

Designing Cultural Values into Interaction

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ABSTRACT

In this paper, we highlight possibilities for designing intangible cultural values into interactions with technologies in heritage spaces. We do this specifically through the design of *ʔeləwkw* — *Belongings*, an interactive tangible table installed in a cultural heritage museum. The tabletop was collaboratively designed to communicate complex and narrative information and values about Musqueam culture. Rather than focusing only on content and interface design, we wanted visitors to also experience Musqueam values through their interactions with the system. We describe our value-sensitive design process, present five interdependent design goals, discuss the design strategies that enabled us to meet these goals, and evaluate our approach through a user study. From our design process and evaluation we offer recommendations for designing values into interactions more generally and for tangible interactions specifically in ways that support visitors' experience and understanding of specific cultural values through technology.

Author Keywords

Intangible cultural heritage; indigenous heritage; museums; tangibles; digital tabletops; value sensitive design.

ACM Classification Keywords

H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces, Evaluation/Methodology.

INTRODUCTION

Researchers are increasingly exploring how human values take shape in our digital technology (e.g. [19, 21, 44]). While initially these explorations examined universal values, culturally specific values can also be designed into digital systems and our interactions with these systems [10]. At the same time, museums continue to incorporate technology into exhibits, allowing visitors to engage with information in different ways and in greater depth. Digital

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CHI 2017, May 06-11, 2017, Denver, CO, USA

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ACM 978-1-4503-4655-9/17/05...\$15.00

DOI: <http://dx.doi.org/10.1145/3025453.3025908>

technologies are also being used to move beyond a focus on tangible heritage objects to address the challenges of safeguarding intangible cultural heritage—the traditions or living cultural expressions that are passed on from generation to generation [43, 62]. In this paper we highlight possibilities for designing intangible cultural values into interaction in heritage spaces. We do this specifically through the design of an application for a multi-touch tangible table. Much of the work in this area has been focused on how and what visitors learn through interaction with tabletops (e.g. [2, 3, 4, 14, 15, 34]), how to design to support visitor engagement (e.g. [5, 8, 40]), and issues around initiating and sustaining interaction in public spaces (e.g. [23, 35, 37]).

The intersection of these research domains remains largely unexplored, yet holds great potential for using interaction design to convey cultural values and presenting intangible elements of culture in interactive museum exhibits. How do we design to convey and allow others to experience intangible cultural ideas, such as values?

In this paper we explore how collaborative interaction design could convey such values, driven by our research question: *What are effective design strategies that enable visitors to directly experience cultural values while they interact with Indigenous knowledge using a tangible tabletop system?* We examine the design goals, our design strategies related to each goal, and the evaluation of *ʔeləwkw* — *Belongings*, an interactive tangible tabletop at the Museum of Anthropology (MOA) at the University of British Columbia (UBC) which uses replicas of belongings from *čəsnaʔəm* (an ancient village site where modern day Vancouver, Canada is now located) with Musqueam intangible cultural knowledge and was part of the *čəsnaʔəm, the city before the city* exhibition exploring this history through the voices of Musqueam community members. From our analysis we offer generalizable design recommendations that can be used by researchers and designers of tangible interaction who want to support users in experiencing intangible elements of culture.

We will introduce ourselves here to situate ourselves as the authors, curators, researchers, and designers. We, the authors and faculty members and students from UBC and Simon Fraser University (SFU), comprised the core development team. Rowley at the time was co-head of the

Department of Anthropology at UBC, Associate Professor, and Curator of Public Archeology at MOA. She has significant experience working collaboratively with the Musqueam Indian Band, and she and Wilson, a Master's student at UBC and a member of the Musqueam Indian Band, were the co-curators of MOA's exhibit. Our SFU team included Hennessy, an Assistant Professor with a background in anthropology whose own work is focused on the collaborative development of culturally specific new media applications and installations, and Antle, an Associate Professor who has expertise in tangible computing and embodied interaction. Matkin was a Master's student under Antle, and Muntean was a Master's student under Hennessy and the project manager of the tabletop. Our team also included two undergraduate students who had previously completed work with Antle. While the UBC team provided the content and museum-related support, the SFU members focused on the technical aspects of development, interaction design, fabrication of the physical aspects of the tangible interface, and the programming of the tabletop. All team members participated in the overall activity design of the table.

We begin this paper with a summary of related work, then outline our five interdependent design *goals* and describe the design *strategies* we employed to achieve these goals. Next we present our visitor study along with our results and design *recommendations* derived from what we have learned about designing cultural values into interaction.

RELATED WORK

Our work is situated in the areas of Value Sensitive Design, collaborative design with Indigenous communities, cultural heritage in human-computer interaction, and museum tabletop exhibits.

Value Sensitive Design

Value Sensitive Design (VSD), developed by Friedman, Khan, and Borning [19, 21], considers how human values are embedded within technologies and how these technologies can in turn shape values. Instead of the original, universal "values of human import" of VSD [20], here we look at certain cultural values that the design team carefully considered before the specific and specialized system was developed. Le Dantec et al. called for such an extension of VSD [44], recognizing that the classification of values was limiting and the "ex post facto value analysis" allowed for examining how systems affect users but not for informing system design. Borning and Muller later reflected on the next steps for VSD [10]. In this paper we take up three of the four topics discussed: addressing the universal vs. culturally specific values issue as an empirical one, strengthening Musqueam voice in publications, and making our own voices as researchers and designers more clear. Durrant et al. drew upon concerns from VSD in their research on values in curating videos in a human rights archive [18]. They noted a particular challenge for interaction designers is to enhance cultural engagement

with sensitive archive materials while supporting empathic interactions, a challenge we take up in a different context here.

Collaborative Design with Indigenous Communities

Designing with Indigenous communities has similarities to and divergences from theories of participatory design and co-creative experiences (e.g. [7, 39, 40, 55, 58]). We see our collaborative process as more closely related to ideas of post-colonial computing as examined by Irani et al. and its response to uneven economic and power relations and cultural epistemologies [38]. The authors mention examples of information management systems as an intersection of cultural understandings and technology [61, 63] while grappling with issues of cultural property ownership (e.g. [11]), and we see our work as extending these ideas of creating technologies that communicate traditional cultural knowledge and allow for multiple ontologies and worldviews (e.g. [13, 48, 60]). The collaborative models displayed by museums and Indigenous communities (often in developing databases for cultural heritage) (e.g. [29, 31, 32, 33, 53, 54, 57]) informed our design process, though our work here explores new technologies for communicating this cultural information to the public.

Intangible and Digital Cultural Heritage in HCI

While the study of cultural heritage is an established domain in HCI research (e.g. [16, 22, 28, 46, 66]), the study of intangible and digital heritage remains underexplored in HCI (see [9]). This is not to say that no one is conducting such research. There are authors discussing new media and museums in the digital age (e.g. [41, 51]), looking at the digitization and safeguarding of cultural heritage [1, 45, 47, 52], technology for the museum space [27, 42], and connecting different forms of heritage such as natural, tangible, and intangible [24, 30]. Giaccardi and Palen explain how evolving information and communications technology can allow multiple media and interactive technologies to work together for users to experience and think about cultural heritage differently [25]. Multimodal or cross-media interaction can facilitate the exploration of tangible and intangible aspects of heritage together and allow new ways to engage with specific cultural values. Indeed, there are many examples of collaborations with Indigenous communities on multimodal projects that allow for archiving, storytelling, and interacting with intangible cultural heritage (e.g. [37, 56]). Our work contributes to this space by exploring how we can use the unique features of tangible touch tables in particular to convey both tangible and intangible cultural heritage to museum visitors.

Tangibles and Tabletops in Museums

Researchers are studying the design and use of tangibles in museums for both navigating the museum itself (e.g. [12, 65]) or information in interactive exhibits (e.g. [17, 49]). One example by Horn describes an approach to tangible interaction in which designers can evoke "social constructions or conventions", cultural forms such as counting systems, games, or currencies that often involve a

physical artifact (Horn suggests that a high fidelity reproduction of the original cultural form is necessary) [34]. Horn and others have shown that cultural forms can be used for interaction design to utilize users' cognitive, physical, and emotional resources to increase usability and create meaningful experiences for users and observers [5, 34, 36, 59]. We extend this work, using cultural forms for interaction and experiencing values.

Mapping Place is an exhibit that introduces cultural concepts through the combination of a multi-touch table and an interface of physical objects [14]. It is based on a culturally specific storytelling device that utilizes beads, shell fragments, and carvings on a wooden board to guide stories and record history. The activity teaches the Luba peoples' mapping practices and perspectives through embedded cultural logic and structure, though Chu et al. found that participants who received a lesson before interacting with the exhibit showed better conceptualization and utilization of abstraction and symbolism in ways more similar to the Luba [14]. We wanted create this type of background lesson in the system itself, thus preparing visitors to experience values through their interactions.

Hornecker presents a field study of the *Tree of Life*, an interactive multi-touch tabletop exhibit that allows visitors to access information through a question-answer dialogue [35]. The question-answer format did not engage users as deeply as hoped and there were not enough layers to allow users to delve deeper. Others have recommended design approaches that may alleviate these issues such as presenting activities that initiate construction and testing of hypotheses, discovery, and meaning making (e.g. [15, 35, 64]) and reward visitors for early successes as well as for persistence in exploring further content [2, 15, 23, 35]. A balance between drawing visitors in and enabling them to persist and gain deeper understandings is key [15, 23, 35].

DESIGN REQUIREMENTS AND GOALS

The *ʔeləw̓kʷ — Belongings* project emerged in the context of the long-term collaboration between MOA and the Musqueam Indian Band (described in greater detail in [50]) and was designed in conjunction with members of the Musqueam community. Our collaborative design process and focus on values was a result and continuation of this relationship.

During our first design meeting, we developed nine main goals for the project, including highlighting Musqueam voices which was central to the overall exhibition. This session allowed us to see where our personal goals (and values) were as curators, designers, and researchers. Our team's interactions with the Musqueam Indian Band included representation at the Exhibit Advisory Committee meetings with Musqueam elders, visits to Musqueam reserve land to collaborate with community members on creating the photographic imagery, and incorporation of Musqueam language and values in our process. The Exhibit Advisory Committee was integral to ensuring that

Musqueam's voice and values drove the exhibitions. Rowley and Wilson were members of this committee and attended the weekly meetings, reporting on our work and asking questions on behalf of our *ʔeləw̓kʷ — Belongings* design team. Many images on the tabletop were taken by community members, but Muntean also visited Musqueam to take photographs. For example, Muntean and Wilson worked with the Musqueam Fisheries Commission to photograph the fish preparation process and develop the main tabletop image.

The development team worked to incorporate Musqueam cultural values, and even their *hən̓q̓əmin̓əm* language, in the design process including all related documentation and communications, such as using Musqueam's approved abbreviation for *čəsnaʔəm*, *csnm*, in file names and even in the code written for the tabletop application. Another example of this focus on values is evident in the use of the term "belongings" in the title of the tangible table and throughout this paper. While belongings excavated from *čəsnaʔəm* are more commonly referred to as "objects" or "artifacts", the Musqueam see them as still belonging to the hands that created them. As such, we adopted the term *ʔeləw̓kʷ*, a *hən̓q̓əmin̓əm* term meaning belongings, to discuss what has been removed from *čəsnaʔəm*.

This collaborative design with cultural partners and the reflection upon cultural values throughout the process were so important that we consider them to be requirements for the design process. It is through this process that our goals and design recommendations developed. From the beginning of this process it was evident that Musqueam values and traditional knowledge were important to convey. Yet we wanted to move beyond descriptions of values and enable people to directly experience these values. Our commitment to this direction emerged early in the process and was likely a result of wanting to honor Musqueam's intentions for the exhibition and representation of their culture [26] and our own desire as designers and researchers to push the boundaries of design. In addition to these two requirements, we agreed upon five interrelated design goals that we hoped, when met, would enable visitors to experience cultural values through their interaction with a tabletop system.

Design Goal 1 [DG1]: Draw in People

In line with previous work (e.g. [3, 37]) our first goal was to draw in people to the space and initiate interaction with the table. Since the table was to be placed in a small alcove that was part of the larger exhibition, we needed a way to attract visitors into the space and encourage them to engage with our system.

Design Goal 2 [DG2]: Learn about Musqueam Culture

At the simplest level, we wanted people to learn something new about the Musqueam people, culture, and identity both past and present. The curators noted that by displaying ancient belongings, visitors might mistake material culture to be the same as culture, resulting in a false impression that

Musqueam culture is only about the past. Our learning goal was for visitors to understand that Musqueam is a contemporary society that has existed in the region for thousands of years.

Design Goal 3 [DG3]: Understand Richness of Belongings
Building on the basic knowledge in DG2, we also wanted visitors to understand the richness of information about the belongings, including how they were used and how common they were. In line with trends designing exhibitions for cultural heritage (e.g. [25]) and the notion of cultural forms [34], we wanted to display the belongings in such a way that people could interact with them physically rather than passively view them behind glass.

Design Goal 4 [DG4]: Understand Complexity of Stories
Building on DG2&3 and addressing issues raised in [35] about lack of depth and the importance of understanding the complexity of value-laden content [3], we wanted visitors to understand some of the complexity of information related to belongings excavated from *čəsnaʔəm*. We envisioned visitors learning some of the many stories related to each belonging.

Design Goal 5 [DG5]: Experience Cultural Values
Rather than telling visitors about culture values, our goal was to have visitors experience values through their interaction, adding cultural specificity to ideas from previous work that showed how enabling visitors to make their own interpretations about values through interaction had a greater impact than simply telling them about values [6]. Learning basic information about Musqueam culture through DG1-4 would provide context for visitors to experience values through interaction, similar to the prior lesson in [14]. We determined the values we wanted to focus on during the development process working with the curator and representatives of the Musqueam Indian Band. The most important value we wanted visitors to experience was that Musqueam cultural knowledge should be treated with respect. Other values included the importance of *hənčəminəm* language, the acknowledgment of belongings as still belonging to the ancestors who created them, and that access to culture knowledge is not given freely but should be earned. Our goal was for visitors to experience these four values through their interactions with the table.

SYSTEM DESCRIPTION AND DESIGN STRATEGIES

ʔeləw̓k^w — *Belongings* comprises a Samsung SUR40 table, three monitors, twelve replicas, and two activator rings. The physical installation occupies part of the exhibition space with three walls, with one monitor on each wall (See Figure 1). One monitor plays a series of photographs detailing the process of cleaning a fish. The remaining monitors are each associated with one of the ring tools. The table itself sits in the center of the space, displaying an image with a top-down view of a fish-cutting table. A rolling museum cart is nearby with twelve physical belongings for use on the table: six ancient belongings (celt, slate blade, cedar bark, net weight, decorated piece, and harpoon) and six

contemporary belongings (Coke can, ice cube, quarters, keys, status card, and tide chart).

The monitors are intended to contribute to our goal of bringing people into the space [DG1]. The main monitor facing the gallery incorporates rich visuals with the slide show of a fish being cut and cleaned. The two side monitors display an image with all twelve belongings and play videos of Musqueam community members when visitors unlock special stories by exploring the belongings, thereby connecting tangible and intangible heritage.



Figure 1. Museum setup ©Reese Muntean

Salmon fishing is used as an overall theme for the table, because it has been part of the Musqueam way of life for thousands of years, supporting DG1 and DG2. The image on the table shows a fish cutting table surrounded by related contemporary tools. Different items appear in the image including the bloody fish, fish fillets, knives, an axe, a woodpile, an iPhone, an oilcan, a gas can, a fishing net, boots, pavement, and a tote of fish. While the image serves to bring people over to the tabletop and offer a sense of Musqueam identity, each of these areas of the image also matches one of the physical belongings.

The belongings sit next to the tabletop on the cart. Like cultural forms [34], the replicas of ancient belongings were designed to look and feel as similar to the originals as possible [DG3]. However by allowing visitors to learn about the ancient belongings by directly handling them physically we break with traditional social practices around museum artifacts, which are typically behind glass.

Because they would be handled, we made sure that the look, texture, and weight were as close as possible to that of the original belongings. With permission from the Musqueam Indian Band, molds of the original belongings in MOA were made and replicas cast. The molds and material allowed us to approximate the texture and weight of the originals. The replicas were hand painted to match the details and colour variations of the originals. For the modern belongings we used the actual items coated in resin or sealer. Using the belongings as system inputs required the use of fiducial markers on each belonging, so we modified them to be small enough that they would not distract from the belonging or hinder the use of the belongings on the table. The cart, too, was incorporated as part of this dedication to representing the belongings accurately. In museum storage, artifacts are kept in small plastic zip lock bags. On the cart, we placed the belongings

on top of zip lock bags containing a slip of paper with an image of the replica and its name in hənqəminəm.

The two wooden rings sit on the table and are painted to match the specific monitors. There are four hənqəminəm terms etched around the rings, which serve as activators for the belongings. The hənqəminəm is included here to reiterate the importance of traditional language as included in our goals, DG2 and DG5.

Instructions are positioned on two sides of the table. The instructions include an illustration that shows how to put a belonging in the ring and text that explains the four hənqəminəm categories on the ring. These categories are *stem tə ʔi ?* (What is this?), *tətələt* (Understanding it), *snəweyət* (Teachings since childhood), and *cyəθəs* (Having stories). When a belonging is placed in a ring on the table, a digital ring with the English translations of the hənqəminəm etchings appears on the table around the physical ring.

To access each category, visitors must complete different interactions, akin to small matching puzzles. The categories reveal different layers of information about the belongings as a way to convey the complexity of the stories that these belongings can embody [DG4]. This information appears on the table in the form of quotes from Musqueam community members, images, text, and historic documents. The activities required for each category take time and thought, and the correct answers are not always obvious. This was intended as a way for visitors to earn cultural knowledge and spend time engaging with Musqueam values. Once visitors complete the first three categories, they unlock a video of a Musqueam community member sharing their culture, stories, and lived experiences [DG5].

USER SCENARIO

We will now walk through each of these categories to explain the interactions involved and give examples of specific belongings and the information connected to them.

stem tə ʔi ? (What is this?)

To access basic information about a belonging's function, a user must place a belonging in an activator ring on the tabletop. This activation of the belonging brings up cards on the table that explain what the belonging is and what it was used for. This simple interaction brings people into the activity [DG1] and communicates information about the physicality of the belonging [DG3]. Handling the belonging and accessing the basic information meets the goal of understanding the use and place of the belongings in everyday life. With the small stone belonging, visitors feel the weight and texture of the rock and learn that it is a net weight that was used to place fishing nets in the river. Once visitors have basic knowledge they can explore *Understanding it* or *Teachings* which add different layers to the information about the belongings [DG2-4]

tətələt (Understanding it)

When visitors touch the *Understanding it* section of the digital ring, dotted lines appear around hotspots on the table

that correspond to particular belongings. The visitor must move the belonging and ring over the correct spot on the image to access information about a belonging's importance and place in Musqueam life.

Some connections are more obvious than others, e.g. the slate blade and the modern knife are both used for cutting. Other connections are more abstract and do not relate directly to the belonging's use, like the Indian status card that pairs with the tote of fish because of the fishing regulations imposed on First Nations by the Indian Act. The information cards in this case explain how the fishing tradition of the Musqueam people has changed with the laws that have been imposed upon them.

snəweyət (Teachings since childhood)

Visitors can learn more about the belongings in the *Teachings* category by matching an ancient belonging to its contemporary counterpart. Rather than connecting a belonging to the underlying image, here visitors are asked to make connections between the ancient and modern physical belongings. Through this activity visitors learn about continuity of Musqueam culture.

When a visitor touches the category on the digital ring, a black circle appears just outside the ring. Visitors place the matching belonging in the circle. The Coke can matches to the celt, representing extensive trade networks. The Coke can actually represents the global market economy, and the celt tells the story of Musqueam's history of trade. Ancient Musqueam people, too, had far-reaching trade routes that enabled them to acquire resources—like the nephrite from which this celt was crafted—that were unavailable in the region.

cyəθəs (Having stories)

When visitors touch *Having Stories*, a progress bar (specific to that belonging) appears to show how much more of the belonging they need to explore before they can unlock the video, encouraging them to spend more time with the information [DG5]. Once a visitor successfully completes the interactions for the first three categories, the progress bar becomes a button, allowing them to play a video clip with a Musqueam community member sharing his or her own personal narrative relating how they learned certain aspects of Musqueam culture and knowledge, relating intangible cultural knowledge to belongings.

USER STUDY

We conducted a field study of our *ʔeləw'k'v* — *Belongings* in the gallery space at MOA to address our research question: *What are effective design strategies that enable visitors to directly experience cultural values while they interact with Indigenous knowledge using a tangible tabletop system?* The study consisted of observations and open interviews with 24 visitors. Two researchers conducted this study in the gallery space over the course of two weeks. We collected data for 11 men and 13 women ranging in age from 18 to over 50 years old.

Researchers observed visitors interacting with the table. When a visitor had spent at least 2 minutes with the table and successfully put a belonging in a ring to access *What is this?*, a researcher would ask them to participate. We settled on this time and interaction milestone method of visitor selection as the one with the least bias. We drew from Block et al.'s study [8] on fluid grouping at tabletop exhibits, excluding those who the researchers characterized as *Shoppers* and *Joiners*. If the visitor agreed to participate, the researcher would step aside as they continued their exploration of the table. When visitors had finished using the tabletop, they filled out a brief questionnaire with demographic information and completed a structured interview lasting 10-20 minutes.

Data Collection

Our observational notes provide evidence that addresses how visitors entered the space and began interaction [DG1]. We designed our interview questions to explore visitor experience related to our other design goals [DG2-5]. We asked about visitor experiences in order of the goals (from entering/engaging to basic learning to deeper learning and the experience of values).

We began the interview with questions on what visitors learned about Musqueam culture and how they learned this (e.g. *What was something that surprised you about Musqueam culture that you didn't know before?*) [DG2].

To gauge visitors' understanding of the belongings and their stories [DG3&4], we asked questions about what they thought the objects represented, why they thought we called them belongings and if they saw any relationships between the four categories on information for each belonging (e.g. *While using the table, you placed different objects in the ring. What do you think those objects represent?*).

We asked visitors questions about what they learned of the values of Musqueam people [DG5] (e.g. *Can you describe what you learned about Musqueam values that you didn't know before? How did you learn this?*). We followed up by explicitly telling them that one Musqueam value is that culture knowledge should be treated with respect and then asked visitors to describe if/how they might have experienced that with the tabletop. We also asked if there were any other values that might have been reflected in what they were doing with the belongings on the table. We followed up by explicitly mentioning each value and asking visitors to describe if/how they might have experienced that with the tabletop (e.g. *A central Musqueam value is that cultural knowledge should be treated with respect. Can you describe any ways you might have experienced this value in the exhibit by what you did?*).

Analysis

Interviews were audio-recorded and transcribed. In our analysis we looked at data from each interview question separately. In order to address the interdependent nature of our design goals we also looked across data sources to

explore how our inter-related strategies impacted visitor experience. Three researchers individually analyzed the transcriptions using open coding to identify emergent themes. The researchers individually went through two passes of the interview transcripts alongside observational notes. In the first pass we each identified themes, in particular looking for themes that related design features with visitor responses or behaviours. We looked for themes that were common, interesting, unexpected or indicated problems with the design. In the second pass we each fine-tuned our description of the themes and looked for inter-relationships between them. Then the three researchers worked as a group and compared themes. We had inter-rater agreement on all themes except one, for which we discovered we had used different terms to describe the same elements. While this level of coherence was unexpected, it gave us confidence in the reliability of our coding.

RESULTS

Our analysis provides evidence for validation of our approach of using inter-related goals and design strategies to enable museum visitors to experience Musqueam cultural values through interaction, and highlights areas where we need further refinement or exploration.

While acknowledging that our consent protocol influenced the time spent with the table, our participants interacted with the table for at least 4 minutes, with an average of 8.8 minutes and a median of 6.5 minutes. One participant spent 40 minutes using the table. Participants overall enjoyed the experience and left with new information about Musqueam culture.

We also note that while our participants logged a total of 212 minutes with the tabletop, no one was able to access a video by exploring all four categories of information. User interface issues were a factor here, and we addressed these issues in a software upgrade (which is not reported in this paper), drawing on insights from this user study.

Engaging and Learning about Musqueam Culture

We found that three design features contributed to achieving our goals that people would enter the space, interact with the table, and learn something new about Musqueam culture. The visually interesting salmon cutting slide show and the fish cutting image on the tabletop were successful in attracting people into the space and conveying basic information about Musqueam life. The cart of physical belongings also drew people in and immediately informed them visually about the culture due to their display in this particular exhibit context as well as the inclusion of both ancient and modern belongings. All participants understood that the Musqueam people were a fishing society in the past, and that they still live in Vancouver today and carry on the fishing tradition of their ancestors.

"I learned that obviously fish is a big part of it, or else that whole graphic wouldn't be there, and they're using nets..."

They have to pay attention to the tides when they're fishing.” – P22

The combination of the monitors along with the instructions, the rings, and the belongings—specifically the Coke can—all worked towards enticing people to interact. People picked up the belongings and rings from the cart and placed them on the table with little more than an illustration. The Coke can was a particularly interesting belonging that caught the eye of many participants. It motivated them to interact with the other belongings. Thirteen participants commented on this explicitly.

“I put the Coke bottle in there I just laughed at the description of it. It seems like just lacking of culture subject to all of our modern marketing and immediacy of our consumerism and all of that.” – P16

Similarly, the combination of the belongings, the ring tool, and the *What is this?* information cards worked as an entry point to interacting with the table. Although *What is this?* was an entry into the complex information available, this activity was valuable in itself as it gave basic information about the belongings that people might not be familiar with.

“I spent most of the time exploring What is it? rather than stories.” – P17

People learned new things about Musqueam’s fishing culture and the tools they used. Seventeen participants were able to explicitly describe a new piece of information about Musqueam culture that they accurately learned. They did this through their interactions with the ring, which enabled them to access information cards, as well as through directly handling belongings as physical forms. One participant described seeing a harpoon in a display case elsewhere, but actually learning more about it from interacting with it on the tabletop.

“I’ve seen those, it’s the harpoon? I’ve seen those in a couple display cases on my way here, and never knew what it was and what it would be used for, so it was kind of interesting to see what that was about.” – P03

Richness and Stories about Belongings

Our second two design goals were about visitors reaching deeper understandings: the richness of information represented by belongings (beyond the identity and simple function) and the complex stories related to belongings. We found that three design features helped us to achieve these goals. These features were the selection of both ancient and modern belongings, the fidelity of the replicas, and the complexity of the four inter-related activities.

Ancient and modern belongings

Thirteen participants expressed that they understood the continuity of Musqueam culture in their interview responses, referencing the history of Musqueam people and their community today. The design feature of using ancient belongings with contemporary items worked well to get people thinking about cultural continuity.

“They’re a changing culture. It’s sort of something I gleaned just by looking at the objects on the table in the first place. When you approach it and you see a harpoon and a Coke can together, you almost don’t need the table.” – P22

“This goes back again to the idea of the old object and the new object co-existing, in the sense that there’s hardly ever a distinct line between “Oh, this is the culture before, there’s the culture now.” – P18

The belongings, although they were physical objects, also represented intangible elements such as the complexity of their stories. As one participant expressed it,

“Obviously Coca-Cola is not just Coca-cola.” – P11

Three participants overlooked the modern items, choosing to focus on the unfamiliar belongings. Their curiosity was satisfied by discovering what the ancient belongings were and what they were used for simply by accessing *What is this?* However, they missed some of the rich stories about the modern objects, and because they did not pair ancient and modern belongings, they missed learning about how traditions had evolved or remained the same (*Teachings*).

“I didn’t end up putting anything like the Coke can or the keys in there, I put all the little things that I didn’t know what they were for on the table.” – P03

Belonging Physical Fidelity

The fidelity of the belongings, our careful considerations of how realistic they should look and feel, and the choice of displaying everyday belongings were important in having visitors understand that they were of utility and value. Eight participants described the importance of the ability to handle the belongings and how it allowed for a better understanding of them.

“It was just nice to have something in your hand. It gives you a little bit better perspective in maybe how it was used and how in relation to the other objects and giving you a little more perspective in that way.” – P16

“I was using a knife... I kind of felt like the modern day knife, what we’re used to now, is very different than what they had, but that’s what they had. It’s what they were using, and it’s easy to understand how these tools were used and how these tools were created.” – P04

The fidelity of the belongings also affected other aspects of interaction and impressions about values, which we will discuss in the Values section below.

Activity Complexity

The belongings and physical-digital ring were designed to enable visitors to trigger four different activities, each with a different kind of information about the belongings. Participants clearly understood that there was more information available about the objects, even if they could not understand how to interact with all four categories. For example, our design decision to place duo-language labels

of the four categories of information on the ring tool enabled visitors to realize there was more information available. As one participant explained,

“It seemed almost like an intricate web. On the onset, it seems like they're four separate things that you kind of click on, and then after while you play around with it a little bit, and you start realizing that no, they're all connected. In order to fully understand it, you have to spend a considerable amount of time and mental effort to actually go through each of these little links and each of these little webs to actually get to that full understanding of how they're connected.” – P18

The *Understanding* task of matching belongings to the underlying image was effective in getting people to think about the continuity of culture as well as context. Visitors found that the ancient tools such as the slate blade and celt had more obvious connections to their modern day versions: the knife and the axe. By using some recognizable ancient tools and pairing them with modern counterparts, we enabled many visitors to understand the continuous and long history of Musqueam culture.

“Because the background was the modern objects, so to connect what is the possession of the belonging and how does it connect to a modern object that is still used today.” – P20

Our decision to have belongings used on a tabletop display of a fish-cutting table provided context for the belongings. This decision enabled visitors to visually understand that the belongings and their stories related to one another, the belongings were embedded in complex stories [DG4] and the belongings showed how the Musqueam live today. For example, one visitor said,

“It's to give the object a place in the context so it isn't just an object in isolation. It's an object that connects to other objects, like the people, other functions. It has a functional reason for being there. It doesn't exist in isolation. It exists in context so it's trying to give context.” – P06

“It's good to know what something does, but there's so much more to it than just what it does and what's involved in actually using it... how long it takes to do things and there're other pieces involved in using it and the engineering that goes behind it. There's so much more involved than just what it is. It adds another dimension to the object.” – P16

The *Teachings* category, even though fewer people successfully accomplished that activity, still aided in achieving DG4 by showing the richness and complexity of information.

“(Matching ancient belongings to ancient belongings) would be important to understand how they're still used the same way and how those uses have changed. That would be important. How perhaps we've left behind some of the

ancient uses or we rely on newer ways of learning in ... new contemporary ways of fishing.” – P19

The four categories together on the ring, along with the status bar aided visitors' understanding that there was more to the story. When asked the relationship among the four categories, participants responded,

“Sort of different levels of depth to the conversation, right, so one was just a description of the object or belonging and then an application of it, how it was used and then how it connected to something else.” – P17

“It seems like something can be a tool, but there's something deeper behind it. It gives a little bit more layers to the piece and it makes it less of just an object. It gives you a little bit more insight into the culture and pieces together.” – P16

Values

The values we focused on were: treating cultural knowledge with respect, the importance of the hənq̓m̓iṇəm language, the notion that belongings still belonged to the ancestors, and that cultural knowledge should be earned. Without meeting our first four goals, it seems unlikely visitors would experience values through interactions. Once visitors entered the space, interacted with different objects, learned about Musqueam people, and began to see the complexity of information available [DG1-4], they were cued to experience values. We found that these interrelated design strategies enabled visitors to experience values.

For example, we purposefully broke the tradition of displaying belongings behind glass, placing replicas on a museum cart (See Figure 2) where they would normally only be accessible to museum staff. Seven participants noticed respect reflected in the way they carefully handled and returned the belongings to their proper places. Even the contemporary belongings were treated with some reverence, due to social cues as some participants noted.

“I knew that I needed to put (the belongings) back where I found them in order to leave it for someone else to be able to follow me and do the table. In that way, that's teaching me to be respectful for the display itself.” – P05

“I treated them carefully. Actually the Coke can you treat it a bit like a cultural artifact, but I think that's because of the... social rules.” – P06



Figure 2. Belongings cart ©Reese Muntean

We also identified the physical-digital activity categories using both the hənqəmīnəm language and English, which created depth of content through non-linear layers (rather than linear game levels) and showed progress each time a belonging was placed in a ring. People were able to recognize values in their interactions, specifically in terms of the time and effort spent with the table.

Participants engaged with the table for an average of almost nine minutes, which illustrates the success of our choice to create complex interaction possibilities with inter-related activities and twelve different tangible belongings to use. Many visitors recognized that spending time to learn about this information was a way of respecting Musqueam culture.

“By taking the time to look at it... I'll walk up and actually read more of what I'm looking on other than just looking at something. Definitely, taking the time to digest what I read and think about it from a different person's place.” – P08

“I think in that way it's giving your undivided attention as a way of showing respect.” – P15

“This is interesting. It's subtle, but the value is having the respect to stay with something no matter what the situation is. My respect would have gone longer if it was a human. My respect was shorter because it was technology. That reflects on culture. If it is a human passing down traditions, it is longer term than to go back and just put out a book and try to teach it from a book. That's a huge lesson that I surreptitiously got, but no one spelled it out for me.” – P21

The tabletop was a complex system, and people did not necessarily discover its full functionality. However, they did understand that making the effort was a sign of respect and earning knowledge.

DISCUSSION

In this paper we ask *“What are effective design strategies that enable visitors to directly experience cultural values while they interact with Indigenous knowledge using a tangible tabletop system?”* Yet key aspects of our collaborative approach extend beyond the tangible tabletop form. Our design process involved the close collaboration among team members with varying values and perspectives and our cultural partners. Through this collaboration we developed our goals for this project, including the desire to communicate values through interactions, the values that would be communicated, and the design strategies to meet these goals in a cultural tabletop exhibit by moving from basic engagement to deeper learning, then to the experience of cultural values.

From this process we introduce six recommendations for such designs. We generalize our findings so that other designers of technology for cultural heritage can support visitors in their experience of cultural values, through tangible interactions or interactions more broadly. We reiterate that these design recommendations exist within the

context of collaboration with Indigenous partners in the design process and reflection on cultural values throughout.

Design Recommendations

1. *Cultural Forms.* Use both physical forms and the social practices around the forms to reflect values. Unusual or intriguing representations of cultural forms can draw people in. For example, the unusual images of fish and the high fidelity of the physical belonging replicas brought people into the space and enticed them to interact with the table, supporting Hornecker's concept of access points and entry points [37] and Horn's cultural forms [34]. Furthermore, the design of the physical properties can highlight values. In the case of the production of the belonging replicas, great care was taken to create replicas that shared the look and feel of the originals. These replicas took weeks to make, highlighting that ancient belongings were hand crafted and important. Social practices can also guide interaction and communicate tangible and intangible knowledge, such as values. Interaction design can mimic, mirror or reverse such practices. We played on traditional museum storage practices and in doing so both utilized and broke social practices around (not) handling artifacts in ways that enabled visitors to experience respect for the objects.

We do see a missed opportunity in this work to connect the social practices of the ancient belongings back to the physical cultural forms of the replicas. For example, we imagine visitors moving the slate blade in a cutting action as part of their interactions with the system.

2. *Accessible Information.* Create opportunities for immediate interaction and access to basic information. Placing a belonging in a ring marked with hənqəmīnəm provides a very simple form of access allowing visitors to interact immediately, quickly learn basic information, and gain exposure to the value of language. Furthermore, obtaining the basic *What is This?* information was simple, in line with the idea of apprehendability [4], offering the early successes [2, 15, 23], encouraging visitors to continue, priming them to understand more complex concepts [14], and offering multiple layers of information [35].

We designed for access, as others have recommended, yet we also designed deeper layers of information that required time and effort to access, reflecting values of earning knowledge and treating cultural knowledge with respect. We ensured access, but the structure and activities of how further information was accessed reflected a cultural value.

The complexity of the system along with our decisions to give little instruction or feedback were intended to slow visitors down to take time with the information. This did work, yet we were hoping visitors would be able to access more content than they actually did. While some visitors did uncover the multiple layers of information available from the different categories, which can enable richer interactive experiences [15, 23, 35], most did not reach this level of understanding.

For *Understanding it*, many participants understood from the dotted line what they were supposed to do but were still unable to do so. This was a combination of technical issues (e.g. accidental touches changing the category on the digital ring) as well as interaction design issues leaving participants confused about how to complete the task. For *Teachings*, visitors were uncertain as to what they should do or assumed the table was malfunctioning. These activities need clear instructions on the table or salient feedback to help visitors access the information. In our post-study revisions to the system, we improved usability of the *Teachings* and *Understanding it* activities, which may enable more visitors to reach the *Having Stories* content.

While we do see these issues of instruction and feedback as an area in which we can improve the design, it also speaks to the success of the interactions in helping visitors understand the complex stories and values we wanted to convey. *peləwk^w* — *Belongings* is rich with content that tells specific stories about the belongings of the Musqueam people and their continuing culture, but visitors were able to grasp information about Musqueam culture and identity, complex meanings behind the ancient and contemporary belongings, and even the specific value of earning and respecting knowledge without actually accessing much of the content.

3. *Connect*. Connect the exhibit to visitors' lives. The contemporary belongings provide connections from the exhibition to visitors' personal worlds. This provides a comparative foundation that may encourage visitors to connect cultural values to their own values. The juxtaposition of ancient and contemporary belongings encouraged visitors to think about the combination of objects, mentally engaging with the belongings before even physically interacting with them.

4. *Contextualize*. Provide context through different modalities. We found that, as suggested by Giaccardi and Palen [25], the multimodal information and the multimodal forms of interaction aided the exploration of tangible and intangible cultural heritage and allowed for new ways of engaging with specific cultural values. The tabletop fish cutting table image, the belongings, and the *hənqəmínəm* language on the rings provided immediate context for visitors (before ever accessing the informational content) Visual and physical elements of our design immediately convey the strong fishing tradition of the Musqueam. The pairing of modern and ancient belongings creates a contextual timeline, connecting past and present.

5. *Hands on values*. Design the physical properties of tangible objects to convey cultural values in such a way that visitors can immediately perceive those values as they view and handle the objects. Visitors viewed and carefully handled lifelike replicas of belongings, and then placed them back in their marked location on the cart. Because of the replicas' high-fidelity form and their presentation, visitors directly experienced reverence and respect for these

belongings, and by extension for the culture. There are many possibilities for reflecting values in physical forms. For example, the value of recycling could be communicated by low-fidelity, easily decomposable forms.

6. *Non-linear explorations*. Allow for different pathways for exploring information. We used four non-linear but inter-related activities that enabled visitors to engage with belongings in a variety of different ways, all of which conveyed complexity of information and reflected values without forcing visitors to explore all content. In other tabletop designs, tangible objects often trigger only simple pieces of information (e.g. [35]) or have single-use functions (e.g. magnifying glass). We suggest that a single belonging can enable a series of interrelated non-linear activities, providing a rich interactional experience. Individually these non-linear activities can appeal to visitors in different ways, with some people preferring basic information and others enjoying more puzzle-like activities. Taken together, these activities help to convey complex information and can be used to embody cultural values. While visitors could explore as much or little of the content they liked, the number of belongings and the ring's belonging-specific status bar hinted at the depth of information available and conveyed values around taking time, care, and effort to understand Musqueam culture. The specifics of activity designs will necessarily change based on the cultures, values, and exhibitions -- providing rich opportunities for new research.

CONCLUSION

In this paper we explore how cultural values can be communicated through interactions with a digital system, illustrating how values can be made tangible through a collaborative design approach to an interactive tangible tabletop museum exhibit. We see that experiencing cultural values through interactions is possible as a result of a collaborative process with a careful consideration of cultural values, physical and digital content design that lays a foundation for conveying values, and value-sensitive interaction design. We describe how we communicated cultural values by embodying them in tangible objects, playing on social practices, embedding them in activities that together with digital content creating opportunities for visitors to experience values through their interactions. We offer six design recommendations that may benefit designers of other culturally specific heritage applications and exhibits.

We found that tangible and embodied forms of interactions can be effectively used to support a greater understanding of values, Indigenous heritage, and continuity of culture in a museum setting. Overall, we hope our process and design can further the discourse around technology and values. We see our work as a successful contribution in understanding how to engage with cultural values during the design process and how to ensure that values are communicated through interactions with the resulting system.

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