Available Online at www.e-iph.co.uk
Indexed in Clarivate Analytics WoS, and ScienceOPEN

E-B Environment - Behaviour Proceedings Journal

IC-ACT2024Kuching

https://icactech.wixsite.com/first

e-IPH e-International Publishing House Ltd., United Kingdom

International Conference of Art And Creative Technology Malaysia
Borneo Cultures Museum Sarawak, Kuching, Sarawak, Malaysia, 23 - 24 October 2024
Organiser: Faculty of Art, Sustainability and Creative Industry, Sultan Idris Education University (UPSI), Malaysia

Improving User-Experience of Augmented Reality for Intangible Cultural Heritage of Yangjiabu Woodcut Craft through Participatory Approach

Li Run*, **Muhammad Zaffwan Idris**
** Corresponding Author*

Department of Multimedia Creative, Faculty of Art, Sustainability and Industry,
Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia

lirunshiny1997@163.com, zaffwan@fskik.upsi.edu.my
Tel: +60147224282

Abstract
This study explores how participatory design can improve user experience in AR applications for Yangjiabu New Year Woodcut Prints, a form of Chinese intangible cultural heritage. By involving designers, users, and cultural inheritors, the research aims to create AR products that respect cultural value while enhancing usability. The conceptual framework is based on prior literature and considers factors affecting user experience, cultural characteristics, and stakeholder relationships. This paper provides theory in support for the positive impact of participatory design on AR user experience in the context of intangible cultural heritage.

Keywords: Intangible cultural heritage; Augmented reality; Participatory design; User experience; Yangjiabu New Year woodcut prints

DOI: https://doi.org/10.21834/e-bpj.v10iSI36.7590

1.0 Introduction

1.1 Background

Cultural heritage includes tangible heritage, such as artifacts, buildings, etc., as well as intangible heritage such as traditions, knowledge, and rituals passed down from generation to generation. Cultural heritage reflects who we are and where we come from, and shapes the collective memory of groups, which is important for the development of human civilization (Wagner et al., 2023).

The release of the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage in 2003 brought "intangible cultural heritage" onto the world stage, into people's view, and research as an important topic. Before this, especially in Western countries, cultural heritage only referred to tangible heritage such as architectural heritage, and the research value of intangible cultural heritage, such as traditional folkloric skills, dances, and stories, was often overlooked.

Tangible objects are considered heritage because they express certain social values; the tangible needs to be understood and interpreted through the intangible, and the intangible needs the tangible to be transmitted. As Arjun Appadurai puts it, "Intangible heritage, by its very nature, serves as a map for human beings to interpret, select, reproduce, and disseminate cultural heritage, and is thus an important partner to tangible heritage (Munjeri, 2004). The protection and dissemination of intangible cultural heritage can help to reduce cultural homogeneity, increase human cultural diversity, and enhance human creativity (Idris et al., 2016).

DOI: https://doi.org/10.21834/e-bpj.v10iSI36.7590

As one of the oldest countries in the East, China is rich in resources of intangible cultural heritage due to its vast area and many ethnic groups (Dang et al., 2021). On May 20, 2006, the State Council of China issued a notice on the official website of the central government approving the Ministry of Culture's identification and publication of the first national list of intangible cultural heritage. The list divides the intangible cultural heritage into nine categories: folk literature, traditional music, folk dance, traditional drama, Chinese opera, acrobatics and athletics, folk art, traditional handicrafts, traditional medicine, and folklore, among which the YangJiaBu New Year woodcut prints are listed, belonging to the category of folk art.

As the first batch to be included in China's national intangible cultural heritage, YangJiaBu New Year woodcut prints used to be an indispensable item for every family during the Spring Festival. The late Ming and early Qing dynasties were the most prosperous period for the development of woodcut New Year prints. At that time, the annual sales volume of Yangjiabu New Year Woodcut Prints was as high as tens of millions. In addition to meeting the needs of local people, it was also exported to Jiangsu, Anhui, Shanxi, Henan, the three Northeast provinces of Inner Mongolia, and other places. It was famous for its variety, large scale, and wide sales range.

However, in modern life, the figure of woodcut New Year prints is more and more distant from us. On the one hand, due to the number of inheritors being down. The production process of woodcut New Year prints is very complicated, and the profit is not high; the young generation is not interested in engaging in this industry (Dai, 2018). On the other hand, the demand for New Year prints has dropped greatly. The main audience of woodcut New Year prints is farmers, and with the continuous development of China and the deepening of urbanization, the number of farmers has decreased rapidly. According to the latest data from China's seventh national census, the number of people living in rural areas is 509.79 million, accounting for 36.11 percent of the country's population, down by almost half from 63.91 percent 20 years ago. In addition, people living in the farming age in the past paid much more attention to the Spring Festival than modern people, and people's indifference to the Spring Festival customs is also one of the reasons for the decline in the demand for woodcut New Year prints (Feng, 2005). Each traditional skill is the wisdom of the ancestors and the wealth of the Chinese nation. The once-popular Yangjiabu New Year Woodcut Prints have once again come into people's vision and become the subject of research by many scholars in recent years.

In recent years, digitization and ICT (Information and Communication Technology) applications have been recognized as effective means of preserving cultural heritage (CH) while generating significant resources (Hou et al., 2022). The intervention of digital technology can, to a certain extent, preserve cultural heritage that is fading and or cannot be recovered, and break the limitations of time and space to give audiences a multidimensional sensory experience, which helps to enhance the breadth and depth of cultural communication. In addition, driven by the global pandemic, culture and digital technology are working more closely together (Wagner et al., 2023).

1.2 Issue

The core concept of human-computer interaction products is user experience, and AR design is no exception (Konstantakis, 2020). Most scholars regard user experience as a result and pay more attention to users' experience after interacting with products. However, user experience should not only be an evaluation of the outcome of the interaction, but it can be measured before and during user interaction with the product (Konstantakis et al., 2017). Therefore, when developing AR products for Chinese intangible cultural heritage, such as the Yangjiabu New Year Woodcut Prints, the user experience can also be evaluated at the early stage to understand user expectations and how the experience changes over time.

Compared with material cultural heritage, intangible cultural heritage pays more attention to human subjectivity. It can be said that without human participation, intangible cultural heritage will gradually disappear and cease to exist. Therefore, in the use of digital technology to express intangible cultural heritage, the importance of "people" can not be ignored. Moreover, in such a topic, there are often many people involved, including researchers, intangible cultural heritage inheritors, audiences, etc., and researchers are the active party. When a designer or researcher creates an artifact purely through their lens, without considering the perspectives and methods of others, the resulting work will reflect only their viewpoint and interpretation of reality (Rodil, 2018). It may not be possible to fully extract all aspects of the intangible cultural heritage, and sometimes the public may receive incomplete or even incorrect information.

To express all aspects of the heritage as completely as possible and give the audience a good user experience, participatory design may provide a way for the digital design of intangible cultural heritage. Participatory design is a design strategy that brings users into the core process of design, also known as ‘co-creation,’’co-design,’ or ‘collaborative design.’ It encompasses strategies that prove to be beneficial not just during the initial stages of a project, but also in the later design phase, allowing the end users of the product, service, or experience to engage actively in both stages of the solution they are collaboratively crafting. The defining principles of participatory design listed by Robertson and Simonsen are: 1. Take a stand, 2. Truly participate 3. Learn from each other 4. Practice 5. Design (Robertson & Simonsen, 2013).

1.3 Aims for the Study

Therefore, the focus of this research is to explore the process of building an AR product that can present all aspects of Yangjiabu New Year Woodcut Prints as much as possible and provide users with a good user experience. The rest of the study includes a brief methodology, evidence from the literature, a conceptual framework, and conclusions.

To better understand the process of using digital technology to disseminate intangible cultural heritage Yangjiabu New Year Woodcut Prints, we first reviewed the tripartite digitization model, then discussed the characteristics of Yangjiabu New Year Woodcut Prints and the problems encountered when using digital technology to disseminate, then sorted out the relationship between inheritors, AR designers, and users, and discussed the main factors affecting user experience. Based on the above considerations, we provide a moderate conceptual framework for the relationship and design process between Yangjiabu New Year Woodcut Prints, inheritors, AR designers, and users.

2.0 Literature Review

2.1 Tripartite Digitisation Model

More and more scholars believe that the inclusion of digital technology in the study of intangible cultural heritage has a positive impact on the protection of heritage. Therefore, an interdisciplinary approach is advocated that can include more digital technology solutions. The tripartite digital model proposed by Rodil et al. (2016) provides an observation Angle for the digitization of intangible cultural heritage, which includes three parts: capture, reproduction, and dissemination. The following fig.1 illustrates this approach.

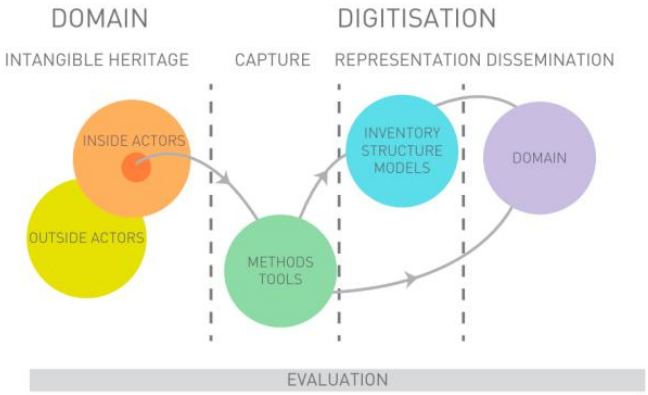

Fig.1: Tripartite Digital Model (Rodil et al., 2016)

The first phase in the Tripartite Digital Model is data capture for the chosen cultural resource. The capture must identify (i) the data source, (ii) the type of data, and (iii) the method and methodology for collecting the data, which may be text, audio, video, motion, and so on, depending on the reason for which the data is acquired, and none is more useful. In addition to identifying data sources, it is crucial to differentiate among various data types. This distinction is important, as it significantly influences the methods used for data analysis. For instance, written documents (data sources) may include eyewitness testimonies or ethnographic studies. Meanwhile, a video (data type) could capture anything from a television news broadcast to a traditional dance performance (Rodil et al., 2016). Finally, it is essential to develop and reach a consensus on data collection techniques and methodologies. In this step, the people involved in the activity are mostly designers, inheritors, or craftsmen.

After the data is collected and analyzed, it needs to be structured in some way or another. In this case, ontology provides a suitable representation that allows qualitative reasoning about the structure of the data. This step is reproduction. In structuring the data, the participants are mostly researchers and professional designers.

The next step is dissemination, and there is no denying that the mode of communication is quietly changing with the change of technology. From paper prints to computer and mobile phone screens to VR eyes, sensors, and other interactive communication methods. The process of communication is an interactive process among designers, intangible digital products, and users. Some researchers try to classify communication into static, dynamic, and interactive communication strategies. Static dissemination refers to the one-way transmission of an aspect or content of the intangible cultural heritage to the audience, such as the static dissemination of articles published in journals or video materials recording the intangible cultural heritage. Dynamic dissemination refers to the simultaneous search for resources and a combination of resources, such as users searching for multiple samples of an element on the intangible cultural heritage archive web page. Interactive dissemination refers to allowing the audience to experience aspects of the intangible cultural heritage in some way, such as teaching crafts in a classroom and enabling the audience to manipulate them themselves.

2.2 Augmented Reality (AR)

Augmented reality is the addition of virtual information on top of the real-world view and the display of enhanced views. It is often used in outdoor scenes to enrich what is still visible by superimposing virtual reconstructions on the real picture (Persada et al., 2018). Most exhibitions of intangible cultural heritage require the free and unrestricted movement of visitors, which has led to people's preference for mobile use of smartphones when exploring the exhibition (Galatis et al., 2016).

2.3 User Experience (UX)

User Experience (UX) is a basic notion of Human-Computer Interaction (HCI) that is widely employed even though no consensus has been achieved on its extent (Konstantakis, 2017). User experience (UX) is a complex concept that includes the research, development, and assessment of the interactions that shape how a user engages with a service, product, or system. User experience (UX) stems from a combination of a user's intrinsic factors—such as their behavior, expectations, needs, and motivations—and the features of the designed system or product, which include aspects like complexity, intended purpose, usability, and functionality. Additionally, the context or environment in which this interaction takes place also plays a crucial role in shaping that experience (Konstantakis et al., 2018).

A range of UX metrics exists to assist with collecting and understanding data within a cultural framework. Hassenzahl and Tractinsky (2006) identified these metrics as tools for assessing user experience. A good UX is typically defined by two main components: pragmatic and hedonic qualities, and further broken down into the following eight criteria.

- Usefulness
- Reliability
- Ease of use
- Efficiency
- Accessibility
- Identification
- Pleasure
- Stimulating

Through the above eight dimensions, users' expected user experience when using AR products of Yangjiabu New Year Woodcut Prints can be evaluated, and the obtained data will help design AR products that are more in line with users' expectations.

Xu and colleagues (2024) introduced two concrete augmented reality interfaces tailored for cultural artifacts: Postcard AR and Cube Museum AR. They conducted three user studies to evaluate and enhance these designs. The results demonstrated that gamified physical augmented reality interfaces significantly boost users' motivation, engagement, and performance in exploring cultural heritage.

2.4 Participatory Design

The intangible legacy is a dynamic entity, a cultural realm that includes a wealth of know-how, shaped through stories, oral traditions, personal experiences, and communal practices, continually adapting to cater to the diverse needs of its various audiences. Consequently, besides bridging the gap between digital archivists and individual bearers of intangible cultural heritage, it's just as crucial to refresh communication strategies with the wider public, aiming for an interactive exchange that emphasizes creating knowledge(Hou et al., 2022). For this aspect of intangible cultural heritage, participatory design is very crucial. When a designer develops a product solely from their perspective, ignoring alternative ways of expressing ideas or different approaches to interaction, the outcome will inevitably reflect just that designer's worldview and interpretation of reality (Rodil, 2015).

Participatory Design is a design method in which developers collaborate closely with users to create better-suited solutions. From a political standpoint, participants must be empowered to create their digital legacies and tools, which they will ultimately come to utilize (Kensing & Blomberg, 1998).

One fundamental principle of Participatory Design is to engage in design activities within the users' environment, as developers must gain insights into the context where their creations will be utilized. This understanding can be achieved through ethnographic approaches and discussions that are rooted in the specific setting. Simultaneously, the participants, referred to as co-designers, become familiar with the technology, empowering them to think critically and impact the development process. (Rodil, 2017).

Kelty and colleagues present a framework consisting of seven dimensions for participatory design, originally tailored for the realm of information technology, but potentially relevant to a variety of contexts. The aim is to guide research-driven practices within a more extensive field of participatory design by providing a prescriptive framework that lays down the foundational principles of the agenda. It also offers a defined tool for analysis and execution, all the while allowing room for experimentation. Kelty et al. (2015) identified seven dimensions, which are:

1. The educative dividend of participation
2. Access to decision-making and goal setting, in addition to task completion
3. The control or ownership of resources produced by participation
4. Its voluntary character and the capacity for exit
5. The effectiveness of voice
6. The use of metrics for understanding or evaluating participation
7. The collective, affective experience of participation

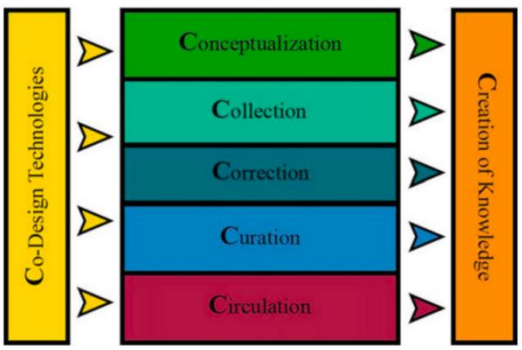

Fig.2: 7C Model (Maasz et al., 2018)

Maasz et al. employed the 7c approach of participatory design to conserve and expand indigenous knowledge. Their research and development efforts are guided by a community-based codesign methodology that is founded on participatory design and action research principles. Continuous collaboration with all study participants is pursued (Maasz et al., 2018). All encounters between researchers and the community are contextualized by a variety of unknown and unpredictable elements that encourage reciprocal learning.

2.5 Characteristics of Yangjiabu New Year Woodcut Prints

Zhang Lian (2015) in "Yangjiabu New Year Woodcut Prints Artistic Characteristics" analyzes three aspects: modeling, composition, and color, and points out that the modeling of Yangjiabu New Year Woodcut Prints has the characteristic of programmed modeling, which refers to the Yangjiabu New Year Woodcut Prints summarizing, refining, and creating twice the objects to be depicted to form a regularized and fixed expression of the depicted objects so that they can be quickly and efficiently portrayed with simplicity and clarity. The essence of the corresponding things can be portrayed quickly, effectively, and simply. In terms of composition, New Year's paintings are characterized by "fullness" and "symmetry". The fullness of the composition not only meets people's aesthetic needs but also has a certain connection with the printing process, because Yangjiabu New Year Woodcut Prints are all hand-printed; if there is a large area of blank space on the plate, it is easy to cause the paper to collapse and pollute the picture. In terms of color, Yangjiabu New Year Woodcut Prints are composed of contrasting colors of red, green, yellow, and purple, which are bright, vivid, and harmonious, in line with the cheerful atmosphere of festivals, and therefore have become the traditional coloring method of Yangjiabu New Year Woodcut Prints.

Fig. 3: Yangjiabu New Year Woodcut Prints (Gate-God prints)

3.0 Methodology

A study of relevant research was done to investigate publications that use digital technology to communicate intangible cultural assets and to suggest techniques that may benefit the design process. Queries are created, and various search phrases and keywords are utilized to gather data. Data are sourced from SCOPUS, ScienceDirect, Wiley, and other reliable databases. Keywords and search phrases include "user experience", "augmented reality", "intangible cultural heritage", "participatory design", and "tripartite digitization model". The search phrases were combined with the Boolean operators AND, OR, and wildcards (" ") to find all relevant papers. The researchers restricted their search to 2015 to 2024 to discover and incorporate all relevant studies. They removed all material that was not classed as research publications, such as papers, book chapters, books, and debates, from the review. Following the initial search, researchers performed deduplication, standardized formatting, and validity screening on all data.

4.0 Initial Findings

Based on literature review and data analysis, this paper proposes a conceptual framework for designing an AR system for Yangjiabu woodcut New Year prints. This framework is not an empirical summary but is derived from three aspects:

(1) Participatory design literature explicitly states that multi-stakeholder collaboration enhances the usability and cultural appropriateness of digital cultural products;

(2) Research on intangible cultural heritage digitization emphasizes that user participation strengthens cultural understanding and interactive experiences;

(3) Data processing results indicate that the symbolic and cultural semantics of New Year prints require joint interpretation and selection by designers, inheritors, and users.

Therefore, this study's conceptual framework proposes that incorporating a designer-heritage bearer-user collaboration mechanism into the AR design process can enhance user satisfaction across three dimensions: cultural accuracy, usability, and aesthetic experience. Although this framework has not undergone empirical validation, its clear theoretical derivation provides a solid foundation for subsequent prototype development and user testing as a theoretical model.

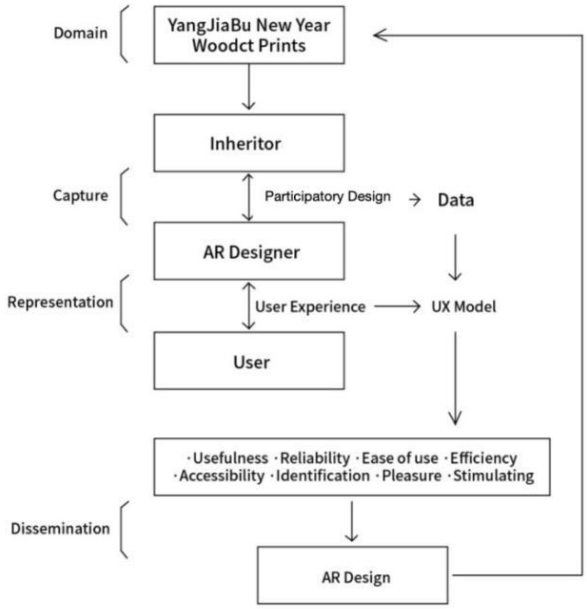

Fig.4: Conceptual Framework

5.0 Discussion

In recent years, intangible cultural heritage has attracted the attention of more and more scholars, and the Chinese government is also encouraging the protection and dissemination of intangible cultural heritage. The addition of modern digital technology has revitalized the ancient traditional culture of intangible cultural heritage, and the number of users using digital technology is also increasing.

This study and future studies based on this framework are intended to help the AR products of Yangjiabu Woodcut New Year Prints bring users a good experience, and users who get a good experience can join the ranks of the dissemination and protection of intangible cultural heritage, to form a virtuous circle. This study can reveal how benign interactions are formed between different participants in the process of digitization of intangible cultural heritage, and the data generated by interaction is conducive to the experience of intangible cultural heritage digital products. This study can improve the design process of intangible cultural heritage digital products and refine the ways of capturing, reproducing, and disseminating them in the process, which is conducive to the sustainable development of intangible cultural heritage.

6.0 Conclusion & Recommendations

This study developed a conceptual framework for the Yangjiabu Woodcut New Year Prints AR system based on participatory design theory and intangible cultural heritage digitization research. Findings indicate that through collaboration among designers, inheritors, and users, the AR system's cultural accuracy, usability, and user experience can be enhanced. This framework provides a theoretical foundation for subsequent prototyping and empirical research.

Future research can advance in three directions: conducting user testing to validate the framework's applicability in actual AR prototypes; expanding participant types to include more inheritors and users across different age groups; and deepening cultural content modeling to optimize the alignment between New Year print semantics and interactive methods.

Acknowledgment

The author is very grateful to the University Pendidikan Sultan Idris (UPSI) for their work at the Borneo Cultures Museum Sarawak, Kuching, Sarawak, where the 1st ICACT was held. Thank you to WOS Publishing for completing the research for this project.

Paper Contribution to Related Field of Study

The study involves identifying key factors in the user experience of digital interaction design of intangible cultural heritage to explore strategies for using digital technologies to develop intangible cultural heritage and enhance the efficiency of the dissemination of intangible cultural heritage knowledge. The protection and dissemination of intangible cultural heritage involve three parties: designers, inheritors or craftsmen, and users. As a design method suitable for multi-party collaborative work, participatory design helps to bring together various forces to present all aspects of intangible cultural heritage more comprehensively.

References

Achiam, M., Haldrup, M., & Drotner, K. (2021). Experimental Museology: Institutions, Representations, Users (1st ed.). Routledge.

Bekele, M. K., Pierdicca, R., Frontoni, E., Malinverni, E. S., & Gain, J. (2018). A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage. Journal on Computing and Cultural Heritage, 11(2), 1–36.

Dai W. (2018). Research on the value and protection of Weifang YangJiaBu New Year Woodcut Prints. Humanities World (02), 39-43.

Dang, Q., Luo, Z., Ouyang, C., Wang, L., & Xie, M. (2021). Intangible Cultural Heritage in China: A Visual Analysis of Research Hotspots, Frontiers, and Trends Using CiteSpace. Sustainability, 13(17), 9865.

De Luca, V., Barba, M. C., D'Errico, G., Nuzzo, B. L., & De Paolis, L. T. (2023). A user experience analysis for a mobile Mixed Reality application for cultural heritage. Virtual Reality, 27(4), 2821–2837.

De Paolis, L. T., Gatto, C., Corchia, L., & De Luca, V. (2023). Usability, user experience and mental workload in a mobile Augmented Reality application for digital storytelling in cultural heritage. Virtual Reality, 27(2), 1117–1143.

Feng Jicai.(2005). The Value of Chinese Woodcut New Year Pictures and the Significance of Census -- General Preface of Chinese Woodcut New Year Pictures. Folk Culture Forum (01),53-58.

Hou, Y., Kenderdine, S., Picca, D., Egloff, M., & Adamou, A. (2022). Digitizing Intangible Cultural Heritage Embodied: State of the Art. Journal on Computing and Cultural Heritage, 15(3), 1–20.

Idris, M. Z., Mustaffa, N. B., & Yusoff, S. O. S. (2016). Preservation of Intangible Cultural Heritage Using Advance Digital Technology: Issues and Challenges. Harmonia: Journal of Arts Research and Education, 16(1), 1.

Galatis P, Gavalas D, Kasapakis V, et al (2016) Mobile augmented reality guides in cultural heritage. In: MobiCASE, pp 11–19

Kensing F, Blomberg J (1998) Participatory design: issues and concerns. Comput Support Coop Work (CSCW) 7:167–185

Konstantakis, M., Michalakis, K., Aliprantis, J., Kalatha, E., & Caridakis, G. (2017). Formalizing and evaluating Cultural User Experience. 2017 12th International Workshop on Semantic and Social Media Adaptation and Personalization (SMAP), 90–94.

Konstantakis, M., Aliprantis, J., Teneketzis, A., & Caridakis, G. (2018). Understanding user experience aspects in cultural heritage interaction. Proceedings of the 22nd Pan-Hellenic Conference on Informatics, 267–271.

Konstantakis, M., & Caridakis, G. (2020). Adding Culture to UX: UX Research Methodologies and Applications in Cultural Heritage.

Legal Instruments UNESCO. 2003. Convention for the Safeguarding of the Intangible Cultural Heritage 2003.

Levin, I., & Mamlok, D. (2021). Culture and Society in the Digital Age. Information, 12(2), Article 2.

Lenzerini, F. (2011). Intangible Cultural Heritage: The Living Culture of Peoples. European Journal of International Law, 22(1), 101–120. https://doi.org/10.1093/ejil/chr006

Maasz, D., Winschiers-Theophilus, H., Stanley, C., Rodil, K., & Mbinge, U. (2018). A Digital Indigenous Knowledge Preservation Framework: The 7C Model—Repositioning IK Holders in the Digitization of IK. In D. S. Jat, J. Sieck, H. N.-N. Muyingi, H. Winschiers-Theophilus, A. Peters, & S. Nggada (Eds.), Digitisation of Culture: Namibian and International Perspectives (pp. 29–47). Springer Singapore.

Munjeri, D. (2004). Tangible and Intangible Heritage: From difference to convergence. Museum International, 56(1–2), 12–20.

Persada, A. G. (2018). Emotional Design on User Experience-based Development System. 2018 International Conference on Electrical Engineering and Computer Science (ICECOS), 225–230.

Robertson, T., & Simonsen, J. (2013). Participatory design: An introduction. In T. Robertson & J. Simonsen (Eds.), International handbook of participatory design (pp. 1–17). Routledge.

Rodil, K. (n.d.). A Perspective on Systems Design in the Digitisation of Intangible Cultural Heritage.

Rodil, K. (n.d.). Reflections on Visualization in Cross-Cultural Design.

Rodil, K., & Rehm, M. (n.d.). A Decade Later: Looking at the Past while Sketching the Future of ICH through the Tripartite Digitisation Model.

Rodil, K. (n.d.). Reflections on Visualization in Cross-Cultural Design.

Wagner, A., & De Clippele, M.-S. (2023). Safeguarding Cultural Heritage in the Digital Era – A Critical Challenge. International Journal for the Semiotics of Law - Revue Internationale de Sémiotique Juridique, 36(5), 1915–1923.

Xu, N., Li, Y., Wei, X., Xie, L., Yu, L., & Liang, H.-N. (2024). CubeMuseum AR: A Tangible Augmented Reality Interface for Cultural Heritage Learning and Museum Gifting. International Journal of Human-Computer Interaction, 40(6), 1409–1437.