code brochure in this study, the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) design model was used (Çakır et al., 2019). ADDIE model was among the preferred models because it has been determined that it increased the academic success, motivation, and self-confidence of the researcher, and provided permanence in learning (Göksu et al., 2014). The QR codes used in the design study of the brochure distributed in the current study were prepared in accordance with the principles of the Cruse and Brereton (2017) study in line with the purpose of use in the brochure.

Analysis Phase: In the analysis phase of the study, it was determined for whom and for what purpose the design would be developed. First, after examining the STC information brochure given to the visitors in the STC, it was aimed to re-design the STC brochure by making changes and enriching it with a QR code for high school students.

Design Phase: This stage was especially related to the selection of materials for the new QR code brochure to be designed and the planning of this brochure. This plan was implemented in two phases:

Examination of the existing STC information brochure: First the existing STC information brochure was taken by going to the STC. This brochure was a brochure prepared for people who visited the STC. Brochure were examined in terms of the design the information in it, pictures, photos, etc.

The sections in the STC included Virtual Park, Experimental set-ups, Planetarium, Max Flight, Age of Dinosaur, Simulator, and Workshops. These areas were made in accordance with the levels of primary and secondary school students. In addition, there was an area in the STC where exhibitions suitable for scientific content could be held. There were also two separate places: the STC shop and the STC cafe. Scientific toys, souvenirs, and institution-related items could be purchased from the shop, while snacks and beverages can be taken from the cafe.

The STC brochure design with QR code: After the current STC brochure was re-examined in terms of how it should be arranged for secondary school students, information about the STC was obtained from the institution officials. Permission has been obtained from the relevant institution for the necessary materials (photographs, pictures, text, etc.) to be used in the new brochure to be designed. Some photos rendered images (images without background), logos, videos, and information about the institution were taken from the institution's website (Bursa Bilim ve Teknoloji Merkezi, BTM, [Bursa Science and Technology Center, STC], 2024). Some photographs of the STC were taken by the first researcher of the study. Materials such as text, video, picture, photograph, and web links to be used for the redesigned QR code brochure were selected. It was planned to convert some of these materials into QR codes. Based on material design principles such as where the collected materials (text, pictures, photographs, QR code) would be found in the brochure, what would be at the forefront, font, and color, and how the brochure with QR codes would be designed.

Development Phase: Materials such as text, video, picture, photograph, and web link to be used for the redesigned QR code brochure were selected. Some of these materials have been converted into QR codes. The brochure was redeveloped with a QR code, paying attention to where the selected materials would be in the brochure, what should be at the forefront, font, font size, and color. The brochure was prepared according to the principles of material design (Tezci, 2006). The brochure was developed with the PhotoScape program.

After the QR Code brochure was shown to three experts (two Computer and Instructional Technologies Educators and one Mathematics Educator) to get expert opinion, some changes were made in the brochure in line with expert opinion. Finally, the arranged brochure with the QR code was validated by the same experts again. Later, the brochure was printed in the printing house after being arranged front and back, and each page with three columns.

Implementation Phase: After the brochure in QR code was distributed to the students participating in the study, a trip was organized to a science and technology museum in the Marmara region in Turkey. Thus, the designed brochure was applied to 21 people consisting of 11th and 12th-grade students in a vocational and technical high school in the Marmara region in Turkey. Thus, the effectiveness of the brochure was examined.

Evaluation Phase: Pre-interview, before-trip, and after-trip interviews were conducted with the students about the trip and the brochure with the QR code. All data were analyzed according to the content analysis technique. All findings were tabulated. Finally, in the findings section, some suggestions were made about the brochure design.

4. Findings and Discussion

4.1 Attendance to Any Science-Based Trip or Science and Technology Center (STC) Trips Before

When the students were asked whether they had attended any school or STC trips before, the answers were as follows: While 5 students participated in a trip, 16 students did not participate in any trips at all. 3 students participated in a trip mentioned that they were informed about the place beforehand. Again, 3 of the 5 students who participated in the trip before participated in a trip for a different purpose other than science and technology, while 2 students participated in a trip for purposes such as zoo and history museum. It was determined that only 3 of them were distributed brochures before the trip.

Brochure distributed. He gave information about the places we would visit. (S17)

4.2 Connotations and Definitions About the STC Before and After the Trip

The students' connotations about the STC before and after the trip are given in Table 1 and Table 2.

Table 1.

Connotations about the STC before and after the trip

Theme	Sub-theme	BT* f	AT* f
Scientific and technological tools / products / inventions (36; 21)	Scientific instruments / Technological instruments, inventions, products / Scientific and technological instruments / Electronic instruments / Various instruments / Images / Projects / Simulator, Scientific studies	22	17
	Robot	1	-
	Telescope	1	-
	Sculpture / Model / Dinosaur	-	1
Exhibition (8; 0)	Show / Presentation / Exhibition / Fair	8	-
Physical features of the building (11; 0)	Wide / Large	11	-
Visitors (4; 0)	Everyone, small-big, young-old	3	-
	18 years and older	1	-

*BT: Before Trip; *AT: After Trip

According to Table 1, the students' associations with the STC were varied. However, when the total before-trip and after-trip connotations of the students were examined, it was observed that before-trip connotations were more common. The words that come to the minds of students about the STC before and after the trip were mostly "Scientific instruments / Technological instruments, inventions, products / Scientific and technological instruments / Electronic instruments / Various instruments / Images / Projects / Simulator, Scientific Studies" (22; 17) observed to be concentrated.

Table 2.

Definitions of the STC before and after the trip

Theme	Sub-theme	BT* f	AT* f
STC description (10; 16)	A place that informs, teaches, and educates	8	-
	The place that provides information in the field of technology / A place indicating the benefits and harms of technology / The place that indicates the place of technology in our lives	1	6
	The place where the application is made in the scientific field / The place where the test sets are located. / The place that brings physics and chemistry together	1	4
	The place where technological, life-enhancing tools are found	-	4
	The place where sculpture and model are exhibited	-	1
	It is a complex place.	-	1

*BT: Before Trip; *AT: After Trip

According to Table 2, the students made the definition of STC in more detail after the trip. It has been determined that students' definitions of STC were mostly related to technology and science.

Examples of students' definitions of STC before and after the trip:

It is about space, science, and then tools, space. Where there are tools that make science-related life easier. (S20-Before Trip)

It is a place used to present inventions made to inform people, that is, machines and mechanisms used in space, space sciences, and experimental instruments. (S20-After Trip)

Something is coming with more science and technological tools. It is a building where there are more tools and such a technological thing in a large area. (S2-Before Trip)

Science related tools are coming. The place that contains them in a complex. (S2-After Trip)

Studies in the field of science. A kind of fair. A place where science-related inventions, innovations and aiming to better inform people. (S11-Before Trip)

Innovations and inventions made in the field of science. The place that brings them together. (S11-After Trip

4.3 Purposes and Expectations of Participating in The STC Trip

The students' purposes for and expectations of participating in the STC before-trip, and their responses indicating to what extent they achieved their expectations after-trip are demonstrated in Table 3 and Table 4.

Table 3.

Purposes of participating in STC trip before the trip

Theme	**Sub-theme**	**BT* f**
Learning (28; 0)	Having knowledge about science / Having knowledge, learning new information, learning something / Being informed about unknown technological tools	21
	Seeing things that have not been seen before, seeing new projects / Seeing soft information reflected in life / Seeing something	5
	Seeing technological tools	2
Curiosity (3; 0)	Curiosity	2
	Curiosity about technology	1
Examination (2; 0)	Examination / Stand tour	2
Experiment (1; 0)	Experimentation	1
Social activity (2; 0)	Having fun / Socializing	2

*BT: Before Trip

Table 4.

Expectations about the STC trip before and after the trip

Theme	**Sub-theme**	**BT* f**	**AT* f**
Curiosity / Interest (13; 9)	Increased curiosity, enthusiasm, increased interest	11	5
	Increased interest in science	2	3
	Increased interest in technology	-	1
Get informed (5; 8)	Get informed	5	-
The feeling of having gone to the STC (2; 0)	The brochure was very detailed and lively.	2	-
Experience increase (0; 1)	Experience increase	-	1
Social activity (0; 19)	Have fun / Have a good time	-	19

*BT: Before Trip; *AT: After Trip

In Table 3, it is seen that most of the students aiming to gain knowledge and learning in general achieved their goals after the trip. Responses from students were as follows: Completely (6), Very good / Good (11); Partially, Medium (4). As can be seen in Table 4, it is seen that there was a great increase in the trip expectations of the students after the brochure with the QR code was distributed and after the trip ends (6) and this expectation has been mostly met (7). As a result, before the QR code brochure was distributed, the students had a certain purpose, but after examining the QR code brochure, the curiosity and interest increased tremendously, and their expectations were also shaped. At the end of the trip, these expectations and goals were met to a great extent.

Purpose:

I agree to learn more on my knowledge. (S5-Before Trip)

I totally got it. (S5-After Trip)

Expectation:

I am informed. I got different information for myself. My curiosity increased. [Expectation after examining the brochure with QR code] (S5-Before Trip)

Fully welcomed. My interest and knowledge increased. I satisfied my curiosity, I had fun. (S5-After Trip)

I did not expect much before, but now it has made a nice change. (S6-Before Trip)

Fully welcomed. I had fun. My knowledge has increased. I satisfied my curiosity. (S6-After Trip)

4.4 The Most Curious and Impressive Part of the STC Before and After the Trip

Table 5 shows that the students found most curious and impressive sections during the STC before and after trip.

Table 5.

The most curious sections in the STC before the trip and the most remarkable sections in the STC after the trip

Theme	Sub-theme	BT* f	AT* f
Planetarium (6; 5)	Informative	6	2
	Funny		1
	Interesting		1
	A new experience		1
Experimental Set-ups (5; 3)	I was able to implement it myself.	5	1
	Related to the course		1
	Related to Electronics		1
Simulator (4; 21)	Funny	4	8
	Impressive, interesting, exciting		7
	Realistic		4
	Interactive		1
	A new experience		1
Virtual Park (3; 3)	Informative	3	1
	Funny		1
	Interesting		1
Age of Dinosaur (1; 0)	Age of Dinosaur	1	-
Max Flight (1; 0)	Max Flight	1	-
Electronics	Electronics	1	-

*BT: Before Trip; *AT: After Trip

According to Table 5, the students were most curious about the Planetarium (6; 5) and Experimental Set-ups (5; 3) sections before the trip, and they were most impressed by the Simulator section (4; 21) during the trip. Students explained that the simulators were fun, exciting, and realistic as the reasons for being affected.

4.5 Contributions of the STC Trip to the Students and Lessons

The students mentioned that the STC trip's contributions to them and lessons are illustrated in Table 6.

Table 6.

Contributions of the STC trip after the trip to the students and lessons

Theme	Sub-theme	AT* f
Contribution to the students (22)	I am informed.	15
	I had fun.	4
	I applied for the lesson taught before.	1
	I gained experience.	1
	It contributed to me.	1
Contribution to lessons (22)	I was informed about the courses. / I was informed about the physics course. It reinforced and refreshed my knowledge in the course.	10
	I applied and tried.	8
	I applied the experiments related to physics lesson.	1
	It did not contribute. / It was something I knew.	3

*AT: After Trip

According to Table 6, they straight forwarded that they contributed to their lessons thanks to their information during the STC trip where the QR code brochure was distributed. For example,

I had the chance to get to know the experimental set-ups better and apply them. We applied what was taught in the lessons. (S10-After Trip)

I had more information, so I learned something about planets. It contributed to the lessons in terms of practice. (S4-After Trip)

On the other hand, one student told:

It did not contribute to my lessons, I just had fun. (S15-After Trip)

4.6 Suggestions About the STC Trip

The students also made some suggestions about the STC trip (See Table 7).

Table 7.

Suggestions about the STC trip

Theme	Sub-theme	AT* f
Yes (15)	Everyone come and see.	12
	Set the age limit	2
	Certain age groups come together.	1
No (6)	-	6

*AT: After Trip

According to Table 7, the students recommended others to go there because of their experiences after the STC trip (12). However, there were some students who made suggestions about the age level of the institution:

Age limit should be set. (S16-After Trip)

The students' recommendations were asked about the STC QR code brochure before and after the trip. 16 people answered this question, giving no suggestion.

4.7 Recommendations About the QR Code Brochure

The students' recommendations about the STC QR code brochure before and after the trip is shown in Table 8.

Table 8.

Recommendations about the STC QR code brochure before and after the trip

Theme	Sub-theme	BT* f	AT* f
Appearance (34)	Nice, good	14	-
	Similar, same	1	12
	More visual	-	5
	Interesting / More noticeable	2	1
Content (26)	Informative, clear, and more detailed	14	-
	Rich, abundant	7	-
	Containing video / Live	3	-
	Funny	1	-
	Add interesting questions	-	1
	More foldable	-	1
	Communication section is smaller	-	1
	Time-saving	-	1

*BT: Before Trip; *AT: After Trip

According to Table 8, which includes the students' opinions about the brochure, the students liked the QR code brochure as it was informative and guiding, and it had a lot of content with QR codes. In addition, while many students remarked that they could prepare a brochure like this one, some students made suggestions:

I think it would be better to have a QR code. So, we can see it live and there was even a 360 degree view, panoramic. I quite liked it. (S16-After Trip)

My suggestion was that I used to prepare a brochure in a way that would make you curious, not as a topic, but simply by asking questions. (S18-After Trip)

If it were me, I had made the brochure folded. I would not have been given such a wide space to visit and contact information. These are also my suggestions. (S19-After Trip)

The students asked whether the QR code brochure helped them during the STC trip or not after the trip (See Table 9).

Table 9.

Helping condition of the QR code brochure during the STC trip

Theme	Sub-theme	AT* f
Guidance (23)	Informed	12
	Guided / It kept me from getting lost. / I found the place I was looking for easily.	6
	Very Good / Good	2
	Partially	1
	See the contents beforehand	1
	Saving on time	1

*AT: After Trip

In Table 9, it is seen that the QR code brochure was the most helpful in terms of being informative (12) and being a guide (6). For example,

He gave information about what we can do and what we will see before coming here. (S12-After Trip)

At the end of the trip, the students were asked whether they suggested to examine the QR code brochure by the visitors before the STC visit. The answers are shown in Table 10.

Table 10.

Suggestions about visiting STC by examining the QR code brochure before the trip

Theme	Sub-theme	AT* f
Guidance (24)	To inform. / To summarize the content briefly.	14
	To guide / Convenience / Benefit	7
	Saving on time	3

*AT: After Trip

As can be seen in Table 10, all students suggested to examine the QR code brochure beforehand the trip. It was understood that the most common reason for recommendation was its informative feature (14).

After the trip, the students were also asked, "If you visited the STC without a QR code brochure, how would your trip be?" The frequency distribution of the answers given to the question is shown in Table 11.

Table 11.

Opinions about visiting the STC without a QR code brochure after the trip, before the STC trip

Theme	Sub-theme	AT* f
Guidance (28)	I would not understand anything because I was traveling, the trip would not be understandable. / It would be ignorant.	17
	I was forced.	4
	It would be a waste of time.	4
	It would be boring.	2
	I was lost.	1
Others (2)	I was exploring.	1
	More different	1

*AT: After Trip

In Table 11, the prevailing opinion was that it would be a meaningless trip. One of the students who supported this, S4, declared:

I would not have known about this place. It would be a waste of time.

However, S18, who had a different opinion, expressed:

It would be a nice trip. I would discover it myself. I would examine it by discovering it myself, not by looking.

As a result, the QR code brochure contained a lot of information about the STC. It could reflect these in audio-visual with a QR code guiding students. The students said that this feature also saved time and the trip was efficient by discovering more sections in less time.

In this section, research findings are explained by benefiting from related literature. When the literature on QR codes was searched, it was stated that QR code was an online information source and its use with printed materials had the potential to increase learning success in the field of education (Acartürk, 2012). For this purpose, the use of QR codes in education is increasing rapidly. QR codes can be used in education, both in class and as extra-curricular activities, or in printed sources. As a printed source, in the exam preparation books, URL links of the question solution videos are given by means of QR codes, allowing students to easily find solutions by reading the code. The textbooks of the Ministry of National Education also include videos from the Education and Informatics Network, EBA [EIN], 2020). Teachers can also prepare many activity sheets with QR codes as in-class teaching materials. It can be preferred more with its simplicity, high data capacity, and easy use. Using the QR code can increase students' motivation, interest in the course, course success or performance, permanence, and can create a positive attitude. There were many studies supporting this situation (Bozkurt et al., 2018; Çakır et al., 2015; Önal, 2017; Pérez-López et al., 2013). It can be used for different purposes in extracurricular activities or trips. Antonioli et al. (2014)

mentioned in their studies on QR codes that they could be used in extracurricular activities or trips in the field of education.

In the current study, a trip was organized as an out-of-school learning environment, and student opinions were taken about the effect of the trip on the lesson. It was thought that it was effective STC trip, and the trip was interesting thanks to the QR code brochure designed. Most of the students confirmed that the science and technology center trip contributed to the lessons, that they applied and tried what they learned in the lesson. Özcan and Yılmaz (2018) also conducted a study via planetarium trip without brochure enriched QR code and they indicated similar findings.

Additionally, it was acquired that trips to science centers were more effective in affective states (Flexer & Borun, 1984). In their study, 416 secondary school students were administered visual and verbal tests after the scientific trip. According to the test results, although there was no cognitive effect in the lessons, they determined that there was a big difference visually. It was asserted that the students found the trip more enjoyable and interesting than the course taught in the classroom.

In the related literature, there are studies in which QR codes were used as teaching or non-teaching material. However, there were few studies related to using QR code brochures during a trip. Çetin (2020) reported that the prospective biology teachers' expectations were largely met, especially related to birds and social activity. The field trip was efficient outdoor activity for the students, and it contributed to their lessons since field trip was done with brochure enriched QR code.

In a quasi-experimental study, Chen et al. (2017) found that although learning performance was higher in students using iBeacon technology, no significant difference was found between the two groups. University students said that the trip was more efficient thanks to this mobile technology during the science center trip. In the interviews held after the trip, the question, "Did the technology and learning content improve your visiting experience?" was asked. All students gave a positive answer in the positive category. The same is true in the current study, and the studies support each other. Therefore, it is thought that the use of technology in trips to science centers will make the trip more efficient and enjoyable. During the trip to the Energy Park in Ankara (Bozdoğan & Yalçın, 2006), it was determined that the interest and academic success of primary school students towards the Science course increased at the end of the trip. In the study in which a single group pretest-posttest model was used, it was approved that academic achievement was not a predictive feature of students' interest scores. This situation seems to support this study, based on the opinion of some of the students in the current study stating, "It was what I already knew, I only experienced what I knew".

In this current study an extra-curricular material was developed and its effect on students was examined by using it in one of the extracurricular activities. As a result, the use of QR code technology, which was easy to use, in out-of-class activities and non-teaching materials provided increased motivation at least as much as its effect on using it in the course or as an instructional material.

5. Conclusion and Suggestions

This study aimed to get the opinions of the students about the science and technology center trip, which was visited with a brochure enriched with a QR code. According to the research results, the students' connotations, and definitions of the STC before the trip were related to technological tools, products, demonstration, and presentation. They expressed the STC as a place that taught and gave information. After the trip, the students associated the STC with technological tools, products, scientific studies, projects, and simulators. They defined the STC as a place that informed and taught more before the trip. While they replied about the STC as a place that gave more information in the field of technology after the trip, they indicated that the STC as a place of technology in our lives and where technological tools were located.

The students expressed that they aimed to be more informed and learn and they achieved their goal after the trip, they mostly replied that they were met very well and completely. When the students were asked about their expectations about the STC trip before the trip, the students were most curious, interested, and eager. When asked about the fulfillment of these expectations after the trip, they stated that they had the

most fun and had a great time, and accordingly, their expectations were met very well or completely. The students found the Sections of Planetarium and Experimental Set-ups most curious before the trip, they stated that their favorite part was the Simulator and Planetarium after the trip. Most of the students stated that they were informed as a contribution to the student and that they applied and tried what they learned in the lesson as a contribution to the lesson.

When students were asked about their suggestions about the STC trip, the students expressed that everyone should come and see it. When students were asked for their opinions and suggestions about the QR code brochure designed for the STC trip, the students' responses were nice and good, and they revealed that it was informative and had rich and abundant content. When the students were asked whether the brochure designed to help them during the trip was asked, the students articulated that they gave more information and became a guide. When the same question was asked again after the trip, they disclosed that they thought the same and affirmed that there was no change of opinion, while some students added that the visual was much more. In addition, when the students were asked about their thoughts about examining the brochure before the STC trip, the students disclosed that they helped inform and guide the person the most. When asked about their opinions about the situation before the STC trip was taken without examining the brochure, the students answered that more trips would be meaningless, incomprehensible, lost, and a waste of time.

If the brochure created in the current study is to be re-designed in future studies, it is necessary to ensure that the brochure contains visual content suitable for the age group of the target audience, that the information content about the advertised institution is accurate, concise, and that the necessary permissions are obtained before the materials such as the institution logo are used, that the brochure serves its purpose, that it serves the purpose of interest and curiosity. It should be noted that it is arousing.

This study was carried out with a small study group. Since it is important to carry out such studies with larger study groups in terms of the generalizability of the results, another travel brochure study with a larger sample size can be conducted and the results can be compared. Different studies can be conducted on how the QR code will create a change in students' interest in science. Other studies can be carried out based on different variables such as students' readiness levels and socio-cultural structures of this situation. It can be investigated what effect teachers' attitudes toward technologies such as QR codes will have on variables such as student success, attitude toward the lesson, and motivation. In addition, by taking this study as an example, the results to be obtained by using QR codes in different non-teaching materials or extracurricular activities can be re-evaluated.

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