

## Article

# Human–Computer Interaction (HCI) Advances to Re-Contextualize Cultural Heritage toward Multiperspectivity, Inclusion, and Sensemaking

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**Abstract:** Today's social and political movements against dominant Western narratives call for a re-contextualization of cultural heritage (CH) toward inclusivity, multiperspectivity, and sensemaking. Our work approaches this challenge from a Human–Computer Interaction (HCI) perspective, questioning how HCI approaches, tools and methods can contribute to CH re-contextualization. Through collaborative reflection on our research practice, we identified four diverging case studies highlighting the different roles of HCI and its increasing entanglement with CH. Case studies 1–3 focus on HCI as a medium for CH, case 4 on digital CH, and thereby on the HCI–CH entanglement. Our reflections contribute to CH re-contextualization by highlighting the need for co-design and slow design approaches, the role of HCI technologies in preserving, communicating, and shaping CH, and open questions and challenges related to the increasing HCI–CH convergence.

**Keywords:** cultural heritage; contextualization; multiperspectivity; entanglements; inclusion; sensemaking; indigenous peoples; communication



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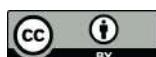
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## 1. Introduction

Cultural heritage (CH) is a society's foundation and living memory, shaping how humans understand historical developments and contemporary social systems as individuals and a collective [1,2]. However, current social and political developments offer a critique of that history, arguing that it is mainly narrated and written from a one-sided Western and, thus, colonialist perspective, which too often ignores the needs, perspectives, and experiences of underrepresented people (e.g., Indigenous people) [3–5]. This demands a re-contextualization of approaching and communicating CH toward an agonistic and democratized discourse that allows preservation, multiperspectivity, inclusion, and sensemaking across cultural backgrounds and origins [1,6]. Only in recent years, the international heritage community has started to recognize the importance of prioritizing such people-centered approaches to CH over expert-centered ones (These efforts are exemplified by the various working groups of the International Council on Monuments and Sites (ICOMOS) under the title *Our Common Dignity—A Rights Based Approach to Cultural Heritage* (see <https://www.icomos.org/en/what-we-do/disseminating-knowledge/icomos-working-groups?start=1>, last accessed 18 June 2024), especially in the context of identifying the role of heritage in achieving the *Sustainable Development Goals (SDGs)*;

<https://sdgs.un.org/goals>, last accessed 18 June 2024). These initiatives advocate that the cultural, environmental, and socio-economic concerns of people and communities have to be taken more prominently into account in the development of local, national, and international heritage policies and practices, including through the use of modern communication technologies [7–9].

To re-contextualize CH communication from a socio-technical perspective—CH re-contextualization is impacted by other areas of expertise, political policies, appropriate legislation, etc. However, as those are outside our expertise, we focus only on HCI advances—into a meaningful and inclusive dialogue [6], we must reflect on and consider target groups and available means and tools. Today's communication happens often online and via digital and social media platforms [10]. Nevertheless, interactions in tangible and intangible CH still rely heavily on analog communication, such as the display of certain cultural artifacts that indicate the identity and status of the owner [11], or drumming to express the connection to each other and the surroundings [12]. Particularly for Indigenous and traditional Western communities, analog communication is part of the cultural identity community members understand and trust [13,14]. In contrast, there are partial hesitations against digital technologies, as they introduce Western values and often cannot fully represent the culture's meaning and richness [15]. This divide underscores the complexity, sensitivity, and multi-dimensionality of re-contextualizing CH for inclusive and equitable exchange and understanding across cultural backgrounds. This challenge is exacerbated by the lack of reflection and re-consideration of tools and methods to approach the re-contextualization in the first place [16].

We see advantages in Human–Computer Interaction (HCI), an interdisciplinary research field focusing on user-centered design to create interfaces, tools, and platforms adapted to users' abilities, skills, socio-cultural backgrounds, and contexts [17–19]. The field enables CH communication through experience. It has developed multiple approaches and technologies to preserve and re-contextualize CH, including augmented (AR) or virtual reality (VR) storytelling [20–22], tangible interaction [23,24], and accessible 3D replicas of CH artifacts and environments [25–27]. In the process, HCI research further emphasizes the need to protect users and build socio-emotional relationships with them, particularly when dealing with vulnerable users from minoritized groups or users with lower socio-economical status or lower digital literacy skills [17]. Additionally, participatory [28] and co-design [29] approaches enable engaging users early and throughout development, ensuring their communication needs, habits, and styles are accommodated. Consequently, HCI provides tools and methods for CH re-contextualization and communication that foster an agonistic and democratized discourse.

Our work builds on a research workshop about CH re-contextualization held at an international research conference in which four of the authors participated [30]. Based on these initial discussions, we applied a form of collaborative reflection [31,32] on our individual long-term practice experiences in five online sessions, in which all authors reflected on the role of HCI advances in re-contextualizing CH toward multiperspectivity, inclusion, and sensemaking, highlighting recent developments and challenges. We focus on multiperspectivity—defined as a “*concept expressing the willingness to take someone else's viewpoint*” [33]—and inclusion—here focused on social inclusion in the form of “*fostering solid bonds between groups despite their differences*” [34]—toward empowering minoritized groups to share their perspectives and CH as equals. In addition, we aim for sensemaking, which is the process of contextualizing an experience that supports empathy, meaning, and connection-making [35,36], which are relevant qualities for creating shared understanding. To this end, we present four case studies (see Table 1) from the authors' own research areas that have applied and explored HCI approaches, methods, and technologies in and for different contexts and purposes. Each case study highlights challenges, opportunities, and open research questions, following the guiding question:

*How can HCI research approach CH re-contextualization to enable multiperspectivity, inclusion, and sensemaking?*

**Table 1.** Overview of the case studies and the HCI–CH relationship presented in each.

Case	Context	HCI for	Location	Project Phase
1	Intangible CH as a Factor in Design Ideation	Inclusion Multiperspectivity	England, Europe	Ideation
	<b>Contributions:</b> methodological choices and flexibility to foster inclusion and cohesion <b>Meta-level challenges:</b> communicating individual social and cultural values to others <b>Approach:</b> co-design, arts-based methods <b>RQs related:</b> researcher diversity, reflexivity, arts-based methods, slow science <b>HCI–CH relationship:</b> pre-figuring			
2	Interaction Design for Indigenous Museum and CH	Multiperspectivity Sensemaking	Northern Finland, Europe	Exploration and Prototyping
	<b>Contributions:</b> value of listening and flexibility <b>Meta-level challenges:</b> exploring sensitive topics, Indigenous-led project <b>Approach:</b> participatory design, prototyping, iteration <b>RQs related:</b> empowering locals, involving experts, co-design <b>HCI–CH relationship:</b> pre-figuring, enabling and facilitating			
3	CH management for Cultural Landscape	Inclusion Sensemaking	Afghanistan, Asia	Analysis to Documentation
	<b>Contributions:</b> visualize the impact of planning decision to local stakeholders <b>Meta-level challenges:</b> foster feedback and stakeholder participation <b>Approach:</b> field survey, remote sensing, 3D modeling, community involvement <b>RQs related:</b> self-determination on heritage values, reconciliation after conflict <b>HCI–CH relationship:</b> mediating and converging			
4	Social Media Data as Digital CH	Sensemaking	Germany, Europe	Evaluation
	<b>Contributions:</b> facilitating sensemaking of and empowerment over one's own data <b>Meta-level challenges:</b> data bequest of one's digital identity and possessions <b>Approach:</b> web application testing, lab study <b>RQs related:</b> AI assistance, data ownership, future digital cultures and CH <b>HCI–CH relationship:</b> converging			

Each case study further informs different project phases (from Ideation to Documentation):

**Case 1** presents a methodological approach to enable multiperspectivity already in the *Ideation* stage of HCI projects, fostering inclusion early in technological development.

**Case 2** reflects on *Exploration and Prototyping* as a means of communicating with Indigenous user groups to achieve a shared understanding of different cultural values more quickly.

**Case 3** focuses on 3D scanning and modeling in Cultural Landscape *Analysis and Documentation* and preservation to support decision-making in CH management and discusses digital tools to promote sensemaking through active stakeholder participation. **Case 4** discusses digital data legacies and the development of personal cultural heritage through social media and online platforms, highlighting the need for further *Evaluation* of the increasing HCI components in CH entanglements (Figure 6).

Results from our reflection emphasize the intra-dependencies between both fields, identifying HCI's crucial role in CH re-contextualization. HCI serves as a communication mediator for CH, and CH provides the foundation for prefiguring HCI. At the same time, HCI and CH increasingly converge in the form of HCI technologies turning into CH artifacts, enabling the formation of online groups or identities. Both roles require reflecting on and adapting HCI research and development approaches toward the ever-evolving CH pace and dynamics to support CH re-contextualization. Our work contributes with four case studies showcasing the diverging and broad possibilities of HCI to support CH re-contextualization while reflecting on its role in preserving, communicating, and shaping CH. Furthermore, we contribute with open questions and challenges related to the increasing HCI–CH convergence.

## 2. Background

HCI has explored CH preservation and communication to various extents, which we briefly introduce below, focusing on sensemaking interactions. This section builds the backbone of all the concepts and terminologies applied in this work, multiperspectivity and inclusion, which we will relate to decolonialism and pluriversality.

### 2.1. Interactive CH for Preservation, Experience, and Sensemaking

HCI research has approached interactive CH intending to preserve [22,37,38] and to access [39,40] and create meaningful experiences with it [41,42]. Work concerning preservation approaches comprises digitizing tangible [43,44] and intangible [22,45] CH, such as scanning physically built environments to create their 3D virtual replicas [46] and recording cultural dances [47]. One of the prominent challenges at the HCI–CH intersection is the low level of digital maturity and difficulty in accessing digital data across cultural institutions and stakeholders. Projects, such as the *Cultural Data Space* (see <https://en.acatech.de/allgemein/time-to-raise-the-curtain-on-the-culture-data-space/>, last accessed 25 March 2024), address these issues as part of national digitization strategies, aiming to create a networked infrastructure that allows easy access and sharing of data across institutions while preserving data ownership [48]. Another challenge is the limited accessibility of objects and locations. For example, Häkkilä et al. [40] developed a virtual replica of an inaccessible historic graveyard on the border between Finland and Russia. Their work highlights the benefits of enabling remote access and experiences and the ethical consideration for designers when creating a “true” replica of a sensitive space. These projects are only exemplary for CH digitization projects globally but emphasize the need for HCI involvement and advances in this context.

Creating meaningful interactions of and with CH contributes to its preservation through users’ socio-emotional engagement and understanding of its relevance to users’ lives and beyond [49]. In-group and intergroup communication shapes the process of making sense of experiences and happens throughout all conversational platforms, including onsite and online [50,51]. In Chang et al. [50], the authors explore a social augmented reality application as a communication medium between museum visitors using voice and AR touch traces on virtual objects. The findings showed that social interaction contributes to users’ immersion, engagement, and understanding. AR has been widely explored to contextualize CH through engaging and vivid storytelling, enabling users to feel, e.g., like they are becoming part of an event and decision-making processes in former times [20]. The increased personal and emotional involvement triggers empathy [52], sensemaking [20], and dialogue [1]. In another example, Angeli et al. [53] explore the role of context in a competitive two-player game to support agonistic remembering—the contextualized representation of information to take multiple perspectives and avoid the deterministic value system of good and bad [54]. This approach supported taking an agonist perspective but required additional information in a debriefing, revealing the challenge of balancing contextualization and engagement. These examples highlight the effectiveness of interactive technology in (re-)contextualizing CH for longer-lasting, meaningful user experiences by (a) setting information into context and (b) providing alternative means for communication.

### 2.2. Multiperspectivity and Socio-Cultural Inclusion

Multiperspectivity can be seen as the prerequisite for and the result of socio-cultural inclusion and cohesion, decolonization, and pluriversality. HCI methods and tools that consider multiperspectivity do so in order to foster socio-cultural inclusion and cohesion [34,55], the decolonization of perspectives and HCI designs [56], and pluriversality [57]. This includes arts-based methods, such as digital storytelling and drawing, which have been shown to foster discussions around intangible CH “particularly in communities at risk of social exclusion”, to help identify intangible values and personal memories and to support mutual understanding and empathy [45,58], and, with this, multiperspectivity, through the sharing of individual experiences. Also, a diverse range of interactive technologies, including CH

apps for digital storytelling and engaging with virtual avatars, has been explored to capture a more diverse range of experiences through cultural engagement and participation, in turn fostering multiperspectivity, social cohesion, and inclusion [34,59,60]. Social cohesion thereby refers to “*removing barriers and promoting equality for participation in culture*” [34]. Another advantage of interactive technology in this context is the possibility of content and interaction modality adaptation and customization. Giglitto et al. [61] emphasized the need to tailor communication to a community’s needs and avoid “one size fits all” solutions. This supports multiperspectivity and connects well with research involving (intangible) CH and HCI since CH research is increasingly based on sharing a variety of subjective experiences and memories [45,62]. A re-contextualization of (intangible) CH through HCI should foster multiperspectivity and enable individuals to share their own individual stories with each other and researchers. Notably, it has been argued that the reflexivity required for such inclusive sharing of different experiences and knowledge needs to be dialogic and is thus reliant on multiperspectivity in the first place [1].

Another example of interactive technology and its contributions to CH is Historical Geographical Information Systems, which combine data from geosciences and cultural data to help (re-)contextualize heritage sites, supporting their accessibility as well as a general shift of CH “*away from mere preservation towards its role in community formation, shaping shared identities, and the environment*” [63]—and thus socio-cultural inclusion. On that note, Meissner [64] urges researchers and practitioners to consider not only social cohesion, the “*feelings of belonging*” to a community or place, but also social distinction. The latter refers to what Meissner [64] calls heterogeneous cultural preferences and divergent expectations of participants regarding a community’s (lived) CH. This is connected to supporting multiperspectivity, but it goes beyond that: It is also connected to the danger of reproducing social hierarchies and reinforcing power relations, such as gender inequalities and power imbalances. Thus, as stated by Meissner [64], it is indispensable for researchers to reflect on their own socio-cultural background—and on more general issues related to undemocratic, elitist, and colonial practices in (HCI and) CH [16,65]. This reflection is vital to creating the necessary, safe space for multiperspectivity, joint sensemaking, and socio-cultural inclusion in CH and HCI [66].

### 2.3. Decolonialism and Pluriversality

In recent years, a discussion of decolonizing practice for design research has been presented [67,68], also in regards to technology and CH [69], to support multiperspectivity and inclusive sensemaking in HCI. Decolonizing in design can mean dismantling power relations, resisting biases, and considering the Western influence on current technology [56]. Its potential has further been described as “[...] *re-imagining and re-designing futures together through deep listening and deep criticality*” [70]—a potential further highlighted by Ansari [67] concerning the co-existence of different cultures and worlds that designers can foster and support in their research and practices.

Pluriversality is one approach suggested for decolonizing design [57]. In their book *Designing for the Pluriverse*, Escobar [71] describe the concept as “*a tool for reimagining and reconstructing local worlds*” and include pluriversity to achieve multiperspectivity. A problem for development can be the lack of adoption of new technologies by the local marginalized communities. Thus, a focus on localized solutions has been recommended [72]. The decolonizing design approach and pluriversal views can be involved when working with, e.g., Indigenous and marginalized groups to empower them to tell their own stories [21]. Researchers emphasize the need for decolonizing “..*in, by and through participatory design*” [73]. Yet, Tlostanova [68] emphasize that merely using participatory methods is not enough to decolonize design. Lazem et al. [56] have looked at the challenges and paradoxes of decolonizing HCI, suggesting that researchers both in the North and in the South collaborate on the topic of decolonization. Akama and Yee [74] discuss the role of plurality in social innovation and design processes, highlighting the role of relationships and reciprocity. Indigenous cultural heritage faces various issues when digital tools are considered, such

as commodification [75]. Thus, HCI technologies and approaches must be applied with special care in the design process featuring marginalized cultures.

### 3. Case Study Selection and Collaborative Reflection

Before presenting the case studies, we want to acknowledge that we are a group of researchers from Australia, Finland, Germany, and the UK, with one of us being from a Levant Arab cultural background and the others from a white European and Australian cultural background. Each author approaches interactive CH from a different perspective and in collaboration with local communities of Indigenous people or refugees, e.g., in the UK with young refugees and asylum seekers from Eritrea, El Salvador, Turkey, and Kurdistan; in Finland with the Sámi; and in Australia with Aboriginal and Torres Strait Islander peoples and with Pashtuns, Tajiks, Uzbeks, Hazaras, and Turkmens in Afghanistan.

The case study selection and meta-level reflection are based on collaborative reflection in five online meetings. The workshop at the international conference [30] provided the initial setup to trigger collaborative reflections on this paper's guiding research question. The workshop showed the broadness and diversity of ongoing HCI research around the world for and in CH and identified similar challenges, such as building trusting relationships with minoritized groups, enabling multiperspectivity, or integrating a culture's true values in interaction design for outsiders to experience and understand. All workshop proceedings can be found in [76]. These emerging themes build the basis of this paper's focus on reflecting on the role of HCI to re-contextualize CH toward inclusion, multiperspectivity, and sensemaking.

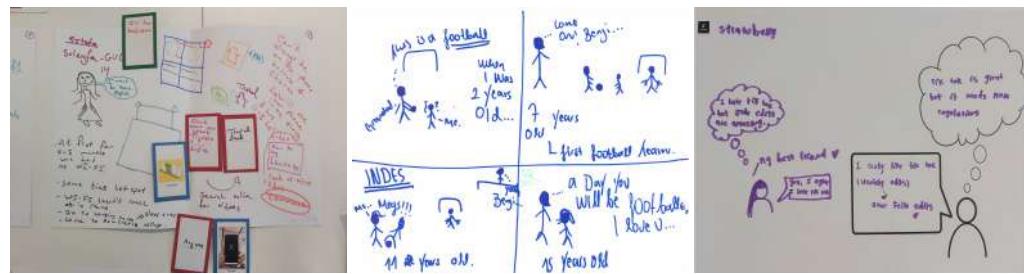
We continued the discussions in smaller online meetings depending on the researchers' availability, which resulted in this work's meta-level reflections. Each researcher contributed with rich insights concerning diverse cultural backgrounds and research experiences related to CH re-contextualization. Prilla et al. [31] define such meetings as collaborative reflections, or "*meetings in which a team reflects on its practice, or discussions in which workers mutually reflect on stressful situations*", which resulted in new insights, perspectives, and shared understandings. While we did not follow a structured approach, we discussed and reflected together on our core questions, taking our different research projects as examples: (1) What role does HCI take in the preservation, communication, and representation of cultural heritage? And (2) how can HCI research approach CH re-contextualization to enable multiperspectivity, inclusion, and sensemaking? Our reflections led to the selection of case studies that represent the diversity and complexity of CH re-contextualization and the different roles HCI incorporates related to CH. Furthermore, we selected these case studies because, as shown in Table 1, each case study contributes to different HCI tools, approaches, and project phases, emphasizing the diverse, interlaced, and increasingly co-dependent HCI–CH relationship. The entangled relationship is reflected throughout an HCI iterative design process from ideation to evaluation, impacting the CH re-contextualization, highlighted by our case study selection.

## 4. Case Studies

### 4.1. Re-Contextualizing Intangible CH as a Factor of Inclusion and Cohesion in Design Ideation

In this case study, we reflect on (unexpected) benefits and barriers we encountered in a co-design project on mobile-technology- and social-media-supported self-organized learning environments (SOLEs) [77] with young refugees and asylum seekers (YRASs) from diverse cultural backgrounds. The project aims at exploring the YRASs' perspectives on their use and opinions of such SOLEs and of underlying (social media) platforms, giving them space to also reflect on the role that their socio-cultural environment and community play. The project thus aims to open up the HCI narrative to embrace the YRASs' CH as an influencing factor in HCI projects and to re-contextualize CH towards multiperspectivity, socio-cultural inclusion, and cohesion. The project took place in the North East of England and was run with the volunteer project North-East Solidarity and Teaching (NEST). We used a two-phase co-design approach, with this case study focusing on the first phase

that elucidates the YRASs' digital ecosystem, i.e., with whom, how, where, and when they learn with digital technologies in both their home country and the UK, (see [78] and <https://tincrow.net/soles-for-ras>, last accessed 14 May 2024, for more details on this project). Like the others, our case study presents a re-contextualization of CH in HCI by asking what types of CH we are dealing with and how they connect. We offer a view of intangible CH playing out during co-design research, of CH as an influencing factor rather than an explicit object of study. Thus, we emphasize methodological approaches towards (social and cultural) inclusion and cohesion in the early phases of HCI projects, e.g., to bridge communication issues (see Figure 1). Our reflection centers around three key methodological takeaways for methodological approaches to become more inclusive in HCI design by considering intangible and inherited CH as an important influence during (the early stages of) co-design research in HCI, instead relegating it to being an explicit object of study: (1) the need for researcher reflection in/on action and reflexivity on a micro and macro level, i.e., from single activities to the overall research approach; (2) arts-based methods as a way to try and overcome barriers and provide a safe place for expression and sensemaking; and (3) the importance of “slow science” as opposed to the prevalent “fast science” in HCI (and beyond) that often runs contrary to achieving multiperspectivity and building rapport.



**Figure 1.** Arts-based artifacts from a co-design project with young refugees and asylum seekers (from left to right: visual storytelling with cue cards, draw–write–tell, pupil view template).

We anticipated navigating language and cultural/social barriers because the YRAS and the researchers came from different (Non-)European backgrounds and countries, including Eritrea, El Salvador, Turkey, Kurdistan, Iraq, Lebanon, Germany, and the UK. To account for this diversity—and to avoid a tokenistic approach towards it [79]—we wanted to ensure that the YRASs as a group felt in control of the narrative and took ownership of the project. Assuming “traditional” HCI methods, such as interviews and questionnaires, would not adequately support this, we opted for a co-design approach in combination with participatory arts-based methods, guided by the rationale that both are said to hand over (large amounts of) control and power to participants [80,81]. To elucidate the YRASs’ stories of their learning experiences and digital ecosystem, we advisedly chose to use draw–write–tell [82], cue-card supported visual storytelling [83], and pupil view templates [84] due to their focus on storytelling to share experiential knowledge. In all of this, we considered ourselves “*facilitators of negotiations and explorers of opportunities and potentials*” [85], as guides for the YRASs’ storytelling—which in itself is and carries the YRASs’ intangible CH [86], and has been shown to (i) foster discussions around intangible CH “*particularly in communities at risk of social exclusion*” and to (ii) help identify intangible values and support mutual understanding and empathy [45]. It bears repeating that we aimed to explore the YRASs’ digital ecosystem for learning. So, while CH was not our main object of study, it did shine through in our activities as an influencing factor. Our methodology aimed to support this by fostering an atmosphere of openness of actively sharing and listening to different perspectives, an atmosphere of (socio-cultural) inclusion and cohesion in the group. Also, our own diverse cultural backgrounds sensitized us to (some of the) YRASs’ experiences, fostering empathy and rapport with the YRAS living in a foreign country with social and cultural norms different from their own. This led us beyond reflection on action towards reflexivity, critically inspecting our own experiences, values, and beliefs [87–89]. All of the

above was crucial to the project as it allowed us (i) to bridge communication/understanding issues we otherwise might not have been able to resolve and (ii) to elucidate aspects of social/cultural inclusion, cohesion, and thus multiperspectivity related to the YRASs' digital ecosystems. It also shows that the socio-cultural backgrounds, and thus arguably the CH of participants and researchers, must be considered in projects that strive for multiperspectivity, inclusion, and cohesion in HCI research, whether focused on CH or not. In other words, intangible and inherited CH is a crucial factor when interacting and working with participants and reflecting on these interactions during data collection and analysis in HCI projects. So it should not just be considered important when it is the explicit object of study but needs to be (re-)contextualized as an influencing factor of such projects and a path towards multiperspectivity and socio-cultural inclusion and cohesion in HCI.

During the workshop activities, we noticed that our approach of using co-design and arts-based methods (ABMs)—in combination with meeting the YRAS repeatedly, building rapport and trust—was indeed helpful to create a safe space for the YRAS to open up, reflect on and share their experiences. They allowed us to gain valuable insights into their diverse uses of digital technology (in general and for learning), thus identifying gender and race as barriers to their technology use, e.g., social media [78]. However, we also noticed an increased need for us to be flexible in the way we use ABMs. Not all language barriers (nor the shyness of some YRAS) could be bridged by our ABMs, and we had to adapt them, for example, by repeating instructions and changing their wording on the fly, by improvising sentence completion for the “tell” phase in draw–write–tell and by being accepting of indirect communication via mediators and translators, i.e., participants helping, translating and summarizing for each other—even though this can influence the stories ultimately being told as it mixes joint with individual reflection. Such methodological flexibility is inherent to ABMs—due to their focus on introspection and interpretation [90]—so openness to engage with ABMs and to embrace their philosophical worldview is an important factor here for both participants and researchers [91]. An example illustrating the benefits of such methodological flexibility should not go unmentioned here: We asked for the visual storytelling scenes—which showed the learning experiences of a fictional young YRAS—to be shared by the YRASs but left the “how” to them. To our surprise, they chose to perform/roleplay the scenes, which proved to be a lot of fun for players and the audience, stimulating bonding and discussions that distilled vital aspects and values underlying their stories, e.g., (their perceptions of) different social/cultural roles of girls and boys and how these influence their technology use. So ABMs can be a safe space to share life experiences [92], e.g., using indirect storytelling through the eyes of a protagonist similar to the YRAS, yet not identical. But ABMs can also bypass healthy barriers and thus always have to be employed carefully [93]. More generally, ABMs are just one cogwheel in the research machinery; others are context, setting, and additional methods, which can influence (and interfere with) people's openness to share or explore arts, power (im-)balances between participants and/or researchers and thus inclusion, cohesion, and multiperspectivity.

We also noticed that the pace of our sessions and the project was slower than expected in the otherwise high-turnover world of HCI and “fast science”. This is related to working with a student-led volunteer project (NEST), gatekeepers, and people from different cultural backgrounds and heritages and an increased need to spend more time on building rapport, trust, and mutual understanding. It was also related to an increased organizational load due to fitting our research into the YRASs' everyday lives and NEST's structured activities for them. In other words, this was and still is a slow science [94] project, and it needs, for the reasons above but also to give participants (and researchers) enough time to reflect and arrive at a common ground, to create a safe and open space to listen and share actively. Thus, it builds a stronger basis for empathy, inclusion, cohesion, and multiperspectivity. Indeed, we want to call for slow science in HCI (and beyond) to embrace longer-term projects instead of short-term pay-offs [95], not only during ideation but also during other phases of technology (co-)design and development. This will come with its own challenges,

such as an increased practical, technical, and methodological complexity [96] and effects on decision-making, goal prioritization, and power relations [97]. However, these challenges are worth the benefits such an approach can carry, foremost in its contributions to socio-cultural inclusion and cohesion as a “fertilizer” for multiperspectivity in HCI research projects.

#### 4.2. Exploring Designs through Prototypes for Indigenous Museums

In this case study, we present an exhibition design for an Indigenous Sámi museum, conducted collaboratively with the museum personnel and artists. We explore the design process and the tools that HCI and interaction design can offer to these kinds of collaborations; see Figure 2. The Sámi people, the only Indigenous peoples in Europe, live as a minoritized group in four countries: Finland, Sweden, Norway, and Russia. There are nine living Sámi languages, all endangered, and various cultural groups [98].



**Figure 2.** Testing the designs in a cardboard and digital screen prototype to explore the best layout.

Due to history, which is plagued with assimilation policies and colonialism, Sámi museums represent important institutions through which the indigenous Sámi community can foster their identity and CH and have a role in strengthening the community and revitalizing the culture. As described by Silvén [99], “Sami representations in heritage and museums have always contributed to defining Sami identity and the societal position of the Sami”. These museums take a somewhat different role from conventional museums, which are memory organizations specifically focusing on the past and are typically targeted to tourists. The Sámi museums have a central role in the decolonizing movement in Northern Europe and in bringing back the Sámi artifacts bought, collected, or taken from the area (see Harlin [100]). For example, Porsanger [101] describes how a Sámi drum was returned to a Sámi museum in Karasjok, Norway, highlighting its positive impact on the community. The repatriation process can create interest in the community regarding heritage and “...stimulate the more active use of museums by both locals and tourists” [101].

The Sámi Museum Siida involved over 300 local Sámi people when building the new exhibition. The new exhibition’s focus was not solely on the past but on presenting the continuum of indigenous CH to the present and modern living Sámi culture. Technology was brought in, e.g., to augment multimodal experiences and digitalize heritage, allowing interactive experiences to re-contextualize it for sensemaking and multiperspectivity. Moreover, in the exhibition renewal project, the main target group was the Sámi people and community—with the goal being the creation of an exhibition design for them—and, secondarily, the other museum visitors. Thus, technology had to support the overall purpose of the exhibition and community as opposed to just visitors as users.

So, how can the designers scaffold the process for exploring the possibilities of CH in practice? As digital technologies can enable engaging museum experiences (e.g., Hornecker [102]), their advantage is not limited to the outcome of the design process. Digital technologies also enable a design process where different concept designs can be prototyped, discussed, and evaluated in an agile manner (Figure 2). We explored three ways for quick prototyping: SINCO (Service Design Laboratory) [103], Virtual Reality [104], and rapid physical prototypes [105]. In SINCO, it is possible to simulate different physical

environments and multisensory experiences through various movable screens, speakers, and physical props. The flexible layout and user of digital tools allowed for quick testing of ideas for the museums (Figure 3), changing the setup during the workshops.



**Figure 3.** Prototyping a space at the service design lab with PowerPoint and ideating a concept for gesture interaction for projected 360 images.

During this overall work, we noticed that the pace of the HCI field and cultural institutions might diverge; thus, shared ways of working must be found for fruitful collaboration. This was discovered during the project through trial and error, as different ways of understanding the design context and the role of technology were negotiated. In our case, prototyping methods, both online and offline, were used to enable better communication and find the proper way to show the cultural content. Working quickly on something concrete gave the stakeholders a way to discuss the issues in practice, even with existing cultural or language barriers. A slow process of building trust by learning about each other can enable a more inclusive space for understanding and sharing different perspectives. Being able to discuss this in detail can be essential when balancing storytelling and technology. We found that rapid prototyping also allows for changing plans and flexibility, as well as determining the narrative that the stakeholders want to be told in a particular case and the optimal way of showcasing it. Through HCI prototyping methods, different ideas can be visualized and tried out physically or digitally, bridging the language or cultural gaps that may exist. This also allows stakeholders to actively participate, share their thoughts in a participatory design setup, and have a shared goal to aim towards.

During the process, it became necessary to understand the plurality of values, including the local values [106]. Certain design choices were made with the culture first, such as not being able to touch particular objects due to their sacredness. This shows that instead of focusing only on engagement or immersive properties, cultural values should be considered first, such as what kind of things can be shared. This can seem counterintuitive in a design process, where the user is put first, and everything should be accessible and easy to use. However, in a culturally sensitive design process, the conventions and rules of the culture, e.g., who can use certain artifacts, have to be respected. Thus, having an understanding of multiperspectivity and making sense of the contents was necessary.

In future work, we will work on a tangible participatory design tool that can be used to engage various stakeholders in technology development projects while keeping ethics in mind. The aim is to enable the stakeholders to discuss the entanglement of the context, tools, and goals for better re-contextualization. We encourage researchers and developers in the HCI field to set aside their preconceptions of good user experience that focus only on the user and, instead, listen to the local cultural experts and participants and their views on showcasing heritage through technology and its impact on the community. Thus, this case highlights the role of the design context and participatory methodologies.

#### 4.3. Digital Landscape and Community Involvement of the Bamiyan World Heritage (Afghanistan)

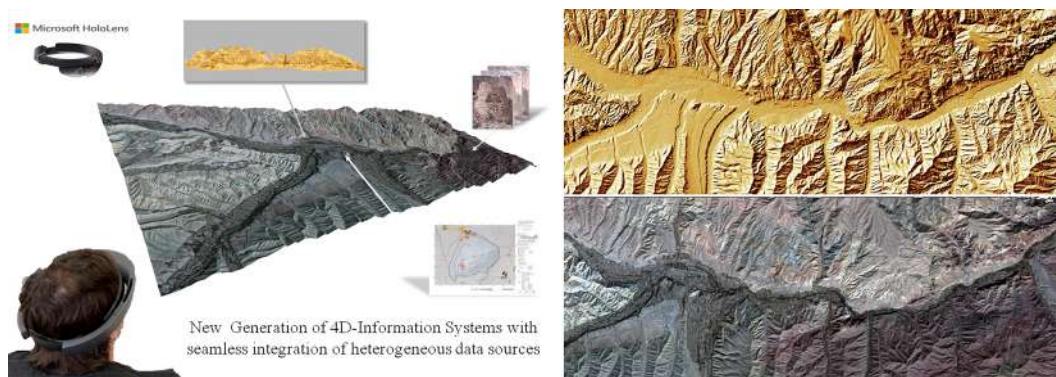
The third case study incorporates HCI best practices in heritage documentation into broader regional development initiatives in Bamiyan, a valley located in central Afghanistan and known for the once-largest depictions of standing Buddha figures. The project thereby

showcases the difficulties of managing and reconstructing CH at a landscape scale in post-conflict Afghanistan. Throughout its history, the country has been subject to internal and international wars and tensions [107,108]. These historical continuities and discontinuities have resulted in the coexistence of traditional and modern social realities, with a diverse society rich in ethnicity, religion, and culture. Therefore, HCI-CH preservation methodologies must consider the shared and contested narratives in “post-conflict” situations to support long-lasting valorization efforts that sustain societal cohesion.

The Taliban’s destruction of the monumental standing Buddha figures of Bamiyan in 2001 [109–111] and the fall of the initial regime pushed the need to rebuild the destroyed infrastructure of the country, causing a multifaceted and global discussion. On the one hand, reconstructions are often used to restore a monument to its presumed original state before destruction, which may refer to an “ideal state.” On the other hand, some argue that monuments should be left as they were destroyed, preserving the traces of the conflict and all the layers of time to serve as memorials to war. To ensure long-term preservation, it is also essential to enable local people to benefit from modern development in post-conflict situations. Therefore, the inclusion of advanced visualization tools in planning technologies is essential to enable discourse and informed decision-making.

Following the destruction of the Buddha figures, the entire *Cultural Landscape and Archaeological Remains of the Bamiyan Valley* received UNESCO Cultural World Heritage status in 2003. This led to the implementation of an international safeguarding program (for details of the long-year safeguarding program, see <https://whc.unesco.org/en/activities/2/>, last accessed 18 June 2024) aimed at ensuring the long-term preservation of the site and its historical value, as stated in the nomination’s Statement of Significance, as the most “Western” testimony of Buddhism in the Central Asian region and the center of early cross-cultural exchanges between China and India. However, for generations, local people have not attributed any religious significance to the figures, as Buddhism has not played a role in the region since the spread of Islam in the 11th century [112]. The figures were no longer considered depictions of Buddha. Still, they had been reinterpreted and given new identities, integrated into the mythical story of the Bamiyan Valley’s Islamization [113].

While rebuilding the country with massive international support, the Afghan national government decided to develop the Bamiyan Valley into a provincial capital and a commercial and residential hub for the entire central region of Afghanistan. One obstacle to realizing this vision was the lack of accurate data on the built environment due to outdated maps at an inadequate scale and uncertainty about the exact extent of the Cultural Landscape to be protected. To address this, a plan was needed to accurately depict the physical morphology of the valley’s landscape and a methodology to identify the cultural and historic elements worthy of protection. These objectives resulted in the Bamiyan Cultural Master Plan to fulfill the obligations of the UNESCO World Heritage Convention, protect the valley’s natural and cultural aspects, and initiate an urban development process that integrates the protected CH zones. A mixed methodological approach was used to map the culture of the Bamiyan Valley area, combining traditional on-site cultural mapping with advanced documentation techniques such as laser scanning [114]. In addition, remote sensing technologies, land surveys using Differential GPS (DGPS) measurements, and high-resolution stereo satellite imagery for 3D photogrammetric analysis were used to generate a Digital Elevation Model (DEM) of the valley (see Figure 4). By overlaying the DEM with cultural layers in a geographic information system (GIS), we obtained precise insights into the topography and extent of archaeological areas beyond the designated boundaries of the World Heritage property [115]. In the university’s VR lab, we used the derived topographic models to remotely identify the impact of development projects (e.g., road construction) on the World Heritage property well in advance and to explore alternatives in the early stages of some developments [116].



**Figure 4.** Experimental XR setting to seamlessly blend different media resources on the heritage property based on the 3D digital landscape topography as an orientation ground [115].

We presented the study's results to local stakeholders in public meetings and workshops facilitated by UNESCO and in local communities, projecting thematic maps and the 3D digital relief overlayed with protection zoning schemes. We also illustrated the results of near-surface archaeological excavations to explain the need for adapted land-use practices to avoid the damage and degradation of cultural elements. Villagers attending the meetings could check the experts' presentation accuracy by blending the presentations with orthophotography from Google Maps on their mobile devices and immediately verifying the extent to which their land and houses were affected by the protected zone. Local people have never experienced such transparency in planning before.

The interaction with the communities revealed that although the government authorities had adopted the protective zoning plans, the implementation in daily practice was a top-down approach, where individual landowners were directly confronted with the land use restrictions derived from the preservation objectives. The authorities insisted on implementing these restrictions without answering the resulting questions, such as that of basic compensation for the perceived "loss of value" due to the prohibition to use the land in the most desired way (i.e., value creation through urbanization). In addition to the conflicting interests arising from development needs and cultural protection requirements, we have found that the acceptance of universal value concepts such as "World Heritage" is only possible if local values are included. In particular, in addition to the direct link between land use value and the livelihoods of local people, this includes an appreciation of local stories and narratives that are part of the place's oral history and shared by its people. Otherwise, any proposed land-use restrictions aimed at preserving the Cultural Landscape in the long term will be opposed and likely rejected by local communities [117].

Cooperation among stakeholders at the international, national, and local levels is essential for managing World Heritage sites. The case highlights the link between the preservation of CH and its role in peace and reconciliation efforts, especially in conflict-affected regions. Based on such experiences in the field, ICOMOS and ICCROM have elaborated for the international heritage community on this topic and have jointly prepared guidance for heritage professionals since such discussions greatly affect debates on sensemaking and value attribution and also heavily impact the balancing of local power structures. These guidelines address issues of reconstruction within the process of post-trauma recovery and maintaining the value of places exploring the potential for heritage to be an agent of human-rights-based social and economic recovery [118]. Incorporating HCI design technologies and methodologies into heritage management at an early stage can provide innovative ways to engage stakeholders and the wider community in the preservation and interpretation of heritage sites, highlighting and emphasizing individual people's views and visions, including their underlying motivations. Yet greater collaboration between the classical conservation community and HCI designers is needed, as, by integrating examples such as those presented below, stakeholders can create more inclusive,

engaging, and sustainable approaches to preserving and interpreting cultural heritage for future generations.

#### 4.4. Re-Contextualizing Digital CH: The Legacy of Social Media Data

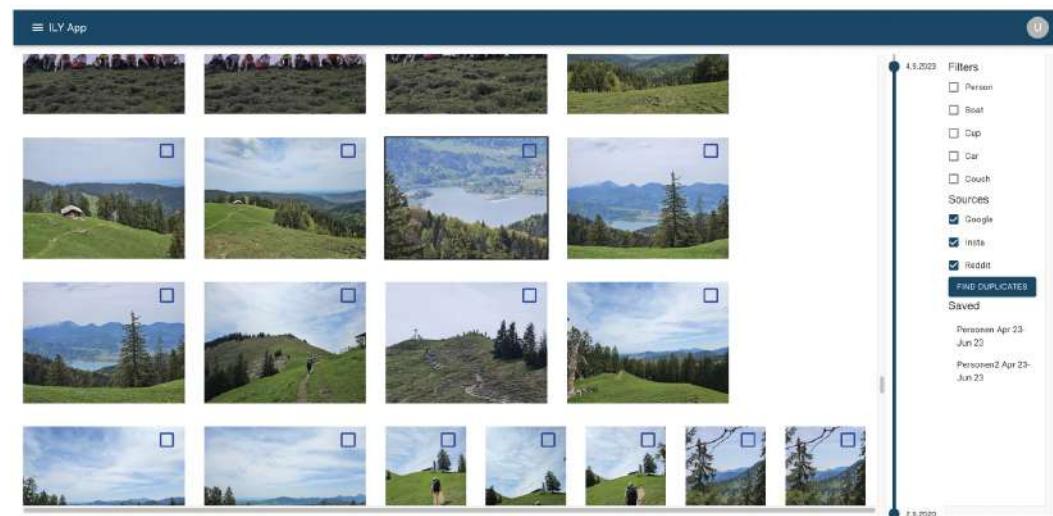
In this case study, we reflect on preliminary work concerning the digital legacy of social media data. We argue that the meaning of the term *digital CH* as we know it today is twofold. One relates to the tools and interfaces applied to preserve and experience analog CH [119,120] as presented and discussed in the previous case studies. In contrast, the second results from the increasing usage of digital services and the creation of online identities [121,122], which, in our argumentation, create personal digital CH.

Elaborating on our argumentation, users spend an average of 6.4 h per day online globally [123] in different community platforms and other activities. Thus, the digital realm is becoming an increasing part of our contemporary and future CH, inducing new social norms, values, behaviors, and CH preservation requirements. Furthermore, technology has changed how we communicate and experience our world, moving many conversations, rituals, or habits into the digital realm. Social media platforms further enable us to create one or more digital identities that can survive their creator [124] and add value on individual, social, cultural, and economic levels [125]. The breadth of possibilities for curating digital identities enables users to craft them independently from their analog lives while all along remaining bound to similar needs for social acceptance and belonging [126]. Beyond the individual, companies, institutions, and governments also maintain online identities to quickly reach a broad audience via different communication channels and platforms. This shift also relates to increasing communication and identity representation based on images and videos [127]. With all these new digital data, identities, and communities, we create digital cultures that shape the basis of dynamic, volatile, and globally connected CH.

Related to this development, new questions arise regarding data ownership and agency. Those questions relate to the level of individual user inclusion and the understandability of the massive amount of data. The situation aggravates considering end-of-life scenarios when the data agency has to be handed over to an “heir” [128]. While many regulate their obituary through a testament, our digital data often remains untouched, lacking clarification on how to proceed. The reasons for treating the digital and the analog legacies differently are based on multiple reasons, among others, the lack of transparency of digital data, a data overload [129], and users’ neglecting attitude to engage in the topic. The latter can be partially explained by the post-mortem privacy paradox [130] that describes the discrepancy between users’ attitudes versus their actual behaviors regarding data preparation before death [130,131]. The paradox adds to the privacy paradox [132,133] and describes how users’ action opposes their attitude by willingly handing over digital data for further usage, application, or access by third parties but consider data privacy very relevant. In most cases, data handling by companies and involved third parties stays non-transparent, leading to companies having knowledge and perspectives of an individual user other than the users themselves. At the same time, users have the “*right to be forgotten*” [134,135] and decide how and by whom their data will be used after their death. However, digital data, such as our social media images, scale very quickly and immensely compared to the uniqueness and stability of built heritage or physical artifacts. This makes digital data nontransparent and hard to maintain [129]. HCI research addresses the challenge by exploring different tools and approaches that empower, motivate, and enable users to handle their data transparently and guard their agency and ownership.

In our case study, we developed and explored a smart web interface (see Figure 5) that assists individuals in managing their social media image inheritance across platforms by contextualizing and customizing the data for and with users. We applied two artificial intelligence (AI) tools, YOLOv8 (<https://yolov8.com/>, last accessed 4 March 2024) to enable contextualized image search, and DeepFace (<https://pypi.org/project/deepface/0.0.53/>, last accessed 4 March 2024), for face, person, and limited emotion recognition. Additionally, users could create their own filters and image clusters, customizing the

data display according to their needs and understanding in collaboration with the AI. In this way, they prepared data access for other individuals or larger groups in the case of their death. The application further aims to support users in managing their data nowadays across social media platforms. For example, if a picture should be deleted, users can define which platforms it should be deleted from. However, the possibilities of contextualizing the images were limited and depended on available and reliable tools and users' mental models of meaningful image clusters. This highlights a challenge of digital data legacy because the created clusters might not correspond to the "heir's" mental model and thus cause misunderstanding and non-transparency when handling the data inheritance. However, our tool focused solely on the data creator's perspective, excluding the heir's user experience.



**Figure 5.** Creating a digital legacy based on social media images: This image shows the AI-supported interface with meaningful filters created by the AI and self-created clusters by the user to pass on to their heirs.

We identified more challenges when testing the interface with users and their personal social media images. For one, there is also a lack of awareness of the consequences and understanding why maintaining a digital data legacy is important. Further, data maintenance and death preparation are also associated with serious, low-fun activities that some users prefer to avoid. In similar situations, HCI research applies nudges [136,137] or gamified approaches [138,139] to motivate users implicitly into action-taking and behavior-changing. In the context of digital data legacy for CH re-contextualization, such approaches can foster multiperspectivity and sensemaking but are ethically questionable. Additionally, non-prepared digital data legacy triggers questions about the remembrance of users regarding what will be remembered and shared of an individual's digital identity after their death or how the data and digital identities will be used continuously by platform owners and other members of the person's network. We see further outstanding questions about how digital data will contribute to shaping CH or how online community cultures, e.g., gaming communities, could support the re-contextualization of analog CH. Our example also emphasized AI's efficiency in supporting sensemaking and facilitating access to one's and other's data. However, this also questions how much we want independent AI systems to define our digital CH and legacy and to what extent multiperspectivity, inclusion, and sensemaking play a part in it. This last case study focused on technologically enabled digital social and cultural developments that increasingly develop parallel to analog CH and that must be considered in CH re-contextualization.

#### 4.5. Summary of Case Studies

Each case study addressed the role of HCI in re-contextualizing CH differently, as well as the HCI–CH relationship.

Case study 1 describes a scenario where *CH prefigures HCI*, in the sense that the design of the mobile-technology- and social-media-supported self-organized learning environments (SOLEs) was driven by the dialogue between the cultural lenses of each YRAS participant—more specifically the “*social and contextual factors influencing their engagement in and experiences with digital tools to learn and develop their learning skills outside of school*” [78]. In other words, the HCI system is the outcome of the co-design process, whereas CH provides crucial considerations for its effective design. As a result, the HCI researchers embark on a curatorial effort to remove barriers and friction when designing the content of the digital technology platform, thus ensuring it reflects the cultural perspectives of its eventual users.

While CH is not the subject matter in this context, it plays a significant role in the background, determining the stances participants may take toward the system and, consequently, its features, design, purpose, and very reason to exist. The success of the HCI system design, within this context, is on the co-design process, ensuring a sufficient level of inclusion for the participants, and thus needs to be grounded on relationship-building and cultural awareness to allow the safe and open sharing of multiple perspectives.

Three of the four case studies applied co-design and participatory approaches. Case study 2 describes a similar scenario to the one summarized above, however, from an inverted perspective: here, HCI is brought into the co-design process of a CH exhibition to create space for discussion around how it will be presented and, consequently, interpreted and understood. In other words, in this scenario, *HCI prefigures CH*, facilitating curatorial decisions. Importantly, technology functions here not only as a mediator of cultural expressions but also as an enabler and facilitator of conversations about the potential forms those expressions may take—essentially impacting the communication culture between and within cultural groups. CH is here the subject matter, and technology is a vehicle for ontological decisions about its presentations and dissemination. Like in case study 1, the co-design process relies on relationship building and a shared acceptance of multiperspectivity among participants as a shared value framing the design process.

Case study 3 takes this entanglement a step further, using a participative approach to understand and consider local needs and implement the local cultural identity in the XR prototype. Here, digital technologies were explicitly employed to reveal hidden information about CH in the Bamiyan Valley area. This led not only to a greater amount of data but also an objective mapping of what was regarded as CH by some, prompting active checking and consultation with local communities to debate its value. Through a combination of applied technology, cultural outreach, and relationship building, it allowed CH to be problematized and, in the process, have its nature reassessed by those primarily linked to and affected by it in light of competing priorities such as opportunities for social and economic inclusion.

In turn, this enabled more informed societal decision- and sensemaking and contributed to community self-determination. Importantly, the digital artifacts generated in the process became themselves CH, not only for documenting sites of heritage significance but also for playing a key role in civic participation and social cohesion. Neither CH nor HCI take clear precedents in the process but are rather inherently linked in continuous *co-constitution* and mutual influence: one cannot be interpreted without the other. Yet, a lesson learned from this case study is the need to integrate the motivations and development aspirations of local people directly by and through communities at the outset of planning activities, especially in such international cooperation projects.

The co-constitution reaches a state of full identity in case study 4, which discusses the processes and outcomes of *HCI as CH* by addressing AI assistance in managing personal data legacies. While the original study focused on testing the interface, it represents multiple online communities, social media platforms, and digital identities that are part of our contemporary CH. Thus, here, HCI pre-configures a novel intangible form of CH.

In comparison to the other case studies, case 4 did not include a co-design approach but involved HCI experts in making design decisions about meaningful data aggregations and classifications. Also, by enabling data selection and intentional exclusion, there is the risk of creating a polished, limited heritage that undermines other perspectives and experiences. It limits the level of multiperspectivity and sensemaking that can be expected when passing on prepared digital legacies. And yet, the increasing HCI–CH entanglement requires finding means to understandably aggregate and share digital CH and prepare it for future developments.

## 5. Discussion

Our work addresses how HCI can approach re-contextualizing CH toward multiperspectivity, inclusion, and sensemaking by considering four diverging case studies. We discuss our results with a focus on the HCI–CH relationship and entanglements and their impact on CH re-contextualization. We also raise the consequences for HCI technology and research, followed by acknowledging the work's limitations.

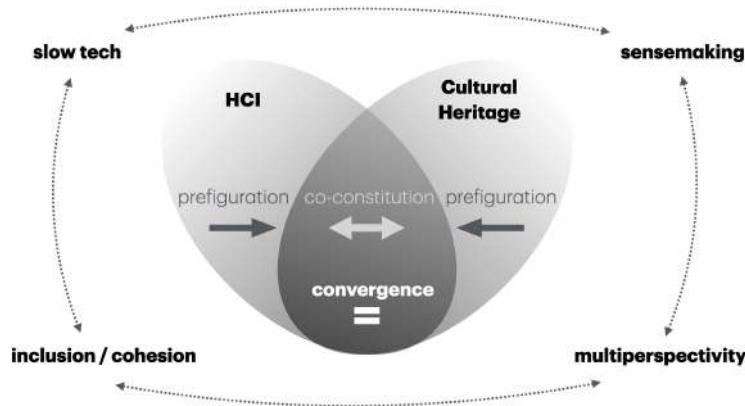
### 5.1. The Role of the HCI–CH Relationship and Entanglements in CH Re-Contextualization

The four case studies show the diverging and complex variety of HCI–CH projects, including the broad range of contexts, technologies, and people and, thereby, the emerging roles of technology as a mediator of social interactions and a vehicle for cultural expression. In comparison, none of the case studies is about HCI per se, but they concern its roles in re-contextualizing CH and in articulating social relationships and communications around it. These new roles are significant for revealing the entanglements between technologies and the various human and non-human world elements increasingly acknowledged as, or pertaining to, CH.

What emerges out of those case studies is a new reality where HCI and CH are largely *entangled* [140,141]: On the one hand, HCI becomes, and partially is already, instrumental in mediating the re-contextualization of CH, including its discovery, articulation, and documentation. On the other hand, HCI pervades culture to such an extent that it becomes CH itself (see case studies 3–4 and Figure 6). In line with this, we refer to Barad [142]’s work, which pointed out that the mere use of an instrument to observe an event changes the very nature of the event itself and, consequently, the interpretations we may make of both. The event, observation device, and observation data are intrinsically related in an existential way: the very existence of each is only understood in relationship to the another [142]. They do not take part in interaction (which implies their nature as pre-existing, independent entities) but in *intra-action*, a term that points to their co-constitution. Likewise, there are a growing number of voices alluding to a shift currently underway, whereby technologies can no longer be interpreted in isolation as an interaction between humans and computers but rather must be understood relative to everything else around them [141], in what has been referred to as the “Fourth Wave of HCI” [140].

The shift not only challenges CH conventions through the increased potential for interaction, participation, and analysis offered by HCI tools, but also exposes HCI practice, purpose, and ethics to the critical lens of heritage, cultural, and decolonial studies [143], and thus subjects them to scrutiny and reevaluation. This includes the reevaluation of artificial intelligence algorithms to ensure inclusive data sets and processing that represent the target society as discussed in Cernadas and Calvo-Iglesias [144], enabling access to digital legacies of our ancestors, as approached by, e.g., Doyle and Brubaker [128], whether a community’s cultural identity is appropriately represented in an interaction design [13,14], etc. While researchers are already working on individual aspects related to these open questions, the changes are too broad, complex, and nontransparent to provide an exhaustive list. Furthermore, these different roles and entanglements require a shift in perspective and preservation of computer-mediated cultures and digital identities. It poses new challenges to the HCI–CH relationship, such as developing preservation practices for, e.g., digital

or hybrid legacies and artifacts, emphasizing the need for continuous research on this HCI-CH entanglement.



**Figure 6.** Model for the entanglement between HCI and Cultural Heritage (CH). The central diagram illustrates the different relationships between HCI and CH observed in the case studies. Surrounding the entanglement are the four ethical precepts sustaining an ethical approach to it.

### 5.2. Consequences for HCI Technology and Research

As the integration of digitalization and technology, and the consequent interactions with it, are becoming cross-cutting themes in CH presentation and access, it is essential to consider how HCI advances can answer that. Realizing that technology is not just instrumental in mediating CH but can also influence and manifest the perceptions, attitudes, and values presented through the experience puts more responsibility on the researchers and developers. The ethical and participatory design aspects in different development phases become emphasized, as well as openness to pluriversal narratives and interpretations, which may become a critical part of the final design. In line with prior work [145], our case studies emphasize the need for HCI research to understand the local context and to be culturally “calibrated” when developing technological advances.

Enabling CH re-contextualization toward such a connected and inclusive understanding starts at the data level. It requires appropriate and accessible infrastructure and a level of connectivity with clearly distinctly managed data spaces to ensure that CH ownership stays with the people [48]. Many people are not experts in information technology or secure data connections but rely on HCI to bridge the gap and provide the technical infrastructure and interaction concepts to facilitate integration and usability.

One of the first necessary steps is to create awareness about the various forms of entanglement between HCI and CH, which demands both research and practice to be repositioned toward longitudinal technological approaches. It is crucial not only to use HCI tools in the context of CH but also to allow enough time and space for the development, maturation, and manifestation of the impact of technology qua CH in society, as well as to correct course if needed. Likewise, slowness is necessary to allow the emergence of different perspectives by the local people to whom the heritage relates, who ought to be afforded opportunities not only for self-expression but also for self-determination.

“Slow tech”, which “*encourages people to reflect and think about [technology]*” in its expression and context, [146], thus becomes a prerequisite to allow for the comfortable sharing of the digital and personal cultural heritage, mitigating challenges preventing inclusion and multiperspectivity. These may include not only the algorithm bias [147] and other unintended consequences of transferring HCI methods and technologies across cultural contexts but also the methodological biases posed by the researchers’ background, which may affect the progress and objectivity of conversations around CH. In that context, technology can no longer be understood as a mere tool but as an instrument re-contextualizing postcolonial ethics [143] of how to deal with CH subjects in the moment and over time.

HCI-entangled CH goes on to further design the world and society [148] as the embodiment of that ethical articulation of cultural heritage. As a result, capturing those entanglements as they interplay is more than an ethical approach: it is also an exercise in futuring [149], responding to systemic forces in society and prefiguring a world where CH is predicated on multiperspective, collective sensemaking, cultural inclusion, and social cohesion.

Moreover, some methods that play a central role in HCI-oriented projects, such as rapid prototyping and quick exploration of ideas, may require a more thorough consideration of the technology's expression and impact, reflecting the "slow tech" approach in Figure 6. This accounts for the design features, graphics, symbols, templates, or other design elements used in the rapid prototyping phase as early drafts or placeholders that may contain elements that are foreign or even insulting in a sensitive design context [146]. This also highlights the risk in HCI research that approaches and prototypes may lead to misconceptions or dismantling of the trust in participatory processes when ignoring the role of HCI in HCI-CH entanglements. Consequently, HCI advances in CH should be aware of the entanglement and sensitive and responsible role that HCI takes to drive CH toward multiperspectivity, inclusion, and social cohesion.

### 5.3. Limitations and Outlook

Our work refined the HCI-CH relationship through a non-exhaustive and diverse set of case studies, reflecting the role, tools, and methodologies of HCI in different project phases to foster CH re-contextualization (see Table 1). However, all case studies focused on the potential positive impact of HCI technologies and research on re-contextualizing CH, not addressing the risks of misuse or decontextualization. While this was out of the scope of this work, these are highly relevant impacts that need to be researched further to preserve and contextualize CH through HCI. Furthermore, re-contextualizing CH is highly complex and is approached very differently, aggravating it for HCI researchers to scale or generalize their findings. Based on our work, we see the potential for developing principles for HCI-CH designs that could inform and guide HCI researchers in their decision-making and argumentation. Yet, we also see the need for HCI research to change attitudes to accept slow pace and low generalizability as valuable research contributions that (re-)contextualized HCI-CH projects need to succeed. It will require adaptations of performance measurement that we task the HCI community with pushing forward to enable a more agonistic and democratized CH.

## 6. Conclusions

Exploring the advances in HCI for CH re-contextualization illustrates a profound entanglement that transcends traditional disciplinary boundaries. Our four case studies highlight that technology acts not merely as a tool but as CH itself, indicating a paradigm shift in which HCI becomes an integral component of cultural production, dissemination, and preservation and thus a crucial factor in CH re-contextualization. Thereby, HCI serves as a mediator and manifestation of CH, impacting how HCI can support CH re-contextualization. Considering HCI as a mediator requires adapting methodological approaches and interaction design concepts that allow users to change perspectives and trigger compassion and understanding for their own and other cultures, setting CH in focus. In comparison, considering HCI as a CH manifestation opened multiple research questions we must address in future work.

This partially new role introduces challenges and ethical considerations. For one, CH re-contextualization requires a nuanced understanding of the socio-cultural contexts, emphasizing the need to adopt slow and reflective HCI approaches to technological interventions in CH when HCI acts as a mediator. Furthermore, enabling multiperspectivity and inclusion demands a reevaluation of conventional research and design practices, focusing on empowering local communities and safeguarding diverse narratives and individual perspectives (see Sections 4.1–4.3). In comparison, HCI as CH comprises the impact of technology on behavior changes, social norms, and communication styles, as well as the

increasing digitization of our cultural heritage and (non-) available access to having such means of digitization and preservation (Sections 4.3 and 4.4).

Ultimately, the complexities of HCI-CH entanglements are an ethical imperative and an exercise in envisioning a more inclusive and cohesive society. Our work suggests re-contextualizing CH and its communication by adapting HCI tools, methods, and approaches and considering the inherited cultural role of HCI that shapes the preservation of past, current, and future CH.

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