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Immersive Technologies for Improving Visitors' Digital Experience in Contemporary Crafts Exhibitions

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Introduction

Professional craft practitioners are now working across a broad range of crafts disciplines, including basketry, ceramics, galss, jewellery, metalwork, and so on, using a contemporary aesthetic. Contemporary craft practice is no longer restricted to making objects, but also includes consulting and other knowledge-based services based on craft skills (Brown 2014). This research aims to explore how to use immersive technologies to digitally represent the contemporary crafts, especially the material aspects in museum exhibitions. It also aims to investigate how immersive technologies may enhance visitors' digital experience in the contemporary crafts exhibition. Based on the literature review, this paper firstly elaborates the crafts from dimensions of practicality, cognition and ontology in the contemporary context. This research is interested in exploring and understanding how the different humanistic values of crafts can be captured through the interactions with the digital craft objects in immersive exhibitions, either physical or virtual domains.

This paper describes several common immersive technologies and different roles they may play in a museum environment. Through case studies, the paper indicates the role of immersive technologies in improving visitors' digital experience in the contemporary crafts exhibitions and investigates how immersive technologies may enhance visitors' digital experience to identifying suitable solutions to meeting visitors' expectations in contemporary crafts exhibitions. Accordingly, the research further elaborates approaches to designing an immersive exhibition of contemporary crafts within a digital experience based on the practical, cognitive, and ontological aspects of craft.

Understanding Crafts in the Contemporary Context

In *Craeft: How Traditional Crafts Are about More than Just Making*, Langlands (2017) explains the term 'craft' in etymology and comes to understand 'craft' as a broad

concept. The history of the word ‘craft’ in English goes back to the Anglo-Saxon civilisation around 1200 years ago. The Old English word for ‘craft’ was ‘craeft’, which was first used by Alfred the Great (849–899AD) when he translated the classical Latin text into Old English. The meaning of ‘craeft’ at the time was very diverse and difficult to define in a single way, as it had different meanings in different contexts. The word ‘craeft’ became a universal word used by the king to solve a series of translation dilemmas regarding words with multiple meanings. In Anglo-Saxon sources, ‘craeft’ means ‘power or skill in the context of knowledge, ability, and a kind of learning’ that includes physical skill, but also mental and spiritual virtue or excellence.

Figure 1: The framework of craft research proposed by Alexander Langlands in 2017.

Langlands (2017) argues that the multiple uses of “craeft” to solve Alfred's translation dilemmas illustrates the deeper meaning of the term, which expresses a ‘quality or state of being’ that is impossible to define. Drawing on this interpretation of ‘craeft’ in Old English, the author further elaborates that the word ‘craft’ has three meanings: ‘physical skill’, ‘mental skill’ and ‘spiritual skill’ (see Figure 1). Regarding the physical dimension, a craftsman knows not only how to use materials according to the conditions of nature and seasons, but also how objects and systems connect and fall apart to realise function. Regarding mental skill, craftsmen think more deeply about where the materials come from, how they are made and what happens to them after

use. Spiritually, craft provides a meaningful understanding of the materiality of the world through coordination. Craft practitioners take pleasure in using their skills and expertise by craft-making with increasing contemplation and meaning in human life.

There are many interpretations of 'craft' in previous studies. From the perspective of aesthetics, crafted objects are assumed to be made with love and care, which are related to touch, sight and cognition (Rowley 1997). Combined with these aesthetic values, craft (unlike art) is characterized by the making of functional objects that serve a useful purpose (Becker 1978). Before the Arts and Crafts movement, craft was seen as several related definitions. Metcalf (2002) noted that the skilled work is a form of secret knowledge in ‘craft’. It also meant the decorative arts, which denoted handmade luxury goods for use and display inside buildings as well as for use and display on the human body. Craft as handmade objects has long traditions of pre-industrial production. It also meant trades and folkways, which tended to take place in and around the home, were eroded by the availability of mass-produced consumer goods (Metcalf 2002).

In the twenty-first century, craft is a discourse that contributes to the social world and our identities within it (Phillips & Hardy 2002). Viewing craft in this way focuses attention on the personalised relationships between producers and consumers (Bell et al. 2018). According to Bell et al. (2018), craft is defined by culturally and socially constructed patterns of action and language that are the result of social relations. Consequently, it develops continuously and is inextricably linked to the socio-cultural, economic, and historical circumstances in which it occurs.

In the contemporary context, craft is commonly understood as 'culture of making', 'tacit knowledge', and 'localisation'. It also represents a 'way of thinking'. Viewing craft in this way can transform what we know as 'invisible knowledge' into 'explicit knowledge' that can be explained and transmitted (e.g. Niedderer & Townsend 2014). Some of the leading contemporary scholars in the West who have devoted themselves to discovering and exploring the scientific and humanistic value of 'craft' include Glenn Adamson (2010), Howard Risatti (2007), Richard Sennett (2008), Trevor Marchand (2016), and Kristina Niedderer (2009), among others. Although they have their own theoretical perspectives due to their different disciplinary backgrounds, they have a consensus that the essence and value of traditional craft

lies in the humanistic values conveyed through its materiality (artefacts, skills and knowledge) and worldview.

Aboriginal Australians also have a rich craft culture that is closely linked to both ceremonial ritual and daily life. Australian Indigenous crafts are typically manufactured from natural materials, such as plant fibres, human hair and animal fur. Aboriginal people first learned to make functional items, including baskets, nets, bags, fish traps and other objects, either through traditional means or techniques introduced to their culture. Once they comfortably mastered the employed techniques, they managed to create the space for more innovative work. In this way, Aboriginal artists describe their important stories and personal life experiences, reconnecting and reinterpreting their cultural heritage and expressing their cultural identity (Keller 2010).

In summary, ‘craft’ in its contemporary context is a broad and sophisticated concept. It covers all aspects of humans’ productive life – from the manufacture of a toothpick to the design of an aerospace facility, from the production of a single product to the overall planning of a service system. It could be further elaborated from three dimensions, which are practicality, cognition, and ontology.

Practicality: crafts create an ecological regional material culture

Adamson (2010) defines ‘craft’ in an open-ended way, suggesting that it is a relatively small-scale production activity based on the use of materials and centred on skill and expertise. This definition expands the scope of craft, including manual labour in the pre-industrial revolution. It encompasses traditional crafts, modern crafts and contemporary crafts in the multimedia digital age. However, these definitions and interpretations undeniably agree that craft is the embodiment of materialised knowledge, materials, localism and small-scale production (Shiner 2012). Scholars generally discuss the relationship between knowledge and the tangible elements of craft. For example, Sennett (2008) argues that crafts establish ‘spheres of skill and knowledge that humans cannot express in terms of verbal ability’. These techniques, skills and expertise are acquired over a long period of time by engaging in a slow-paced process of handcrafting. The knowledge cannot be acquired entirely in the form of verbal knowledge in the classroom, but must be learned, mastered and internalised in practice. The knowledge is passed on from generation to generation, developing and even innovating.

Normally, craft products have a low environmental impact. Lots of traditional craft materials, such as wood, wool and vegetable dyes, are renewable. Human labour is often an important part of the production process and is also renewable. The ecological character of craft products is not only expressed with eco-friendly resources, renewable raw materials and respect for nature, but also reflected in the cultural essence of craft products (Steward 1972). Crafts use local raw materials and appropriate techniques in a local context. The use of techniques is limited and influenced by the specific context, adapting as it changes. This process of continuous evolution creates a unique culture that becomes part of the local ecosystem, producing material products adapted to local characteristics. At the same time, craft products that contain local culture also reflect ecological and cultural change. Although the 'cultural ecology' (Steward 1972) can be used to explain the interrelationship between craft products and local culture, the arguments need to be further elaborated and explored to analyse the ecological interactions between the production of craft culture and its environment.

Cognition: crafts reflect systematic cognitive and thinking styles

The perception of craft has changed due to the development of cognitive research, neuroscience, philosophy of thinking and ethnographic fieldwork, particularly in relation to the transmission and learning of craft knowledge through apprenticeship. Crawford (2010) argues that crafts embody multiple ways of perceiving and can generate complex thought processes. Polanyi (1997) interprets craft practice as a kind of 'tacit knowledge' or 'imaginative knowledge'. For example, one must acquire the skills of driving or cycling in practice, rather than by only receiving theoretical knowledge. Moreover, Polanyi (1997) sees the acquisition and transmission of 'tacit knowledge' as a complex cognitive process that derives from other types of knowledge (e.g. abstract and conceptual explicit cognition). In *The Craftsman*, Sennett (2008) points out that human reflection and self-awareness are present and occurring in the crafting process, rather than unconsciousness and self-judgement. And such judgements act back on habits that are only intentional, thus altering preconceived schemes. Thus, intentional cognition and abstract explicit cognition interact inseparably in the crafting process.

Experience and practice are essential in acquiring and sharing 'tacit knowledge' of craft. The quality of craft products depends on the joint use of experience and practice. They represent two aspects of human wisdom: empirical and conceptual cognitions. Gardner (2000) proposed the Multiple Intelligence Theory, which

suggests that physical experiential intelligence and logical abstract cognitive intelligence are equally important. In addition, some scholars argue that the ‘tacit knowledge’ of craft can be encoded, externalised, and taught. Most of a craftsperson's intrinsic or intentional (tacit) knowledge can be illustrated or translated into a text so that it can be taught (Niedderer & Townsend 2014). Nimkulrat (2012) explains that ‘positioning craft practice in a research context can facilitate the reflection and articulation of knowledge generated from within the researcher-practitioner’s artistic experience, so that the knowledge becomes explicit as a written text or as a means of visual representation.’ This compiled explicit knowledge can in turn correct the deficiencies of cognitive conceptual thinking in empirical practice.

Furthermore, Follett and Valentine (2010) argue that the thinking process in crafting is system-thinking. Craft can be used as an effective medium to provide design organisations with plenty of information, particularly in the context of interdisciplinary collaborations (e.g. Woolley 2011). The complex thinking system and material entity of craft knowledge facilitates knowledge sharing and cross-boundary exchange. These interdisciplinary collaborations integrate different fields of knowledge through 'boundary objects', using the mindset of crafting process (Brown & Duguid 1998).

Ontology: crafts as 'authentic' beings

The 'authenticity' of crafts refers to both material authenticity and philosophical authenticity, especially the latter, which is related to 'moral psychology, identity and duty' (e.g. Jones & Yarrow 2013). In terms of material authenticity, traditional crafts use natural materials, human labour and ecological resources. Sennett (2008) indicates that the driving force of craft-making derives from the desire to create perfect craft products. Such pursuit is not only technical but artistic and individual, as the initial motivation is driven by the individual's requirements for materials and skills. However, with control of material and technique, craft practitioners could achieve a kind of self-satisfaction that brings freedom, beyond the initial constraint determined by the properties of the material and the rules of the technique. In this process, craft practitioners critically review their goals and values and take responsibility for their work.

Niedderer (2009) similarly argues that 'authenticity' is produced during the intimate interrelationship between crafts, makers and users in the process of making and using craft respectively, which is expressed in the authenticity of the association between craft makers and users. However, neither machine-controlled mass

production nor modern mechanised management can produce high-quality human behaviour or self-fulfilment. The physical skills as traditional intelligence are eventually stripped away by instrumental rationality, and traditional artisans are 'de-skilled' (Tweedie & Holley 2016). In recent years, a growing number of researchers and practitioners have become more pertinent in criticising modern meaningless and purposeless craft work and its inauthenticity, based on numerous examples of empirical sciences (e.g. Marchand 2010). In these studies, the dignity and value of craft and the hand-head-heart interaction are confirmed. Crafts become more authentic and ethical in our life.

To summarise, the cognitive and ontological significance of craft is in fact much greater than the practical dimension. However, the essence of craft cannot be manifested only in the other two dimensions, without the practical dimension. Thereby, reconstructing the meaning of craft in the contemporary context is an important proposition for the further craft studies. Adamson (2010) argues that the definition of craft is always being established through its external differences. This suggests that craft is not just a product of the pre-industrial revolution; rather, the practical, cognitive and authentic value of craft can be used as references in contemporary theories and future design practices.

The Application of Immersive Technologies in Museum Exhibitions of Traditional and Contemporary Crafts

This research is interested in exploring and understanding how we can capture the different humanistic values of craft through the interaction with the digital craft object in a museum context, either in physical or virtual domains.

It should be emphasised that an increasing number of museums around the world are innovating new ways to connect with their audiences with immersive technologies. The different types of immersive technology include 360-degree tours, virtual reality (VR), augmented reality (AR), mixed reality (MR), and extended reality (XR). The 360-degree tour is the most basic and familiar immersive technology. Most smartphones enable museum visitors to view 360-degree images of an exhibit or the whole exhibition space, wherever they are. Virtual reality is another very familiar type of immersive technology which enables visitors to perceive virtual experiences as though they were authentic (Guttentag 2010). By providing an opportunity for personalised and tailored cultural heritage experiences (Southall et al. 2019), VR enables visitors to access inaccessible objects (Jung & Michopoulou 2019) and

delivers reflective learning experiences within the cultural heritage context (Han et al. 2019). Augmented reality is a different type of immersive technology which combines the real and virtual world, while allowing real-time interaction and aligning real objects or places and digital information in 3D (Azuma 1997). This means that museum visitors who experience AR are not completely shut off from the real world. Instead, AR extends their real experience by offering them the opportunity to examine selected museum objects from various viewing angles in a virtual environment. MR is somewhat a combination of AR and VR. The MR environment can engage with multiple senses (e.g. audio, motion, haptics, taste/flavour, and smell) – for example, to display realist diorama or virtual art – and is often augmented by touch-screen systems and large projections or displays (Reiss & Tunnicliffe 2011; Tunnicliffe & Scheersoi 2015); visitors make sense of the real and/or virtual world around them with some flexibility of interactions and senses (Goffman 1986). Extended reality is the term used to describe the full spectrum of immersive technologies (VR, AR, MR) and refers to experiences in which technology is used to enhance, support, improve, or change the affordances of reality (Orr et al. 2021). XR focuses on weaving together each enabler's heterogeneous interaction layers so as to deliver a unique experience, one that integrates users in both a physical and a virtual representation of the same geographical space at the same time (Margetis et al. 2021).

Following are a few examples of digital representation in exhibiting traditional or contemporary crafts. Each of them uses different immersive technologies.

Case Study 1: The Small Museums Alliance Representing Territory (SMART) project in Austria

There are many small thematic museums in the Alpine area that tell the stories of history, culture, and ancient crafts. The SMART project aims to preserve the historical and cultural heritage of local communities and to offer visitors new opportunities to discover and experience the Alpine area from anywhere in the world. Accordingly, the project has created several web-based augmented reality experiences. The experiences are accessible directly through a web browser on both desktop computers and smartphones and tablets, without the need for an app.

Using a desktop computer or laptop, visitors can explore the 3D models of crafts by zooming in and out of and turning the objects around with the mouse. For the easiest access to the AR experiences, visitors can simply scan the QR codes with a smartphone or tablet to place the objects into their own spaces. After scanning,

visitors can click on the icon at the bottom right of the 3D visualisation and then place the object into their own spaces to start the AR view.

Figure 2: “The Stag of the Biberg”, 3D model of the bronze figure in AR viewed from a smartphone

In the AR view, the size, angle and location of the object can be changed, depending on the user’s own space. Users worldwide may enjoy the AR experience, hence their level of satisfaction increases parallel to the use of AR technology.

Case Study 2: The Glass Drawing Room Virtual Reality Experience from the Corning Museum of Glass (CMOG) in New York

The Glass Drawing Room virtual reality reconstruction was designed as an in-gallery experience as part of the exhibition *In Sparkling Company: Glass and the Costs of Social Life in Britain During the 1700s* (May 2021–January 2022). As part of the exhibition, the Corning Museum of Glass has recreated this now-lost interior in virtual reality through a 360° video that present visitors with an opportunity to explore every corner of the room and view the mirrored glass panels come alive in all lights, especially candlelight.

Figure 3: One of the 360° scenarios from the Glass Drawing Room video tour

Figure 4: Full rendering of the Glass Drawing Room

Figure 5. The VR Exterior of Glass Drawing Room at night

> The exhibition's version of the Glass Drawing Room was developed using Autodesk 3D (a computer graphics program) and Unity (a 3D rendering engine) by Noho and MakeBelieve, a group of virtual reality specialists based in Dublin and Athens. Unity provides a real-time experience that allows the user to move around the room freely or use the controller to jump to any fixed point. Because the period of the room relied on natural or candlelight for illumination, users have the ability to switch between day or night with the press of a button. Switching from day to night is transformative, taking the user back to a warm but vulnerable candlelit time. (CMOG 2021)

This VR experience was designed to run on both the VR headset and a large interactive touchscreen within the exhibition space. Instead of digitally representing a single glasswork, the exhibition provides a real-time experience that allows visitors to move around the room freely with VR devices. By using Unity, which is a 3D rendering engine, visitors can press a button to switch the lighting in the virtual room between day and night. The experience would have been even more impressive if visitors could have interacted with any single object (e.g. a glass light) to experience the material aspects of the objects.

Case Study 3: Web-based exhibition of various contemporary craftworks of graduates at the University of the Arts London

The University of the Arts London has constructed a web-based exhibition of graduates' craftworks. It aims to explore how to represent material aspects of crafts in a contemporary context. These contemporary crafts are represented by 360° imagery or videos to inform the audience about contemporary craft-making research, process and products.

For instance, focusing on ceramic and homeware design, Phoebe Ho has handmade a series of ready-to-use vases. The process of craft-making is represented by photos that offer the audience a deep impression of the designer's research and handmaking story. The products are digitally represented from different angles using 360° imagery, which allows the audience to observe the marks and grooves that punctuate the face of each vase. Viewers are allowed to take these vases home as a gift of mindfulness for raising the level of consciousness in their daily lives.

Another example is a collection of jewellery made by Maggie Heya Wang. The collection integrates two of the most natural materials – wood and stone. The movable elements of the designs interact subtly with the wearers' motion so that the stones seem to merge with the wood, thus generating a novel tension. The video displays diverse jewellery wearing approaches through the wearers' interactions to demonstrate the materials' non-deformable properties through forces of nature such as tension and gravity.

Design for Visitors' Digital Experience in Immersive Exhibitions on Contemporary Crafts

Examining the above case studies, we see that digital representation in contemporary crafts can be conducted from a perspective of practicality, cognition and ontology.

From the practical perspective, immersive exhibition design in contemporary crafts should be focusing on digitally representing the material aspects of contemporary crafts. Many museums are actually in the process of prototyping digital models of crafts. For example, the Australian Museum in Sydney owns a collection of 3D glasswork objects made by German glassmakers in the late 19th century. Using Photogrammetry, a variety of photographs of the object from different angles can be captured and stitched together. By dragging and clicking a mouse around the loaded 3D images, web users can view and explore the objects in different sizes and dimensions. Colours and textures of the objects are well represented digitally and the clear 360° imagery allows web users to observe the more detailed features of the objects.

Figure 6a: *Aureliana augusta, a* German glasswork in late 19th century, collected by the Australian Museum, Sydney

Figure 6b: The 3D model of *Aureliana augusta*

From the cognitive perspective, exhibition design should be focusing on how to use immersive technologies to explain craft knowledge, especially the knowledge used during thinking and making processes. A good example is the digital experience on glass in the French National Conservatory of Arts and Crafts, Paris. This 2020 project aimed to use digital storytelling about the process of glass-making to improve visitor engagement. It featured a mobile app that was developed with AR technology and a living room demonstration. Users could scan the objects with the app and then view them in AR space. Concerning the fact that some objects were related to other objects that were displayed in different museum spaces, the virtual objects associated with the glass-making process could be picked up in the same virtual room and placed at the right step. The most interesting features of the experience were that users could pick up objects and place them back again, objects could be collected in a treasure chest for later use, objects could be used with other objects by placing them with a marker next to that other object, and referenced media for the collected object was available as background information, while a collection of digital objects could be used to make simple puzzles. As a gamification element, the user received badges after completing specific tasks or reaching certain goals. The glassworks were not digitally represented in this case; however, the digital representation of the tools of glassmaking and the AR game provided visitors with an immersive experience that was helpful to understanding the glassmaking process, while giving an insight into prototyping virtual contemporary craft models.

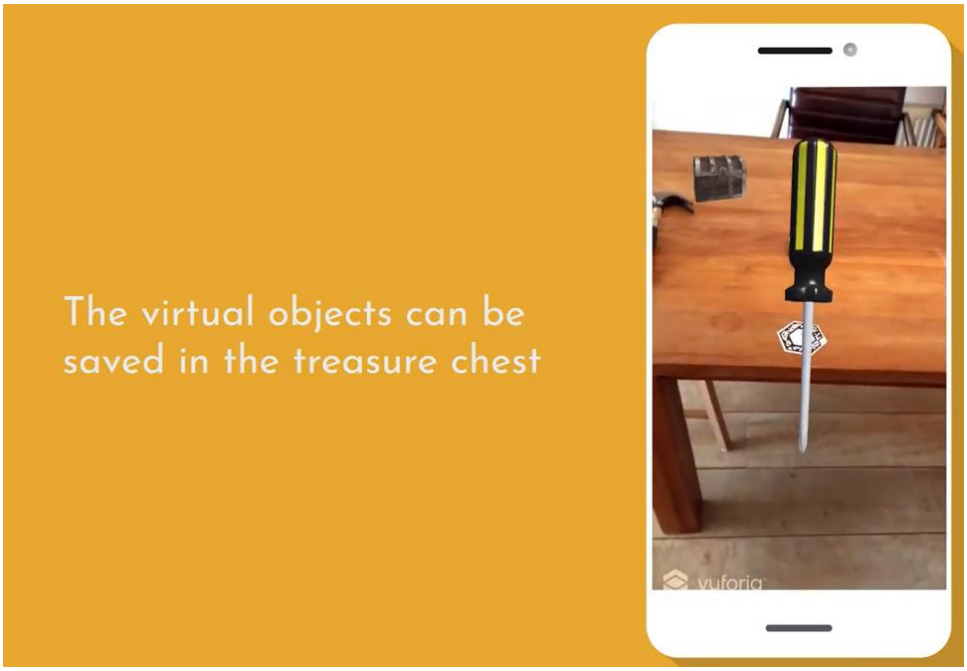

Figure 7: An animated presentation on the AR game about using glassmaking tools (https://www.youtube.com/watch?v=mKdIHrIoJjU&t=3s)

From the ontological perspective, appropriate immersive technology can be used to tell the stories of contemporary craft practitioners by representing how they gain self-fulfilment through their physical skills and express human values. Taking as an example an immersive exhibition on the ancient Chinese craftsmanship and culture of gilt-decorated black lacquer in Shanghai, the exhibition was like a long landscape scroll that began with Chinese craftsmanship from the golden age of cultural exchange between East and West in the 17th and 19th centuries and progressed to a contemporary interpretation of traditional craftsmanship. Using cutting-edge visual and audio technologies, a variety of digital narrative scenarios played out in chronological order, creating a multi-sensory interactive experience for visitors. For example, visitors were able to view a historic trading story or a specific craft-making process by touching a certain part of the screen. The traditional craftsmanship was transformed from history into a powerfully rich and interactive celebration of Chinese craft culture and community, while the exhibition information was augmented through the interactivity and content enrichment. It also supported a sense of identity, especially with regards to the history of Chinese craftsmanship.

Figure 8. Large-scale projections with digital narrative scenarios about Chinese gilt-decorated black lacquer (Photo by Fangqing Ma, Oct 2022)

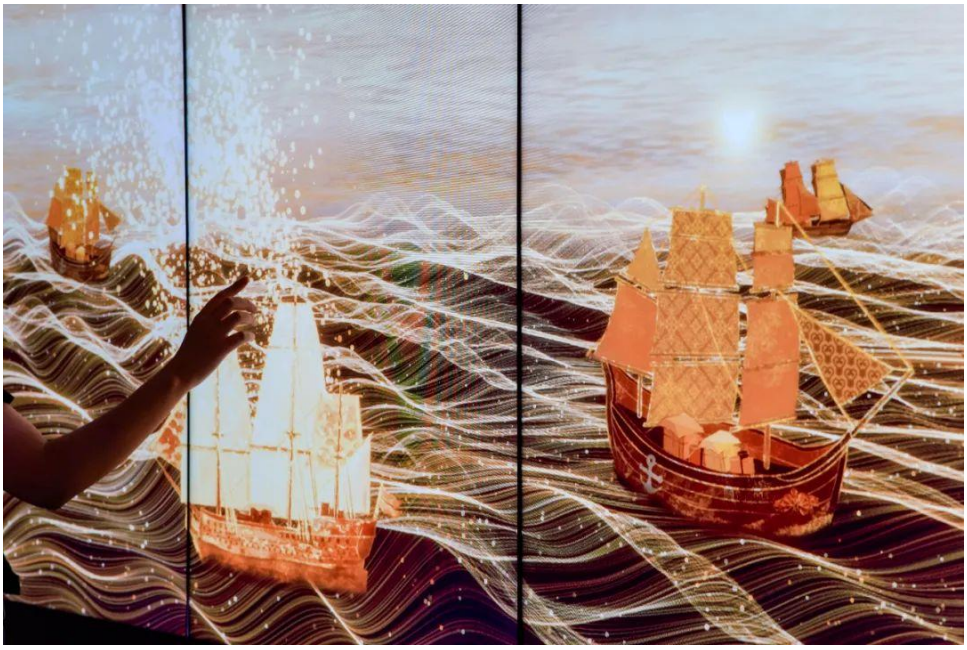

Figure 9. A visitor is touching a certain part of the screen to view a historic trading story (Photo by Fangqing Ma, Oct 2022)

Conclusion

A growing number of museums around the world aim to create a memorable experience by designing immersive scenarios to engage visitors in craft-making stories. Approaches to digital representation of contemporary crafts can be developed that stimulate the senses of visitors to the museum's collections, adding to the emotional and cognitive experience of the exhibit. Museum visitors retain their expectations of the history and culture of contemporary crafts even through advanced technology. Museum curators and exhibition designers are expected to employ new methods — from idea development and conceptual creation to storytelling and sensory design — for representing contemporary craft practitioners' spiritual world. Suppose museums aim to promote multi-sensory access to the diversity of contemporary crafts? In this case, an immersive exhibition offers the opportunity to reconstruct and visualise embodied knowledge with digital materials, which should be prepared to account for the logic of learning.

In summary, immersive technologies can give visitors access to the general dimensions of digital representations of contemporary crafts physically or virtually. Enhancing storytelling about contemporary crafts and creating an experience that elicits a desired emotion or response, immersive technologies can structure rich exhibition scenarios, especially in virtual spaces. With the development of 3D printing, lots of craft practitioners would like to represent their artwork with this

technology. Thus, there is also an opportunity for mixed reality technologies combining digital experience with 3D printing to give a sense of touch and texture of craft in the near future.

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