



Artificial Intelligence in Accessible Museums

Didem Islek ¹
Fahriye Altinay ²
Zehra Altinay ³
Rustam Shadiev ⁴
İpek Danju ⁵

¹ Ataturk Faculty of Education, Division of Curriculum and Instruction, Near East University, North Cyprus, didem.islek@neu.edu.tr, <https://orcid.org/0000-0002-4056-8894>

² Societal Research and Development Centre, Institute of Graduate Studies, Faculty of Education, Near East University, North Cyprus, fahriye.altinay@neu.edu.tr, <https://orcid.org/0000-0002-8452-5992>

³ Societal Research and Development Centre, Faculty of Education, Near East University, North Cyprus, zehra.altinay@neu.edu.tr, <https://orcid.org/0000-0002-6786-6787>

⁴ College of Education, Zhejiang University, China, rustamsh@gmail.com, <https://orcid.org/0000-0001-5571-1158>

⁵ Ataturk Faculty of Education, Division of Curriculum and Instruction, Near East University, North Cyprus, <https://orcid.org/0000-0003-1738-5261>

Abstract: *This research aims to conduct a bibliometric analysis of published research on the use of artificial intelligence in accessible museums in the Web of Science Core Collection database. Through bibliometric research, the general framework of research on specific subject areas can be determined. A total of 30 articles were reached in the research. The research findings were analyzed and visualized through the "Analyze Results" option provided in the WOS viewer and Bibliometric tool and ten articles were selected from a systematic review. The findings of the research revealed that research on the use of "artificial intelligence in accessible museums" started in 1997, and then continued to be published with an increase in 2017 after a twenty-year break. The year with the most publications was 2022. The vast majority of research has been published in English. Research on this topic has also been published across Europe. Research has been widely disseminated in the USA, Italy, Spain, France, Romania, India, Bulgaria, Greece, and the Netherlands. However, the majority of the research is indexed in Springer and some in IEEE and MDPI. Most of the studies were prepared in the form of papers and some of them were prepared in the form of articles. Finally, the findings reveal that the research prepared on this subject has been addressed every year since 1997 with the keyword "artificial intelligence" until 2022, while the keyword "cultural heritage" has been mostly used since 2008. As a result, the results obtained from the bibliometric research show that the use of artificial intelligence in museums has become increasingly widespread year by year.*

Keywords: *accessibility; museums; artificial intelligence; accessibility in museums; bibliometric analysis*

How to cite: Islek, D., Altinay, F., Altinay, Z., Shadiev, R., & Danju, İ. (2024). Artificial intelligence in accessible museums. *BRAIN: Broad Research in Artificial Intelligence and Neuroscience*, 15(3), 236-248. <https://doi.org/10.70594/brain/15.3/18>

1. Introduction

Rapid developments in the age of technology, where transformations are taking place, have popularized the use of artificial intelligence that can be integrated into many fields. Artificial Intelligence is defined in different ways in related research. Vidu et al (2021) define artificial intelligence as a type of intelligence that is capable of performing at an intellectual level, with the ability to influence and understand various situations and environments.

Tamer & Övgün (2020) define artificial intelligence as a digital technological application that provides an interactive learning environment and functions in a capacity close to human intelligence. The use of artificial intelligence in various sectors is diversifying and increasing today. This type of intelligence can be used in industrial and healthcare applications, in the banking sector, in the fields of mathematics and logic, statistics and psychology, and in many other disciplines (Gümüş, 2019; Tabier & Bakanay, 2023).

In this context, artificial intelligence is thought to gain more importance in different disciplines in the coming years in the rapidly advancing digital transformation era (Meço & Coştu, 2022). Artificial intelligence, which is believed to facilitate learning and motivation in individuals, has become a highly preferred application in the education process (Tabier & Bakanay, 2023). When the use of artificial intelligence in education is examined, it is seen that it makes many contributions to the teaching process.

Related studies indicate that artificial intelligence offers a more personalized and special environment to the student, thus enabling the student to actively participate in the educational process (Kuprenko, 2020; Luckin et al., 2016). However, it is also mentioned in the literature that some artificial intelligence technologies gamify teaching and that teachers can provide more effective classroom management thanks to this method (İşler & Kılıç, 2021). At this point, it is thought that the use of artificial intelligence in museum education can be effective in reinforcing learning and making museums accessible (Aslan, 2022).

1.1. Using Artificial Intelligence in Museums

Artificial intelligence has become one of the most important digital technologies used in museum education (Aslan, 2022). Research suggests that artificial intelligence can be useful in realizing the educational function of museums (Tabier & Bakanay, 2023). It is also stated that thanks to this application, information pools can be created about the artifacts in museums and these pools can be used within the scope of museum education programs (Wang, 2021). The use of artificial intelligence in the museum environment provides many advantages. Examples of these advantages are presented below:

Artificial intelligence;

- It enables the archiving and cataloging of artifacts in museums and can easily classify digital collections (Magdalena & Lim, 2023).
- It can also analyze visitor experiences. Thanks to visitor experience management, applications such as monitoring visitor numbers, predicting visitor attendance accordingly, and analyzing feedback from visitors can be performed (Magdalena & Lim, 2023).
- Visitors can easily visit museums in their home or office environment.
- It provides virtual tour opportunities. Virtual guides can tell stories about a painting or sculpture in a museum (Candello, Pichiliani, & Pinhanez, 2020).
- It can also provide a voice assistant application. Thanks to this application, visitors' questions about the artifacts in the museum can be answered by the artificial intelligence application. For example; what an artifact is and who it is can be answered through this application (Candello, Pichiliani, & Pinhanez, 2020).
- It offers interactive exhibition opportunities.
- It helps visitors to have impressive experiences.
- With face recognition technology, it provides individual museum tours according to the age, gender, ethnicity, and interests of visitors.

- Robotic assistants, interactive displays, and chatbot technologies can be used in applications ranging from customer service to entertainment. Robotic assistants can be used to help customers with things like helping them find products or making recommendations. Interactive displays allow users to interact with digital content in more natural ways. AI-powered chatbots can be used to answer visitors' questions or provide information about artifacts in museums. In short, the robotic assistant provides visitors with information about collections and guided tours, while interactive displays offer visitors a more engaging way to explore and interact with art (Rani, Jining, Shah, Xaba, & Singh, 2023).

1.2. Case Studies on the Use of Artificial Intelligence in Museums

In related studies, it is mentioned that the use of artificial intelligence in museum education has become increasingly widespread and important in many countries (Aslan, 2022; Gümüş, 2019; Vidu et al. 2021). At this point, it is thought that mentioning the sample applications of artificial intelligence in museums, which increases the accessibility of museums, may be effective in pointing out the importance of the subject. In this context, sample applications in museums are mentioned below.

- Chatbots have been used in many museums for more than a decade. One of the first museums to use this application is Museum Form. In this museum, an avatar called Max was created in 2004 and started to act as a virtual guide in the museum. Today, the application in this museum continues. This avatar was renewed in terms of design compared to 2004 (Kopp et al. 2005; Vidu et al. 2021). Similar applications are also available in Anne Frank's House in Amsterdam, Cooper-Hewitt Museum in New York, Field Museum in Chicago, Carnegie Museum in Pittsburg, Smithsonian Museums in Washington, Dali Museum in Florida, Barnes Foundation in Philadelphia, House Museums in Milan, Musée du Quai Branly in Paris, National Art Museum in Belarus (Ashri, 2017; Charr, 2019, 2020; Levere, 2018).
- The Akron Museum of Art in the USA also uses a chatbot called Dot. The most important task of this robot is to provide digital tour guidance. How to use the robot is introduced to the visitor with the help of the kiosk at the entrance of the museum (Gümüş, 2019).
- The Dali Museum in Florida also has an artificial intelligence application. It is an artificial intelligence application that allows visitors to interact with Dali. In this application, an AI algorithm is used to "learn" how Dali speaks (Vidu et al., 2021). Today, Artificial Intelligence (AI) is not only revolutionizing various sectors (education, healthcare, technology, transportation), but it will also make other sectors like the museum sector more inclusive and accessible to a wider range of visitors, including those with disabilities, in the next century. With Personalized Experiences, AI can create experiences that are specific to each visitor's individual needs and preferences. For example, a visually impaired visitor can receive audio descriptions of exhibits, while a hearing-impaired visitor can benefit from sign language interpretation or subtitles. In terms of Advanced Accessibility, AI-powered tools can help eliminate barriers for visitors with disabilities. These include features such as automatic subtitles for videos, tactile models for visually impaired visitors, and virtual tours for those with limited mobility. With the Advanced Information Retrieval experience, AI-powered search engines can make it easier for visitors to find information about exhibitions, collections, and events. This can be especially beneficial for those who have difficulty with traditional search methods.

AI can create interactive and engaging learning experiences for all visitors, increasing inclusivity so that, for example, AI-powered games and simulations can make complex topics more accessible and enjoyable. With Data-Driven Processing, one of the most important issues today, AI can analyze visitor data to identify areas where accessibility can be improved and adapt future exhibitions and programs accordingly. Of course, the biggest problem is the cost: Implementing AI technologies can be expensive, especially for smaller museums. In terms of privacy, the collection

and use of visitor data can raise privacy concerns that need to be addressed. Also, AI is still constantly evolving and may have limitations in its ability to accurately interpret, respond to, and learn from human behavior. But while AI can increase accessibility, it cannot replace the human touch and personal connection that can be so important for visitors with disabilities.

Let us begin with examples of AI Applications in Accessible Museums:

Artificial intelligence (AI) has the potential to revolutionize museum accessibility. Here are some specific AI tools that can be used to enhance the experience for visitors with disabilities.

Some examples used nowadays are:

- Virtual Tours: AI-powered virtual tours can provide immersive experiences for visitors who cannot physically visit a museum.
- Object Recognition: AI can help identify and describe objects in exhibits, even for the visually impaired.
- Translation Services: AI-powered translation tools can make museums more accessible to visitors with different language backgrounds.
- Social Robots: AI-powered social robots can serve as guides and companions for visitors, providing information and assistance.

As a result, AI offers significant potential to make museums more accessible to people with disabilities. By overcoming challenges and using cutting-edge technology, museums can create inclusive and welcoming spaces for all visitors.

- Image and Object Recognition: AI can accurately identify and describe objects in exhibits, even for those with visual impairments. This can be done through image recognition and natural language processing.
- Optical Character Recognition (OCR): OCR software can extract text from images, allowing visually impaired visitors to access information from labels, signs, and documents.
- Tactile Graphics: AI can assist in the creation of tactile graphics, providing a tangible representation of images and diagrams for visually impaired visitors.

Audio Accessibility

- Speech-to-Text Transcription: AI can transcribe audio content from lectures, guided tours, and multimedia presentations, making it accessible to visitors with hearing impairments.
- Audio Description: AI can generate audio descriptions that describe visual elements of exhibits, allowing visually impaired visitors to understand the content.
- Sign Language Translation: AI-powered tools can translate spoken language into sign language, making museums accessible to visitors who are deaf or hard of hearing.

Interactive Experiences

- Virtual Reality (VR) and Augmented Reality (AR): AI can enhance VR and AR experiences for visitors with disabilities by providing adaptive controls, audio descriptions, and haptic feedback.
- Personalized Guides: AI-powered virtual guides can provide tailored information and assistance to visitors based on their individual needs and preferences.
- Interactive Games and Simulations: AI can create interactive games and simulations that are accessible to visitors with disabilities, making learning more engaging and enjoyable.

Data Analysis and Accessibility Insights

- Visitor Analytics: AI can analyze visitor data to identify areas where accessibility could be improved and to tailor future exhibits and programs accordingly.
- Predictive Analytics: AI can predict visitor needs and preferences, allowing museums to proactively address accessibility challenges.

By leveraging these AI tools, museums can create more inclusive and welcoming environments for visitors with disabilities, ensuring that everyone has the opportunity to enjoy the benefits of cultural heritage.

From the above-mentioned museum examples of artificial intelligence applications, it can be understood that these applications offer rich information, provide digital guidance, and allow visitors to have positive experiences from the activities in museums.

1.3. Related Studies

When the related studies are examined, it is understood that there are studies prepared in the field of museums and artificial intelligence. Vidu et al. (2021) provided theoretical information on the use of artificial intelligence in museums. In the study, the applications related to artificial intelligence in museums were introduced together with the names of the museums, and information on how the applications are used and their advantages were given. In the study by Tabier and Bakanay (2023), the importance and advantages of artificial intelligence applications applied in museum education environments in preschool education were mentioned.

In the research, the use of artificial intelligence in teaching and the necessity of developing artificial intelligence-oriented education programs were emphasized. In addition, the applicability of artificial intelligence in preschool education was examined and evaluated in the context of museum education environments. As a result of the research, it was predicted that artificial intelligence can be effective in increasing the motivation of preschool students, improving their cognitive skills, and developing their problem-solving skills. In the research prepared by Aslan (2022), the use of artificial intelligence in the field of museum education is discussed. In the research, the benefits of using artificial intelligence in the field of museum education and general information, functional features of the use of artificial intelligence in museums, as well as examples of museums that use artificial intelligence applications are mentioned.

As it can be understood, the research in this field has generally focused on the advantages of applying artificial intelligence in museum education. In these studies, museums that benefit from this application were introduced. No bibliometric research on the use of artificial intelligence in museums was found in the literature. Bibliometric analysis aims to examine the content, structure, and development of research on a subject and to reveal trends (Akyılmaz, 2022). With this analysis, the number of studies on the relevant subject is revealed, and contributions and collaborations between authors and countries are evaluated. Thus, transparent results can be obtained by using publications, and mathematical and statistical methods. (Lee et al., 2020; Thompson & Walker, 2015). At this point, it is thought that conducting bibliometric research on the use of artificial intelligence applications in accessible museums can yield effective results in terms of determining the direction and orientation of research. In this context, it is believed that the research will also make significant contributions in eliminating the missing dimension in the literature since it is the first of its kind.

2. The Aim of the Study

This research aims to perform a bibliometric analysis of the articles published in the Web of Science Core Collection database on the use of artificial intelligence in accessible museums. The conducted analysis aimed to answer the research questions below.

1. What is the distribution of the publications by years in WOS?
2. What is the language and country distribution of the publications in WoS?
3. What are the most preferred publications venues?
4. What are the document types published?
5. What is the time trend of the topics about the use of AI in accessible museums?

3. Methodology

This study utilizes the bibliometric analysis method, which is a widely used method for the precise examination of vast quantities of data, to investigate publications relating to the use of artificial intelligence (AI) at accessible museums and establish a series of distribution patterns.

Data Collection & Analysis

Initially, a systematic examination of the literature is conducted to get the relevant data for the analysis. The data are acquired by the Core Collection on the Web of Science (WoS) database. The WoS database offers convenient access to a substantial quantity of top-notch literature and is widely used in bibliometric research. The systematic research performed covered All Fields, all of the indices, years, and document types of the publications, and the search method is; "artificial intelligence" AND (accessible OR accessibility) AND (museum or museums). A total of 30 documents were imported on the day of the research (23rd of October 2023). The imported documents were analysed and visualised via the "Analyse Results" option, provided within WoS, VOSviewer (van Eck & Waltman, 2010), and Bibliometrix tool (Aria & Cuccurullo, 2017) of R! Programming Language.

4. Results

4.1. Publication Year Analysis

The publication year analysis was performed with the Bibliometric tool of R! Programming language and illustrated in Figure 1. As represented in Figure 1, the first and only publication regarding AI in accessible museums is from 1997. However, the results show that this topic was out of interest until year 2017 and during these two decades, there were a total of 3 publications. In 2017, 5 documents were published and 2022 was the most productive year with a total number of 9 publications. For the year 2023, no documents were recorded until the day of this research (23rd of October 2023) and this indicates a less productive year again.

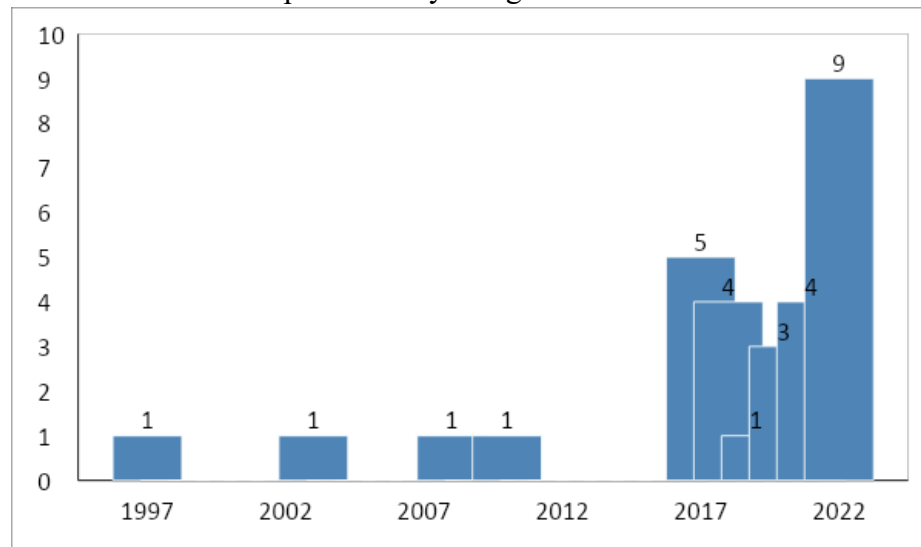


Figure 1. Publication Year Analysis

4.2. Language and Country Analysis of Publications

4.2.1. Language Analysis

The language analysis was conducted with the "Analyse Results" option that is provided within the WoS database. The results show that 28 documents out of 30 (~93%) were published in the English language. In addition to this mostly preferred publication language, 1 publication was made in French language and 1 publication was made in Spanish language which counts for a percentage of 7% together.

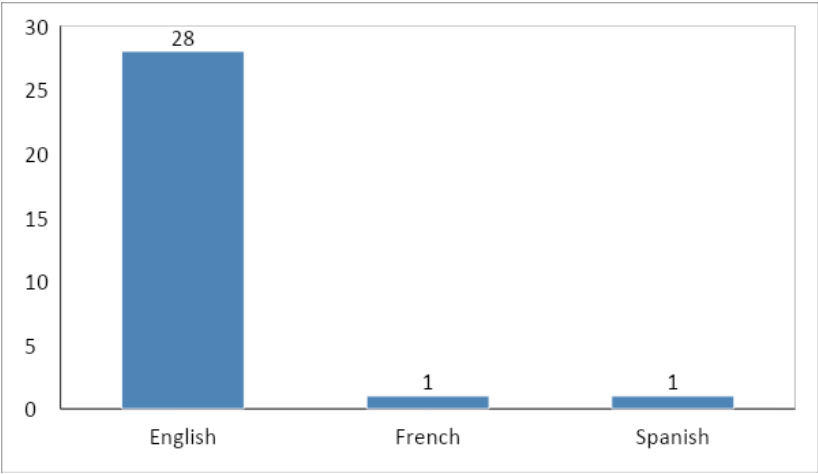


Figure 2. Publication Language Analysis

4.2.2. Country Analysis

The productivity of countries was analysed with two bibliometric visualisation tools, VOSviewer and Bibliometrix tool of R! Programming Language. Below, the top 10 list of productive countries are presented in Table 1. In general, the USA is the most productive country with 6 documents (~19%) which is closely followed by Italy and Spain with 5 documents each (~17%). These top 3 countries cover 53% of the published documents. The rest of the countries in the list have a maximum of 2 documents and 1 document per country which accounts for ~5% and ~4%, respectively. Figure 3 represents the worldwide distribution of the productivity of countries.

The bibliometric coupling of the countries was mapped with VOSviewer,

The results indicate that the European countries such as Spain, Italy, and France are having a strong collaboration while the most productive country, the USA, highly interacts with Israel and Hungary.

Table 1. Top 10 Country List

Region / Country	Frequency
USA	6
ITALY	5
SPAIN	5
FRANCE	2
GERMANY	2
INDIA	2
ROMANIA	2
BULGARIA	1
GREECE	1
NETHERLANDS	1

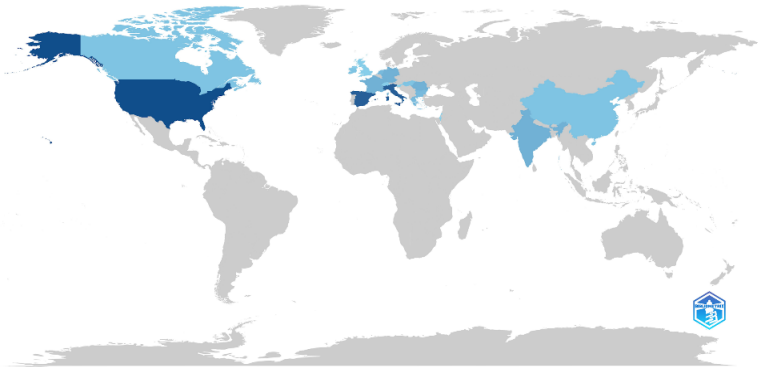


Figure 3. Worldwide Distribution of the Countries' Productivity

Bibliometric Coupling of the Countries can be listed as Ireland, USA, Israel, Hungary, Switzerland, France, Italy, and Spain.

4.3. Most Preferred Publication Venues

The WOS Analyse Results tool was used to analyze the most preferred venues. The analysis results show that Springer Nature is the most preferred publication venue with 11 documents (~37%) which is followed by IEEE with 4 documents (~13%) and MDPI with 3 documents (10%). The top 5 list is presented below in Table 2.

Table 2. Analysis of the Preferred Publication Venues

No.	Publication Venue	Frequency
1	SPRINGER NATURE	11
2	IEEE	4
3	MDPI	3
4	ASSOC COMPUTING MACHINERY	2
5	ARCHIVES & MUSEUM INFORMATICS	1

4.4. Document Type Analysis

The analysis of the document types was conducted through the analyser provided within the WOS database. Proceeding Papers and Articles are the only two documents observed in the analysis (Figure 5). 18 documents are Proceeding Papers which accounts for 60% of the documents whereas 16 documents (40%) were counted for Articles.

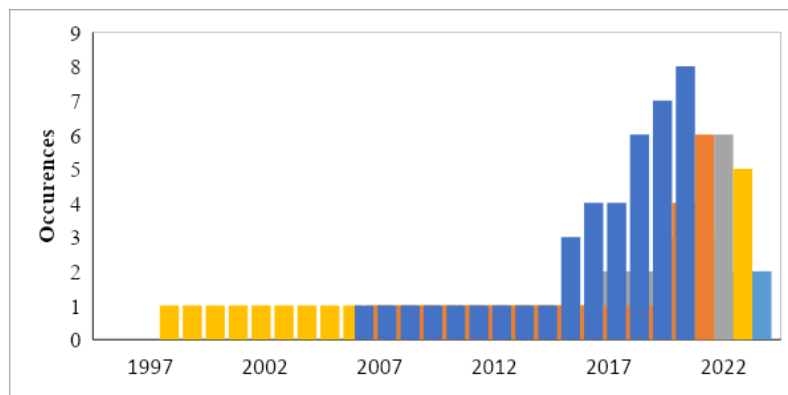
4.5. The time trend of the topics about the use of AI in accessible museum

4.5.1. Keyword Analysis

VOSviewer and Bibliometric tools were used to perform the keyword analysis. Figure 6 shows the top 15 used keywords by the authors. The top 5 author keywords were found to be cultural heritage (f=8), museums (f=6), virtual reality (f=6), artificial intelligence (f=5), and accessibility (f=2).

4.5.2. Keyword Analysis by Years

To examine the time trend of the author keywords, analysis was performed with a Bibliometric tool. The top 5 keywords mentioned in the previous section were used to produce the illustration in Figure 4. The most preferred keyword, “Cultural Heritage”, first appeared in the year 2008 and started to increase after the year 2017. Although the most frequent author keyword was “Cultural Heritage”, the keyword “Artificial Intelligence” appeared in all years.

*Figure 4. Time Trend of Author Keywords*

4.5.3. Accessible Museum and AI

In this part, ten studies discuss the key terms on accessible museums and the practical sides of AI. The aim of the articles and outcomes are given in Table 3.

Table 3. The aim of the articles and outcomes

Article Title	Aim	Outcome of the Study
Interactive description to enhance accessibility and experience of deaf and hard-of-hearing individuals in museums	The article explores enhancing accessibility and the museum experience for deaf and hard-of-hearing (DHH) individuals through interactive descriptions.	The authors developed three prototypes — active-linked, graph-based, and chatbot-based—aimed at providing engaging and informative content tailored to the needs of DHH visitors. These prototypes significantly improved information accessibility compared to traditional text descriptions, making it easier for DHH individuals to understand and enjoy exhibits.
Models and tools for the digital organisation of knowledge: accessible and adaptive narratives for cultural heritage	The article delves into the complexities of data organization within the cultural heritage sector and emphasizes the critical need for accessibility in presenting this information.	In summary, the article presents a comprehensive analysis of the current state of digital organization in cultural heritage, highlighting the need for innovative models and tools that promote accessibility and engagement.
Enhancing traditional museum fruition: current state and emerging tendencies	The primary objective is to explore and synthesize digital storytelling guidelines and technological advancements that can improve the museum experience for older and mobility-impaired individuals.	The use of content analysis to categorize findings into three primary themes demonstrates a systematic and structured approach to synthesizing existing literature. This methodological rigor is essential for drawing meaningful conclusions.
Early virtual science museums: When the technology is not mature	The study aims to do a systematic review of virtual science museums.	This paper has discussed three case studies of early science museum-related websites in the 1990s and early 2000s. The Virtual Museum of Computing (VMoC), established in 1995, is effectively now a historical digital artifact. Changing digital technology environments have overtaken the need for such resources.
AI-Based Language Translation and Interpretation Services: Improving Accessibility for Visually Impaired Students	The article aims to develop and evaluate a machine translation (MT) system designed to enhance the educational experience for non-native Arabic-speaking teachers and their native Arabic-speaking students.	This study presents a valuable contribution to language education, highlighting how machine translation can facilitate better learning experiences. By improving comprehension and engagement, these systems can play a crucial role in modern educational practices.
Enhancing traditional museum fruition: current state and emerging tendencies	The main objective was to engage CH professionals in understanding technical solutions to improve research quality.	Given the enormous amount of research in the field, this work may serve as a useful starting point for understanding key technologies created to date, though it does not provide an in-depth survey of all topics.
A sensemaking system for grouping and suggesting stories from multiple affective viewpoints in a museum	The primary aim is to develop a system that enriches museum experiences by enabling users to form deeper emotional connections with exhibits.	The article demonstrates how an emotional-focused sensemaking system can transform museum experiences. It suggests future directions for research, where user feedback and further development of the system could form the basis for upcoming projects.
Immersive Serious Games: Shifting paradigms from activism to AI. In The Arts and Computational Culture: Real and Virtual Worlds	The study aims to discuss immersive serious games in museums.	The article posits that the combination of serious games and participatory research can significantly contribute to public health initiatives by promoting education, engagement, and empowerment within

		communities, ultimately leading to improved health outcomes.
Digitally enriched museum experiences—what technology can do	The article explores how digital technologies can transform museum experiences, making them more engaging and accessible for a diverse audience.	The article addresses challenges such as ensuring accessibility for all visitors, including those with disabilities, and the need for staff training to effectively implement these technologies. The goal is to provide insights into how museums can evolve in the digital age by integrating technologies, and creating inclusive experiences.
Toward Accessible Mixed Reality in the Museum: Usability Principles for Disadvantaged Visitors and a Feasibility Evaluation for a New MR System	The article examines the MIRA project, which aims to enhance museum accessibility through Mixed Reality (MR) technologies.	The MIRA project seeks to revolutionize museum experiences by leveraging MR technologies to meet the needs of elderly individuals, people with disabilities, and children. By emphasizing accessibility and engagement, the project aims to enhance visitors' enjoyment and understanding of cultural heritage.

5. Discussion & Conclusion

As a result of the findings obtained from the research, it was determined that studies on the use of artificial intelligence in accessible museums started to be researched in 1997. However, the analysis of the WOS database revealed that only three studies were conducted in 2003, 2008, and 2010 in the intervening 20 years. It was in 2017 that this issue was revisited by researchers. The results obtained reveal that research increased especially in 2022.

This result shows that the importance of research on the use of artificial intelligence in museums is increasing today. Similar to this finding, Aslan (2022) states that the use of artificial intelligence in the accessibility of museums is increasing worldwide. Again in Sezgin Özrilli & Özrilli (2021) research, it is stated that artificial intelligence transforms museums into pleasant and privileged places with interactive exhibition applications so that visitors can access collections more easily. Understandably, the results of related research also reveal that the use of artificial intelligence in museums is becoming a trending topic in research.

According to another result obtained from the research, 93% of the research prepared in this field was prepared in English. The rate obtained reveals that almost all of the studies are written in English. This result may be since English is preferred as an international language in many parts of the world and this language is preferred as a second language after the mother tongue. Smith (2015) supports this finding and states that English is a common language in the world of science today and has become a communication tool used in many fields every day.

In addition, the results show that most of the studies on the use of artificial intelligence in museums were conducted in the USA, Italy, and Spain. However, research has also been undertaken by researchers in Germany, Romania, India, Bulgaria, Greece, and the Netherlands. This result reveals that the use of artificial intelligence in museums has started to be seen as important, especially in Europe and America, and that researchers in these countries tend to work on this issue. When the relevant research is examined, it is understood that examples of artificial intelligence use are becoming increasingly widespread, especially in museums in Europe and America, and applied studies are being produced (Gümüş, 2019). At this point, it can be said that the production and dissemination of these studies in these continents that use artificial intelligence applications is an expected result.

According to another result obtained from the third question of the research, the majority of the studies on the use of artificial intelligence in museums are indexed in the Springer database. Springer database provides text access to many periodicals and book series of Springer Publishing House. In addition, this database covers subjects such as Chemistry, Physics, Astronomy, Engineering, Environmental Sciences, Mathematics, Computer Science, Earth Sciences, Medicine, Economics, and Law (Üsküdar University Library Portal, 2023). As can be understood, the Springer database offers a wide range of content and includes valuable research from many fields. The fact

that the majority of museum research on the use of artificial intelligence is included in this database reveals that this topic is preferred by researchers on an international platform.

Another result obtained from the research is that research on the use of artificial intelligence in museums is prepared in the form of articles and papers. In this context, museums are becoming increasingly common in every developed country and also in underdeveloped countries. Thousands of new museums are created around the world every year, and thousands more are being expanded or improved, especially through advances in innovation. In this context, the research procedure and article in this field are taken as basis.

The reason for the growth of articles and reports about access to museums and artificial intelligence is; Because museums are no longer just places where products are exhibited. For this reason, there was a tendency to publish articles and proceedings. Advanced technology has been developed in recent years. The concept of museum management in the world and Turkey changed in parallel with this development. How the museum can change the introduction of digital technology. The 'virtual museum or e-museum' section and research on these topics are based on the use of the Internet in collections and privileged museums (Kalyoncu & Güneş, 2019).

Finally, the research findings reveal that the research in this field tends to focus mostly on "Cultural Heritage" and "Artificial Intelligence". In recent years, there has been an increase in research on access to museums, virtual reality, artificial intelligence, and cultural heritage. According to the research results; virtual reality, artificial intelligence, and cultural heritage stand out as popular topics, as indicated in articles on museums and access to museums. It was also seen to win. Bordoni, Mele, & Sorgente (2016) and Sevi & Türküresin (2023) also emphasized in their books that accessible museums, cultural heritage, and artificial intelligence are the two most preferred disciplines in the field of museology.

6. Recommendation

As a result of the findings obtained from the research, it is recommended that future research on the use of artificial intelligence in museums should include experimental research applications to obtain reliable results. Merits of AI applications can be used in various services in different regions of the world.

7. Limitations and Future Studies

There are some limitations to this research. First, the study's dataset is based on a small sample and focuses on a single topic Artificial Intelligence in Accessible Museums. Future studies may incorporate larger samples and topics as well. In addition, not all research outputs are indexed in this bibliographic database so there will always be data gaps in any result. Also, no database indexes all published works, and none covers all subject areas equally.

References

- Akyılmaz, M. (2022). Bibliometric analysis of the use of artificial intelligence in museum education. *International Journal of Museum Management*, 14(3), 325-339.
- Ashri, L. (2017, April 3). How museums are using chatbots. *Chatbots Magazine*. <https://chatbotsmagazine.com/how-museums-are-using-chatbots-5-real-worldexamples-34e9d4858dd9>
- Aslan, A. A. (2022). Yapay Zekânın Müze Eğitimi Alanında Kullanılması. *Sanat Ve Tasarım Dergisi*, -(30), 1-14. <https://dergipark.org.tr/en/pub/sanatvetasarim/issue/73722/1215186>
- Bordoni, L., Mele, F., & Sorgente, A. (2016). The 10th workshop on artificial intelligence for cultural heritage. *Cambridge*.
- Candello, H., Pichiliani, M., & Pinhanez, C. (2020). Learning AI with museum playful experience for children. *IDC2020 Workshop: Creating Opportunities for Children's Reflections on AI, Robotics and Other Intelligent Technologies*.

- Charr, M. (2019, September 14). How are museums using chatbots? *MuseumNext*. <https://www.museumnext.com/article/how-are-museums-are-using-chatbots/>
- Charr, M. (2020, May 22). Museum chatbots: Is 24/7 museum service the way forward? *MuseumNext*. <https://www.museumnext.com/article/museum-chatbots-is-24-7-museum-service-the-way-forward/>
- Gümüş, F. (2019). Artificial intelligence applications, effects, and future in museums (Master's Thesis). *Istanbul University, Institute of Social Sciences*, Istanbul.
- İşler, B., & Kılıç, M. (2021). Use and development of artificial intelligence in education. *New Media Electronics Magazine*, 5(1), 1-11. https://doi.org/10.17932/IAU.EJNM.25480200.2021/ejnm_v5i1001
- Kalyoncuoğlu, M., & Güneş, E. (2019, April). A new approach to the transformation of museums. In *5th International Conference on New Trends in Architecture and Interior Design* (p. 33).
- Kopp, S., Gesellensetter, L., Krämer, N. C., & Wachsmuth, I. (2005, September). A conversational agent as museum guide: Design and evaluation of a real-world application. In *International workshop on intelligent virtual agents* (pp. 329-343). Springer.
- Kuprenko, V. (2020). Artificial intelligence in education: Benefits, challenges, and use cases. *Towards Artificial Intelligence*. <https://medium.com/towards-artificial-intelligence/artificial-intelligence-in-education-benefits-challenges-and-use-cases-db52d8921f7a>
- Lee, I., Lee, H., Chen, Y., & Chae, Y. (2020). Bibliometric analysis of research assessing the use of acupuncture for pain treatment over the past 20 years. *Journal of Pain Research*, 13, 367-376. <https://doi.org/10.2147/JPR.S235047>
- Levere, J. L. (2018, October 25). Artificial intelligence, like a robot, enhances museum experiences. *New York Times*. <https://www.nytimes.com/2018/10/25/arts/artificial-intelligence-museums.html>
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. London: Pearson Education.
- Magdalena, P. S., & Lim, Y. S. (2023). Artificial intelligence in the context of cultural heritage and museums: Complex challenges and new opportunities. *European Parliamentary Research Report*.
- Meço, G., & Coştu, F. (2022). Eğitimde yapay zekânın kullanılması: Betimsel içerik analizi çalışması [Using artificial intelligence in education: Descriptive content analysis study]. *Karadeniz Technical University Social Sciences Institute Journal of Social Sciences*, 12(23), 171-193.
- Rani, S., Jining, D., Shah, D., Xaba, S., & Singh, P. R. (2023). Exploring the potential of artificial intelligence and computing technologies in art museums. In *ITM Web of Conferences*, 53.
- Sevi, E., & Er Türküresin, H. (2023). Opinions of social studies teacher candidates on value acquisition in virtual museums. *Journal of International Museum Education*, 5(Special Issue), 27-44. <https://doi.org/10.51637/jimuseumed.1351676>
- Sezgin Özrili, A., & Özrili, Y. (2021). Müzelerde interaktif (etkileşimli) sergileme uygulamaları. *İnönü Üniversitesi Sanat ve Tasarım Dergisi*, 11(24), 85-102. <https://doi.org/10.16950/iujad.938628>
- Smith, L. E. (2015). English as an international language: No room for linguistic chauvinism. *Journal of English as a Lingua Franca*, 4(1), 165-171. <https://doi.org/10.1515/jelf-2015-0015>
- Tabier, E., & Bakanay, Ç. D. (2023). Museum educational environments and artificial intelligence applications in preschool education. *Journal of Social, Humanities and Administrative Sciences*, 9(65), 3082-3088. <https://doi.org/10.29228/JOSHAS.70500>
- Tamer, H. Y., & Övgün, B. (2020). The digital transformation office in the context of artificial intelligence. *Ankara University SBF Journal*, 75(2), 775-803. <https://doi.org/10.33630/ausbf.691119>

-
- Thompson, D. F., & Walker, C. K. (2015). A descriptive and historical review of bibliometrics with applications to medical sciences. *Pharmacotherapy*, 35(6), 551-559. <https://doi.org/10.1002/phar.1586>
- Vidu, C., Zbucnea, A., & Pinzaru, F. (2021). Old meets new: Integrating artificial intelligence in museums' management practices. In *Strategica: Shaping the future of business and economy* (pp. 830-844). <https://strategica-conference.ro/wp-content/uploads/2022/04/63-1.pdf>
- Wang, B. (2021). Digital design of smart museum based on artificial intelligence. *Mobile Information Systems*, 6, 1-13. <https://doi.org/10.1155/2021/4894131>