

Research and Development Web-Based Virtual Military Museum as a Tool for Edu-Tourism from Home During the Covid-19 Pandemic

Aniesa Samira Bafadhal¹, Muhammad Rosyihan Hendrawan^{2*}

¹Department of Tourism, Universitas Brawijaya, Malang, Indonesia

²Department of Library and Information Science, Universitas Brawijaya, Malang, Indonesia

*Corresponding author. Email: mrhendrawan@ub.ac.id

ABSTRACT

The Indonesian government has implemented a resilience policy against the Covid-19 pandemic through the learning from home (belajar dari rumah/BDR) program and the fulfillment of the demands for the Guidelines for Cleanliness, Health, Safety, and Environmental Sustainability (CHSE) aimed at preventing the spread and infection of Covid-19 is no exception at the museum. The Brawijaya Museum has a dual role as an educational tourist destination site as well as a military site that stores a number of artifacts, rare book collection, and archives of the Indonesian National Army (Tentara Nasional Indonesia Angkatan Darat/TNI AD) histories related to service to the Republic of Indonesia. Therefore, this type of R&D research with a qualitative approach was carried out to create virtual content for the Brawijaya Museum based on augmented reality and virtual reality (AR/VR) as a means of distance learning during the Covid-19 pandemic. After the development of the virtual content of the Brawijaya Museum, a test of the effectiveness of the content was also carried out in providing experiences and feelings as if they were psychologically present (telepresence) from the perspective of museum managers and students. The Brawijaya Virtual Museum can be a win-win solution strategy for site managers and edu-tourism tourists where it is possible to travel and learn from home through virtual reality and augmented reality content regarding architecture and also the collections of the Brawijaya Museum without having to visit directly during the Covid-19 pandemic.

Keywords: R/VR, Covid-19 pandemic, edu-tourism military museum R&D, , virtual museum, telepresence.

1. INTRODUCTION

Health issues related to being at home during the Covid-19 pandemic [1, 2] have made traveling and learning from home popular among students. The Covid-19 pandemic has been declared the worst public health emergency in modern history by many countries. The Covid-19 pandemic has brought the world to a standstill with policies on physical distancing, social distancing, lockdowns and travel restrictions in various countries, which have had a systemic impact on society and business.

The Ministry of Education and Culture, Republic of Indonesia (Kemendikbud RI) has issued Circular Letter Number 15 of 2020 concerning Guidelines for

Organizing Learning from Home in an Emergency Period for the Spread of Covid-19 to strengthen the Circular Letter of the Minister of Education and Culture Number 4 of 2020 concerning Implementation of Education in an Emergency Period of Covid-19 pandemic. The circular letter stated that the purpose of implementing Learning From Home is to ensure the fulfillment of the rights of students to obtain educational services during the Covid-19 pandemic, protect education unit residents from the adverse effects of Covid-19 and prevent and transmit Covid-19 in the educational facilities do not expect the museum as a type of educational tourism.

This is also reinforced by the issuance of the CHSE program or Guidelines for the Implementation

of Cleanliness, Health, Safety, and Environmental Sustainability in Tourist Attractions as an operational guide from the Decree of the Minister of Health Number HK.01.07/Menkes/382/2020 concerning Health Protocols for Communities in Places and Facilities General in the Context of Prevention and Control of Covid-19. This guide is intended for entrepreneurs and/or managers, employees, and local tour guides in meeting the needs of visitors for clean, healthy, safe, and environmentally friendly tourism products and services during the Covid-19 pandemic.

According to Bodger et al. [3], edu-tourism refers to any “programme in which participants travel to a location as a group with the primary objective of engaging in a learning experience that is directly related to that location”. Some academics such as McGladdery and Lubbe [4] have defined edu-tourism as “an activity involving traveling away from one's home with the primary or secondary purpose of learning in a unique environment”. Matoga [5] notes that “commercial tourism functions according to the model the traditional 3S (sun, sea and sand) tourism model has been replaced by the 3E (education, environment, and entrepreneur) tourism model, where tourists focus more on meeting their cognitive needs rather than relaxing passively at seaside resorts.

It is undeniable that being confined for too long at home, especially during the Covid-19 pandemic, has made millions of people bored, stressed, and have limited access and space for traveling and learning. The lives of today's teenagers are also very different from previous generations where access to a virtual environment allows them to continue their activities and interact using virtual reality technology [6]. As more and more human activities move into the virtual world, the virtual world becomes a reflection and simulacrum of modern society. The development of the internet, computers and sophisticated technology keeps our bodies at home, but able to feel, act, interact, and travel and learn everywhere at the same time.

Museums have recognized the fundamental role of new information technologies in museology management. The trend of using technology in a museum is increasing so that a new term is created for museological discussions about changes, problems, and challenges, which is called new museology [7] or “cybermuseology” [8]. Apart from the benefits, it also offers challenges for stakeholders. To answer the challenges and development of society, museums must

be developed through edutainment. Therefore, various technologies have mediated museological functions.

Emerging metaverse technologies, such as virtual reality (VR) and augmented reality (AR) are now seen as important and integral tools for museums [9]. Müller [10] predicts that museums will continue to develop and reinvent themselves in the virtual world, to ensure that they fulfill their mission to help people travel and learn edu-tourism in the 21st century or what is known as virtual museum.

A virtual museum is an institutional memory that uses virtual reality and augmented reality technology derived from the architecture and museum collections through an immersive virtual world. The collection is not only for cultural and natural heritage, but also for tangible or intangible popular culture. It can be accessed onsite and online from the physical museum separately for preservation, record keeping, research, recreation, education and tourism purposes [11].

Rayward and Twidale [12] explain “in the same way that museums are not simply physical warehouses or storehouses of artifacts organized to allow the most efficient access to them, virtual museums are not simply databases of digital images linked to information retrieval software” According to Pujol and Lorente [13], virtual museum refers to a digital spatial environment, contained in the WWW or exhibitions that reconstruct a real place and/or act as a metaphorical knowledge, where visitors can communicate, explore, and modify space and digital or digital objects.

The architecture of the virtual museum allows it to be dynamic and interconnected. Virtuality is then conveyed in the same way as in a period room or diorama, by creating images that speak to the mind through the senses [14]. Several researchers have studied VR-based virtual museums, such as Gutowski and Kłos-Adamkiewicz [15] and Carvajal et al. [16]. Virtual museum has several other terms, some of which are “3D VR site museum” [17, 18] and “3D virtual museum” [19, 20, 21].

Virtual reality and augmented reality offer realistic experiences and allow “visits” to environmentally sensitive sites that are not suitable for many visitors [22] by diverting the quantity of tourist visits directly through virtual visits to virtual reality and augmented reality content so as to

complement real visits. [19, 23] or used by tourists as an alternative to real visits [24, 25, 26] and can help manage visitor flow of a tourist destination by considering the capacity and carrying capacity of the destination [19]. Huettermann et al. [27] and Zubiaga [28] explain virtual reality and augmented reality could be as an edu-tourism platform [29] especially during the implementation of policies related to the Covid-19 pandemic and as a media and promotion [30] to increase visitors as part of post-pandemic resilience strategy.

The Brawijaya Museum in Malang City is a national type A museum as a military museum of the Indonesian National Army which was inaugurated on May 4, 1968 with its main collections mostly of historical objects in the form of combat and military equipment during the struggle for Indonesian independence from Dutch and Japanese colonialism. The Brawijaya Museum has a role as an educational medium, as a place of recreation, as a place for scientific research, as a place for mental development of struggle and the inheritance of the values of the '45 and TNI '45 for the Indonesian national army and the general public and as a place for mental development of struggle in the context of regional development. In addition, the Brawijaya Museum also has the Brawijaya Museum library which stores a number of rare book collection, and archives on the history of the Indonesian National Army related to service to the Republic of Indonesia [31].

Based on the pre-research interview with Captain Yudi Asmara (Head of Documentation, Historical Search and Library of Brawijaya Museum) on February 4, 2021 stated that *"...at our museum there has been a drastic decrease in visitors during the pandemic, especially from student study tours and community, we expect relevant parties and academics to help develop recovery strategies during and after the pandemic..."*

Therefore, this study aims to develop the contents of the Virtual Museum Brawijaya (lab-based experiment). Currently, there are more and more museums that have made virtual tours such as Museum Nasional Indonesia, Museum Manusia Purba Sangiran, Museum Sumpah Pemuda, and the National Palace Museum, Michelangelo's work, namely the David statue [32] and the Pieta Florentine statue [33] in the museums of Florence, Italy, statues of the Terra Cotta Warriors in China [34], Geguti Palace in Georgia [35], etc.

Virtual tourism can change conventional experiences and result in the emergence of new types of tourism experiences [36]. One of them is virtual experience,

which is defined as the capacity to provide a sense of being present (tele-presence) in a virtual environment [37]. Slater and Wilbur [38] define tele-presence as referring to the user's subjective psychological response to a virtual reality system. This is considered capable of providing a new form of interactive learning and travel from home in the midst of a pandemic.

However, in Indonesia there has been no research on creating virtual reality content for museums. Although some researchers in Indonesia have indeed developed virtual reality content using 3D models, the development objectives are more focused on tourism promotion such as [39, 40, 41] for the benefit of e-learning history education, research This research proposes a web-based VR-based virtual museum R&D for historical education tours as well as confirming telepresence capabilities on the virtual museum's content from the perspective of users and managers which have not been found in previous research. Therefore, this research is a pioneer and is expected to fill the research gap.

Based on the background and research problem that has been described, the objectives of this study were:

- a. Identifying the current condition of the Brawijaya Museum during the Covid 19 pandemic based on the CHSE elements from the Ministry of Tourism and Creative Economy, Republic of Indonesia.
- b. Conducting R&D for the creation and development of virtual reality-based Virtual Museum Brawijaya content as a medium for educational tourism during the Covid-19 pandemic.
- c. Evaluating the ability of Brawijaya Virtual Museum content in providing telepresence from the perspective of site managers and students.

2. RESEARCH METHODS

2.1. Research Design

This type of research is Research and Development with a qualitative approach consisting of direct observation techniques, audio-visual material and experimental interviews conducted from April to May 2021 using the Multimedia Development Life Cycle (MDLC) model, Gall et al. [42] stated that "basically research and development have two main objectives,

they are to develop a product and to test the effectiveness of the product.” The MDLC method has 6 stages, namely concept, design, material collecting, assembly, testing dan distribution [43].

2.2 Data Collection

This study uses a qualitative approach to data collection as follows:

2.2.1 Observation

This study uses passive participation observation [44] namely the researcher comes directly to the Brawijaya Museum and is observed, the researcher shows his role as an observer, but is not involved in the activities at the Brawijaya Museum.

2.2.2 Audio-Visual Material

Cresswell [44] states that qualitative audio and visual materials is a method of collecting data in the form of photos, art objects, videotapes and all kinds of visuals and sounds The audio-visual material of this research is a picture taken by researchers to strengthen the results of this study obtained from 360° videos and 360° photos related to the historical educational vehicle for the Brawijaya Museum at the research location.

2.2.3 Online Experimental Interview

In-depth interviews in this research intensively involve a number of 5 respondents from the management of the Brawijaya museum and students to explore their perspectives on virtual reality content as a tourism education tool that has been prepared. This interview is complemented by this experiment using a pre-experimental design in the form of a one-shot case study [45]. After being treated using the Brawijaya Museum's virtual tourism content experiment that has been compiled in this study, the informants will be interviewed via an online meeting application to confirm the effectiveness of the virtual reality content in providing the sensation of telepresence. Finally, researchers using interactive analysis model from Miles et al. [46] framework to collect, analyze, and interpret interview data. Structuring interview with closed-fixed response interview applied in this research in which interviewers ask each informant a series of pre-established questions with limited set of response categories [47]. The assessment is carried out by giving a “true”, “so-so” or “not yet” answer regarding the

statement of the content.

2.3 Research Instruments

2.3.1 Field Notes

Observation instruments in the form of field notes/logbooks, commonly used in systematic observation where researchers work according to the guidelines that have been made usually contain a list of types of activities that are likely to occur or activities to be observed based on 20 CHSE items.

2.3.2 Check List of Audio-Visual Materials

The audio-visual material check-list contains a list of things that will be collected data where the researcher simply writes a check mark in the symptom column based on a 360° video and 360° photo related to the Brawijaya Museum.

2.3.3. Online Experimental Interview Guide

The researcher developed an interview guide that included questions about the problems to be explored during the interview. The interview guide was prepared based on the ability of virtual reality content to provide telepresence, namely a sense of being really present in a virtual world, using the MEC Spatial Presence Questionnaire (MEC-SPQ) from [48].

2.4 Data Analysis Technique

To analyze the results of observations and audio-visual material in the form of text, video and 360 photos, this study uses content analysis and to analyze the results of interviews, researchers use descriptive statistical analysis.

3. RESULTS

3.1. Concept Design Stage

The concept stage in this study was carried out using the passive participation observation method. In figure 1, of the 22 CHSE items, it can be identified that the Brawijaya Museum is able to provide 33% of supporting facilities to support the Covid 19 safety protocol, such as the availability of hand washing facilities with soap and hand sanitizer, a place for

measuring body temperature, a closed trash can specifically for the disposal of masks.

In addition, researchers assessed that the Brawijaya Museum was able to implement the provision of supporting equipment and supplies by 29% such as first aid boxes, fire extinguishers, written information on procedures for self-rescue from natural disasters and fires, maps of safe gathering point locations and clear evacuation routes.

Furthermore, the Brawijaya Museum is also able to carry out service system adjustments during the Covid 19 pandemic, including officers and tourist visitors using masks, there is a system for online reservations, filling in biodata before entering tourist attractions, forming a special team to handle emergency conditions, the availability of waste and waste management from tourist attractions with a rating of 23%.

While the smallest assessment is the availability of a written warning related to the Covid-19 condition at the Brawijaya Museum with a value of 15% such as the lack of written advice not to make physical contact, not touching the face, especially the eyes, nose and mouth, maintaining a distance of at least 1 meter, washing hands thoroughly using soap/hand sanitizer, wearing a mask, applying sneezing and coughing etiquette, an appeal to always consume healthy food and vitamins, throw garbage in its place.

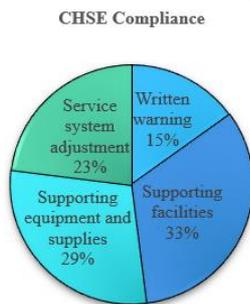


Figure 1 Observation Results of CHSE Brawijaya Museum Compliance during the COVID-19 Pandemic

In general, the Brawijaya Museum has indeed implemented the Covid pandemic safety protocol, but it has not been maximized in several aspects, especially the written appeal on the site that can harm visitors indirectly. Therefore, researchers consider it important to

prepare alternative direct visits, one of which is using the Brawijaya Museum virtual tourism.

3.2 .Design Stages

In this stage, the system design is made using flowchart and storyboard design methods as a basic description of the virtual tourism product that is built and as a design guide for the content as shown in Figure 2.

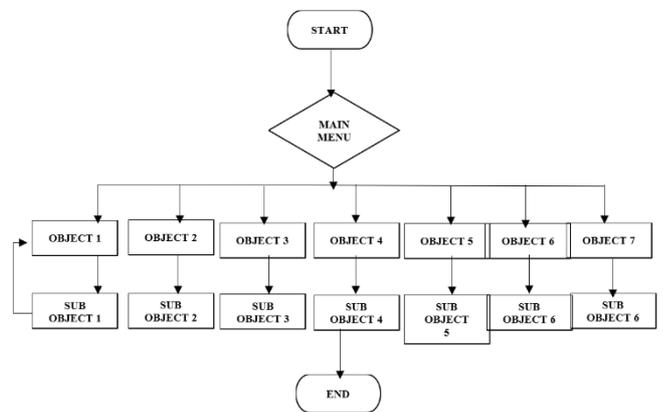


Figure 2 Content Flowchart of Virtual Tourism Brawijaya Museum

3.3. Material Collecting Stage

This stage is carried out using the audio-visual method. The audio-visual material of this research is a picture taken by the researcher to strengthen the results of this study obtained from 360° photos at the Brawijaya Museum. For taking pictures, hardware equipment is used, namely Ricoh Theta SC 360° Camera, Android Smartphone, Digital Camera and Ricoh Theta application software apk 1.26.0 for Android.

3.4. Assembly Stage

The assembly stage is the stage of making all virtual tourism objects or materials. Content creation requires hardware in the form of a PC with Windows OS, Gear Bobo VR Z5, Andoid Smartphone, and software in the form of A-Frame, Assemblr, Glitch, Cardboard VR Application.

The results of the development at this stage can be accessed at the link <https://museum-brawijaya.glitch.me> with a display as shown in Figure 3 for virtual reality and Figure 4 for augmented reality.



Figure 3 Virtual Tourism Museum Brawijaya Content Based on Virtual Reality



Figure 4 Virtual Tourism Museum Brawijaya Content Based on Augmented Reality

3.5. Testing Stage

The testing stage is carried out after completing the assembly stage by testing the content using a virtual experience assessment of users, namely museum managers and students while exploring the Brawijaya Museum virtual tourism destination with an experimental online interview method.

This study measures telepresence in VR experiences, using the MEC-SPQ [48]. Based on Table 1, the respondent's answers to the first second and first statements "Feel like you are really in the virtual environment" on average answered "true", and "so-so" there was no answer "not yet". Based on peer review, the same answer was also found, so it can be concluded that users feel really exploring in the Virtual Museum Brawijaya environment.

For the second statement "Feel really take part in exploring the virtual environment" the majority of informants stated "true" and only one informant answered "so-so" and no answer was found "not yet".

This is supported by peer review answers that support the statement so that it can be concluded that users feel as if they can be involved and become part of tourism at the Brawijaya Virtual Museum.

For the third statement "It's as if the real location is the virtual environment", the majority of the informants stated "so-so" and only two informants answered "true" and there was no answer "not yet". This is supported by peer review answers that support the statement so that it can be concluded that users seem to feel a shift from the real world to a virtual environment when using the Brawijaya Virtual Museum. For the fourth statement "Felt as if I was physically present in the virtual environment" all informants stated "true" and no answer was found "not yet". This is supported by peer review answers that support the statement, so it can be concluded that the ability of the Virtual Museum Brawijaya which allows users to be able to cast a free view in all directions and explore the virtual surroundings of the museum has convinced users to feel as if they are physically present.

Table 1. Results of Interviews and Triangulation related to Telepresence

Nu mb.	Telepresence Virtual Brawijaya Museum	Informant					Peer	Noted
		1	2	3	4	5		
1	Feel like you are really in the virtual environment	So- so	True	True	So- so	True	So-so	Valid
2	Feel really take part in exploring the virtual environment	True	True	True	So- so	True	True	Valid
3	It's as if the real location is the virtual environment	So- so	So-so	True	So- so	True	So-so	Valid
4	Felt as if I was physically present in the virtual environment	True	True	True	True	True	True	Valid
5	The objects in the virtual environment give the feeling of being able to do many things with them.	True	So- so	True	So- so	True	True	Valid
6	Get the impression that you can be active in the virtual environment (playability).	So- so	True	True	So- so	True	True	Valid
7	Feel like you can move between objects in the virtual environment	So- so	True	True	So- so	True	True	Valid
8	You can do whatever you want in the virtual environment	Not yet	So- so	So-so	Not yet	So- so	Not yet	Valid

For the fifth statement “The objects in the virtual environment give the feeling of being able to do many things with them” the majority of the informants stated “true” and “so-so” and no answer was found “not yet”. This is supported by peer review answers that support the statement so that it can be concluded that the visual display presented at the Virtual Museum Brawijaya makes it appear as if the object looks real and the augmented reality capability also makes it possible to interact with objects and get additional information. For the sixth statement “Get the impression that you can be active in the virtual environment (playability).

“true” and “so-so” and no “not yet” answers were found. This is supported by peer review answers that support the statement, so it can be concluded that the ability of the Virtual Museum Brawijaya content to move rooms from one room to another virtually creates a feeling as if the user can move actively in a virtual environment.

For the seventh statement “Feel like you can move between objects in the virtual environment”, “true” and “so-so” and there is no answer “not yet”. Virtual Museum Brawijaya content to drive augmented reality

content in several spots Virtual Museum Brawijaya allows users to explore and interact and engage with virtual objects. For the eighth statement "You can do whatever you want in the virtual environment", overall respondents acknowledged the ability to explore in the Virtual Museum Brawijaya environment but found the answer "not yet" from the respondents. that the content capability of the Virtual Museum Brawijaya is still limited where not all rooms and objects can be explored by users because they are not yet available in virtual form The overall results of the assessment of museum managers and students after using content show the ability of Brawijaya Museum's virtual content to provide a sense of psychological presence (telepresence) than average. the average of the informants' answers. Even so, the content is considered not too optimal in providing a virtual experience while visiting the virtual museum.

In addition, the validity of the data was checked using source triangulation. Checking is done by comparing what the research subjects said in interviews and comparing with the results of each informant's answers plus peer reviews while exploring the virtual content of the Brawijaya Museum. It can be concluded that on average the five respondents and one research colleague answered the same thing so that it can be said to be valid.

The results of this study support the research results from Zarzuela et al. [29], where the use of virtual reality in Serious Game offers a different, fun, entertaining, educational tourism, way to learn or review different aspects of a destination such as history, can be presented as a complement.

3.6. Distribution Stage

The distribution stage is the stage where virtual tourism content is stored in a storage media and is ready to be accessed on a hosting platform to online the Brawijaya Museum virtual tourism content so that it allows users to travel and learn history from home. In addition, in the future, destination managers can take advantage of content as a substitute or complimentary product from real tourist visits at direct locations by using additional equipment in the form of Virtual Reality gear.

4. CONCLUSIONS

The virtual tourism content developed in this study is considered to be an alternative solution considering the condition of the Brawijaya Museum which is experiencing potential dangers because there are still several elements of CHSE that have not been fulfilled by the site so it is quite risky for students who study and travel directly to the museum site. can be a complementary product or a substitute product for real tourist visits to Kayutangan because it is considered to have been able to provide virtual experiences, especially telepresence, even though it is not optimal.

The Brawijaya Museum's virtual tourism can be a win-win solution strategy for site managers and edu-tourism tourists where it is possible to display virtual reality and augmented reality content on architecture and also the collections of the Brawijaya museum without having to visit directly during the Covid-19 pandemic.

The manager of the Brawijaya Museum can then organize a paid remote virtual tour program using virtual content that has been developed in this study accompanied by local guides so as to provide more complete information to edu-tourism tourists at home. Even so, it is necessary to pay attention to the confidentiality and security of data because the Brawijaya Museum site is a site with a strategic role that has a dualism of spatial functions, namely as a tourist destination as well as a vital military location that is still active.

Further research can continue the results of this study by testing virtual experiences both immersion and telepresence while visiting virtual tourism content using a quantitative approach, so as to obtain comprehensive and generalizable results

ACKNOWLEDGMENT

The authors are grateful to Documentation, Historical Search and Library of Brawijaya Museum for fully support this research and also thanks to Universitas Brawijaya, Indonesia for supporting this research under grant number 536,115.1/UN10.C10/PN/2021.

REFERENCES

- [1] M.T. Tull, K.A. Edmonds, K.M. Scamaldo, J.R. Richmond, J.P. Rose, K.L. Gratz, Psychological outcomes associated with stay-at-home orders and the perceived impact of COVID-19 on daily life, *Psychiatry Research*, vol. 289(113098), 2020. DOI: <https://doi.org/10.1016/j.psychres.2020.113098>
- [2] K. Saurabh, S. Ranjan, Compliance and psychological impact of quarantine in children and adolescents due to covid-19 pandemic, *The Indian Journal of Pediatrics*, vol. 87, 2020, pp. 532-536. DOI: <https://doi.org/10.1007/s12098-020-03347-3>
- [3] D. Bodger, Leisure, learning, and travel, *Journal of Physical Education Recreation Dance*, vol. 69(4), 1998, pp. 28-31. DOI: <http://dx.doi.org/10.1080/07303084.1998.10605532>
- [4] C.A. McGladdery, B.A. Lubbe, Rethinking educational tourism: proposing a new model and future directions, *Tourism Review*, 2017.
- [5] L. Matoga, Exploring the history and heritage of communism in NowaHuta District in Krakow, Poland: Potential or a problem in managing tourism in a city?, *Journal of Hospitality Management and Tourism*, vol. 6(7), 2015, pp. 90-103. DOI: <https://doi.org/10.5897/JHMT2015.0160>
- [6] E. Kuntsche, B. Simons-Morton, T.t. Bogt, I.S. Queija, V.M. Tinoco, M.G.d. Matos, M. Santinello, M. Lenzi, Electronic media communication with friends from 2002 to 2006 and links to faceto-face contacts in adolescence: an HBSC study in 31 European and North American countries and regions. *International Journal of Public Health*, vol. 54, 2009, pp. 243–250. DOI: <https://doi.org/10.1007/s00038-009-5416-6>
- [7] P. Kostadinova, Heritage virtualization–innovations in museum narrative, *Innovations*, vol. 8(2), 2020, pp. 69–72.
- [8] A. Leshchenko, Digital dimensions of the museum: Defining cybermuseology’s subject of study. *ICOFOM Study Series*, vol. 43, 2015, pp. 237–241.
- [9] D. Zielasko, N. Feld, C. Flemming, P. Lungershausen, A. Morgenthal, S.D. Schmitz, T. Mattern, B. Weyers, Towards preservation and availability of heterogeneous cultural heritage research data via a virtual museum, *GI VR/AR Workshop*, 2020.
- [10] K. Müller, Museums and virtuality, *Curator: The Museum Journal*, vol. 45(1), 2002, pp. 21–33.
- [11] M.R. Hendrawan, Virtual Museum, *Encyclopedia of Tourism Management and Marketing*. Eds. Buhalis, Dimitrios. Cheltenham, UK: Edward Elgar Publishing, 2021, 9781800377486. DOI: <https://doi.org/10.4337/9781800377486> Web.
- [12] W.B. Rayward, M.B. Twidale, From docent to cyberdocent: education and guidance in the virtual museum, *Archives and Museum Informatics*, vol. 13(1), 1999, pp. 23-53.
- [13] L. Pujol, A. Lorente, The virtual museum: a quest for the standard definition, In *Archaeology in the Digital Era* (pp. 40-48), Amsterdam University Press, 2014.
- [14] S. Beer, Digital heritage museums and virtual museums, *Proceedings of the 2015 Virtual Reality International Conference*, 2015, pp. 1-4.
- [15] P. Gutowski, Z. Kłos-Adamkiewicz, Development of e-service virtual museum tours in Poland during the SARS-CoV-2 pandemic, *Procedia Computer Science*, vol. 176, 2020, pp. 2375–2383. DOI: <https://doi.org/10.1016/j.procs.2020.09.303>
- [16] D.A.L. Carvajal, M.M. Morita, G.M. Bilmes, Virtual museums. Captured reality and 3D modeling, *Journal of Cultural Heritage*, 2020.
- [17] M.D. Robles-Ortega, F.R. Feito, J.J Jiménez, R.J Segura, Web technologies applied to virtual heritage: An example of an Iberian Art Museum. *Journal of Cultural Heritage*, vol. 13(3), 2012, pp. 326–331. DOI: <https://doi.org/10.1016/j.culher.2011.10.001>
- [18] J. Zhao, Designing virtual museum using Web3D technology, *Physics Procedia*, vol. 33, 2012, pp. 1596–1602.
- [19] Z. Hu, Z. Cao, J., Shi, Research of interactive product design for virtual tour-ism, in: D. Jin, S.

- Lin (eds.), *Advances in electronic engineering, communication and management*, Proceedings of the EECM 2011 International Conference on Electronic Engineering, Communication and Management, held December 24-25, 2011, Beijing, China, 2012, pp. 411-416.
- [20] C. Kiourt, A. Koutsoudis, G. Pavlidis, *DynaMus: A fully dynamic 3D virtual museum framework*. *Journal of Cultural Heritage*, vol. 22, 2016, pp. 984–991. DOI: <https://doi.org/10.1016/j.culher.2016.06.007>
- [21] A.R. Miranda, J.M.V. Melón, E. Calparsoro, J.G. Iñáñez, *Study, revalorization and virtual musealization of a ceramic kiln based on information gathered from old excavations*, *Digital Applications in Archeology and Cultural Heritage*, vol. 7, 2017, pp. 1-9. DOI: <https://doi.org/10.1016/j.daach.2017.08.003>
- [22] D.A. Guttentag, *Virtual reality: Applications and implications for tourism*, *Tourism Management*, vol. 31, 2010, pp. 637–651. DOI: <https://doi.org/10.1016/j.tourman.2009.07.003>
- [23] J.M. Dewailly, *Sustainable tourist space: from reality to virtual reality?*, *Tourism Geographies*, vol. 1(1), 1999, pp. 41-55.
- [24] L. Kaelber, *A memorial as virtual traumascap: Darkest tourism in 3d and cyber-space to the gas chambers of Auschwitz*, *e-Review of Tourism Research* 5, 2 (June), 2007, pp. 24–33.
- [25] G. Ritzer, *The McDonaldization Thesis: Explorations and Extensions*, SAGE Publications, London, 1998.
- [26] R.S. Bristow, *Altruistic adventure voluntourism: help manage the park you visit*, *Adventure Tourism and Outdoor Activities Management: A 21st Century Toolkit*, pp. 145-154, 2019.
- [27] M. Huettermann, T. Thimm, F. Hannich, C. Bild, *Requirements for future digital visitor flow management*, *Journal of Tourism Futures*, 2019.
- [28] M. Zubiaga, J.L. Izkara, A. Gandini, I. Alonso, U. Saralegui, *Towards smarter management of overtourism in historic centres through visitor-flow monitoring*, *Sustainability*, vol. 11(24), 7254, 2019. DOI: <https://doi.org/10.3390/su11247254>
- [29] M.M. Zarzuela, F.J.D. Pernas, S.M. Calzón, D.G. Ortega, M.A. Rodríguez, *Educational tourism through a virtual reality platform*. *Procedia Computer Science*, vol. 25, 2013, pp. 382-388.
- [30] M. O'Rawe, A. Gibson, *virtual reality as a promotional tool: insights from a consumer travel fair*, 2017.
- [31] *Museum Indonesia Museum Brawijaya*, retrieved from https://www.museumindonesia.com/index.php?show=museum&museum_id=50, 2019.
- [32] M.D. Benedetto, F. Ponchio, L. Malomo, M. Callieri, M. Dellepiane, P. Cignoni, R. Scopigno, *Web and mobile visualization for cultural heritage*. In *3D Research Challenges in Cultural Heritage* (pp. 18-35), Springer, Berlin, Heidelberg, 2014.
- [33] F. Bernardini, H. Rushmeier, I.M. Martin, J. Mittleman, G. Taubin, *Building a digital model of Michelangelo's Florentine Pieta*, *IEEE Computer Graphics and Applications*, vol. 22(1), 2002, pp. 59-67.
- [34] J.Y. Zheng, Z.L. Zhang, *Virtual recovery of excavated relics*, *IEEE Computer Graphics and Applications*, vol. 19(3), 1999, pp. 6-11.
- [35] F. Ferrari, M. Medici, *The virtual experience for cultural heritage: methods and tools comparison for Geguti Palace in Kutaisi, Georgia*, In *Multidisciplinary Digital Publishing Institute Proceedings*, Vol. 1, No. 9, 2017, p. 932.
- [36] D. Zejda, J. Zelenka, *The concept of comprehensive tracking software to support sustainable tourism in protected areas*, *Sustainability*, vol. 11(15), 4104, 2019. DOI: <https://doi.org/10.3390/su11154104>
- [37] M. Gutierrez, F. Vexo, D. Thalmann, *Stepping into virtual reality*, Springer, London, 2008.
- [38] M. Slater, S.A. Wilbur, *A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments*, *Presence: Teleoperators & Virtual Environments*, vol. 6(6), 1997, pp. 603-616.
- [39] A.H. Fauzi, A.A. Gozali, *Virtual Reality to promote tourism in Indonesia*, *Jurnal Sistem Komputer*, vol. 5(2), 2015, pp. 47-50.

- [40] S. Syarifuddin, Virtual Museum: A Learning material of Indonesia national history, *International Journal of Multicultural and Multireligious Understanding*, vol 4(6), 2017, pp. 51-60, 2017. DOI: <http://dx.doi.org/10.18415/ijmmu.v4i6.96>
- [41] M.L. Famukhit, L.Y. Maryono, B. Eka, Interactive Application Development Policy Object 3D Virtual Tour History Pacitan District based Multimedia, *International Journal of Advanced Computer Science*, 2013. DOI: <https://doi.org/10.14569/IJACSA.2013.040303>
- [42] M.D. Gall, J.P. Gall, W.R. Borg, *Educational Research: An Introduction*, 7th Edition, Pearson Education, Boston, 2003.
- [43] A.C. Luther, *Authoring interactive multimedia*, Academic Press, Inc, Massachusetts, 1994.
- [44] J.W. Cresswell, *Research design: qualitative, quantitative, and mixed methods approaches*, Sage Publication, Inc., USA, 2016.
- [45] K. Williamson, G. Johanson, *Research methods: information, systems and contexts*, Chandos Publishing, UK, 2018.
- [46] M.B. Miles, A.M. Huberman, J. Saldana, *Qualitative data analysis: a methods source book (3 rd ed.)*, SAGE Publications, Inc., USA, 2014.
- [47] A.J. Pickard, *Research methods in information*, Facet Publishing, London, 2007.
- [48] P. Vorderer, W. Wirth, F.R. Gouveia, F. Biocca, T. Saari, F. Jäncke, C. Klimmt, MEC spatial presence questionnaire (MEC-SPQ): Short documentation and instructions for application. Report to the European community, project presence: MEC (IST-2001-37661), vol. 3, 2004, pp. 5-3.