Pathfinder
A Canadian Journal for Information Science
Students and Early Career Professionals

ISSN 2563-2493
https://doi.org/10.29173/pathfinder31

Museums Without Walls: A Temporal Analysis of Virtual Exhibitions in GLAM Institutions

Freyja Catton[1], Laura M. Smith[2]

[1]School of Library and Information Studies, University of Alberta, freyjacatton@gmail.com
[2]School of Library and Information Studies, University of Alberta, laura.meghan.smith@gmail.com

To Cite:

Catton, F. and Smith, L.M. (2021). Museums without walls: A temporal analysis of virtual exhibitions in GLAM institutions. *Pathfinder: A Canadian Journal for Information Science Students and Early Career Professionals. 2*(2), 72-85. https://doi.org/10.29173/pathfinder31

Abstract

An effective virtual exhibition (VE) uses technology to engage viewers and presents opportunities for greater interactivity than a user can experience by viewing a traditional physical exhibition. This modern form of presentation supports further learning and discovery of collection materials. It facilitates a deeper level of understanding by utilizing easily accessible information sources such as links, documentation, or audio/video. Despite the excitement and opportunities afforded by immersive virtual reality (VR), many if not most VEs remain accessible for visitors without VR equipment via browsers or webpage-based exhibitions. This paper uses a literature review and temporal analysis to explore the development of VEs for gallery, library, archives, and museum (GLAM) institutions.

Keywords: virtual exhibitions, temporal analysis, technology, GLAM, cultural institutions

Exhibitions have always been important outreach programmes for galleries, libraries, archives, and museums (GLAM institutions). French art historian, philosopher, and critic André Malraux's seminal work *Le musée imaginaire* ("imaginary museum") introduced the idea of a democratic "museum without walls" in 1947 (Allan, 2020; Maggio, 2013). This precursor to the virtual exhibition (VE) was focused on photography at the time, but introduced a way to assemble, group, and display artifacts outside of the museum building (Allan, 2020; Maggio, 2013; Manovich, 2013).

In a contemporary continuation of this idea, Lester (2006) contends that the virtual exhibition (VE) is the next logical step from the physical exhibition. Exhibitions are a vital form of communication and with the use of the internet, they can extend outreach to a global audience (Lester, 2006). The author observes “new possibilities to develop the design and learning opportunities of the [virtual] exhibition, giving access to a broader audience” (Lester, 2006, p. 85). These possibilities became available with the advent of the internet and were further enriched with Web 2.0 and the advent of virtual reality technology (VR).

VR is defined as “a technology that enables a person to interact with a computer-simulated environment, be it based on a real or an imagined place” (Tate Art Gallery, n.d.). There is much overlap between the discussion of VR and VEs, but VR discourse often involves specific hardware equipment, while VEs tend to focus on the end product. We would argue that VEs adopt VR principles but remain accessible for visitors without VR equipment via browsers or webpage-based exhibitions. This results in more equitable opportunities for users to engage with the information.

VEs are particularly relevant for GLAM institutions of the digital age because the presence of an online exhibition offers opportunities for promoting the institution and their collections and increases access to the collection materials on display. Utilizing emerging technologies to create effective VEs means that GLAM institutions will be able to expand their reach to visitors all over the world, generating interest in collections, cultural artifacts, and cultural heritage. In recent years, exhibitions have been moving towards digital and online formats. Coincidentally, the COVID-19 pandemic has highlighted access issues for those who are unable to visit physical exhibition spaces, leading to increased interest in digital programmes such as VEs.

Through temporal analysis and literature review, this paper will explore the different technologies and approaches that GLAM institutions have utilized to present their VEs. These exhibitions use different combinations of technology resulting in various levels of immersion. From simple curated webpages with images and hyperlinks, to fully immersive virtual reality with headsets and haptic technology, and all the experiences in between — so long as there is interest and some funding, there are

opportunities for VEs for each GLAM institution.

Technology Introduction and Background

VEs use a variety of technology and techniques to present information to visitors in a virtual format. Internet access is the main requirement for VEs. Beyond that, VEs may be presented using:

- Webpages — presentation of exhibition content using webpage structure. It may involve simply navigating through images, or it may be organized into subtopics and subpages.
- Hotspots — used to supplement browser or VR presentation with text, photos, hyperlinks, video, and/or audio. Visitors can interact with hotspots to gain more information about a particular artifact.
- 3D representation of individual artifacts or of the virtual display space — this can be created by using 3D modelling tools, 3D scanning, panoramic photographs, or stereoscopic images based on drawings, blueprints, or on-site measurements (Carmo & Cláudio, 2013).
- 360° photography — uses panoramic photographs and stitches them together for a 360° viewing experience. Unlike 3D modelling, this format is fixed and does not allow for structural changes.
- System architecture — used to design a VE or the collection housing digital objects. This architecture can include different repositories that are indexed using XML languages.
- Digital objects — each digital object has metadata requirements which are set before being displayed in VEs. Copyright limitations must also be considered before display.
- Virtual Reality (VR) — intended to provide an immersive experience of a VE, VR uses 3D or panoramic reproduction. VR may be fully immersive using VR equipment such as headsets and haptic gloves (navigate with glove controls), or partially immersive using a web browser (navigate with mouse controls).

Temporal Analysis

1990s — Websites established and interest in digital exhibitions begins

By the mid 1990s, many museums and art galleries had established websites, but these pages served primarily as an advertisement for the institution and were not utilized as an extension of the organization. Some GLAM organizations and LIS academics recognized the importance of the internet to cultural heritage information early on and saw great potential for digital collections. When contemplating the virtual museum of the future, Fopp (1997) predicted that "digital representations of 3-dimensional objects will be capable of being 'handled', examined in great detail, 'purchased' for display, or acquired for research" (p. 145). The author continued by musing that "it may be that we shall see museums which *only* exist in the virtual world" (Fopp, 1997, p. 146). Like Malraux, Fopp anticipated a fundamental shift in the culture of museums due to emerging technologies.

In the early days of this technology, VEs consisted mainly of digital images of records exhibited on the web with descriptions that included contextual information. VEs presented a fundamental change in viewership and a significant break from physical traditions. One of the central issues at the beginning of VEs was the visitor's experience as a virtual viewer, namely in that the viewer would experience a representation of an item and not the item itself. Lester (2006) wrote "the impact of this encounter is lost, or reduced, through the use of a computer screen, and the [viewer must reconcile the] knowledge that the image experienced is only a representation" (p. 94). This concern reinforced the prediction that VEs would likely not replace the physical museum, archives, or special collection library. Instead, the VE was a separate complementary experience, and could be planned in conjunction with physical exhibitions. Benefits to the organization included lessening the security risk for the physical object and better opportunities for a dynamic platform of outreach.

Along with websites, computers and 3D technology supported early interest in VEs. Garibotto et al. (1999) described VEs in a similar manner as Fopp, adding that multimedia technology would allow for personalized visits and access to more detailed information than typically available at a physical exhibition. In one of the earliest VR case studies we found, Garibotto et al. (1999) described the development of a VE about the Lorena Court in Italy as an attempt to freeze an event that takes place only in a short time frame. Garibotto et al. (1999) used web pages, audio and video streams

(MPEG files), and a virtual 3D navigation of the exhibition rooms based on panoramic photos. Utilizing the computer program 3D Studio as a tool to develop VEs and virtual museums, Garibotto et al. incorporated stereoscopic display, projection of real images into a panoramic display, and internet and image processing software packages to develop 3D representation of VEs (Garibotto et al., 1999). This example showed that once the concept of VEs was introduced and understood, the question was how to use technology effectively.

Early 2000s — Development of VEs

Literature on VEs from the early 2000s seems to focus on practical struggles with implementing 3D spaces in VEs. More GLAM institutions were developing and testing VEs. Technological advances, such as flash audio and video files helped VEs become more engaging (Carreras & Mancini, 2014). Depending on the size and type of organization, implementation of VEs might have required changing operations and inter-departmental collaboration that could include “professional writers, artists, archivists, graphic designers, multimedia technicians, technical specialists and curator[s]” (Foo, 2008, p. 25). User expectations were higher than what could be delivered at the time, as visitors expected a much more realistic looking environment and felt there was a lack of human presence within the space (Severson, 2001). Users wanted high fidelity human characters they could interact with, and VE developers had to work within the limitations of time, budget, and PC-based real-time computer graphics (Severson, 2001). In the literature of the time, there was notable interest specifically in reconstructing architecture (Jacobsen & Holden, 2007).

The concept of the VE also shifted partially at this time, now defined as a “web-based hypermedia collection of captured or rendered multi-dimensional information objects, possibly stored in distributed networks, designed around a specific theme, topic, concept or idea, and harnessed with state-of-art technology and architecture to deliver a user-centered and engaging experience" (Foo, 2008, pp. 22-23).

3D technology at this stage seemed focused on recreating, supporting, and searching for individual objects in a system architecture to support digital collection management and future virtual exhibitions (Foo, 2008). These online collection efforts

are visible today in institutions such as the British Museum and the Museum of Modern Art in New York (Smith, 2020).

2010s — Consumer access to VR and development of VEs

By 2010, the literature on VEs was defined by 3D presentation and VR, although case studies of the time still mostly reflect simple webpage formats. At this juncture, Bonis et al. (2013) defined VEs as "single- or multi-user realistic three dimensional (3D) representations of artifact collections, in which visitors navigate, observe the exhibits, learn related information presented with various media, and in some cases interact with them" (Bonis et al., 2013, p. 183), adding later in the article that the difference between 2D interfaces and 3D representation is the level of immersion. With this technology, it was possible to present virtual artifacts in a state never before seen in real-life, such as assembling fragments to depict an entire image (Hecher et al., 2011). These enriched digital artifacts could be presented in 3D for the virtual visitor. Greater interactivity and user engagement could be seen as a result of this technology:

> The interactive, multisensory nature of the web allows visitors a greater exploratory and active role, thus enhancing the learning experiences available, so that 'whilst we only remember 10 percent of what we read, we remember 90 percent of what we say and do. (Lester, 2006, p. 88)

Bonis et al. (2013) also advocated adaptive user navigation in exhibition design. They advised that user needs may influence the development of the content and exhibition design, and that user studies would be beneficial during and prior to the exhibition development. Hecher et al. (2011) provided updates for exhibition authors using the computer software program eXhibition:editor3D to help develop VE spaces and equipping the rooms with the desired exhibits. User expectations and limitations were addressed, both from the visitor perspective and from curatorial roles, which have traditionally not required specialization in technology (Hetcher et al., 2011; Ciurea & Filip, 2016; Caggianese et al., 2018). Whether designing web pages or immersive VR experiences, organizations should be able to create VE experiences without knowledge of complex coding or high overhead costs (Hetcher et al., 2011; Carmo & Cláudio, 2013). It seems the overall expectation in the literature was that VEs would continue to be implemented using web technologies along with 3D modelling.

The increased interest in 3D modelling coincided with the rise of consumer VR headsets, which were introduced to the market circa 2014-2016 (Hahn, 2017). Hahn (2017) gave an overview of the equipment for immersive VR experience available to consumers, including Facebook's Oculus Rift, the HTC Vive, Sony's PlayStationVR3, and the mobile-based VR option Google Cardboard. This new availability of VR technology to consumers meant that fully immersive VEs would be more accessible at home. The popularity of VR became more widespread as equipment costs became reduced (Caggianese et al., 2018); however, space, price, and equipment, such as headsets and powerful computers required to run the systems, meant that immersive VR technology was not nearly as accessible as personal devices like smartphones. The increased usage of smartphones by the mainstream population highlighted the importance of the development of VEs that function with mobile technology. Mobile technology would have significantly more potential users than immersive VR technology.

2020 — Current state and looking forward

VEs continue to aim to expand the reach of the collection, with the added impetus to continue public interest in the institution beyond the brick-and-mortar institution. Notably, the social environment of the 2020 COVID-19 pandemic has increased interest in VEs (Smith, 2020). Due to the pandemic, the National Gallery of Art (NGA) in Washington, DC, quickly created virtual content, including virtual tours, and reported that they saw a 400 percent increase in website traffic in the first week the museum closed (Haigney, 2020). The NGA Chief of Communications, Anabeth Guthrie, said, "This is a chance for us to connect meaningfully without audiences and show that we are more than the sum total of the art in our galleries" (Haigney, 2020, p. 23). This sentiment was echoed anecdotally by other GLAM institutions, resulting in increased social media outreach and the prioritization of the development of VEs.

Development of GLAM VEs may be aided by the rise of virtual fair or marketplace exhibitions, such as book fair exhibitions in which online conferences and online exhibit spaces allow for online meetups and posting of videos (Rosen, 2020). As users become more fluent and comfortable with VEs, designers will have more clarity over user expectations of VE experiences, which in turn should contribute to improved

VE design.

While smartphones and mobile devices dominate consumer access to the internet, consumer access to immersive VR technology such as headsets continues to be a challenge due to cost and limited public use of this emerging technology. The added difficulty of current pandemic safety restrictions has highlighted the fact that accessing VR from the institution is not always a viable option, and reduces visitors' access to fully-immersive VR technology. This means that for now and the near future, development in 3D and VR presentations will need to continue to prioritize web-browser access, and will need to support both computer and mobile formats.

Currently there are grant resources such as the Virtual Museum of Canada, now called Digital Museums Canada, which provides funding and guidance for developing VEs in Canada (Digital Museums Canada, 2021). Budget and time limitations are challenges for all aspects of operations for GLAM institutions, particularly archives. VR exhibitions may become more common as interest grows, but we anticipate a continuation of web page based VEs, simply because the technology is comparatively accessible for many institutions from the designer and funding point of view.

Selected Case Studies

In researching examples of VEs and what technology they have employed, we found a wide range of possibilities for different institutions. We observed that archives predominantly continue to use webpage-based exhibitions, while there is more interest from museums and galleries in developing VR-based exhibitions. The different approaches are likely related to different funding levels, staff resources, and past work in digitizing collections. These five case studies were selected to show the range of interacting technologies in VEs. URLs are available in the References section.

Echoes of the Past (n.d.) by the Didsbury and District Historical Society

This VE, accessible from the Digital Museums Canada website, is a single web page with a series of photos with metadata. This VE is curated and easy to use, but not very immersive. The web page size is fixed and does not respond to browser size. Visitors view one image at a time and click "next" to navigate images. There is also a

button to hide or show hotspots at the top of the web page, but the hotspots are not functioning. The presence of hotspots suggests there are potential resources for the exhibitions (such as links or videos, etc.) that have not been realized or utilized. Seeing the images one at a time means it is difficult to see how the images relate to one another.

Ella May Walker (2012) by the City of Edmonton Archives

This VE consists of curated webpages, each with selected images, clear text accompaniment, and hyperlinks. Clicking on images leads to a subpage with more images and text; users can go back in the browser to return to earlier points in the exhibition. While not very immersive, there is a nice balance between images and text and a clear effort to provide a story along with evidence taken from the archives. The VE has a nice clean format that responds well to different browser sizes.

Shingwauk Virtual Tour (2020) Shingwauk Residential Centre

This virtual tour of the Shingwauk Residential School is still in development in coordination with Digital Museums Canada (LeMay, 2020). It is intended to complement their in-person tours, which are currently on hold due to the COVID-19 pandemic (LeMay, 2020). The virtual tour is accessible by web browser, and the content is designed with survivors in mind, prioritizing student stories over administrator stories (LeMay, 2020). Users can click around in the virtual tour space to navigate the tour, or click on the webpage to navigate to particular points. The virtual tour features 360 panoramic photography and high-detail photos by the company Liberty 360 Inc., VR, and hotspots including photos, video, hyperlinks to archival records, etc. (LeMay, 2020).

Biennale 4D (2017) by Kathrin Koebel, Doris Agotai, Stefan Arisona (FHNW) and Matthias Oberli (SIK-ISEA)

This project is intriguing because it aims to recreate past exhibitions of the Swiss pavilion at the “Biennale di Venezia” Art Exhibition from archival records in VR format (Koebel et al., 2017). Although developed for full-immersion VR rather than browser-based VR, this project suggests opportunities for creating VEs using archival records. The Swiss-language project was developed for a Bachelor’s thesis project and had limited development time, but was able to realize portions from the years 1951, 1983,

2007, and 2013 (Koebel et al., 2017). The authors advised that reading large amounts of text is difficult with the current resolution of VR headsets and suggested using voiceover recordings in the future (Koebel et al., 2017).

As We Meet (2020) by Lee Cavaliere, Virtual Online Museum of Art (VOMA)

As Fopp had predicted back in 1997, VOMA is a completely virtual-only museum that was funded with Kickstarter in June 2020 and opened to the public in September 2020 (Semple, 2020). VOMA is web browser-based and utilizes VR, hotspots of images, text, and 3D sculptures. There are three gallery spaces, Zero, One, and Two, in the museum with curated exhibitions. Visitors manually explore and navigate the exhibition rather than accessing a navigation bar on the screen. This replicates a physical museum experience. *As We Meet* is an exhibition currently in Gallery Zero. Through their web browsers, users click and drag to navigate the VR space, which is rendered using 3D modelling. Selecting a work of art brings it up on the screen for closer viewing, and clicking on hotspots brings up text for easy reading. Visitors can even navigate into the museum's gift shop or join chats from within the VR space. The project aims to replicate the experience of going to an art museum but from home, anywhere in the world (VOMA, 2020).

Future Use and Impact

It is highly likely that there will be a rise in VR exhibitions as interest in VEs progresses and as VR technology becomes more readily available. At the same time, we suspect that there will still be significant variance for VE techniques continuing into the future due to varying levels of equipment and software availability for users and creators, funding levels to create VEs, digital collection types, and institutional priorities. For many small archives, in particular, curated web pages may be the limit to their digital outreach, but as their digital collections progress and as their technical savvy develops, they may be able to gradually increase the complexity of their VEs.

Curators of future VEs should continue to consider copyright, accessibility, and user impact when developing content. Those developing web page exhibitions will need to consider copyright in particular as search engines may be able to retrieve said images. Those developing VR exhibitions should be mindful that VR headsets may not

be accessible to everyone and that visitors may instead be accessing the exhibition via a web browser on a variety of devices including computers, tablets, and smartphones. Information professionals should also consider funding availability and partnerships, as there are resources available to help develop stronger VEs.

Conclusion

VEs offer great possibilities for GLAM institutions, which were highlighted by the social environment of the COVD-19 pandemic. An effective VE uses technology to engage viewers and present opportunities for interactivity to support further learning and discovery of collection materials. Cultural heritage organizations can use VEs to make the "digital version of a cultural artefact accessible even when the physical access is restricted" and leads GLAM institutions and LIS scholars to reflect on how "users receive and interact with information in a virtual world" (Caggianese et al., 2018, p. 625). With the aid of easily accessible additional information, this modern form of presentation may support a deeper level of understanding than a user can experience by viewing a traditional physical exhibition. A VE may enhance the overall viewing experience by empowering the user to participate and self-determine their interaction.

Despite the excitement and opportunities afforded by immersive VR, VEs remain accessible for visitors without VR equipment via browsers or webpage-based exhibitions. As the "virtual exhibition is a concept that has acquired new meanings along with the evolution of modern information and communication technologies," we look forward to seeing how GLAM institutions continue to shape the user experience (Ciurea & Filip, 2016, p. 28). Cultural organizations will continue to develop and combine their partnerships, financial and staff resources, content, and visitor interests to build more VE structures that fit both their collections and their community.

Conflict of Interest Statement

None declared.

References

Allan, D. (2020). Has André Malraux's imaginary museum come into its own? *Apollo: The International Art Magazine*. https://www.apollo magazine.com/andre-malraux-museum-without-walls/

Bonis, B., Vosinakis, S., Andreou, I., & Panayiotopoulos, T. (2013). Adaptive virtual exhibitions. *DESIDOC Journal of Library & Information Technology, 33*(3), 183–198. https://doi-org.login.ezproxy.library.ualberta.ca/10.14429/djlit.33.4604

Caggianese, G., Gallo, L., & Neroni, P. (2018). Exploring the feasibility of diegetic user interfaces in immersive virtual exhibitions within the cultural heritage. *2018 14th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS),* 625–631. https://doi-org.login.ezproxy.library.ualberta.ca/10.1109/SITIS.2018.00101

Carreras, C. & Mancini, F. (2014). A story of great expectations: Past and present of online/virtual exhibition. *DESIDOC Journal of Library & Information Technology*, 34(2), 87-96. DOI: 10.14429/djlit.34.6749

Carmo, M. B. & Cláudio, A. P. (2013). 3D virtual exhibitions. *DESIDOC Journal of Library & Information Technology, 33*(3), 222–235. https://doi-org.login.ezproxy.library.ualberta.ca/10.14429/djlit.33.3.4608

City of Edmonton Archives (2012). *Ella May Walker* [virtual exhibition]. https://www.edmonton.ca/city_government/edmonton_archives/ella-may walker.aspx

Ciurea, C. & Filip, F. G. (2016). New researches on the role of virtual exhibitions in digitization, preservation and valorization of cultural heritage. *Informatica Economica, 20*(4), 26–33. https://doi.org.login.ezproxy.library.ualberta.ca/10.12948/issn14531305/20.4.206.03

Didsbury and District Historical Society (n.d.). *Echoes of the Past* [virtual exhibition]. http://www.virtualmuseum.ca/sgc-cms/histoires_de_chez_nous _community_stories/pm_v2.php?id=exhibit_home&fl=0&lg=English &ex=00000757

Digital Museums Canada (2021). *About us*. https://www.digitalmuseums.ca/about/mission/

Foo, S. (2008). Online virtual exhibitions: Concepts and design considerations. *DESIDOC Journal of Library and Information Technology, 28*(4) 22-34.

Fopp, M. A. (1997). The implications of emerging technologies for museums and galleries. *Museum Management and Curatorship, 16,* 143-53.

Garibotto, G., Oneto, M. V., Coelho, C., Marson, M., Tartaglione, G., & Maccabruni, L. (1999). Virtual exhibitions as a collection environment of cultural events. *Proceedings IEEE International Conference on Multimedia Computing and Systems, Multimedia Computing and Systems, 1999*. IEEE International Conference On, 2, 762. https://doi-org.login.ezproxy.library.ualberta.ca/10.1109/MMCS.1999.778581

Hahn, J. F. (2017). Virtual reality library environments. *Mobile Technology and Academic Libraries: Innovative Services for Research and Learning.* Chicago, Illinois: Association of College and Research Libraries, 237-248. https://www.ideals.illinois.edu/handle/2142/96159

Haigney, S. (2020). The dizzying experience of visiting virtual museums. *Art in America*. https://www.artnews.com/art-in-america/features/virtual-museumtours-google1202682783/

Hecher, M., Mostl, R., Eggeling, E., Derler, C., & Fellner, D.W. (2011). Designing virtual exhibitions on multi-touch devices. *Information Services & Use,* 199-208.

Jacobsen, J. & Holden, L. (2007). Virtual heritage: Living in the past. *Technè: Research in Philosophy & Technology, 10*(3), 55-61.

Koebel, K., Agotai, D., Arisona, S., & Oberli, M. (2017). Biennale 4D — A journey in time: Virtual reality experience to explore the archives of the Swiss pavilion at the “Biennale di Venezia” art exhibition. *2017 23rd International Conference on Virtual System & Multimedia (VSMM)*, 1–8. https://doi-org.login.ezproxy.library.ualberta.ca/10.1109/VSMM.2017.8346280

LeMay, J. (2020). Virtually sharing: Creating exhibitions and tours online. *Maskwacis Cultural College Microlearning Series* [online presentation].

Lester, P. (2006). Is the virtual exhibition the natural successor to the physical? *Journal of the Society of Archivists, 27(1)*, 85–101.

Maggio (2013). Le musée imaginaire by André Malraux. *Neatly Art: From Wunderkammern to Modern Forms of Artistic Compulsion*. https://neatlyart.wordpress.com/2013/05/30/andre-malraux-chez-lui-maurice jarnoux-over-the-last/

Manovich, L. (2013). Museum without walls, art history without names: Methods and concepts for media visualization. In Carol Vernallis, Amy Herzog, & John Richardson. (2013). *The Oxford Handbook of Sound and Image in Digital Media.* (pp. 253-278). Oxford University Press.

Rosen, J. (2020, Sept. 14) Exhibit halls go virtual, too. *Publishers Weekly, 267*(37), 51.

Semple, S. (2020). VOMA: A free virtual art museum for everyone. https://www.kickstarter.com/projects/culturehustle/voma-a-free-virtual-art museum-for-everyone

Severson, J. (2001). Prospects and challenges for creating historic virtual environments for museum exhibition. *Proceedings Seventh International Conference on Virtual Systems and Multimedia*. https://doi org.login.ezproxy.library.ualberta.ca/10.1109/VSMM.2001.969678

Shingwauk Residential Centre (2020). *Shingwauk Virtual Tour* [virtual tour]. http://liberty360.ca/Algoma/10/360.html

Smith, L. (2020). The best virtual exhibitions to explore from home. *Vanity Fair*. https://www.vanityfair.com/london/2020/05/the-best-virtual exhibitions-to-explore-from-home

Tate Art Gallery (n.d.). Virtual reality. *Art Term*. https://www.tate.org.uk/art/art-terms/v/virtual-reality

Virtual Online Museum of Art (VOMA) (2020). *As We Meet* [virtual exhibition]. Curated by Lee Cavaliere for the Virtual Online Museum of Art (VOMA). https://voma.space/