A Design Heuristic for Experiential Learning in Online Museums

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Abstract

This study aims to optimize the educational value of online museums and enhance their benefits for learners at both local and global levels by proposing a design heuristic for experiential learning grounded in existing literature. To achieve this objective, a comprehensive and systematic review of the literature was conducted, focusing on the educational advantages of virtual museums, the limitations inherent in their current design, and key recommendations for improving their effectiveness. The findings indicate that evaluating the quality of online museums requires examining several critical dimensions, including the currency of the website, its accessibility to global users, its educational value, and the degree to which it fosters engagement. Additional criteria include the integration of physical references within the virtual design, the extent to which platforms are user-centered, the issue of user disorientation, and the presence of dynamic and interactive features. Furthermore, the involvement of users in the development and evolution of virtual museums is identified as a significant factor in enhancing their educational impact. Overall, the proposed heuristic provides a clear, applicable, and structured framework that contributes meaningfully to the research community by supporting the design and evaluation of more effective and pedagogically sound online museum environments.

Keywords: Online museums, virtual museums, experiential learning, digital learning, design, instructional design

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Introduction

The accelerating development of digital technologies has profoundly reshaped contemporary educational paradigms, fostering the emergence of innovative learning environments that transcend the spatial and temporal limitations of traditional instruction. Within this evolving landscape, online museums—also referred to as virtual museums—have gained increasing scholarly attention as promising platforms for experiential learning. By integrating multimedia, interactivity, and global accessibility, these environments provide learners with opportunities to engage in authentic, self-directed, and cognitively stimulating experiences that align with constructivist and socio-constructivist perspectives on learning. Empirical and theoretical contributions in the field suggest that such environments enhance intrinsic motivation, promote higher-order thinking skills, and support meaningful knowledge construction through active exploration and engagement.

Notwithstanding these pedagogical affordances, the educational value of online museums remains insufficiently theorized, particularly with regard to their instructional design and evaluative criteria. The extant body of research has predominantly emphasized learning outcomes, while comparatively neglecting the structural and heuristic dimensions that inform the design of effective virtual museum experiences. Furthermore, several challenges persist, including issues of user disorientation, limited interactivity, and inadequate alignment with learner-centered approaches, which collectively constrain the pedagogical potential of these platforms.

In light of these considerations, there is a pressing need to articulate a coherent and theoretically grounded framework that can guide both the design and evaluation of online museums from an experiential learning perspective. Accordingly, the present study aims to develop a design heuristic grounded in a systematic and comprehensive review of the literature. By identifying key dimensions—such as accessibility, engagement, interactivity, and user-centeredness—this research seeks to contribute to the optimization of virtual museum environments and to advance the broader discourse on digital experiential learning.

Methodology:

The literature search was systematic; i.e., comprehensive. Research articles ranged from theoretical, empirical, case study, and literature reviews. It sought to balance between different types of research sources, the most salient of which are foundational theory and current technological trends.

Collecting literature was through keyword searches such as "virtual museum," “online museums,” and “experiential learning”. It was also done through looking at references to existing theories relating to the research topic (flow and cognition). It was done through a longitudinal selection of

articles, with articles covering more than thirty years up to 2024. It was finally done through snowball sampling; i.e., searching the bibliography of every article to collect further information.

Literature

Formal and informal learning have existed since the beginning of recorded history; they have complemented and nurtured one another (Kisiel, 2007), such that any learning missing in traditional face-to-face schools could be attained (Glass, R. & Spiegelman, M., 2007; Vess, 2006; Weiss, M. & Hanson-Baldauf, D., 2008) through experiential learning (Kisiel, 2007). Since the focus of this literature review is on experiential learning effected through virtual museums, it is imperative to study why this type of learning has established itself in the learning domain in such a short time. What merits does it have?

Access:

Virtual museums provide access to learners. For people who do not have access to a physical museum, children with limited access (Picciano, A.G. & Steiner, R.V., 2008), material disadvantages and people who live with disabilities, virtual museums provide them with cultural awareness (Picciano, A.G. & Steiner, R.V., 2008), make them immersed in an engaging, intrinsically motivating and interactive learning environment, which fosters the notion of presence among them. It is related that visitors, for instance, can have access to rare specimens and valuable natural sites (Melber, L.M., 2008).

A Rich Navigating Experience:

The two obstacles that should not impede the learning of a test-taker using CBT are a lack of familiarity and unease with computers (Dooey, 2008). But the learners who are born after 1984 do not perceive technology as an innovative means of learning but as a regular means that constitutes a native language to them (Roffe, 2007). Through touch, sight, and hearing, learners have a real experience (Styliani Sylaiou, Athanasis Karoulis, Yiannis Stavropoulos, and Petros Patias, 2008). Focus is on a museum object, the virtual dimension of the display, the personal context, the shape of the object, the beauty of the object, the meaning behind the display, and the cognitive and affective skills involved in going through the entire experience (Mamur et al., 2022). Also, learners learn to navigate linearly and unidirectionally from one stand to another, following a route that is predetermined (Ya. Murzina, 2020).

Any Informal Setting:

Project-based learning centers on a project building rather than a place and thus can take place in any setting. Learning in any informal setting encourages situated learning (Falk & Storksdieck, 2005).

Intrinsic motivation:

Learning through informal settings can be beneficial to learners in different ways. Learners' intrinsic motivation is increased due to flow and engagement in learning activities. In fact, the element of play (Hmelo-Silver, C.E., 2004) triggers the enjoyable (Dineen et al., 2005) and thereby motivation (Piro, J.M., 2008). Learners' motivation is also increased thanks to the component of free choice of exploration (Melber, L.M., 2008; Rennie, L. & Williams, G., 2006). This is documented through a study where students' knowledge before and after the virtual museum activity (Arabacioglu & Okulu, 2021) was recorded.

Cognition:

Virtual museums improve cognition and learning among learners who navigate them (Wu et al., 2023). Good learner cognition calls upon activity-based or project-based learning (Brown et al., 1989; Collins, A. et al., 1989; Lave, J. & Wenger, E., 1991). As to learning, it is fostered by virtual museums because creation is highly involved in the process (Franceschi & De MiGuel, 2021). Project-based learning triggers learners' curiosity and improves their learning and retention of new concepts. This trend is proven through questionnaires shared with participants of a study (Li et al., 2024), a study where learning through a virtual museum made learners better process the theme of biodiversity in Africa (Underhill & Navarro, 2023) and through a cultural assessment study which indicated that learners performed cognitively better in a post-test than they did in a pre-test (Ermatita et al., 2023).

The ability to solve problems:

Learning through (Csikszentmihalyi, M., 1997) informal settings improves problem-solving skills among learners (Hmelo-Silver, C.E., 2004).

Critical thinking and inquiry-based skills:

Learning through informal settings improves inquiry-based learning and high-order critical thinking (Genç Osman İlhan et al., 2022).

The ability to deal with big themes and ideas:

Learning through informal settings enables learners to deal with big themes and ideas (Piro, J.M., 2008)

Developing visual acuity:

Learning in informal settings such as gaming improves children's visual acuity (Genç Osman İlhan et al., 2022).

Developing an aesthetic sensitivity:

Learning in informal settings allows learners to develop an aesthetic wisdom (Piro, J.M., 2008).

Developing scientific literacy:

Informal settings of learning, such as museums, have been shown to help learners in science literacy (Glass, R. & Spiegelman, M., 2007; Melber, L.M., 2008).Long-term Learning: Through virtual museum learning, learners learn for the long-term (Genç Osman İlhan et al., 2022).

Developing a better cultural awareness:

Museums enable learners to develop cultural intelligence. Through museums, children can develop in a new socio-cultural environment and thereby grow (Ya. Murzina, 2020). Learners form social constructs that are more attuned to their cities and communities, which helps them to be better citizens as they respond to their environment (Nugent, 2006; Piro, J.M., 2008; Soren, 1993). As a result of their experience, it is possible for learners to compare the cultural codes of cultures. As such, they become more cognizant of the codes of cultures, including their own (Mamur et al., 2022; Zhang et al., 2024).

Story-telling skills:

Through virtual museums, learners develop storytelling skills (Genç Osman İlhan et al., 2022).

Active participation:

Learners become active participants in a lesson.

Building Character:

Experiential learning helps children build better character: strong self-esteem, goal orientation, and self-sufficiency (Nichols, J.D. & Steffy, B. E., 1999).

Self-directed learning:

Virtual museums foster self-education and reflection among visitors. This helps young learners to grow. In addition to rational and intellectual faculties, children and adolescents develop emotionally, personally, spiritually, and morally (Ya. Murzina, 2020).

Bridging the gap between teachers and learners:

Learning through museums facilitates communication between learners and faculty (Glass, R. & Spiegelman, M., 2007).

Transferring our knowledge:

Users of experiential learning tech tools can acquire expertise in informal setting technologies and transfer their learning to other parts of their lives.

For teachers:

In a study, teachers expressed their inaptitude in the fields of virtual museums and creative drama (Umralieva et al., 2021). Teachers are, however, eager to learn and view that such tools would help in learners' learning (Umralieva et al., 2021). It has been proven that not only is learning through virtual museums helpful for learners, but it is also helpful for teachers, as through virtual museums, teachers become more knowledgeable regarding a theme and can better design their courses (Arabacioglu & Okulu, 2021). As teachers are involved in virtual museum learning, they develop their expertise in the matter and better design their courses (Mamur et al., 2022). Experiential learning tech tools are of great help to teachers and course designers who want to introduce engaging components in their courses. For instance, a teacher who wants to work with a documentary film to teach an environmental problem can easily have information about that documentary through an online search. Also, a teacher can compile bookmarks of virtual museums to visit with the class while studying Norman Rockwell in a civic education class or spacecraft work in an astronomy class.

In line with all these advantages, there are areas that virtual museums should foster. Virtual museums should foster more critical thinking among learners (Mamur et al., 2022), should fit the constructivist approach (Mamur et al., 2022), and should serve teachers abreast of the progression of technology (Mamur et al., 2022).

Classes should be equipped with internet and should not be overpopulated (Mamur et al., 2022).

Research on the topic of technology and experiential learning tends to focus on the learning outcomes that experiential learning through tech affords (Glass, R. & Spiegelman, M., 2007; Vess, 2006; Weiss, M. & Hanson-Baldauf, D., 2008) such as the innovative aspects of teaching through tech experiential tools, the cognitive load and learning through hypermedia and the high motivation level that tech experiential learning triggers (Jauregi & Bañados, 2008).

As to learners, research has looked at the elements that are key to a good virtual museum, such as soundscapes' design. Indeed, soundscapes design harmonious with objects on display increase the engagement and emotional response of viewers. As learners are more engaged, they are eager to learn more and view objects on display longer (Al-Taie et al., 2022). Also, research has found that the visual appeal as well as the quality of narration are important highlights of a fine, authentic virtual experience. When the quality of a virtual museum is good, visitors are driven by curiosity to visit the museum. The more real the tour, the better the experience (Chekembayeva & Garaus, 2024).

Learners need to have a sense of control and have a good feeling towards the virtual museums that provide them with entertainment and education (Ya, Murzina, 2020). It is recommended that in the conception of virtual museums, learners be involved in the different phases of the museum conception, namely in the communication, research, design, development and deployment of games (Ya. Murzina, 2020). With one notable exception (Hong et al., 2005), while criteria for the design of virtual museums are lacking, criteria for the design of instructional tools in paper-based "normal learning" are abundant (Hong et al., 2005).

When they have successful learning experiences, users recommend the use of the virtual museum for colleagues and friends (Tsita et al., 2023).

The incorporation of games in virtual museums should be done (Li et al., 2024). Indeed, text and audio explanations in physical museums covering historical or scientific concepts are less attractive to visitors than games are (Li et al., 2024). When the design of the technological tools adheres to the curricula, higher-order skills are activated among the learners (Mamur et al., 2022).

Despite this coverage, in research, there are not enough studies on the educational value of virtual museums; therefore, there needs to be more research invested in this topic, especially while using the mixed methods and multiple methods, so that pieces of research are valid and reliable (Islek, Didem, & Asiksoy, Gulsum, 2019). Regarding issues in museum design, one of the challenges of virtual museums is the issue of user disorientation. More physical references should be incorporated in the design of the virtual platforms (Zhang et al., 2024). Dynamic, interactive virtual platforms should be developed. These platforms should be user-centric, catering to the way the user views and experiences the platform (Zhang et al., 2024).

Problem Questions:

Based on this literature review, these are the research problems that an examination of research has reached.

There are a myriad of online museums from different physical museums worldwide; yet, there are not enough studies on their educational value.

There are heuristics on the appropriate design of experiential face-to-face learning, while there is no heuristic regarding the design of online museums' learning. This is important, especially since research shows that there are design issues in the conception of virtual museums.

To address these issues, the study aims to generate a design heuristic based on a systematic review of literature to help researchers and designers help increase the quality and educational efficacy of online museums.

An analysis of a Virtual Museum can be done through document analysis.

Document analysis:

The concept of document analysis is as follows:

Qualitative data consist of quotations and excerpts from documents (Patton, 2014).

Using, studying, and understanding documents are part of qualitative research, otherwise named material culture (Patton, 2014). Document analysis, together with observations and interviewing validate findings as the three sources of research inquiry can be compared with one another (Patton, 2014). There are incentives to pursue more research, whether via direct observation and interviewing (Patton, 2014).

Organizations yield a lot of public and private annals (Patton, 2014). We find documents in several organizations, nonprofit organizations, and philanthropic organizations, some of them (Patton, 2014). Documents explain the processes behind the creation of an organization, deconstruct and demystify organization documents (Patton, 2014). As such, documents are valuable as they provide a holistic outlook and comprehensive understanding of an organization, unlike observations and interviews (Patton, 2014).

Some of the challenges with working with documents are that sometimes, documents can be hard to access, can be incomplete, or inexact (Patton, 2014). The reason documents exist can be difficult to explain (Patton, 2014).

When evaluating a virtual museum, one should:

- Investigate the up-to-date-ness of the site
- Investigate the global access to the virtual museum by world users
- Investigate the educational value of a virtual museum
- Investigate the extent to which virtual museum platforms are engaging.
- Investigate the extent of the presence of physical references or coordinates incorporated in the design of a virtual museum.
- Investigate the extent to which virtual museum platforms are user-centric
- Investigate the issue of user disorientation
- Investigate the presence of dynamic virtual platforms.
- Investigate the presence of interactive platforms.
- Investigate the involvement of visitors in the making of the virtual museum

Under each of these questions are sub-questions generated from the literature review conducted. The final questions and sub-questions are below, and provide a heuristic on how to evaluate a virtual museum.

- Investigate the up-to-date-ness of the site
  - Is the site frequently updated? What is the last update?
- Investigate the global access to the virtual museum by world users
  - Does the museum provide global access to its site to visitors worldwide, and does it offer communication among its constituents?
- Investigate the educational value of virtual museums
  - Is the virtual museum engaging?
  - Does the site have the element of play?
  - Does the site provide touch, sight, and hearing, thereby providing a real experience?
  - Does the site provide learners with a grasp of the world around them?
  - Does the site trigger motivation?
  - Does the site provide the learner with flow and engagement in the activities, thereby increasing motivation?
  - Is the learner's intrinsic motivation increased due to flow and engagement in the learning activities?
  - Does the site enable visitors to have access to rare specimens and valuable natural sites, thereby increasing the learner's science literacy?
  - Does the site provide the visitor with an opportunity to solve problems?
  - Does the site foster cultural intelligence in the visitor?
  - Does the site foster storytelling skills in the learner?
  - Does the site foster aesthetic aptitude in the learner?
  - Does the site foster learning and constructing as far as creation is concerned? (Constructivist approach)
  - Does the site incite a good processing of new themes?
  - Does the site foster good cognitive activity among the visitors?
  - Does the site offer opportunities for learning and remembering new concepts?
  - Does the site provide opportunities for long-term learning?
  - Does the site develop civic engagement among visitors?
  - Does the site foster visitors' cognizance of the codes of world cultures, including that of their own?
  - Does the site offer visitors chances of verifying their learning through assessment?
- Investigate the extent to which virtual museum platforms are engaging.
  - Does the site foster learner engagement in their learning due to guided learning?
  - Does the site provide immersion in the virtual museum for the visitor?
  - Does the site trigger learners' curiosity?
  - How does the site attract the attention of the visitor towards the object on display?

- What context does the site provide to the object on display?
- How does the site attract attention to the space where the object is on display?
- How does the site attract the visitor towards the shape of the object on display?
- How does the site attract the visitor towards the beauty of the object?
- How does the site attract the visitor towards the context of the display and the meaning behind the display?
- Does the site offer opportunities for visitors to engage in kinesthetic exercises?

- Investigate the extent of the presence of physical references incorporated in the design of a virtual museum.
- Does the site allow the visitor to navigate linearly and unidirectionally from one stand to another, following a route that is predetermined?
- Does the site foster good goal orientation among the visitors?

- Investigate the extent to which virtual museum platforms are user-centric
- Does the site provide the visitor with the component of free choice of exploration?
- Does the site foster inquiry-based learning in the learner
- Does the site foster high-order critical thinking in the learner?
- Does the site foster the ability to deal with big themes and ideas in the learner?
- Does the site foster self-education in visitors?
- Does the site foster reflection in visitors?
- Does the site provide opportunities for emotional growth?
- Does the site provide opportunities for personal growth?
- Does the site provide opportunities for spiritual growth?
- Does the site provide opportunities for moral development?
- Does the site foster character qualities such as strong self-esteem among the visitors?
- Does the site trigger high motivation?

- Investigate the issue of user disorientation
- Is the virtual museum platform attuned to the visitors' familiarity with it?
- Does the site allow the visitor to navigate linearly and unidirectionally from one stand to another, following a route that is predetermined?
- Does the site foster good goal orientation among the visitors?

- Investigate the presence of dynamic virtual platforms.
- How does the site attract the visitor towards the virtual dimension of the display?
- Does the site offer opportunities for visitors to engage in kinesthetic exercises?
- Does the site provide opportunities for learning safely in simulated environments?

- Investigate the presence of interactive platforms.
  - Is learning interactive?
  - Does the site foster active participation in the learner?
  - Is a degree of interactive reality incorporated in the site?
  - Does the site provide opportunities to contribute to the content of the museum?

- Investigate the involvement of visitors in the making of the virtual museum

Are the visitors encouraged to be involved in the different phases of virtual museum conception, namely in the communication, research, design, development, and deployment of games?

Conclusion:

In summary, to probe the quality of online museums, researchers should

investigate the up-to-date-ness of the site, the global access to the virtual museum by world users, the educational value of virtual museums, the extent to which virtual museum platforms are engaging, the extent of the presence of physical references incorporated in the design of a virtual museum, the extent to which virtual museum platforms are user-centric, the issue of user disorientation, the presence of dynamic virtual platforms, the presence of interactive platforms and investigate the involvement of visitors in the making of the virtual museum. Probing the right questions would optimize the educational value of online museums, thereby increasing their benefit to the community of learners locally and worldwide.

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Bibliography:

- Al-Taie, I., Di Giuseppantonio Di Franco, P., Tymkiw, M., Williams, D., & Daly, I. (2022). Sonic enhancement of virtual exhibits. *PLOS ONE*, *17*(8), e0269370. https://doi.org/10.1371/journal.pone.0269370
- Arabacioglu, S., & Okulu, H. Z. (2021). Using Virtual Museums to Promote Activity Design Competencies for Out-of-School Learning in Pre-Service Teacher Education. *International Journal of Technology in Education*, *4*(4), 644–667. https://doi.org/10.46328/ijte.183
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, *18*(1), 32. https://doi.org/10.2307/1176008
- Chekembayeva, G., & Garaus, M. (2024). Authenticity matters: Investigating virtual tours' impact on curiosity and museum visit intentions. *Journal of Services Marketing*, *38*(7), 941–956. https://doi.org/10.1108/JSM-09-2023-0343
- Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453–494). Lawrence Erlbaum Associates, Inc. https://www.taylorfrancis.com/chapters/edit/10.4324/9781315044408-14/cognitive-apprenticeship-teaching-crafts-reading-writing-mathematics-allan-collins-john-seely-brown-susan-newman
- Csikszentmihalyi, M. (1998). *Finding flow: The psychology of engagement with everyday life* (Basic Books). https://www.researchgate.net/publication/200026151_Finding_Flow_The_Psychology_of_Engagement_With_Everyday_Life?__cf_chl_tk=SsovaS_ncXkwT0PMAo44y4pZP2k1IpaVLglz.2pJ.UA-1759834690-1.0.1.1-ugt4zklDD4kMEl.F51.xWSZAuG9oPFllQKaBMulzCnI
- Dineen, R., Samuel, E., & Livesey, K. (2005). The promotion of creativity in learners: Theory and practice. *Art, Design & Communication in Higher Education*, *4*(3), 155–172. https://doi.org/10.1386/adch.4.3.155/1
- Dooey, P. (2008). Language testing and technology: Problems of transition to a new era. *ReCALL*, *20*(1), 21–34. https://doi.org/10.1017/S0958344008000311
- Ermatita, E., Puspasari, S., & Zulkardi, Z. (2023). Improving Students' Cognitive Performance during the Pandemic through a Machine Learning-Based Virtual Museum. *TEM Journal*, 948–955. https://doi.org/10.18421/TEM122-41
- Falk, J., & Storksdieck, M. (2005). Using the contextual model of learning to understand visitor learning from a science center exhibition. *Science Education*, *89*(5), 744–778. https://doi.org/10.1002/sce.20078
- Franceschi, R., & De MiGuel, L. (2021). Bibliographic review. The existence of virtual museums for educational purposes is applied to the professional environment. *Journal of Educational Technology and Online Learning*, *4*(3), 464–474. https://doi.org/10.31681/jetol.947155
- Genç Osman İlhan, Erol, M., & Özdemir, F. (2022). Virtual Museum Experiences of Primary School Teacher Candidates During the COVID-19 Pandemic Process. *Malaysian Online Journal of Educational Technology*, *10*(4), 232–243. https://doi.org/10.52380/mojet.2022.10.4.259
- Glass, R. & Spiegelman, M. (2007). Incorporating blogs into the syllabus: Making their space a learning space. *Journal of Educational Technology Systems*, *36*(2), 145–155. https://journals.sagepub.com/doi/abs/10.2190/ET.36.2.c

- Hmelo-Silver, C.E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235–266. https://link.springer.com/article/10.1023/B:EDPR.0000034022.16470.f3
- Hong, J.-S., Chen, B.-H., Hung, S.-H., & Hsiang, J. (2005). Toward an integrated digital museum system – the Chi Nan experiences. *International Journal on Digital Libraries*, *5*(3), 231–251. https://doi.org/10.1007/s00799-005-0116-1
- Islek, D., & Asiksoy, G. (2019). The Studies Conducted Regarding the Virtual Museum Area: A Content Analysis Research. *World Journal on Educational Technology: Current Issues*, *11*(1), 87-93. https://eric.ed.gov/?id=EJ1205376
- Kisiel, J. F. (2007). Examining Teacher Choices for Science Museum Worksheets. *Journal of Science Teacher Education*, *18*(1), 29–43. https://doi.org/10.1007/s10972-006-9023-6
- Jauregi, K., & Bañados, E. (2008). Virtual interaction through video-web communication: A step towards enriching and internationalizing language learning programs. *ReCALL*, *20*(2), 183-207. https://www.cambridge.org/core/journals/recall/article/abs/virtual-interaction-through-videowebcommunication-a-step-towards-enriching-and-internationalizing-language-learningprograms/0FBF5F37F94B448DB3D2173AFB463895
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press. https://books.google.co.ma/books?hl=en&lr=&id=CAVIOrW3vYAC&oi=fnd&pg=PA11&dq=Lave,+J.,+%26+Wenger,+E.+(1991).+Situated+learning:+Legitimate+peripheral+participation.+Cambridge+university+press.&ots=OEpHyoZHDq&sig=PgDhIZR4-VKtICLXW_gesSf6bAc&redir_esc=y#v=onepage&q=Lave%2C%20J.%2C%20%26%20Wenger%2C%20E.%20(1991).%20Situated%20learning%3A%20Legitimate%20peripheral%20participation.%20Cambridge%20university%20press.&f=false
- Li, Z., Zhang, Q., Xu, J., Li, C., & Yang, X. (2024). Gamification of virtual museum curation: A case study of Chinese bronze wares. *Heritage Science*, *12*(1), 348. https://doi.org/10.1186/s40494-024-01464-2
- Mamur, N., Özsoy, V., & Karagöz, İ. (2022). Digital Learning Experience in Museums: Cultural Readings in a Virtual Environment. *International Journal of Contemporary Educational Research*, *7*(2), 335–350. https://doi.org/10.33200/ijcer.799643
- Melber, L. M. (2008). Young Learners at Natural History Museums. *Dimensions of Early Childhood 36*(1), , 22–28. https://research.ebsco.com/c/kxwbvm/search/details/gm2qckj4y5?db=edo
- Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage Publications. https://uk.sagepub.com/en-gb/eur/qualitative-research-evaluation-methods/book232962
- Nichols, J. D., & Steffy, B. E. (1999). An Evaluation of Success in an Alternative Learning Programme: Motivational impact versus completion rate. *Educational Review*, *51*(3), 207–219. https://doi.org/10.1080/0013191999745
- Nugent, R. (2006). Civic, social, and political education: Active learning, participation, and engagement? *Irish Educational Studies*, *25*(2), 207–229. https://doi.org/10.1080/03323310600737552
- Picciano, A. G., & Steiner, R. V. (2008). Bringing the Real World of Science to Children: A Partnership of the American Museum of Natural History and the City University of New York. *Journal of Asynchronous Learning Networks*, *12*(1), 69-84. https://eric.ed.gov/?id=EJ83
- 7470

- Piro, J. M. (2008). Rembrandt and Collections of His Art in America: An NEH Curriculum Project. *Journal of Aesthetic Education*, *42*(2), 1–18. http://www.jstor.org/stable/25160275
- Rennie, L. J., & Williams, G. F. (2006). Adults' learning about science in free-choice settings. *International Journal of Science Education*, *28*(8), 871-893. https://doi.org/10.1080/09500690500435387
- Roffe, I. (2007). Competitive strategy and influences on e-learning in entrepreneur-led SMEs. *Journal of European Industrial Training*, *31*(6), 416–434. https://doi.org/10.1108/03090590710772622
- Soren, B. J. (1993). Nurturing Mind, Spirit, and a Love of the Arts and Sciences: Schools and Cultural Organizations as Educators. *Studies in Art Education*, *34*(3), 149. https://doi.org/10.2307/1320620
- Styliani Sylaiou, Athanasis Karoulis, Yiannis Stavropoulos, and Petros Patias. (2008). Presence-Centered Assessment of Virtual Museums' Technologies. *DESIDOC Journal of Library and Information Technology*, *28*(4), 55–62. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://d1wqtxts1xzle7.cloudfront.net/83811576/Presence-centered_assessment_of_virtual_20220411-32320-1sbw3sx.pdf?1738490576=&response-content-disposition=inline%3B+filename%3DPresence_centered_assessment_of_virtual.pdf&Expires=1759842794&Signature=I5pT3hAXJwZ9XCDaTDlc6X3TcQ9zXpxPk0gKjdUM1oaF7FtdTzaHWltoTXTrJWhX0Wb7DK83tWMGN6SCI4esMUDi8C6w~TCSLRVAbQfycJPKBNfy8B3EBQ9Z-OGz35hJ92p~i~94xueQ-G2ycDgD8gP3QRH3RkzMN8U8rqA-N4ldDWBNL8BORDU3iMYXdKGNqcVRH-ruR8roP1e62C-gTS~6DX6Tsi6FDnjSPz-TdotvvExXmIG~FCqJPfRrLJSk-7YUJ~xb9B3c7sihOvvF8LC8remwc0HnbtT6pjgiQT7CIYoHqwYKLc3FdqfsTCetR~V0RfLIu1Ix86QmTW2~Mw__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA
- Tsita, C., Satratzemi, M., Pedefoudas, A., Georgiadis, C., Zampeti, M., Papavergou, E., Tsiara, S., Sismanidou, E., Kyriakidis, P., Kehagias, D., & Tzovaras, D. (2023). A Virtual Reality Museum to Reinforce the Interpretation of Contemporary Art and Increase the Educational Value of User Experience. *Heritage*, *6*(5), 4134–4172. https://doi.org/10.3390/heritage6050218
- Umralieva, L., Tanirbergenov, M., Yeralin, K., Bolysbaev, D., Makhabbat, D., & Zhanar, S. (2021). Evaluating creative drama studies in virtual museums with teacher opinions. *World Journal on Educational Technology: Current Issues*, *13*(4), 980–993. https://doi.org/10.18844/wjet.v13i4.6286
- Underhill, L. G., & Navarro, R. (2023). The Virtual Museum: An African biodiversity database holding more than two million records. *Biodiversity Observations*, *13*, 252–269. https://doi.org/10.15641/bo.1443
- Vess, D. L. (2006). History to Go: Why iTeach with iPods. *The History Teacher*, *39*(4), 479. https://doi.org/10.2307/30037068
- Weiss, M. & Hanson-Baldauf, D. (2008). E-Mail in academia: Expectations, use, and instructional impact. *EDUCAUSE Quarterly*, *31*(1), 42–50. https://www.researchgate.net/publication/236856937_E-Mail_in_academia_Expectations_use_and_instructional_impact
- Wu, X., Chen, X., Zhao, J., He, T., Xie, Y., Ma, C., & Wang, W. (2023). Research on recognition and intervention of behavior sequences in virtual museum learning. *PLOS ONE*, *18*(9), e0285204. https://doi.org/10.1371/journal.pone.0285204

- Ya. Murzina, I. (2020). Museum As Information and Communicative Educational Institution. *KnE Social Sciences*. https://doi.org/10.18502/kss.v4i13.7711
- Zhang, Y., Zhang, B., Jang, W., & Pan, Y. (2024). Enhancing Spatial Cognition in Online Virtual Museum Environments: Integrating Game-Based Navigation Strategies for Improved User Experience. *Applied Sciences*, *14*(10), 4163. https://doi.org/10.3390/app14104163