

Determining Views on the Effectivity of Augmented Reality Applications in Museums

Didem ISLEK¹

Huseyin BICEN²

¹ Near East University, Cyprus, ORCID ID:

<https://orcid.org/0000-0002-4056-8894>,

didem.islek@neu.edu.tr

² Near East University, Cyprus, ORCID ID:

<https://orcid.org/0000-0002-9172-9790>,

huseyin.bicen@neu.edu.tr

Abstract: *In recent years, visitor-centred approaches have been adopted in museums, which are seen as some of the most important cultural establishments in forming modern culture. Therefore, it is aimed to increase visitor interest towards the collections and to portray the information about the collections more clearly. Digital technology is used to make collections exhibited in museums more interactive and augmented reality applications are used for this. The aim of this study is to determine the views of students on using augmented reality in museums. The research was conducted with the mixed method. The data in the quantitative dimension were collected with a student view questionnaire and the qualitative data were collected using a semi-structured interview form. The findings indicate that students believe they can learn information more permanently if augmented reality is used in museums and that the simpler the technology is, the easier it will be to learn how to use it. According to the results of this research, students stated that they can have more realistic experiences in museums that use augmented reality technology and that they can feel as if they are viewing the exhibitions in a more realistic setting. Students also believed that the historical animation of the exhibitions will result in more motivating and rich content. Additionally, they believe that the augmented reality applications and set up used in museums would positively affect learning.*

Keywords: *Museum, Visitor Focussed Approach, Augmented Reality, Modern Museum.*

How to cite: Islek, D., Bicen, H. (2023). Determining Views on the Effectivity of Augmented Reality Applications in Museums. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 14(3), 379-393. <https://doi.org/10.18662/brain/14.3/480>

1. Introduction

Museums, which are one of the cultural institutions contributing to the modernisation of societies, play an important role in researching, collecting and exhibiting the material and spiritual values of people, Spadoni et al. (2022). Additionally, museums that are also educationary are seen as a platform that can inform visitors about cultural values as well as an effective teaching platform that teaches through living and doing (Lee, 2012). In recent years, in order to increase the visitors' interest in collections within the scope of museum education, a visitor-centre approach has started to be adopted (Güzel & Sucaklı, 2020). Various exhibiting methods are used to portray the collections and the information to visitors. In this context, the related literature states that digital technologies can be used to make museum collections more interactive. Additionally, it is stated that these applications will help visitors to spend more time with the artefacts and enable the information they have learnt to become more permanent (Coşkun, 2021; Spadoni et al., 2022; Güzel & Sucaklı, 2020). In this regard, it is seen that content related audio and 3-D modelling-based guides, interactive digital storytelling and augmented reality applications are the most common tools used to gain the attention of visitors in museums (Kaghat et al., (2020). Particularly due to augmented reality applications, visitors can perceive the exhibits in the museums as if they are in a real setting. In this application, images are selected from a computer platform and connected to the objects in real life. Therefore, virtual information in the form of text or images can be seen through the smart phones of the visitors (Harmankaya, 2010; Styliani et al., 2009). The augmented reality applications can be enriched with digital aspects and can also be used within the museum through tablets as well as smart phones (Akkoç & Coşkun, 2019; Seirafi & Wiencek, 2017). Through this application, visitors can participate in various animations and stories and puzzles related to the exhibits in the museum. Additionally, they can interact directly with the exhibits through various games developed for the exhibits within the museum (Akkuş & Akkuş, 2018). Additionally, individuals can view the content of the collections and imagine the exhibits in their mind through animations and images instead of reading text through augmented reality technologies (Spadoni et al., 2022).

1.1. Augmented Reality Applications in Museums

Augmented reality technology, which is used in many fields, presents museums the opportunity to exhibit their collections in different ways and make them more interactive. These digital applications diverge from the approach of limiting the visitors in the museum to seeing and watching and move toward an approach that increases individuals' interaction with the exhibits and keeps them interested (Coşkun, 2021). This technology enables museums to help their visitors experience collections that have become decayed, changed or destroyed and recreate images of cultural heritage, by revitalizing ancient history with animations and sound effects, providing opportunities to visualize and bring to life the distant past (Marques & Costello, 2018). In recent years, increased interest in this technology in museums has been seen. When the museums worldwide are examined, it is seen that these applications are now commonly used. For example, the "Skin & Bones" application at the *Smithsonian National Museum of Natural History* is an example of augmented reality technology being used as an education material. In this application, the bones exhibited in the museum are covered with skin to show the original form and interactive information is given (Ding, 2017). The theory of evolution is explained in England using augmented reality applications at the *Natural History Museum* in London and the visitors can learn through doing and experiencing (Debenham et al., 2011). The whole of the "Achilles and Penthesileia" statue can be viewed at the *Museum of Art and History* in Geneva with a tablet thanks to augmented reality. The augmented reality application in the *Acropolis Museum* in Greece shows the original architecture re-built and the mythological beings come to life (Güzel & Sucaklı, 2020). As well as these examples, this technology is also used in museums across Türkiye. The *Sakıp Sabancı Museum* in İstanbul is one of the museums that uses augmented reality effectively. The exhibits in this museum have been added to a digital platform with smart devices. Animations are also developed to ensure visitors have an interactive experience. Thanks to the digital applications of the '*Book Arts and Calligraphy Collection*' exhibited in the museum, visitors have the opportunity to examine and zoom in on the works using iPads (Bilici, 2015). Visitors in the *Anadolu Medeniyetler Museum* can read descriptions of the exhibits on the screen and listen to them with the 3D object recognition technology through the cameras of their smart phones (Güzel & Sucaklı, 2020). Similar to the application in the *Anadolu Medeniyetler Museum*, the *Erimtan Archaeology and Art Museum* in Ankara provides visitors the opportunity to access audio with their smart devices. At the *Pera Museum*, visitors can see their own faces on

four different paintings in the collections through an application downloaded on to their cell phone. Additionally, the digital and interactive content of the collections can be accessed through scanning (Türker, 2022).

As can be seen, augmented reality technology is used in many museums around the world to exhibit collections and make them more interactive. In this context, it is important to evaluate the efficiency of augmented reality in museums in order to increase and enhance their usage.

1.2. Related Studies

As a result of the literature review, it was found that research is mostly conducted on the introduction and effectiveness of augmented reality applications. For example, in the study conducted by Güzel & Sucaklı (2020), information on the role and usage details of augmented reality and various examples of museums internationally that use this technology has been provided. The study also included museums using augmented reality technology in Türkiye and other countries and examined the relationship between this technology and tourism. The study results indicated that AR applications play an important role in the development of museums. The study conducted by Akkoç & Çoşkun (2019) investigated the need for technology in order to develop modern museum applications. The research data were obtained through a semi-structured interview form. The findings showed that all of the museum visitors were positive about the use of augmented reality technology in museums. Kaghat et al. (2020) developed an augmented reality application in their study. The research introduced a gesture-based designed audio augmented reality system. The developed application was evaluated in Paris at the Musée des Arts et Métiers. As a result of the evaluation conducted with visitors, it was observed that the model provided ease of access and created a more enjoyable effect. In the study of Aitamurto et al. (2018), an augmented reality (AR) application was developed and the effect of this application on the artistic participation of users was evaluated. In this study, a guide program was developed on augmented reality. As a result of the study, it was found that there was an increase in participants who liked art after using the program in comparison to those who used books. The AR users enjoyed using the application. However, participants felt physically tired from holding the tablet and stated that they would prefer to interact with an immovable image rather than live enlargements.

As can be seen, there are no studies evaluating the effect of augmented reality applications in museums on the education and teaching process of students. It is important to evaluate augmented reality

applications and to identify whether students need these applications to learn more efficiently from museums by providing interactive lessons. It is thought that through this study, this gap in the literature will be filled. It is also believed that this study will be effective in determining the needs of AR technology in museums for students. The future aim of the researchers is to build on this study by developing an AR application that can be used for the education of students in museums in accordance with the data obtained from this study.

2. The Aim of The Research

The aim of this study is to determine the views of students on the use of augmented reality in museums. In this context the study aims to research the needs of students with regard to AR technology in museums and provide detailed insight into these needs. This study seeks answers to the following questions.

1. What are the students' views on the use and effectivity of AR applications in museums?
2. What are the students' views on the advantages of using AR applications in museums?
3. What are the students' views on the disadvantages of using AR applications in museums?

3. Method

3.1. Research Design

The data of this study were collected with the mixed method approach where qualitative and quantitative findings were both used. According to Creswell and Plano Clark (2007), using the qualitative and quantitative research methods together enables the study problem to be examined more closely. It also provides more reliable results by creating a bigger effect that just one method on its own would create (Firat et al., 2014). The quantitative data were collected with a student interview questionnaire and the qualitative data were collected with a semi-structured interview form.

3.2. Participants

The study sample consisted of 51 students taking the Museum Education Applications and Digital Literacies and Ethics courses in the 2022-2023 fall semester. In total 76.5% (n=39) of the students were female and 23.5% (n=12) were male. The students were studying in the departments of Classroom Teaching (54.9%), English Translation and Interpretation (21.6%), English Language and Literature (9.8%) and English Teaching (13.7%) (Table 1). The study sample was selected using the “criterion sample” method, which is one of the sampling methods. Within the criterion sampling method, a criterion can be selected by the researcher, (Grix, 2010; Marshall & Rossman, 2014). The criterion of this study was specified as the students having knowledge about Museums and Augmented Reality Technologies. The study sample was created according to these parameters.

Table 1. The distribution of students within the study group according to departments

Department	Frequency (f)	Percent %
Classroom Teaching	28	54,9
English Teaching	7	13,7
English Translation and Interpretation	11	21,6
English Language and Literature	5	9,8

Source: Author’s Work

3.3. Data Collection & Instrument

The study began with literature review regarding “Augmented Reality Applications in Museums.” In this context, within the first phase of the study, national and international indices were screened, the publications in this field were examined and the problem situation of the study was determined. In the second phase of the study, data collection tools were designed to obtain the views of students. In this direction, to firstly collect the quantitative data, a 5-point Likert questionnaire was used, and to collect qualitative data a semi-structured interview form was developed by the researchers. Information regarding the data collection tools used in this study has been provided in detail in the section below.

3.3.1. Questionnaire on Views Regarding Augmented Reality Applications in Museums

The researchers developed a questionnaire to determine the views of students towards augmented reality applications being used in museums. The questionnaire development began with a literature review. As a result of the review, no questionnaires on determining the views of students on the use of augmented reality applications in museums were found. In the second phase, articles and theses related to the topic were examined, an item pool was formed and the draft questionnaire was prepared. The draft was examined by a museum education specialist (n=1), information technology specialists (n=3) and program development specialists (n=2), and some of the items were taken out of the draft in light of their views. After the scope content of the questionnaire was formed, opinions obtained from four language specialists to prevent misunderstandings and incorrect sentences. In the last phase, after the amendments had been made, the final form of the questionnaire was prepared. The questionnaire consists of two sections. In the first section, there are four questions that include the demographic characteristics of the students who participated in the research. The second section contains 22 questions asking the views related to augmented reality in museums. The questionnaire was prepared in a 5-point Likert style, the options selected were given a score from 1 to 5 and they were “Definitely Agreed”, “Agree”, “Indecisive”, “Do Not Agree”, “Definitely Do Not Agree”.

3.3.2. Semi-Structured Interview Form

In order to increase the validity and reliability of the study, in the context of the qualitative aspect of the study, a semi-structured interview form was developed. This form was developed to determine the experiences that students had regarding augmented reality applications in museums and to evaluate the effectivity of this technology. When preparing the interview form, a literature review was conducted and related studies were used as the basis. Additionally, it was ensured that the questions were in line with the general and sub objectives of the study. The form was prepared in light of the views of education program specialists (n= 4), museum education specialists (n=4), and information technology specialists (n=2). According to the expert opinions obtained, the scope validity of the form was also ensured. The semi-structured form consists of 2 questions. The interview questions are shown in Table 2.

Table 2. Semi-structured interview form Questions

No	Questions
1	What are the advantages of using AR applications in museums?
2	What are the disadvantages of using AR applications in museums?

Source: Author's Work

3.4. Data Collection

In the analysis of the study data, the quantitative data were evaluated according to the MEAN score values of the questionnaire sections. The qualitative data were obtained with the semi-structured interview form to obtain students' views on augmented reality use in museums. Participants were notified that their personal information would not be used within the findings of the study and that it would be kept confidential. Therefore, the reliability and confidentiality of the study were ensured. A descriptive analysis model was used in the analysis of the study data and brief information about the case and situations that the researchers wanted to research was obtained (Buyukozturk et al., 2023). The views of university students were analysed with the scientific analysis method in this study. In the analysis prepared in light of the views, the data correlated to each other were combined together. Additionally, the data obtained were evaluated by remaining faithful to the original and directly using quotes from the participants. In this stage, the findings were defined and evaluated using descriptive analysis. The descriptive content analysis method involves deeply examining and organising the studies conducted independently or on a certain topic. Therefore, that subject or the general trends in that field can be determined.

4. Findings and Discussion

4.1. The Views of Students on the Augmented Reality Applications in Museums and their Effectivity

The views of students on the use of augmented reality applications in museums is given in Table 3.

Table 3. The Views of Students on the Augmented Reality Applications in Museums and their Effectivity

Questionnaire Statements	Mean	Std. Deviation
Use of augmented reality in museums enables me to obtain more information about exhibits	4.21	.70
Augmented reality applications in museums provides me with a more immersive experience	4.27	.56
Thanks to the augmented reality application, I can obtain information about collections and exhibits that I have not previously visited	4.35	.65
Thanks to augmented reality, I can listen to the information about exhibits	4.17	.76
Thanks to augmented reality, watching historical live plays helps the information become more permanent	4.43	.67
I prefer visiting museums where augmented reality is used	4.00	.89
Augmented reality technologies help me experience more real experiences in museums	4.09	.80
I prefer experiencing museums through augmented reality and not in their real platforms	3.01	1.19
I can easily apply museum activities such as preparing a story or live play etc. with the exhibits in museums through augmented reality applications	4.09	.78
Thanks to augmented reality technology, I can access information faster in museums	4.25	.59
Thanks to augmented reality applications, I can learn about the exhibits in the museum in a more enjoyable manner	4.19	.66
Museums equipped with augmented reality motivate me	3.92	.71
Museums equipped with augmented reality do not motivate me to learn	3.13	1.16

I prefer the interfaces of augmented reality applications in museums to be simple, clear and understandable	4.21	.61
I can easily carry out the museum scavenger hunt activity (searching for answers to questions about the exhibits in the museum) with augmented reality applications	4.03	.63
Augmented reality technology in museums enable an effect as if you are viewing the exhibits in their real setting thanks to camera systems and videos	4.01	.78
I can perceive the exhibits in the museums with augmented reality as if I am there myself	4.01	.70
Thanks to the puzzles conducted in museums (completing the missing sections of the exhibits) using augmented reality technology, I can learn easier	3.86	.77
The exhibits in the museums can be enriched with animations using augmented reality technology	4.05	.70
Augmented reality technology helps examine the exhibits in museums in detail	4.03	.87
Augmented reality technology enables audio content with collections in museums, which increases my motivation	4.03	.72
Having exhibition prepared with new technological components through an augmented reality application enhances my interest in the artworks in the museum.	4.00	.77

Source: Author's Work

When the research findings are examined, students replied “definitely agreed” to statements such as “Use of augmented reality in museums enables me to obtain more information about exhibits”, “Augmented reality applications in museums provide me with a more immersive experience”, “Thanks to the augmented reality application, I can obtain information about collections and exhibits that I have not previously visited”, “Thanks to augmented reality, watching historical live plays helps the information become more permanent”, “Thanks to augmented reality technology I can access information faster in museums”, “I prefer the interfaces of augmented reality applications in museums to be simple, clear

and understandable”. These findings show that the views of students are positive and that they find the use of AR applications in museums effective. In a similar manner (Akkoç & Çoşkun, 2019) found that all of the museum visitors believed the use of augmented reality technology in this field was beneficial and they were all positive towards it. The research supports the obtained findings. When the findings are examined, it is seen that students believe that using augmented reality in museums can provide more permanent learning opportunities and that the simpler the technology is, the easier it will be to use. Parallel to these findings (Uluğ & Ertürk, 2022) showed that the design, application and maintenance of AR containing mobile applications will become compulsory for museums in the future, and due to this reason, the technology must be designed as simple as possible.

Additionally it was found that students replied “I agree” to “Thanks to augmented reality I can listen to the information about exhibits”, “I prefer experiencing museums through augmented reality and not in their real platforms”, “Augmented reality technologies help me experience more real experiences in museums”, “I can easily apply museum activities such as preparing a story or live play etc. with the exhibits in museums through augmented reality applications”, “Thanks to augmented reality applications I can learn about the exhibits in the museum in a more fun manner”, “Museums equipped with augmented reality motivates me”, “I can easily carry out the museums scavenger hunt activity (searching for answers to questions about the exhibits in the museum) with augmented reality applications”, “Augmented reality technology in museums enable an effect as if you are viewing the exhibits in their real setting thanks to camera systems and videos”, “I can perceive the exhibits in the museums with augmented reality as if I am there myself”, “Thanks to the puzzles conducted in museums (completing the missing sections of the exhibits) using augmented reality technology, I can learn easier”, “The exhibits in the museums can be enriched with animations using augmented reality technology”, “Augmented reality technology enables audio content with collections in museums which increases my motivation”, “Having exhibition prepared with new technological components through an augmented reality application enhances my interest in the artworks in the museum.” According to these findings, students stated that they can have real experiences in museums equipped with augmented reality technology and have the feeling as if they are viewing the exhibits in real life. Additionally, students state that their experience can be richer and more motivating thanks to historical animations. The findings show that students believed AR applications in museums to be necessary, motivating and invigorating. In parallel to the

findings of this study (Moorhouse et al., 2019) found that integrating innovative and interactive digital technologies such as augmented reality for school children visiting museums will provide motivational and experiential benefits.

Lastly, students replied “indecisive” to “I prefer experiencing museums through augmented reality and not in their real platforms”, and “Museums equipped with augmented reality do not motivate me to learn”. This helps us understand that equipment and applications used in different museums can change the effectiveness of museums.

4.2. Student Views on The Advantages of using Augmented Reality Applications in Museums

Students also stated the advantages of the use of AR applications in museums.

In this regard, participants stated that when they used AR applications, they could obtain more correct and reliable information and that this would provide them with an enriched experience. They said that the AR technology enabled them to view exhibits in detail and that it was a significant advantage to the energy and dynamicness it provided and the opportunity to visit museums through the internet from the comfort of your own home. The fact that museums equipped with AR provide permanent information is also an advantage for people to obtain more detailed information about the exhibits in which they are interested. They stated that the opportunity to easily access museums in distant cities and countries over the internet makes it easier and faster to obtain knowledge. The findings obtained show that students find AR applications motivating, exhilarating, interesting and accessible. In their study, Akkoç & Coşkun (2019) stated that augmented reality was effective and drew attention, parallel to the findings of this study.

4.3. Student Views on The Disadvantages of using Augmented Reality Applications in Museums

In the semi-structured interviews, students stated that a disadvantage maybe the limitations. Aitamurto et al. (2018), in parallel to this study, developed an AR application and examined the effect of this application on the participation of users in art. Participants felt physically tired from holding the tablet and stated that rather than live enlargements, they preferred to interact with a non-moving image. This may prevent people who have researched the exhibits at the museums for some time and gained information on them from sharing their knowledge with others. The feeling

of a real museum is not conveyed, and unless it is simplified, there is a deficiency of knowledge; if the models are not realistic enough, history can be processed in incorrect forms. Not portraying the historical feel will not form a real museum atmosphere and seeing real exhibits virtually can end up in disappointment. In this context, when these factors are considered, it is normal for participants to express their negative views.

Students also expressed that those who are not good with technology will not prefer AR. In a similar study, Sönmez & Zarbızade (2022) shared findings about the application not being developed enough and that there is not sufficient information on augmented reality technology. At this point, in parallel to this finding, it must be noted that the lack of technological knowledge on AR must be resolved, and if needed, participants could obtain education in this field.

5. Conclusion and Future Studies

According to the study findings, students stated that they can learn more information from museums equipped with augmented reality and that they can have an enriching experience through watching historical animations. Students stated that the augmented reality technology in museums can create a feeling of viewing the exhibits in real life through video and camera systems and stressed the importance of this technology being simple and easy to use. Additionally, as a disadvantage, they stated that AR usage in museums may stop individuals who have knowledge about the exhibits from sharing their knowledge in social settings. Additionally, problems with hardware and the AR technology not being close enough to reality is also seen as a disadvantage. In future studies, the effectivity of applications and technology used in museum equipped with augmented reality technology must be examined. In this regard, it is recommended that the needs stated but students are taken into consideration and AR applications are developed and applied in museums accordingly.

References

- Aitamurto, T., Boin, J. B., Chen, K., Cherif, A. & Shridhar, S. (2018). The impact of augmented reality on art engagement: liking, impression of learning, and distraction. *VAMR*, 153-171.
- Akkoç, İ. T. & Coşkun, E. (2019). Implementing of augmented reality (AR) technology to museology activities: A study for modern museum visitors in Eskisehir. *Journal of Tourism and Gastronomy Studies*, 7(4), 2513-2535. DOI: [10.21325/jotags.2019.484](https://doi.org/10.21325/jotags.2019.484)
- Akkuş, G. & Akkuş Ç. (2018). Evaluation of the Mobile Augmented Reality Applications Used in Historical Tourist Attractions. *Journal of Tourism and Gastronomy Studies*, 6(1), 83-104. DOI: [10.21325/jotags.2018.176](https://doi.org/10.21325/jotags.2018.176)
- Bilici, Fatih. (2015). *Pazarlamada Artırılmış Gerçeklik ve Karekod Teknolojileri: Tüketicilerin Artırılmış Gerçeklik Teknoloji Algulamaları Üzerine Bir Alan Araştırması*. (Yayımlanmamış Yüksek Lisans Tezi). Bursa.
- Buyukozturk, S., Kilic Cakmak, E., Akgun, O. E., Karadeniz, S. & Demirel, F. (2023) *Eğitimde Bilimsel Araştırma Yöntemleri*. Pegem Akademi.
- Coşkun, C. (2021). Sanat Müzelerinde Artırılmış Gerçeklik Uygulamaları (Augmented Reality Applications in art museums). *Ankara Üniversitesi Güzel Sanatlar Fakültesi Dergisi*, 3 (2), 103-123. Retrieved from <https://dergipark.org.tr/en/pub/augsfd/issue/67696/1014070>
- Creswell, J., & Plano Clark, V. L. (2007). Understanding mixed methods research. *Designing and conducting mixed methods research*, 1-19. <https://books.google.co.zw/books?id=FnY0BV-q-hYC>
- Debenham, P., Thomas, G. & Trout, J. (2011). Evolutionary augmented reality at the natural history museum. *IEEE*. 249-250.
- Ding, M. (2017). Augmented reality in museums. *Museums & augmented reality—A collection of essays from the arts management and technology laboratory*, 1-15. <https://static1.squarespace.com/static/51d98be2e4b05a25fc200cbc/t/5908d019f5e2314ab790c269/1493749785593/Augmented+Reality+in+Museums.pdf>
- Firat, M., Yurdakul, I. K. & Ersoy, A. (2014). Mixed Method Research Experience Based on an Educational Technology Study. *Journal of Qualitative Research in Education - JOQRE*, 2(1), 64-85. doi: 10.14689/issn.2148-2624.1.2s3m

- Grix, J. (2010). *The foundations of research*.
[http://elearning.fit.hcmup.edu.vn/~longld/References%20for%20Scientific%20Research%20-%20Tai%20lieu%20Phuong%20Phap%20NCKH/2012%20-%20Book%20-%20Foundations%20of%20Scientific%20Research%20\(N.M.%20Glazunov\).pdf](http://elearning.fit.hcmup.edu.vn/~longld/References%20for%20Scientific%20Research%20-%20Tai%20lieu%20Phuong%20Phap%20NCKH/2012%20-%20Book%20-%20Foundations%20of%20Scientific%20Research%20(N.M.%20Glazunov).pdf)
- Güzel, T. & Sucaklı, G. (2020). Müze turizminde artırılmış gerçeklik teknolojisi uygulamaları; Dünya ve Türkiye örnekleri . *Journal of Tourism Research Institute*, 1(2), 71-82.
<https://dergipark.org.tr/tr/pub/jtri/issue/60519/888866>
- Harmankaya, M. B. (2010). Müzelerde elektronik rehberlik uygulamaları. (Yayınlanmamış Uzmanlık Tezi). T.C. Kültür ve Turizm Bakanlığı Kültür Varlıkları ve Müzeler Genel Müdürlüğü, İstanbul.
- Kaghat, F. Z., Azough, A., Fakhour, M. & Meknassi, M. (2020). A new audio augmented reality interaction and adaptation model for museum visits. *Computers & Electrical Engineering*, 84, 106606.
<https://doi.org/10.1016/j.compeleceng.2020.106606>
- Lee, K. (2012). Augmented Reality in Education and Training. *TechTrends*, 56 (2), 13-21.
file:///C:/Users/DC/Downloads/AugmentedRealityinEducationandTrainingbyKangdonLee%20(1).pdf
- Marques, D. & Costello, R. (2018). Concerns and challenges developing mobile augmented reality experiences for museum exhibitions. *The Museum Journal*, 61(4), 541-558.
<https://doi.org/10.1111/cura.12279>
- Marshall, C. & Rossman, G. B. (2014). *Designing qualitative research*.
https://books.google.co.zw/books?id=Wt3Sn_w0JC0C
- Moorhouse, N., Dieck, M. C. & Jung, T. (2019). An experiential view to children learning in museums with augmented reality. *Museum Management and Curatorship*, 34(4), 402-418.
- Seirafi, K. & Wiencek, F. (2017). HoloMuse: A concept for augmented learning in museums. 53–57. St. Pölten. <http://ceur-ws.org/Vol-2009/fmt-proceedings2017-paper7.pdf>
- Sönmez, H. Ş. & Zarbizade, V. (2022). Müzelerde deneyimsel pazarlama araçları olarak artırılmış gerçeklik uygulamalarının üketiciler üzerindeki etkileri: Seka Kağıt Müzesi Örneği. *Kurgu*, 30(1), 77-113.
- Spadoni, E.; Porro, S.; Bordegoni, M.; Arosio, I.; Barbalini, L.; Carulli, M. (2022). Augmented Reality to Engage Visitors of Science Museums through Interactive Experiences. *Heritage*, 5, 1370–1394. <https://doi.org/10.3390/heritage5030071>