

HOW ARE SCIENCE MUSEUMS PERCEIVED IN ITALY?

Tripadvisor as proxy of visitor studies on public engagement

by *Noemi Crescentini and Andrea Rubin**

Abstract

Science museums, science centres and discovery centres (SMCs) are key spaces for dialogue between science and society. Their evolution has integrated scientific and social perspectives, significantly influenced by the digital revolution, as demonstrated by the increase in online visitor reviews. This exploratory study investigates TripAdvisor users' narratives about science museums in Italy and assesses how these reviews reflect the effectiveness of audience engagement. Using Topic Modelling and Qualitative Content Analysis to analyse the reviews, the research identified key themes influencing visitor satisfaction, such as the educational value and interactivity of the exhibition, with the ultimate goal of improving museum practices and audience engagement strategies.

Keywords

Science Museums, Science Communication, TripAdvisor reviews

* NOEMI CRESCENTINI is a Postdoctoral Fellow and Adjunct Professor at the Department of Social Sciences, University of Naples Federico II. Her research interests concern the connections between society and scientific and technological topics and the field of social research methodology.

Email: noemi.crescentini@unina.it

ANDREA RUBIN is Assistant Professor in the Department of Humanities at the University of Ferrara. He is a member of the Research Board of Observa Science in Society and has been involved in numerous national and international projects focused on the relationships between science, technology, and society, as well as the public communication of science and technology. As a journalist, he has collaborated with, and continues to contribute to, various newspapers and science magazines.

Email: andrea.rubin@unife.it

DOI: [10.13131/unipi/a2y1-vp86](https://doi.org/10.13131/unipi/a2y1-vp86)

1. INTRODUCTION

In the past decade, there has been a significant rise in public engagement activities in science communication. Events such as conferences, festivals, interviews, films, and publications are primary channels for disseminating scientific knowledge to the public.

Museums and science exhibitions occupy a central position in science communication landscape, serving as key intermediaries between the scientific community and the public. In line with the theoretical approaches of Public Communication of Science and Technology (PCST), such institutions are conceived as informal learning environments and dynamic and participatory spaces facilitating dialogue between science and society (Schiele et al., 2021). Their function extends beyond the mere transmission of knowledge, taking shape as platforms for critical reflection and public debate on socially relevant scientific issues (Mortensen, 2011; Bucchi & Trench, 2021). Recent data indicates that over 45% of Italians have visited a science museum or exhibition at least once, and 25% have attended a public event focused on science and technology topics (Bucchi et al., 2024), marking unprecedented levels of engagement. Such trends offer valuable insights for stakeholders, especially given the limited—possibly insufficient—audience development research in Italian museums. This surge in public interest represents both an opportunity to foster new initiatives and an affirmation of museums' role as highly trusted sources of information on science and technology for citizens. The Toronto Declaration, for example, emphasizes that museums should serve as forums for open and informed discussion on the ethical, social, and economic impacts of scientific research and new technologies (Toronto Declaration, Fifth Science Centre World Congress, 2008).

A challenge taken up by SMCs which, although reflecting different cultural approaches to science and public communication of science (Schiele et al., 2021), have progressively represented forums for debate (Einsiedel and Einsiedel, 2004; Lehr et al., 2007) between science and society. Originally created as places devoted to conservation, museums have reshaped their structures and functions by reproducing the changes that have taken place in the conception of relations between citizens and experts and are well summarised by the different models of public communication of science. From a first phase, dedicated to conservation and exhibition, there has been a gradual shift to a phase dedicated to the transmission of scientific and technological knowledge (reproducing

the assumptions of the deficit model).

Science and technology museums have gradually changed their communicative paradigm, moving from a deficit model to a dialogue approach. Currently, in the so-called “fourth generation” of science museums, these institutions play a central role in promoting the active involvement of the public (Schiele et al., 2021). However, attempts to overcome the deficit model predate the conceptual shift from Public Understanding of Science (PUS) to Public Engagement with Science and Technology (PEST). As a result, the role of museums has expanded to include promoting debates on controversial science and technology issues such as stem cell research, GMOs, AI, nuclear energy and science policy. However, several studies (Delicado, 2009) highlight the many difficulties that institutions face in putting these participatory objectives into practice. The ability of museums and science centres to engage with the public is therefore closely linked to their continuous ability to adapt to new curatorial practices, internal institutional cultures and changing visitor expectations (Merzagora and Rodari, 2007). In this regard, it is interesting to note that the number of SMCs has grown considerably both nationally and globally, especially thanks to Asian countries such as China. The demand is also coming loud and clear from the public: in Europe, for example, 33% of citizens visit science and technology museums (European Commission, 2021). Italy has EU-average visit rates to science museums, although differences remain related to socio-demographic variables, especially age and education levels.

The evolving sociocultural landscape over recent decades has also driven museums to adopt new roles and address continually emerging challenges. Today’s science museums and science centers are increasingly responsible for catering to a diverse public, meeting demands for accessibility and fulfilling an educational mission through a range of projects and activities. In the nineteenth century, museums primarily focused on preserving and curating collections, like zoos or art and history museums. However, traditional practices in curation, communication, and research alone are now insufficient to meet the demands of contemporary society.

Many museums and interactive science centres have moved away from traditional collections, instead prioritizing experiential learning and engaging audiences with cutting-edge scientific and technological developments (Schiele, 2014). However, museums have increasingly assumed the role of an “agora”, where the concept of “science in action” (Latour, 1987) can be visible yield to the public, rather than functioning solely as a space for the presentation of science as certain, objective,

and free of doubt (Butler, 1992; Durant, 1999). In major science museums, the “public understanding of science” has given way to “public engagement with science” (Elam and Bertilsson, 2003; Lehr et al., 2007; Hagendijk and Irwin, 2006), an adjustment of strategy largely due to the perceived failure of the “deficit model” and an increased intervention of social studies in science. Museums play an important role in promoting cultural heritage also through web channels, social media and interactive platforms, thus offering additional access points and opportunities for participation to a wider and more diverse audience (Cameron & Kenderdine, 2007). In this regard, ministerial guidelines on digitisation and museum communication (for example, the “Guidelines for the digitisation of cultural heritage” issued by the MiC, 2022¹) underscore the imperative to integrate the physical experience with multimedia resources and interactive content to enhance the enjoyment of heritage.

The promotion of open debates and the adoption of digital communication tools have been identified as key factors in enhancing the museum as a space for inclusion, learning and critical debate².

The advent of user-generated data on digital review platforms such as TripAdvisor has profoundly impacted the realm of social research, offering invaluable insights into the public’s perceptions and experiences. Initially developed for the tourism sector, these platforms have undergone a remarkable evolution, transforming into dynamic archives that document a diverse array of experiences. These experiences encompass a wide spectrum, ranging from urban visits and excursions to nature parks to explorations of museums and science centres. The ability to collect and aggregate feedback in real time provides researchers with a unique perspective on visitor engagement, as well as insights into the perception and valuation of cultural and scientific institutions.

In this context, digital platforms emerge as significant arenas for promoting dialogue about science, facilitating interaction between different communities, and stimulating public participation. By sharing reviews and ratings, users not only contribute to the dissemination of knowledge but also actively participate in the construction of a collective discourse reflecting the intersection of science, culture, and society. This process of co-creation, based on digital interaction, reinforces the role of online platforms in fostering greater scientific

¹ <https://docs.italia.it/italia/icdp/icdp-pnd-digitalizzazione-docs/it/v1.0-giugno-2022/index.html>

² <http://musei.beniculturali.it/>

awareness and strengthening the link between scientific institutions and the public.

Our study, which lies transversally between the fields of public communication of science and visitor studies, presents a qualitative and quantitative analysis of reviews of Italian science museums and science centres on TripAdvisor. The findings aim to address the following research questions:

RQ1: What elements are most valued by the public in online reviews?

RQ2: Do these elements pertain to public engagement factors or organizational aspects?

RQ3: What elements (if any) influence the positive or negative rating?

2. TRIPADVISOR AND THE MUSEUM EXPERIENCE IN THE DIGITAL CONTEXT

Digital platforms represent another arena for fostering these science-related dialogues (Van Dijck et al., 2018). Museum experiences extend beyond the physical visit, remaining in visitors' memories and continuing through post-visit online discussions on social media or platforms like TripAdvisor. These platforms influence potential visitors' decisions (O'Connor, 2008) and they also serve as important data sources for real-time analysis of user narratives (Burtch and Hong, 2014). Tourism experiences have been described as inherently personal and subjective responses to organised contexts, activities or events (Packer and Ballantyne, 2016; Packer et al., 2019). These experiences are difficult to measure in objective terms, and emerge from the interaction between individual expectations, environmental characteristics and perceived service quality (ibidem). Despite their intangible and variable nature, tourism experiences exert a significant influence on the decisions and behaviour of other travellers, particularly when shared through digital and social media platforms. The online sharing of such experiences contributes to the construction of collective and participatory knowledge, strengthening trust and reducing uncertainty in tourism-related decision-making processes. This phenomenon highlights the crucial role of reviews and personal narratives in shaping perceptions and promoting destinations, outlining a tourism ecosystem increasingly driven by co-creation dynamics and

virtual social networks.

TripAdvisor has also emerged as a key resource for analysing visitor perceptions, not only about restaurants and hotels, but also in relation to cultural and natural heritage sites, including science museums and centers, as demonstrated in studies on locations like the Danube Delta UNESCO World Heritage site (Stoleriu et al., 2019).

TripAdvisor represents a significant platform for travel reviews and advice, situated within the broader context of *user-generated content* (UGC) platforms. TripAdvisor have been shown to exert a growing influence on the construction of collective meanings and narratives related to tourist and cultural attractions (Green and Jenkins, 2011; Castells, 2010), thereby helping to redefine the way the public experiences and interprets travel (Wakkary et al., 2008). The platform was established in 2000 by Stephen Kaufer, integrating social networking features with booking tools for tourist services. It enables users to contribute reviews, comments and ratings, as well as organise and book accommodation, restaurants and activities. This multifunctional platform plays a pivotal role in the tourism industry by facilitating the sharing of personal experiences and the establishment of a vast network of opinions that significantly influence the travel choices of an increasing number of people (Alaimo et al., 2020).

The constant production of content by users reflects the shift from traditionally monodirectional communication to forms of interactive participation, an expression of the “participatory culture” theorised by the sociology of media and digital public communication (Carpentier, 2011; Couldry, 2012). In this context, TripAdvisor exemplifies a platform where the conventional boundaries between consumer and producer become increasingly indistinct, thereby disintermediating access to information and concomitantly redefining the logic behind the establishment of reputation and authoritativeness (Dedeoğlu et al., 2019). With a substantial volume of over 600,000 reviews published³, the platform has made a substantial contribution to the transformation of tourism-related decision-making processes, thereby expanding the information ecosystem available to travellers.

The ability to access detailed reviews and ratings of other visitors has redefined consumers’ decision-making processes, influencing their expectations, the quality of tourism experiences and, consequently, the selection of attractions, including museums.

In particular, the impact of TripAdvisor on the museum experience is manifold (Su, 2023). Users share experiences and rate museums

³ <https://www.tripadvisor.com/TripAdvisorInsights/abouttripadvisorreviews>

based on their visits, potentially influencing other users' decisions to visit museums (Budge, 2017; de Mendivil, 2018). Furthermore, TripAdvisor, as a platform based on user-generated content, acts as a vehicle for the dissemination of collective narratives and sentiments, potentially influencing the general public's perception, expectations and appreciation towards museum efforts in communicating science to a diverse audience (Dedeoğlu et al., 2019).

The integration of interactive technology, both passive and active, is identified as a key element to increase visitors' social engagement and facilitate their understanding of exhibition content (Ibrahim et al., 2021). Consequently, science museums need to consider the implications of TripAdvisor and other similar user-generated content platforms in the strategic planning and implementation of science communication initiatives. In fact, by understanding the factors influencing social media use and information sharing, museum institutions can develop more effective strategies for using such platforms to enhance public engagement.

Furthermore, Vásquez (2012) describes reviews on TripAdvisor as narratives, specifically as "little stories" about visitors' experiences. Similarly, Carter (2016, p. 235) states that 'reviews, published on TripAdvisor [...] constitute narrative evaluations of tourist sites, i.e. stories of places written by visitors. The process of sharing a review typically commences with the allocation of a title to the review, followed by the reviewer's assessment of their experience on a scale ranging from 1 (terrible) to 5 (excellent). These ratings are accompanied by additional information pertaining to the timing of the visit, the group (e.g. professionals, singles, couples or friends), and, if desired, the submission of personal photographs captured during the visit.

3. METHODOLOGY

In the present work we have chosen to explore reviews of science museums in Italy, with the aim of analysing visitors' perceptions and experiences of these institutions. In particular, the selection of the museums to be analysed was made on the basis of the "Science Museums 2024" list provided by the TripAdvisor platform. The reference population for the analysis includes the first 50 Italian science museums on the list⁴, in order to guarantee a representative coverage of

⁴ 1. Museo Leonardo Da Vinci, 2. Museo della Scienza e della Tecnologia Leonardo Da Vinci, 3. MUSE, 4. Museo Galileo, 5. Città Della Scienza Di Napoli, 6. Leonardo Interactive

the main attractions of the sector.

The research strategy adopted explores the potential and limitations of digital methods (Rogers, 2013; Marres, 2017). These methods are based on automated categorisation processes and algorithmic logics. From a methodological perspective, the adoption of these approaches is driven by two factors: firstly, there is the extensive availability of textual and paratextual data generated by users; secondly, there is the capacity to observe phenomena in an “ecological” manner, that is, as they emerge spontaneously in online interactions (Boyd and Crawford, 2012). This enables access to disintermediated information, providing a picture of museum experiences and perceptions that authentically reflects visitors’ perspectives.

This research consists of a first quantitative explorative part using the *topic modelling* technique implemented through the T-Lab software, followed by a more in-depth qualitative analysis. The latter phase allowed us to examine in detail the experience of science museum visitors using the Nvivo 15 software.

The reviews were collected in all the languages available on the TripAdvisor platform, with a subsequent translation process into Italian to ensure the linguistic uniformity of the dataset.

The decision to utilise TripAdvisor as the exclusive data source stems from its dominance in the tourism review domain, a position reinforced by its vast user base and its systematic arrangement of public reviews. Furthermore, the diversity of user-generated content,

Museum, 7. Tecnoparco Museo di Archimede, 8. MUSA - Museo Universitario delle Scienze e delle Arti, 9. Museum of Optical Illusions, 10. Museo di Palazzo Poggi, 11. Museo Leonardo Da Vinci Experience, 12. MUSME - Museo di Storia della Medicina in Padova, 13. Museo Della Luce, 14. Museo Delle Illusioni Firenze, 15. Creazioni Artistiche Il Faro, 16. Museo delle Arti Sanitarie, 17. Museo Leonardiano di Vinci, 18. La Fabbrica della Scienza, 19. Museo di Storia Naturale - La Specola, 20. "Museo di Scienze Naturali "E. Caffi", 21. IllusionVile, 22. Museo Archimede e Leonardo – Siracusa, 23. Orto e Museo Botanico di Pisa, 24. All About Apple Museum, 25. Museo Nazionale del Cinema, 26. Museo del Bali, 27. Space Dreamers, 28. Parco Astronomico San Lorenzo, 29. Museo Guglielmo Marconi, 30. Museo di Scienze Naturali dell’Alto Adige, 31. Museo Geologico delle Dolomiti, 32. Collezione delle Cere Anatomiche Luigi Cattaneo, 33. Museo Sulphur, 34. Planetario Di Torino, 35. Museo Delle Illusioni Roma, 36. Centro Espositivo Leo Lev, 37. Museo per la Storia dell’Università di Pavia, 38. Laboratorio-Museo Tecnicamente, 39. Museo Paleontologico e parco dei Dinosauri, 40. Museo Della Specola, 41. Museo delle Palafitte del Lago di Ledro, 42. Museo della Natura e dell’Uomo, 43. Museo Geologico e Paleontologico G.G. Gemmellaro, 44. Museo di Zoologia Adriatica Giuseppe Olivi, 45. Centrale Idrodinamica, 46. Museo Paleontologico Territoriale dell’Astigiano, 47. Museo Geologico e delle Frane, 48. MuMa Museo del Mare Milazzo, 49. Collezione di Geologia “Museo Giovanni Capellini”, 50. Museo Universitario.

encompassing extended reviews and numerical ratings, furnishes a complete picture of the visitor experience. Other platforms, such as Google Reviews or Yelp, were excluded on the grounds of limitations in data access and structuring, or due to their inferior level of detail. A singular data source has allowed us to ensure methodological consistency and circumventing issues of heterogeneity in data format and quality.

Data collection was carried out through the use of a Python script, which allowed the automation of the extraction process and ensured a systematic and complete collection of reviews. Overall, the resulting dataset comprises a total of 31,673 reviews, covering a time span from March 2010 to the beginning of September 2024. The use of reviews published on TripAdvisor as a data source provides access to a variety of perspectives from both occasional visitors and regular museum-goers from different cultural backgrounds. In the context of the present study, a demographic analysis of reviewers reveals that 58% of users are of Italian nationality, while 13% represent an international clientele. With regard to the reasons for visits, 34% of respondents indicated that their experience was with family, 27% as a couple, 18% with friends, 8% alone and 2% for work reasons.

The data were collected in accordance with the structure of a standard collection grid (Losito, 2003; Amaturro and Punziano, 2013), which was divided into two main domains (General Information and Contextual Information). These were then organised into a matrix of cases per variable, consisting of 27,785 observations for eleven variables, which were defined as follows:

- General information: *Id; name of the museum; reviewer nickname; date of the post; title of the review; length of the post;*
 - Context information: *type of trip (family, couple, etc.); geographical origin of the reviewer; classification of the geographical context of the reviewer (local if Italian and non-local if international);, text of the post; score (numerical rating assigned by the reviewer from 1 to 5); score sentiment classification (category assigned to the score divided into high, medium and low based on the rating expressed).*
-

4. ANALYSIS AND DISCUSSION

4.1 *Topic modelling*

The considerable quantity of information presented in TripAdvisor reviews presents a significant challenge in discerning a semantic structure. In light of these considerations, we propose a straightforward yet statistically sound approach: Topic Modelling.

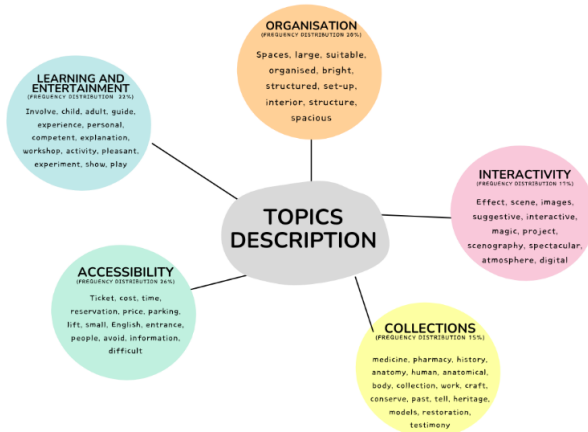
As a first step, we imported the database into T-Lab, a specific content analysis software capable of developing appropriate models based on the textual context. We subjected the textual variable consisting of the corpus of reviews extracted from TripAdvisor to T-Lab's topic analysis procedure, preceded first of all by the following automatic processes. The lemmatisation consists of 1) the standardisation of all verb forms in the same way; 2) the transformation of nouns and adjectives placed in singular number; and 3) the removal of definite-indefinite articles. The frequency threshold was set at 20 occurrences, which led us to exclude all words below this frequency value, eventually reducing the database to 2616 total words in the analysis. Finally, we proceeded to exclude empty segments deemed insignificant or irrelevant to our analysis. Next, we implemented a topic extraction modelling based on Latent Dirichlet Allocation (LDA) and the Gibbs Sampling, a probabilistic generative model proposed by Blei, Ng and Jordan (2003) for identifying latent topics in document collections. The probabilistic LDA (Latent Dirichlet Allocation) model, used by the software employed for our analysis, considers that each individual text within a corpus contains one or more "topics". To identify the different topics present in the corpus, the software identifies groups of recurring words. The set of words would identify a single topic. Each "topic" is imagined as a probability distribution of certain words within the corpus.

Applying this procedure, we extracted five topics, appropriately renamed, respecting statistical criteria such as the consideration of the occurrences of specific words that characterise each topic, as well as the occurrences of words shared between topics. Furthermore, we used semantic tagging (Bolasco, 2013, p. 126) on the selected content in order to identify the right meaning of the document by resolving disambiguation and identifying concepts from a set of words.

Finally, we classified the five topics considering the 32,900 emerging elementary contexts, understood as analysed document fragments in which the topic itself is most relevant. The most significant

parts of documents are evaluated according to the informative weight of their fragments, characterised by their discursive formulas, their position in the document, the specific weight of each word in relation to its dispersion in the text, and other similar factors.

The topics that emerged were appropriately defined as shown in Figure 1. Topics Description



The analysis of themes emerging from the application of Topic Modelling to science museum visitor reviews revealed five thematic areas:

- *Accessibility*: Accessibility is an essential element of the visitor experience in science museums, particularly in terms of inclusivity and usability of spaces. This topic emerges as the topic with the highest frequency distribution, standing at 26%. The reviews analysed highlight relevant aspects such as the absence of architectural barriers, the adequacy of space size, effective crowd management and the comprehensibility of exhibits. Particular attention is paid to the availability of multilingual information in the descriptions of works and scientific content. The most common words are: “ticket,” “cost,” “time,” “reservation,” “price,” “parking,” “lift,” “small,” “English,” “entrance,” “people,” “avoid,” “information”, “difficult”. These findings resonate with the growing scholarly recognition of accessibility as a core tenet in the development of public cultural institutions (Pekarik et al., 1999; Falk & Dierking, 2016). In fact, as the words of a visitor show, references to architectural barriers and space

management emerge:

[...] I understand that to go up in the lift the places are few, so the queue is almost taken for granted, but for access to the museum I don't understand it!!! Only two cashiers to pay, no cloakroom, you enter with backpacks, bags, etc. When asked if the museum entrance could be supplemented with a lift, the answer is NO! (review at Museo Nazionale del Cinema).

Other reviews highlight the critical issues and dissatisfaction related to the management of the public and show dissatisfaction with the management of queues:

[...] There are already quite a lot of people, you get to the back Then the voice at the microphone reminds everyone to go to the ticket office and here People arrive in the lobby all at once, randomly piling up; the queue is engulfed in chaos, people arriving from all sides: tickets distributed randomly (review at Planetario Di Torino)

[...] It would be a good idea to change the office manager and to reprimand his staff for underestimating the influx of people on a day when (given the 1 May long weekend and the following weekend) a greater influx of visitors was to be expected, also in view of the (predicted) adverse weather conditions. The museum, however, is a marvel, spread over four floors (review at MUSE).

Furthermore, the importance of providing descriptions of the works and scientific content in a variety of languages is emphasised, as this is recognised as a fundamental element for a diverse audience. The most frequently occurring keywords, such as “English”, “information” and “difficult”, underscore the necessity to ensure that materials and indications are suitable for non-native speakers as well.

As Falk and Dierking (2016) point out, visitors experiences are shaped by their expectations and by the organisational responses of museum institutions. The critical issues that emerged from the review suggest the need to review the planning of spaces and the use of services (in particular queues and ticket offices), in order to put the principle of inclusivity into practice. This approach is in line with the growing recognition of accessibility as a fundamental value for cultural institutions.

- *Learning and entertainment*: Analysis of the reviews reveals that the museum experience is perceived not only as an educational

opportunity, but also as a form of entertainment. This theme stands out with a frequency distribution of 22%. Visitors report on the ability or otherwise to arouse interest in scientific disciplines, expressing appreciation for the effectiveness with which these institutions also transmit knowledge using engaging modes. In particular, they emphasise the didactic value of the exhibitions and activities on offer, such as educational workshops, which enrich the visitor experience by promoting active and participative learning. The most frequent words are “Involve”, “child”, “adult”, “guide”, “experience”, “personal”, “competent”, “explanation”, “workshop”, “activity”, “pleasant”, “experiment”, “show”, “play”. Some elementary contexts are:

[...] Outdoor exhibition areas and hands-on demonstrations allow visitors to experience Archimedes’ inventions first-hand. This hands-on approach is particularly popular with children and families, making the visit a fun educational activity for all ages. The guided tours are well organised, and the guides are passionate and knowledgeable, ready to answer any questions and provide interesting insights (review at Tecnoparco Museo di Archimede).

Here the educational value is linked to the possibility of experiencing scientific principles first hand, showing how active participation favours the internalisation of knowledge.

Another visitor underscores the inclusive approach and the consideration given to diverse age groups, illustrating the integration of entertainment with learning within an intergenerational framework. The experience is valued by both children and adults, thereby fostering a sense of shared engagement and social interaction:

[...] The visit to the museum is very interesting for both adults and children and, without a doubt, a lot of fun for everyone. All the staff are very friendly and welcoming; during the visit we were guided all the way around making our visit even more enjoyable and interesting (review at Museum of Optical Illusions).

In a review for the Bali Museum, as in many other cases, the visitor makes it clear how the creation of fun games and experiments helps the involvement towards scientific concepts.

[...] The planetarium was excellent and the staff very competent, plus the museum boys had organised some very fun games such as making chickpea bricks etc. and we almost had more fun than the children! (review at Museo di Bali).

Many reviews stress the value of social interaction in museums. Visitors often comment on how competent and enthusiastic the guides and staff are. They respond to queries, provide engaging explanations and facilitate enjoyable activities. Sociological studies on leisure activities emphasise the importance of intergenerational opportunities for collective learning and social bonding (Stebbins, 2009). Entertainment facilitates deeper engagement with scientific concepts (Mossberg, 2007).

- *Organisation*: The theme of organisation emerges with 20% of the frequency distribution and refers to the overall configuration of the museum experience, including aspects such as the clarity of signage, the management and optimisation of visit times, the design of internal routes, and the appropriateness of room sizes. The most frequent words are “Spaces,” “large,” “suitable,” “organised,” “bright,” “structured,” “set-up,” “interior,” “structure,” “spacious”. Some examples of elementary contexts are for example the value of a well-designed layout and an engaging structure for visitors of all ages. The organisation of the spaces allows for the integration of different activities (e.g. experiments, exhibitions), demonstrating how museum design should support the variety of the offer.

[...] The structure alone is worth a visit. Inside it is a paradise of beauty for young and old. Interesting experiments, wonderful animals, exhibitions and all kinds of initiatives. We had 12 children with us. At 4 p.m. we booked a guidebook entitled “But how do you speak?” On the language of animals. At 4 p.m. on time we were met on floor 0 (review at MUSE).

Furthermore, visitors have expressed appreciation for the cleanliness and maintenance of the environment, while simultaneously highlighting a concern regarding the guides’ inability to be heard, which can be attributed to an absence of microphones:

[...] The facility is very well maintained and clean, including the toilets in my opinion half a day is enough to visit it and spend some pleasant time in the company of dinosaurs There is also the possibility of doing the dinosaur discovery tour with a guide but I would suggest a microphone so that you can hear better! We couldn’t hear anything so we went on our own, breaking away from the group (review at Museo Paleontologico e Parco dei Dinosauri).

This observation reveals two salient points. Firstly, the structure is

deemed to be "adequate" for a brief visit. However, the management of guided tours could be enhanced to optimise the utilisation of time and content. The incorporation of elements such as clear signage, well-structured services and itineraries, and adherence to timetables, contributes to a more seamless and enjoyable experience. The ability to complete the museum itinerary within a time frame that meets the expectations of families and groups of visitors is a critical factor in the overall success of the visit.

The topic of organisation encompasses a wide range of elements, including the clarity of signage, the effective management of visiting time (Serrell, 1997; Falk, 1982). The notion that museum spaces are considered "suitable" and "well organised" signifies that visitors not only value the content of the exhibitions, but also the manner in which they are presented and mediated through the design of the environments.

Another important element that emerged from the reviews is the management and optimisation of visiting time. The capacity to conclude a museum experience within a specified timeframe that aligns with visitor expectations is frequently identified as a pivotal factor in determining the success of the visit. By employing effective management strategies for space, time, and activities, museums can meet the evolving expectations of a diverse audience by providing personalised and enriching experiences.

- *Interactivity*: The presence of interactive activities is often cited by visitors as a distinctive element of the experience in science museums and the topic has 17% of the frequency distribution. Reviews suggest that such activities enhance active learning and promote deeper engagement with exhibition content. In particular, interactive exhibits promote the involvement of a larger number of users, avoiding a mere superficial exposition of scientific phenomena and preventing simplified "one-line" explanations (Allen, 2004). The most frequent word are "Effect", "scene," "images," "suggestive," "interactive," "magic," "project," "scenography," "spectacular," "atmosphere," and "digital". Elementary contexts example is for example the possibility of personalising the route according to your interests: visitors can opt for a more structured approach or free exploration, interacting with installations and "optical experiments" that make the visit active rather than passive:

[...] The museum can be enjoyed by enthusiasts, non-enthusiasts, families with children, anyone You can logically approach it, but you can also wander around aimlessly, taken to the "scenographic" rooms

or play with the optical experiments (review at Museo Sulphur).

The presence of immersive and spectacular installations creates an atmosphere that can be described as “magical” and spectacular. In this environment, the experience goes beyond the simple fruition of content, becoming an opportunity for emotional and sensorial involvement. Digital technologies and immersive environments — such as virtual reality (VR) and augmented reality (AR) — can further facilitate this type of interaction (Wojciechowski et al., 2018):

[...]An idea of a museum that goes out of the usual box, but to say that the route is interactive would be reductive in any case I have seen children and adults amazed and excited at the various “stages” of the museum (review at Museo Nazionale del Cinema).

Furthermore, the social and participatory dimension of interactive exhibits, emphasising that they cater to a diverse audience beyond individual visitors, including groups and families. Workshops and “hands-on” sections are designed to promote cooperative learning, curiosity and motivation in participants of all ages, from children to adults (Stebbins, 2009):

[...] The museum is very nice, there are children’s workshops, interesting explanations and many interactive parts that make it usable also for children (review at Muse).

Interactivity is recognised as a fundamental component of the science museum experience, enhancing active learning, promoting inclusivity and enhancing the visitor experience. The integration of digital technologies and immersive environments, in conjunction with a participatory exhibition design, serves to further augment the value of this dimension, catering to the requirements of a progressively diverse audience eager to have meaningful museum experiences.

- *Collections*: This theme incorporates all visitor commentary pertaining to the museum’s collections and has 15% of the topic frequency distribution. The reviews underline the quality and diversity of the collections, as well as the aesthetic and intellectual appreciation of the exhibits. Users often discuss the importance of maintaining the collections and the quality of the exhibits, as well as evaluating their visual organisation and cultural-historical value. The most frequently occurring words and phrases associated with this theme are “medicine”, “pharmacy”, “history”, “anatomy”, “human”, “anatomical”, “body,”

“collection,” “work,” “craft,” “conserve,” “past,” “tell,” “heritage,” “models,” “restoration,” “testimony,” and “museum”. Some reviews emphasize the role of the museum as a connecting space between the past, the present, and the future, with narrative and didactic experiences that enrich understanding and stimulate curiosity. Here the plurality of contents emerges – from historical machinery to sustainability issues – offering a heterogeneous museum experience, favouring the understanding of historical, cultural and scientific phenomena through a multisectoral approach:

[...] One section presents the many different discoveries and inventions of Leonardo da Vinci. Another section is dedicated to food and sustainability, with talking displays and a table showing meals from various countries. The museum includes sections dedicated to rubbish and waste, with an exhibition on the subject, a video on the space nebula that can be manipulated, a small and charming wooden laboratory, exhibits on copper, metals and chemicals, and much more. Besides a large number of specialised sections, the museum also contains a huge submarine, several trains, a glider, a rocket, old cars, a ship, an aeroplane and more. People of all ages can enjoy this museum (review at Museo della Scienza e della Tecnologia Leonardo Da Vinci);

The narrative approach connects the visitor to the exhibits, transforming the collections into stories that connect different eras. Not just “exhibits”, therefore, but tools for emotional and intellectual involvement that increase interest in the discoveries and the personalities behind them:

[...] Here, every object on display, every didactic card, bears witness to the love and passion for an Italian genius who, with his discoveries, left his mark on the whole of mankind. Certainly, the accurate explanations that accompanied me during the visit played a decisive role and I am grateful to those who, by placing anecdotes, explanations of exhibits and repeating experiments in time, guided me on this adventure in which past, present and future intertwine, making the visitor’s imagination soar; (review at Museo Guglielmo Marconi).

The collections in this museum are of particular interest insofar as they illustrate the evolution of knowledge and techniques, with a particular emphasis on the medical and anatomical fields. The exhibits, which include preparations in formalin, mummifications and wax reproductions, are both rare and of a high quality. This makes the

museum a unique place where science and art converge, thereby increasing both its fascination and its educational value:

[...] Immeasurable historical value, from all points of view, both for understanding how modern medicine developed, but also for understanding the greatness of human nature. No museum in the world offers the opportunity like this one to see formalin specimens (with human parts such as brains, hearts, foetuses, eyes, etc.), skeletons, vascular apparatuses, anatomical parts perfectly mummified using techniques that have remained largely a mystery, masterly wax reproductions that are comparable to true works of art (review at MUSA - Museo Universitario delle Scienze e delle Arti).

As the reviews analysed here demonstrate, museum collections are perceived as custodians of memory, capable of connecting past, present and future. This assertion is further corroborated by extant research (Hooper-Greenhill, 2013; Falk and Dierking, 2016), which emphasises the educational and experiential potential of such collections. The emotional and intellectual involvement of the public in these settings arises from the narrative and the context in which the objects are presented. Visitors do not merely “look” at the exhibits; rather, they experience them as evidence that stimulates their curiosity and encourages them to reflect. This underscores the significance of effective museum management and interpretation, which are instrumental in enhancing heritage and promoting meaningful learning.

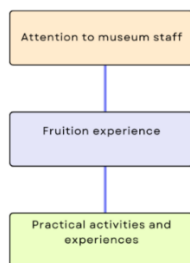
4.2 Qualitative content analysis

At this phase of the research, it was decided to proceed with a qualitative analysis of the reviews. This approach enabled a more profound and contextualised examination of the results derived from topic modelling, thereby facilitating a more precise interpretation of visitor perceptions. This integrated methodology offers a more nuanced comprehension of the topic areas, emphasising aspects and qualitative elements that might not be fully captured by topic modelling approach. One of the main advantages of qualitative content analysis lies in its ability to go beyond the descriptive analysis of the “what” expressed in a text, allowing for a deeper investigation of the “how” and “why” that characterise the underlying meanings (Wiesner, 2022). In the present study, a qualitative content analysis based on a hermeneutic approach was chosen, with the specific aim of exploring the dimensions of public engagement. Indeed, public engagement represents an evolution in the approach of the

scientific community, which is moving away from the traditional deficit or unidirectional communication mode focused on filling knowledge “gaps” (Wooden, 2006; Druckman and Bolsen, 2011) and towards two-way approaches based on dialogue and active participation (Sturgis and Allum, 2004). For this purpose, a stratified sampling of the selected reviews was employed, defining stratification criteria based on the sentiment expressed (high, medium and low) and the type of travel experience (e.g. family or group travel). Textual content analysis was conducted with the aid of Nvivo 15 software, widely used in the social sciences for coding qualitative data, which proved particularly effective in supporting the development of thematic codes and conceptualisation of empirical material (Bazeley and Jackson, 2013; Silver and Lewins, 2014).

The analysis identified three main analytical dimensions related to public engagement (as illustrate in Figure 2).

Figure 2. Analytical Dimensions from Nvivo 15 Software



The first one concerns the attention that reviewers devote to museum staff, with particular reference to guides or lecturers, evaluated in positive or negative terms. Indeed, the ability of museum staff to link scientific concepts to visitors’ everyday experiences makes exhibition content more relevant and meaningful, facilitating a personal connection with science (Rennie and Johnston, 2007).

Reviews tend to praise the staff’s ability to make topics and content clear and stimulating even when there is no satisfaction with the structure or content although language barriers are sometimes reported:

[...] but above all I was impressed by the guide’s passion in explaining the workings of the machines and the whole historical period;
 [...] The young people who accompany you inside the museum do it for free, for the purpose of dissemination, they are volunteers, but they transmit so much passion;
 [...] the guide was really good at getting the children involved, even

getting the adults to participate in the various activities;
[. ..] Very bad staff as they were not prepared to welcome an international clientele (lack of language skills).

The second analytical dimension pertains to the experience of utilising the exhibited content and collections, with a particular emphasis on multimedia tools and exhibition spaces that facilitate access to information. The reviews indicate that the provision of digital resources, including apps, monitors, audio guides and multilingual information panels, enhances the visitor experience, facilitating access to information and deepening comprehension of scientific phenomena (Falk and Dierking, 2016). However, the reviews also reveal some critical issues related to the management of the exhibition space and the quality of the information content. Some critical observations report a perception of insufficient scientific accuracy and a poor ability to maintain the interest of younger audiences. This suggests the need for improvements in both content and communication methods to respond more effectively to the expectations of a diverse target audience.

[...] The tour is guided by numerous multimedia aids, from a smartphone app (to download) to numerous monitors/TVs located in most of the rooms to illustrate the various thematic areas and related scientific instruments;

[...] full of reproductions and didactic panels dedicated to both adults and children;

[...] The route is characterised by panels in various languages with explanations and the audio guide that can be downloaded from your smartphone with qr code is also very useful.

[...] kept in cramped quarters where too many people are let in at once, so that if you don't push your way through, you risk not seeing anything.

[...] no scientific accuracy, no ability to hold the attention of younger audiences.

The third analytical dimension pertains to the hands-on activities and interactive experiences provided by the museum. In the context of science communication, such initiatives, when effectively designed and managed, have the potential to facilitate the deepening of concepts, active public participation, and cognitive and emotional involvement (Bitgood, 2000; Macdonald, 2007). The reviews indicate a dichotomy of opinions. On the one hand, visitors expressed appreciation for the availability of workshops and hands-on activities, which were subject to booking. However, on the other hand, there was frustration at the

poor functionality of the equipment, the limited educational usefulness of some interactive games, and the lack of content capable of stimulating visitors' interest:

[...] It is possible to participate in various workshops, but remember to book them at least the day before, as the number is limited.

[...] Very disappointing because the workshops in this museum are unusable;

[...] The activities that seemed to be most successful were video games which apparently did not have much educational content.

[...] the lack of interesting hands-on activities and engaging descriptions. It felt more like a boring textbook.

[...] Some of the monitors for the games (positioning organs and bones) did not work Maybe because being touch they were too dirty and greasy The finger could not carry the objects on the body and so the game ended without having done anything The sphygmomanometer did not work and while we were unsuspectingly trying it out, an assistant came in and told us that she had to put the sign out

These observations serve to reinforce the notion that accessibility, maintenance of equipment and quality of the proposed content represent pivotal elements in the effective engagement of an audience. In this regard, the incorporation of interactive experiences that align with the museum's communicative objectives and foster curiosity, dialogue, and reflection is essential for enhancing the quality of the visitor experience (Black, 2020; Simon, 2010). Thus, enhancing the relevance of such activities, in conjunction with the attention paid to logistical and experiential aspects, represents a strategic lever for augmenting visitor satisfaction, consolidating learning, and fostering public participation in the collective construction of scientific knowledge.

6. CONCLUDING REMARKS

Science museums operate in a space of intersection between science and society, progressively positioning themselves as models of participatory and inclusive communication (Achiam and Sølberg, 2017). This orientation makes them ideal for supporting and facilitating a new form of interface between science and society, in which active involvement and co-production of knowledge are central (European Commission, 2007).

The present study made it possible to examine, through the analysis

of TripAdvisor reviews, a) how visitors perceive public engagement within science museums (RQ1), b) which are the factors with greater incidence in the museum experience (RQ2), and c) to know the visitors and the critical factors of Italian science museums (RQ3). The utilisation of online review platforms serves as a pertinent perspective for the analysis of visitor experiences and expectations. Taking into account user feedback on Tripadvisor is of great interest when studying the dynamics of use and visitor evaluation. However, it should be stressed that this source must be contextualised in view of its limitations in terms of representativeness. Nevertheless, the data collated are inherently constrained to individuals who opt to proactively articulate their perceptions on such digital platforms, thereby excluding the experiences of those who are not registered or do not actively utilize these instruments (Filieri et al., 2015; Cox et al., 2009).

To avoid generalising conclusions that may not be representative of the full diversity of museum audiences and uses, it is important to be aware of this partial vision.

Nevertheless, online reviews, such as those available on TripAdvisor, serve as a suitable proxy for examining visitors' perceptions and experiences in science museums, offering direct and spontaneous access to users' opinions. These user-generated contributions provide rich, unstructured qualitative data reflecting visitors' actual interactions with museum exhibits, services and activities. Consequently, such information can be considered a valuable resource for identifying and understanding the critical factors and strengths of museum experiences (Tussyadiah and Zach, 2013; Marine-Roig and Clavé, 2015), thus contributing to the optimization of management and communication strategies adopted by science museums.

This study offers three main findings for museum researchers, practitioners and museum governance. Our study shows that visitors who review their experience online effectively reflect the prevailing composition of the audience in science museums and science centres. The audience is mostly composed of groups and families or couples (Merzagora and Rodari, 2007). Rare, if not completely absent, are solo visitors (8%). The composition of the audience is also reflected in the elements that are emphasised or criticised in the online reviews. From the analysis of the reviews, it emerges that visitors have high expectations with respect to various aspects of the museum experience (RQ1): organisation and accessibility of the museum, enjoyment of the collections, interactivity of the exhibitions, preparation of the staff and

presence of hands-on activities. In particular, activities with an interactive and workshop character – dimensions that are increasingly regarded as a fundamental prerequisite in museum offerings – are configured as informal educational tools, aimed mainly at younger visitors (Rennie & Johnston, 2007). This approach reflects the transformation occurred in the recent periods' museum landscape, wherein the educational function is not confined to the mere transmission of knowledge. Instead, it encompasses the advancement of cognitive and experiential processes that facilitate active learning, emotional engagement, and the growth of transferable skills (Kelly, 2007; Simon, 2010). These aspects are considered essential to foster meaningful and accessible engagement. However, not all Italian science museums offer structured opportunities for hands-on activities or interactive experiences, a shortcoming that may limit the effectiveness of engagement, especially for younger audiences, who tend to prefer interactive learning modes over passive enjoyment of exhibitions (Lehrer & Schauble, 2002).

The online reviews voluntarily provided by visitors emphasize the predominance of organizational and logistical aspects over engagement or more properly cultural factors (RQ2). This makes it possible to consider the reviews submitted by visitors on the TripAdvisor platform as an expression of the “science tourist” phenomenon (Lundberg et al., 2022).

From a managerial standpoint, the insights yielded by this study are pertinent to museum administrators, as they are able to utilise the analysis of self-generated user data to evaluate and optimise the visitor experience. The examination of online reviews, for instance on platforms such as TripAdvisor, is a valuable tool for identifying and ranking the determinants of the museum experience. The analysis of such feedback also allows the isolation of positively evaluated elements, which can serve as key indicators of public satisfaction.

Positive and negative aspects (RQ3) also emerged from the present study, as summarised in Figure 3.

Figure 1. Summary of the positive and negative elements that emerged from the analysis of TripAdvisor reviews.

ELEMENTS	POSITIVE	NEGATIVE
MUSEUM STAFF	Staff's ability to make topics and content clear and stimulating	Lack of language skills other than Italian
FRUITION EXPERIENCE	Digital resources, including apps, monitors, audio guides and multilingual information	Management of the exhibition space and the quality of the information content; poor ability to maintain the interest of younger audiences.
ACTIVITIES AND INTERACTIVE EXPERIENCES	Availability of workshops and hands-on activities	Inadequate functionality of facilities, limited educational value of some interactive games and lack of content to engage visitors.
ACCESSIBILITY	Dissatisfaction with queuing management;	Dissatisfaction with queuing management; works and scientific content described in few languages.
LEARNING AND ENTERTAINMENT	Educational workshops, inclusive and age-appropriate approach	Lack of practicality, interactivity and laboratories

From a methodological perspective, this strategy is advantageous in terms of efficiency and cost containment, offering a quicker and less expensive alternative to traditional field research. In contrast, considerable deficiencies are identified with regard to logistical organization, the absence of comprehensive information or captions, the poor maintenance of installations (for example, non-functioning interactive stations), the perception of high costs in comparison to the quality of the offering, and the inadequate management of visitor flows, which frequently result in lengthy queues and overcrowding. Furthermore, the absence of accessibility to certain sections and the inadequacy of provided services (such as bars, restaurants, or rest areas) are frequently identified as shortcomings that detract from the overall experience.

Although the present study focused specifically on Italian museums, the results obtained have a broader scope and contribute to the current debate on the managerial and methodological use of data produced on digital platforms such as TripAdvisor. Online reviews facilitate the identification and mapping of visitors' expectations and perceptions, and contribute to the redefinition of cultural mediation processes, the relationship between museums and their public, and the dynamics of inclusion or exclusion of different audience segments (Parry, 2010; Kelly, 2007). The advent of digital and social platforms for sharing the museum experience has had a profound impact on cultural production and consumption practices, giving rise to more active and dialogic forms of participation (Proctor, 2010; Marty & Jones 2008). In this

context, visitors assume the dual role of users and co-producers of content, directly influencing the perception and reputation of museum institutions. Furthermore, the extensive availability of data from these platforms allows for the exploration of interpretative processes, aesthetic preferences and fruition strategies adopted by heterogeneous audiences, providing valuable insights for the development of more responsive and participatory museum policies (Camarero and Garrido, 2012; Styliandou-Lambert, 2010).

In light of the considerations presented, it is our contention that future research conducted in other museum contexts, from a perspective that is not directly aligned with customer research, may prove instrumental in advancing the conceptualisation of visitor inclusion within the dimensions of the museum experience. A broader database, incorporating additional review platforms such as Google Reviews, Yelp, and specialised thematic portals, would facilitate more nuanced analysis, integrating cultural, social, and technological dimensions, and advance the development of more robust and generalisable interpretative models (Wong, 2015; Lindqvist, 2012). Further research could examine other museums, transcending national boundaries and considering a range of exhibition specialisations. Moreover, further investigation, conducted through direct surveys of reviewers or visitors to science museums, could facilitate the acquisition of more detailed, diverse, and representative information about different audience experiences and expectations. This would provide a solid basis for the development of museum strategies that specifically address emerging audience needs.

REFERENCES

- ACHIAM, M. SØLBERG, J. (2017), Nine meta-functions for science museums and science centres, *Museum Management and Curatorship*. 32(2): 123-143.
- ALAIMO, C., KALLINIKOS, J., & VALDERRAMA-VENEGAS, E. (2020). Platform evolution: A study of TripAdvisor. *Proceedings of the 53rd Hawaii International Conference on System Sciences*.
- ALLEN, S., (2004), Designs for learning: Studying science museum exhibits that do more than entertain, *Science education*. 88(S1): S17-S33.
- AMATURO, E., PUNZIANO, G., (2016), *I Mixed Methods nella ricerca sociale*. Roma: Carocci.
- BAZELEY P., JACKSON K., (2013), *Qualitative data analysis with NVivo*
-

- (Second). London: Sage.
- BITGOOD, S. (2010). An attention-value model of museum visitors. *Center for Advancement of Informal Science Education: Washington, DC, USA*.
- BLACK, G. (ED.). (2020). *Museums and the challenge of change: Old institutions in a new world*. London: Routledge.
- BLEI, D. M., NG, A. Y., JORDAN, M. I. (2003). Latent Dirichlet Allocation. *Journal of Machine Learning Research*. 3: 993–1022.
- BOLASCO, S. (2013). *L'analisi automatica dei dati testuali*. Carocci, Roma.
- BOYD, D., CRAWFORD, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, Communication & Society*. 15(5): 662-679.
- BUCCHI, M., & TRENCH, B. (Eds.). (2021). *Routledge handbook of public communication of science and technology*. London: Routledge.
- BUCCHI, M., PELLEGRINI, G., RUBIN, A., SARACINO, B. (2024). *Annuario Scienza tecnologia e società. Edizione 2024. Edizione speciale: Venti anni di scienza nella società*. Bologna: Il Mulino.
- BUDGE, K. (2017). Objects in focus: Museum visitors and Instagram. *Curator: The Museum Journal*. 60(1): 67-85.
- BURTCH, G., AND HONG, Y. (2014) What Happens When Word of Mouth Goes Mobile? *Proceedings of the International Conference on Information Systems*, Auckland, New Zealand.
- BUTLER, J. A. (1992). Use of teaching methods within the lecture format. *Medical Teacher*. 14(1): 11-25.
- CAMARERO, C., & GARRIDO, M. J. (2012). Fostering innovation in cultural contexts: Market orientation, service orientation, and innovations in museums. *Journal of Service Research*. 15(1): 39-58.
- CAMERON, F., KENDERDINE, S. (2007). *Theorizing Digital Cultural Heritage: A Critical Discourse (Media in Transition)*. Cambridge: The MIT Press.
- CARPENTIER, N. (2011). *Media and Participation: A site of ideological-democratic struggle*. Bristol: Intellect.
- CARTER, P. L. (2016). Where are the enslaved? TripAdvisor and the narrative landscapes of southern plantation museums. *Journal of Heritage Tourism*. 11(3), 235-249.
- CASTELLS, M. (2010). Museums in the information era: Cultural connector of time and space. In R. Parry (ed.), *Museums in a Digital Age* (pp. 427-434). London-New York: Routledge.
- COULDRY, N. (2012). *Media, society, world: Social theory and digital*
-

- media practice*. New York: Polity.
- COX, C., BURGESS, S., SELLITTO, C., & BUULTJENS, J. (2009). The role of user-generated content in tourists' travel planning behavior. *Journal of Hospitality Marketing & Management*. 18(8): 743-764.
- DE MENDÍVIL, N. D. (2018). El comportamiento digital de los museos frente a las exigencias del turista 2.0. *AV Notas Revista de Investigación Musical*. (4): 75-99.
- DECLARATION, T. (2014). Fifth Science Centre World Congress, June 19, 2008.
- DEDEOĞLU, B. B., VAN NIEKERK, M., WEINLAND, J., & CELUCH, K. (2019). Re-conceptualizing customer-based destination brand equity. *Journal of Destination Marketing & Management*. 11: 211-230.
- DELICADO, A. (2009). Scientific controversies in museums: Notes from a semi-peripheral country. *Public Understanding of Science*. 18(6): 759-767.
- DRUCKMAN, J. N., BOLSEN, T. (2011). Framing, motivated reasoning, and opinions about emergent technologies. *Journal of Communication*. 61(4): 659-688.
- DURANT, J. (1999). Participatory technology assessment and the democratic model of the public understanding of science. *Science and Public Policy*. 26(5): 313-319.
- EINSIEDEL, A. A., EINSIEDEL, E. F. (2004). Museums as agora: Diversifying approaches to engaging publics in research. In D. Chittenden, G. Farmelo, and B.V. Lewenstein (eds.), *Creating Connections: Museums and the Public Understanding of Current Research* (pp. 73-86). Walnut Creek: Altamira Press.
- ELAM, M., & BERTILSSON, M. (2003). Consuming, engaging and confronting science: The emerging dimensions of scientific citizenship. *European Journal of Social Theory*. 6(2): 233-251.
- EUROBAROMETER. (2021). European citizens' knowledge and attitudes towards science and technology [Report]. European Commission.
- EUROPEAN COMMISSION: DIRECTORATE-GENERAL FOR RESEARCH AND INNOVATION. (2007). *Taking European knowledge society seriously*. Publications Office.
- FALK, J. H. (1982). The use of time as a measure of visitor behaviour and exhibit effectiveness. *Roundtable Reports*. 7(4): 10-13.
- FALK, J. H., DIERKING, L. D. (2016). *The museum experience revisited*. London: Routledge.
- FILIERI, R., ALGUEZAU, S., MCLEAY, F. (2015). Why do travelers trust TripAdvisor? Antecedents of trust towards consumer-generated media and its influence on recommendation adoption and word of

- mouth. *Tourism Management*. 51: 174-185.
- GREEN, J., & JENKINS, H. (2011). The Moral Economy of Web 2.0: Audience Research and Convergence Culture. In J. Holt and R.A.Perren, *Media Industries: History, Theory, and Method*, (213-226). Hoboken: Wiley-Blackwell.
- HAGENDIJK, R., IRWIN, A. (2006). Public deliberation and governance: Engaging with science and technology in contemporary Europe. *Minerva*. 44(2): 167-184.
- HOOPER-GREENHILL, E. (2013). *Museums and their visitors*. London: Routledge.
- IBRAHIM, F., ZAININ, N. M., JAMAL, S. A. (2021). The need for interactive technology in Brunei Museum: An empirical study of visitor experience. *International Journal of Academic Research in Business and Social Sciences*. 11(16): 180–198.
- KELLY, L. J. (2007). *The interrelationships between adult museum visitors' learning identities and their museum experiences*. Sydney, Australia: University of Technology, Sydney.
- LATOUR, B. (1987). *Science in action: How to follow scientists and engineers through society*. Harvard: Harvard University Press.
- LEHRER, R., & SCHAUBLE, L. (2002). Symbolic communication in mathematics and science: Co-constituting inscription and thought. E. Amsel, J. P. Byrnes (eds.), *Language, Literacy, and Cognitive Development: The Development and Consequences of Symbolic Communication* (pp. 167-192). London: Routledge.
- LEHR, J. L., MCCALLIE, E., DAVIES, S. R., CARON, B. R., GAMMON, B., DUENSING, S. (2007). The value of “dialogue events” as sites of learning: An exploration of research and evaluation frameworks. *International Journal of Science Education*. 29(12): 1467-1487.
- LINDQVIST, K. (2012). Museum finances: challenges beyond economic crises. *Museum Management and Curatorship*. 27(1): 1-15.
- LOSITO, G. (2003). *L'analisi del contenuto nella ricerca sociale*. Milano: Franco Angeli.
- LUNDBERG, E., PERSSON, M., JERNSAND, E. M. (2022). Science tourism: A conceptual development. In *Tourism, Knowledge and Learning* (pp. 26-39). London: Routledge.
- MACDONALD, S. (2007). Interconnecting: museum visiting and exhibition design. *CoDesign*. 3(S1): 149-162.
- MARINE-ROIG, E., CLAVÉ, S. A. (2015). Tourism analytics with massive user-generated content: A case study of Barcelona. *Journal of Destination Marketing & Management*. 4(3): 162-172.
- MARRES, N. (2017). *Digital sociology: The Reinvention of Social*
-

- Research*. Hoboken: John Wiley & Sons.
- MARTY, P. F., JONES, K. B. (Eds.). (2008). *Museum Informatics: People, Information, and Technology in Museums* (Vol. 2). Taylor & Francis.
- MERZAGORA, M., RODARI, P. (2007). *La scienza in mostra: musei, science centre e comunicazione*. Milano: Pearson Italia Spa.
- MORTENSEN, M. F. (2011). Analysis of the educational potential of a science museum learning environment: Visitors' experience with and understanding of an immersion exhibit. *International Journal of Science Education*. 33(4): 517-545.
- MOSSBERG, L. (2007). A Marketing Approach to the Tourist Experience. *Scandinavian Journal of Hospitality and Tourism*. 7(1): 59-74.
- O'CONNOR, P. (2008). User-generated content and travel: A case study on Tripadvisor.com. In *Information and Communication Technologies in Tourism 2008* (pp. 47-58). Vienna: Springer.
- PACKER, J., BALLANTYNE, R. (2016). Conceptualizing the visitor experience: A review of literature and development of a multifaceted model. *Visitor Studies*. 19(2): 128-143.
- PACKER, J., BALLANTYNE, R., BOND, N. (2019). Developing an instrument to capture multifaceted visitor experiences: The DoVE adjective checklist. *Visitor Studies*. 21(2): 211-231.
- PARRY, R. (ED.). (2010). *Museums in a digital age* (Vol. 10). Routledge.
- PEKARIK, A. J., DOERING, Z. D., KARNS, D. A. (1999). Exploring satisfying experiences in museums. *Curator: The Museum Journal*. 42(2): 152-173.
- PROCTOR, N. (2010). Digital: Museum as platform, curator as champion, in the age of social media. *Curator: The Museum Journal*. 53(1): 35-43.
- RENNIE, L. J., JOHNSTON, D. J. (2007). Visitors' perceptions of changes in their thinking about science and technology following a visit to a science center. *Visitor Studies*. 10(2): 168-177.
- ROGERS, R. (2013). *Digital methods*. Massachusetts: MIT press.
- SCHIELE, B. (2014). Science museums and centres: Evolution and contemporary trends. In M. Bucchi, B. Trench (Eds.), *Routledge Handbook of Public Communication of Science and Technology* (pp. 40-57). London and New York: Routledge.
- SCHIELE, B., LIU, X., BAUER, M. W. (Eds.). (2021). *Science cultures in a diverse world: Knowing, sharing, caring*. Singapore: Springer.
- SERRELL, B. (1997). Paying attention: The duration and allocation of visitors' time in museum exhibitions. *Curator: The Museum Journal*. 40(2): 108-125.
- SILVER, C., LEWINS, A. (2014). *Using software in qualitative research: A*

- step-by-step guide*. London: SAGE.
- SIMON, N. (2010). Visitor participation: Opportunities and challenges. *Exhibitionist*. 29: 70-72.
- STEBBINS, R. A. (2009). *Leisure and its relationship to library and museum visiting*. Cham: Palgrave Macmillan.
- STOLERIU, O. M., BROCHADO, A., RUSU, A., LUPU, C. (2019). Analyses of visitors' experiences in a natural world heritage site based on TripAdvisor reviews. *Visitor Studies*. 22(2): 192-212.
- STYLIANOU-LAMBERT, T. (2010). Re-conceptualizing Museum audiences: Power, activity, responsibility. *Visitor Studies*. 13(2): 130-144.
- STURGIS, P., ALLUM, N. (2004). Science in society: Re-evaluating the deficit model of public attitudes. *Public Understanding of Science*. 13(1): 55-74.
- SU, Y. (2023). Proposed museum service operations framework for addressing overcrowding: A Taipei case study. *Curator: The Museum Journal*. 66(2): 329-350.
- TUSSYADIAH, I., & ZACH, F. (2013). Social media strategy and capacity for consumer co-creation among destination marketing organizations. In L. Cantoni, Z.(P.) Xian (eds), *Information and Communication Technologies in Tourism 2013: Proceedings of the International Conference in Innsbruck, Austria, January 22-25, 2013* (pp. 242-253). Berlin, Heidelberg: Springer.
- VAN DIJCK, J., POELL, T., DE WAAL, M. (2018). *The platform society: Public values in a connective world*. Oxford: Oxford University Press.
- VÁSQUEZ, C. (2012). Narrativity and involvement in online consumer reviews: The case of TripAdvisor. *Narrative Inquiry*, 22(1), 105-121.
- WAKKARY, R., MUISE, K., TANENBAUM, K., HATALA, M., KORNFELD, L. (2008). Situating approaches to interactive museum guides. *Museum Management and Curatorship*. 23(4): 367-383.
- WIESNER, C. (2022). Doing qualitative and interpretative research: reflecting principles and principled challenges. *Political Research Exchange*. 4(1).
- WOJCIECHOWSKI, R., WALCZAK, K., WHITE, M., CELLARY, W. (2004). Building virtual and augmented reality museum exhibitions. In *Proceedings of the ninth international conference on 3D Web technology* (pp. 135-144). New York: Association for Computing Machinery.
- WONG, A. (2015). The complexity of 'community': Considering the effects of discourse on museums' social media practices. *Museum &*
-

Society. 13(3): 296-315.

WOODEN, R. (2006). The principles of public engagement: at the nexus of science, public policy influence, and citizen education. *Social Research: An International Quarterly*. 73(3): 1057-1063.