Moving Virtual Reality out of its Comfort Zone and Into the African Kalahari Desert Field

Experiences From Technological Co-Exploration With an Indigenous San Community in Namibia

Rodil, Kasper; Maasz, Donovan; Winschiers-Theophilus, Heike

Published in:
Proceedings of ACM Symposium on Virtual Reality Software and Technology

Publication date:
2020

Document Version
Publisher's PDF, also known as Version of record

Moving Virtual Reality out of its Comfort Zone and Into the African Kalahari Desert Field: Experiences From Technological Co-Exploration With an Indigenous San Community in Namibia

Kasper Rodil
Dept. of Architecture, Design and Media Technology, Aalborg University
Aalborg, Denmark
kr@create.aau.dk

Donovan Maasz
Namibia University of Science and Technology
Windhoek, Namibia
maaszdonovan@gmail.com

Heike Winschiers-Theophilus
Namibia University of Science and Technology
Windhoek, Namibia
hwinschiers@nust.na

ABSTRACT

Indigenous people (IP) living in remote areas, at the margins of mainstream society, are often the last ones to experience emerging technologies and even less to shape those experiences. It could be argued technology exposure and experience is necessary for IP to gain agency in making informed decisions on the rejection or appropriation of novel technologies. In this paper, VR is introduced to a remote San community within a broader community-based research collaboration considering political and ethical perspectives of technology inclusion. The intent was to familiarise the community with the technology through the development and playthrough of a game, to explore future opportunities for joint co-designs of VR applications, meanwhile gauging the barriers for how VR operates outside of its intended setting. The community members expressed their excitement about the experience and the desire to re-create traditional San games in VR. The paper reflects on the community experiences, the setup and use of VR in remote settings, and the choices made to facilitate the familiarization of emerging technology.

CCS CONCEPTS

• **Human-centered computing** → *Empirical studies in HCI*; **Virtual reality**.

KEYWORDS

Virtual Reality, Namibia, San People, User Experiences, Indigenous People, Indigenous Knowledge, Cultural Heritage

ACM Reference Format:
Kasper Rodil, Donovan Maasz, and Heike Winschiers-Theophilus. 2020. Moving Virtual Reality out of its Comfort Zone and Into the African Kalahari Desert Field: Experiences From Technological Co-Exploration With an Indigenous San Community in Namibia. In *26th ACM Symposium on Virtual Reality Software and Technology (VRST '20), November 1–4, 2020, Virtual Event, Canada.* ACM, New York, NY, USA, 10 pages. https://doi.org/10.1145/3385956.3418955

VRST '20, November 1–4, 2020, Virtual Event, Canada

ACM ISBN 978-1-4503-7619-8/20/11…$15.00
https://doi.org/10.1145/3385956.3418955

1 INTRODUCTION

Indigenous people (IP) living at the margins of mainstream society, distant from urban areas, are often the last ones to experience emerging technologies. The reason is not necessarily purposefully with good or bad intention but a systemic phenomenon. Disengaged from an evolving socio-technological ecosystem, opportunities for remote IP to participate in tech experiences and even less in shaping those experiences and society are limited. Thus it leaves IP with little ability to influence emerging technology, missing a critical point of framing the development and incorporating their value systems. Martinez [20] demonstrated perspectives of indigenous technologies fostering sovereignty of IP with his *Radio Healer* performance installation, consisting of indigenous and electronic devices. *"It is a rhetorical public engagement by a group of indigenous people who are considering the colonizing potential of digital media, as well as the appropriation of this powerful and malleable medium to respond to the needs and desires that our communities identify for themselves."* [20].

Hence we postulate that only through early exposure and experience of emerging technologies can IP gain agency to shape experiences of technologies in line with their value systems.

However, considering the lack of every day possibilities to explore technology due to the remoteness and intermittent internet coverage, the exposure of emerging technologies can only be created artificially. Thus technology is introduced to an indigenous community, be it by a travelled community member or a visitor, unintentionally or deliberately. Different political and ethical stances are deliberated in the academic world, ranging from technology imperialism to neocolonialism, mostly depriving IP of their agency to make their own choices and/or ignoring contextual circumstances. Not considering a perspective from within the local context leads to the discrimination of pluriversality [11]. We therefore argue for a more reflective situational approach to appraise and determine the principles and ethics guiding technology exposure.

VR as a technology, has a tremendous potential in cultural digitization contexts where non-verbal and embodied interaction as a non-symbolic approach to computing systems [37] for users with or without digital literacy is possible; for example in cultural education [5] or as efforts of protecting cultural heritage [7] [24],

can foster new experiences and include new demographics as content creators or end-users. In this paper, we deliberate on the very first introduction of Virtual Reality (VR) as a technology, to an indigenous San community in the Kalahari desert, acknowledging local circumstances for its deployment and the expressed interest from the community to work on technological projects. Based on many years of working in indigenous contexts, collaborating on tech projects, we acknowledge already the contextual technological challenges often present, yet having never explored with VR in those settings, this article serves as the first touch-point in what is usually long-term (often several years) project work.

A recent VR project on capturing Aboriginal cultural heritage stresses the importance of collaboration with IP in co-creation efforts [33], this article presents a view before co-design and co-creation even begins. For local stakeholders to transform technologies and applications it is deeply embedded within collaborative design efforts to familiarize with technology to establish a local understanding of what a technology *can be*, prior to realizing what it *can become*.

This stage represents Beguin's *artifact-based learning* approach [10], which is essentially a communication process facilitated by system presentation rather than system description [3]. Embedded throughout is the concept of 'mutual learning as a principle for transdisciplinarity' [26] whereby researchers and local stakeholders learn from the experiences arising from this meeting between context and artifact.

Thus we intended to provide community members with a VR experience, to familiarize with the technology through a tailored, proof-of-concept VR game to bootstrap a technology familiarization stage enabling a starting point for joint exploration and co-design of embodied interaction applications.

The article starts out with an introduction to the methodology of community-based research and underlying reasons for this work. Then the VR game which was specifically designed by students under our supervision is presented, serving to better contextualize to the reader what the community experienced, will be described. In line with recent discourse on VR 'outside the lab' [23], we further discuss the technical and usability issues of VR in a remote community setting, the collective experiences by the San community as well as reflect on choices in technology explorations outside of its comfort zone.

2 A COMMUNITY-BASED RESEARCH APPROACH

The work presented here needs to be seen within its broader context of methodological, political and ethical stance, in relation to the community collaborator's context and aspirations and the researchers' positionality and collaboration premises.

2.1 Community-Based Co-Design (CBCD)

The project work is framed within a community-based co-design paradigm as conceptualized by Blake et al. [2], Sabiescu et al. [25] and Winschiers-Theophilus et al. [39]. Based on principles of participatory design and action research within a research through design methodology, methods and techniques are adapted within an African epistemology characterized by a quest for justice, truth, and harmony [1] focused on knowledge creation for improvement of human relations [38]. Of significance is, that community research collaborators are not participants or subjects but are co-designers [19]. Considering the differences of expertise, mutual learning throughout the process becomes essential. Molapo et al. [22] refer to 'co-design readiness', where participants develop skills gradually over time during technology exploration and participatory design activities. Kauhondamwa and colleagues [16] define an explicit exploration phase consisting of self-reflection, technology experiences and assimilation of design thinking, enabling the participants to meaningfully contribute to the tech co-design and production. Equally, Alessandro and colleagues [29] have used technology as cultural probes to engage indigenous communities into a dialogue around cultural practices and possible digitization, expanding the engagement into joint coding on country activities [28]. Thus a CBCD approach focuses on enabling communities to learn the necessary skills to design technologies that will ensure digitization in their own terms [19]. This includes taking informed decisions as to the choice of technologies.

2.2 Tech Imperialism versus Opportunity - a question of perspective

The action of introducing technologies to indigenous people has unraveled a socio-political debate among academics, ironically mostly excluding indigenous voices. Concerned with designers' Western values embedded in technologies, an uncritical adoption and use of these technologies by IP suggests cultural imperialism or another form of neocolonialism [9]. However, does the active prevention of technology exposure not equally allude a form of apartheid and segregation? Acknowledging the tensions between an indigenous epistemology and the constraints of mainstream technologies, advocates the urgency of including IP into the re-design and appropriation of technologies [38], rather than further excluding IP from shaping technologies.

Ultimately, most agree, that IP should be in control of technology access, use and appropriation [20]. For example, Fernandu et al. [12], members of Namibian marginalized San communities, conceptualized and successfully used an interactive digital performance to advance their political agenda in repositioning themselves in mainstream society. Thus we postulate that it is no longer a question of whether or not IP should be exposed to technology but rather in which manner. Thus we should aim at investigating whether it is culturally appropriate [9], and contextually and ethically appropriate[6].

2.3 The Ethics of sharing technology experiences with IP

Institutional and national ethics regulations, as well as many deliberations on ethical researcher behaviour in the literature, still promote a one-sided approach which does not recognize indigenous participants as research partners. It propagates respect yet does not recognize indigenous communities' interaction protocols [14]. Researchers collaborating with indigenous communities agree that power structures and reciprocity need to be addressed [4], while interaction forms are to be negotiated within each context [39]. As such, institutional ethics guidelines need to be revisited

in accordance with community protocols. For example, Du and Haines[8] present a framework based on trust and respect leading to reciprocity and mutual partnership providing specific guidelines within an Australian Aboriginal context, based on ongoing community consultations. Thus within the context of this study we firstly consider the San code of research ethics [1], which promotes respect, honesty, justice and fairness, care as well as following an agreed upon process. The introduction of technology therefore needs to follow these principles as agreed upon with the collaborating community.

2.4 Community Collaborators

The VR technology presented in this paper, was shared with a community of San people. The San population in Namibia counts between 27,000 and 34,000, and represent approximately 1 percent of the national population [2].They are among the most marginalized ethnic groups in Southern Africa [31]. The word "San" means forager [36]; they are a group of indigenous tribes of hunter-gatherers that inhabited Southern Africa for millennia [3].

Our collaboration community is living in a resettlement near the western border of Botswana, in the heart of the Kalahari Desert. They receive government aid in the form of monthly food packages and free access to water from a borehole. There is minimal infrastructure in terms of electricity, roads or internet connection. The approximately 200 people live in self-erected shacks and the surrounding area is very arid with little to no shade trees or any other vegetation. There are few possibilities for income generation thus the people rely on traditional objects for sale and occasional cultural performances. The San can no longer follow their traditional practices of hunting and gathering due to national regulations and as most of the surroundings is fenced for cattle herding by neighboring tribes. They however still possess fragmented traditional knowledge which they share with pride.

In terms of technology experience, the San community has engaged in multiple projects with our faculty (from e-services to basic computer training) and recently completed a full Augmented Reality (AR) souvenir co-production project was successfully brought to market. In one of the projects, the community received cellphones, which they used mostly for phone calls. Besides the limited use of phones, there is no ICT installed or used in the community, and none of the community members have prior experience with VR.

2.5 Researchers' positionality and Collaboration premises

From a political stance, we find ourselves in a post-apartheid era genuinely supporting national reconciliation, by attempting to reduce tribal and economical inequalities through skill and tech development. Our relation as local researchers, from different ethnicities including San, with the community, is based on an established long-term partnership beyond singular projects and research only, extended to multiple engagements and interactions as well as continuous remote connection. In other words, dialogic and transcultural inter-human relationships have evolved over time between the local researchers, and community members. Reciprocal respect acknowledging distinct perspectives, experiences, values and skills contributing to agreed upon joint endeavour enriches each interaction and design activity and promotes mutual learning. On this basis, visiting researchers from other countries, with pre-defined research intentions, are introduced to the community, who evaluates their interest and willingness to collaborate. The community has explicitly expressed their appreciation for bringing "the world" to their remote place, facilitating experiences of new technologies and learning. While the visiting researchers are given an opportunity to learn how technologies could be perceived and shaped differently than within a mainstream tech space, thereby providing new perspectives.

2.6 Choices of emerging technologies

VR has opened up new avenues to learn and experience what might not be reachable to us, such as the past, interpretations of myths or far away remote places and practices. Suominen and Savula call this: *"To apply gaming for representing the past."* [30].

Mythology plays a significant role in cultural identity and heritage. Having been transferred through many generations and means such as oral stories, and written books, digital games provide possibilities for new audiences such as game-interested youths or urban-living descendants who can freely access other cultures' material on Netflix or Steam - but not their own. The creation of myth-based VR games becomes an exercise of meaning-making and construction of a partially self-imagined virtual world in the absence of detailed information. One example of this challenge of creating multi-sensory mythological VR games based on fragmented, unimodal (and conflicting) sources, is described in the work by Skovfoged et al. [27] about the widespread African myth of the Tokoloshe.

An exemplary initiative has been the Virtual/Digital Songlines (VSL) project [18][13]. The project has developed various theoretical frameworks and tool-kits for the facilitation of digitization, and dissemination of Australian indigenous cultural heritage, and explored VR capabilities and player experiences. The game was co-developed with Australian aboriginals to ensure cultural validity and authenticity of experiences [17]. Thus inspired by such projects we have engaged a group of media technology students into assisting with the development of a VR game as described below, to create a VR experience to be shared with our collaborating community. It is a presentation of a system intended solely to support the San community to experience something culturally relevant and interact in VR (see in 5.3.1 about this dilemma of system presentation).

People working with VR might agree that VR is best understood when experienced. Establishing local understanding of a technology does not happen over night and it is likely that other VR applications would need to be demonstrated as part of familiarization prior to ideation and co-design of VR applications the community would find interesting to work towards.

In summary, at this stage, we as researchers do not know the reception of the technology nor its potential future as a collaborative

[1] http://trust-project.eu/wp-content/uploads/2017/03/San-Code-of-RESEARCH-Ethics-Booklet-final.pdf
[2] https://www.iwgia.org/en/namibia/3506-iw2019-namibia
[3] https://www.sahistory.org.za/article/san

path to an application. It was our agenda to share the technology with the community and let them decide if they found it relevant to pursue as content creators for urban-living San.

3 "TERMITES OF THE GODS" AS A VR GAME

This section describes the VR game's origin, rationales for the choice of VR system and story walk-through.

3.1 Foundation for the Representation

The game focused on a San tribes' cosmology and belief associated with termites as presented by Siyakha Mguni. His interpretations of various rock art, which is described in his book: "Termites of the Gods: San Cosmology in African Rock Art." [21] were studied and served as guiding content. In the elaborate book, Mguni analyzes and reports on various instances of San rock art in order to interpret what intangible properties they might visualize. The actual rock art found on cliff sides is the tangible (and relatively permanent) manifestation of intangible practices tied to the ontological beliefs or cosmology of its makers - the San. The story itself was chosen for being an existing textual, already contemporary anthropological interpretation of cultural product from a time long gone.

The interpretations by Mguni were used for designing and implementing a virtual experience representing elements of this cosmology. Termites were a key source of fat for the San People, and "Supernatural potency is the force that makes contact between the cosmic realms possible" [21]. Termite nests were believed to be "supernatural spaces or portals into primal time" [21]. The passage from the physical world to the spirit realm is explained as "threads of the sky or threads of light that assist the soul's ascent to the sky realm" [21]. Much is still vague regarding the appearance of the spirit realm. It is mentioned that plenty of food, fat, potency, and termite mounds are in God's house in the spirit realm. God's house described as "...house with a single tree next to it in the eastern sky. Their lesser God, Gauwa's house, which is in the western sky, has two trees. While the exterior of this house is 'hairy like a caterpilla" [21]. Many different interpretations of the appearance of the spirit realm are mentioned by Mguni. However, some elements reoccur, such as that gods live in his house in the spirit realm, at least one tree is next to his house, as well as the presence of many animals [21].

3.2 Designing for Mobility

The Oculus Quest [32] was the VR headset of choice, as it features all necessary hardware pre-built into the headset, thus eliminating the need for an external computer and enabling wireless interaction. Furthermore, it features inside-out tracking, which makes it a more agile system for evaluation in a rural area (which perhaps needless to say, come without a well-equipped infrastructure). When developing for the Oculus Quest and other mobile technologies, it is essential to take the limited resources of mobile hardware into account (ranging from battery life to the amount of polygons, which can be rendered while maintaining a reasonable frame rate). Inspired by earlier work on presence, such as studies by Welch and colleagues [35] promoting interactivity over visual realism to increase presence directed the decision to work with a low-poly art-style in order to avoid delay issues that could limit the experience. The low-poly art style consists of flat-shaded objects consisting of a very low subdivision, single-colored albedo maps (the base color), and specular maps (the glossiness).

3.3 Storyline

While a number of detailed descriptions from the book were incorporated in the VR game, much was left to the designers to imagine and design.

Considering that the community has never been exposed to VR, a tutorial level was implemented to ease familiarization with the game mechanics. Due to the opportunity of VR, the mechanics are designed to rely as much as possible on non-verbal, non-symbolic embodied interaction. Thus the community members could focus on the experience, and dedicate energy on familiarizing with the controllers, of which functionality was kept to a minimum. Once the player completed the tasks in the tutorial, entry to level 1 was possible. All of the actions for transferring the player between scenes are signified by a swarm of white glowing termites slowly gathering around interaction points. The overall narrative of the game is to assist a stranger bitten by a snake. In order to heal him, one must pass through to the spirit realm where to obtain "supernatural potency". Figure 1 provides a small overview of the various environments created for the game.

4 EVALUATION OF VR IN THE COMMUNITY

4.1 Methodology and Stages of Evaluation

The evaluation with the community took in total more than two days. We want to stress this point to show how this type of work differs from a classical experimental setup in the sense that learning from our and the community's perspective is happening in and out of formal activities. One example from a facilitation perspective is how the individual play-through becomes a social event unable to control (not that it should be). Another example counts setting up and running VR for evaluation in the community. Based on these points it is reasonable to see the entire trip to the community as one long evaluation with findings throughout the process.

To assist with gaining an overview, Figure 2 illustrates the evaluation divided into four stages, which will be explained under separate headers below. Throughout these four stages there was an extensive data capturing in the form of video, photos and notes all serving for later analysis and review. VR play-through was captured in video using the built-in recorder of the Oculus Quest.

Throughout the trip the language preferred by the individual community member was accounted for by having translators accompanying us. This was quite a complicated process as three languages were spoken intermittently (English, Afrikaans and local San dialect).

4.2 Community Introduction

Having arrived the night before, setting up tents and casually meeting with some from the community around small fires, the first day began with the entire community having assembled at a local shade point (see figure 3 left). After welcoming each other the researchers introduced some of the projects and activities that were planned for this visit, some of them running in parallel with the VR. It is customary to have a collective greeting in which ambitions as well as

Figure 1: The figure shows the different environments in the game. From left to right): 1: Tutorial, 2: Home, 3: Finding Access to Spirit realm, 4: Journey into the Spirit realm and 5: Arrival at the House of God

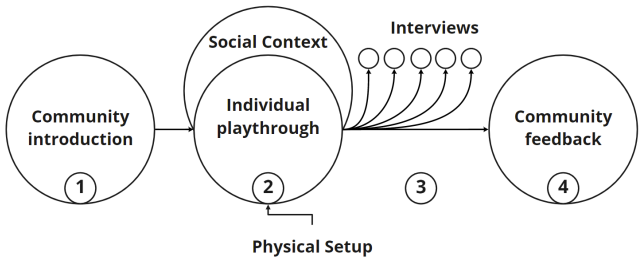

Figure 2: The figure illustrates the four phases of exploring VR with the community

progress on ongoing projects are stated and discussed with the community. At the introductory meeting one of the researchers began to explain, meanwhile wearing the gear, how one could understand VR, for instance that VR is like "being in another world or country where you can see and do things". Quickly, individual community members expressed their interest in joining the VR activities. We had two different VR applications for which we dedicated one day each having as many community members play as was possible in the time frame. The findings and data presented in the sections 4.3.3 (Individual Playthrough) and 4.4 (Interviews) only relates to the VR game described above. The section on Physical setup and Social Context provide findings from both VR activities and were similar throughout. The section on Community Feedback takes a more general perspective of the two VR experiences as a whole.

Figure 3: Community Introduction (Left), Individual playthrough and example of social context (Right)

4.3 Physical Setup, Social Context and Individual Playthrough

4.3.1 Physical setup. Due to the location of the community in the Kalahari Desert and the fact that the sparsely distributed vegetation provided little to no shade, we had to set up a 3*3 m pop-up gazebo, that was demarcated as the VR playroom. The Oculus Quest was specifically chosen due to its inside-out tracking system removing the need for a fixed tracking space setup as an alternative to using lightposts from the HTC VIVE system, and it can run without the need for connected power-consuming hardware (which was not an option). While we are versed in technology studies in remote places we did not expect the Oculus Quest to suffer in so many ways when trying to facilitate play-through. The playroom provided adequate shade from the sun as the VR was not operable in the direct unforgiving sun of the Kalahari desert as the Infrared is overpowered in direct sunlight, which meant that movement outside the tent impacts tracking and the tracking space was of similar size as the tent (3x3m). To accommodate as many participants as interested we had promised the community to play through the night. However, as light was fading the technology gave more and more problems. Car lights and camping lights were positioned all around the playroom to get as much light into the playroom as possible.

But soon hereafter another technology related issue emerged as the VR uses the camera for feature detection and the lack of light disabled the opportunity for proper tracking. Apart from this, the hard illumination attracted quite many large insects flying around the participant's head, although quite amusing at times, it was disturbing a focused VR experience. Thus the session was postponed to the next day.

Due to the overwhelming interest the system ran out of battery quite frequently and in absence of grid power, had to be recharged by means of car batteries and power banks. This further prolonged the sessions.

4.3.2 Social Context. The playroom had collapsible sides that enabled the community to view the current participant from a distance (or so we expected). However, the community members quickly formed a permanent audience inside and outside of the tent to observe the playing participant, who in turn was occupied inside a digital space (see Figure 3 right). As excitement increased, the audience moved closer and closer to the VR participant, thereby limiting her or his physical space of movement. Thus the audience needed to be reminded of the space requirements for the participant. One would wonder why we did not create an isolated space for the VR participant in order to focus on individual experiences? Yet, within a community context, we have learned to appreciate the collective as a more meaningful outlook. Especially in this context the VR experience was extended from the individual to the community within the moment. Furthermore, when the VR participant completed their experience they could not wait to share their stories with the audience. They laughed together about the actions. The

talks about the participants' experiences extended way beyond the sessions into the night shared around the fire.

4.3.3 Individual Playthrough: Participants' VR interactions. The VR game described above, was experienced by one young lady and four men, aged between 24 and 57. They all participated voluntarily and gave informed consent to be recorded and interviewed. At first, the participants seemed very excited about the technology that they were being presented, purely based on curiosity for the unknown. Before the technology was demonstrated it was explained that this technology takes them into a different reality. They were told that they will they see a virtual representation of a world created digitally. This prospect was unknown to them and caused a certain sense of excitement among them. Figure 4 shows participant 1 to 5 as they were busy playing Termites of the Gods. The play-through lasted between 20 and 30 minutes per participant, of which the tutorial scene was the most time consuming.

The VR game was developed to retain as much of everyday interactions with the application, such as picking up a rock (albeit using a controller). But the participants found it challenging to adapt to the interactions and this made the game a little confusing. It was inherently clear to the presenting researcher that some explaining had to be done to reach a certain level of comprehension and skills with which they are able to navigate the virtual realm on their own. The interactions were designed from a premise to have as little use of the controller buttons as possible, from a VR developer perspective, they can be declared almost as assumed intuitive interactions. However, for a non-gamer and first time user nothing was intuitive and everything had to be learned. For instance keeping hold of the controller and keep it in the palm. Thus, the facilitating researcher stayed next to the participant through all the sessions to assist. Also, completion of the game took much longer. One of the reasons that the game took so long to complete, was that most of the participants had trouble learning to climb the ladder. The issue for many participants was that they accidentally let go with one hand before grabbing the ladder with the other hand, thus making them fall down the virtual ladder, resulting in having to start over. Other participants did not reach close enough to the ladder to interact with it, perhaps not adequately perceiving the distance of objects in VR.

The first participant was a female participant. Due to various reasons (some had work obligations, etc) we only had access to one female participant to try out the VR game (see 1 from figure 4). She was curious and enticed yet at the same time nervous in anticipation of the VR experience. As dictated by the local code of conduct, a woman is not alone with another male than her husband, and to ensure she was more at ease her session was facilitated by one of our female researchers. The participant was cautious about the technology and uneasy at first but she felt highly motivated to experience the VR. She eventually seemed to adapt to the overwhelming experience of the technology and started to enjoy the game and the interactions that go into it, however due to time constraints she did not manage to complete all the game scenes.

The second participant (see 2 from figure 4) was a male participant. After he was geared up, the session was initiated and surprisingly the initial experience seemed overwhelming for him. Normal daily interactions one expected to carry over into VR were lost, such as looking around. The gentleman was amazed by the mere vision he received at the point when the headset was placed over his eyes, causing him to stare straight without turning his head to look around. The presenting researcher encouraged him to look around and talk about the surroundings he experienced in the technology. The participant was so amused by the animated scenery he lost focus of what the in game tasks were and just spent some time gazing around. As the first male participant of Termites of the Gods VR, the community gave special attention to the participants physical movements in the real world. With every interaction, we heard the community discuss in their language what was happening, formulating their own reality of what the participant could be experiencing visually.

The third participant (see 3 from figure 4) was an elderly gentleman from the community, his son was part of the first VR session (out of the scope of this paper) and felt therefore compelled to also experience the technology. As an elder of the community, he held a certain stature or respect as a knowledge holder. What was extremely interesting about his time in the VR, in the first scene, where the player is requested to kill the snake with the stone at hand. The participant was taken by surprise from the compelling sound effects of the dying snake and his mere reaction of jumping backwards was extremely amusing to the entire community as it elicited quite a number of laughs. At this point the presenting researcher became more aware of the social mechanisms at play in the community. If the VR participant spent some time in a certain scene of the game, he received comments or directions of use from the community audience. To be noted here, the advice often came from community members who themselves had not experienced the VR but who had paid attention to previous participant's actions and comments, as well as hearing the advice given by the facilitator.

The fourth participant was another elderly gentleman (see number 4 of figure 4). From the talk of the community and sharing of the stories by the previous participants, he was excited to get into the VR and experience the new technology. But he found the in-game interactions more difficult to cope with than some of the other participants. Most of his time was spent attempting to climb the ladder. However, he could not adapt to the controller interactions that well for him to manage climbing the ladder and to interact in-game. Assistance was therefore given to the participant to aid him in climbing up the ladder, simply to allow the participant to experience the more enticing scenes such as scene two to four as depicted in section three of this paper. The participant was not as talkative about his physical experiences during the playing of the VR, and his exact difficulties could not be identified. Out of the entire research trip, participant four spent the most time inside the VR game, being assisted by the presenting researcher in navigating the VR environment.

The fifth participant (see 5 from figure 4) was a younger gentleman from the community. He was much more at ease with the technology. As mentioned earlier because of the extent of knowledge sharing within the community, the community was able to assist the participant in the usage of the game. And because they could communicate in their local dialect, the presenting researcher believes it was much easier for him to understand the task at hand. He did not experience any extreme difficulties in the usage, and

Figure 4: Participants one to five, experiencing the VR.

therefore, as a result, had an immediate seemingly enjoyable experience. His amusement was inherent from smiles on his face time and again, when he gets a question from the community on an element of the game.

As the fifth participant ended his experience in the virtual realm, the presenting researcher came to the conclusion that the community was at this stage by all means of appearance familiar with the technology. From the elderly to the small kids in the community each one took some part of the experience one of the participants had, and as a collective they have the knowledge to facilitate usage of the VR game. This concept of collective knowledge is an interesting concept that contributes to the idea of shared experiences.

4.4 Interviews: Participants' Post Experience Expressions

The participants were interviewed individually by one of the researchers together with a community member fluent in English. The participants were prompted in their own language to share with us what they had experienced. They responded in their mother tongue and the answer was then translated to English, while the entire interview session was video recorded. A post-situ review by an independent native speaker confirmed the translations.

All participants repeatedly expressed their happiness about having experienced the VR technology saying (translation) *"It was very nice being there, in another country/world"* and they'd like to experience it again. This seems to contradict the researcher's observations, who considered the lengthy challenges of interaction to have rendered the experiences less ideal for the participants. While there were many objects represented in the game, different scenes and perceptible experiences to have, all participants independently referred to the same few embodied elements. Namely in terms of bodily experience, they mentioned the bitten man that they helped by killing the snake with a rock and lifting him up, as well as the climbing of the ladder. No mention was made of the travelling on the back of the termite. In terms of objects, they were all excited to find elephants, giraffes and other animals which they recognized but do not have in their surroundings. One participants said (translation) *"I'm very happy, some of the animals do not exist here and I did not see those for a very long time"*.

Thus the focus was on the familiar and recognisable, very few mentions of the other elements of which there were plenty including flowers, houses, termites, bridges, etc. One could also speculate that they only mentioned what was familiar and for which they have words in their language. In the drawings additional plants and hairy houses were depicted. Besides the animals they were most fascinated by the beauty of the many different rocks. It is well noted that the community lies in the middle of the Kalahari Desert and there are literally no rocks or (hardly even stones) in the surroundings, just sand. Thus the excitement about the rocks was understandable.

Contrary to the men, the woman expressed that she felt anxious in the beginning but overcame it proudly. She was also the only participant who never climbed a real ladder in her life. Considering the time spent on the climbing as well as the frequent mention of it we prompted for more comments on the experience. One participant stated, that *"So for me first i was struggling to climb, but later i learned how to climb so it was very nice"*, which may indicate that the participant felt some sort of accomplishment. He further stated that *"after climbing up i saw the sky with the stars i saw everything was there. giraffe, butterflies, everything"*. Figure 5 shows an example of participant 3 climbing the virtual ladder.

Figure 5: The figure shows: left: an image of a participant climbing the ladder. Right: the virtual ladder

When asked if the participant had climbed real ladders and how this VR ladder felt, he said that *"there is a difference between climbing the real ladder and this one. It does not feel the same"*. Another participant confirmed *"I climb up the ladder but it was not the real ladder because i was standing in the same place while, but I feel, that I saw that I was climbing in reality. And when I reached the top, it was some way different from the first place where I was"*. One participant compared the ladder to a real ladder by saying *"This one is different from that one because this one you use to climb with your hand"* probably referring to one using their feet and legs to climb a ladder in real life. Yet another one said that *"It was very nice to climb the ladder also, we can see this technology is something special and to me it was very nice, very beautiful I enjoy it"*. They all expressed gratitude for bringing this technology to them and are

looking forward to experience more. The concept of the ladder is further discussed in 5.1.2.

4.5 Community Feedback

At the end of the trip, on the last day before returning back, a community feedback session was convened with more than 30 members (some also dropping in during the meeting). Many topics were discussed (ranging from how to sustain a garden in the sparse terrain to the planned installment of a cell-tower on a nearby hill), here the focus is what is relevant to the VR elements of the research. The community assisted with translations from non-English speaking participants, thus to retain this authenticity quotes are not further edited by authors. Furthermore, the expressions below were made in presence of everyone else, who paid close attention to the speaker. If there were differing opinions brought up, these were resolved among the participants to reflect the standpoints as seen from the collective.

When asked what they thought about the VR experience, one participant answered that *"...we never know about this system. It is very new to us, but now we learn what this technology is"*. Another participant addressed the difficulty of the experience, and said that *"It was not that complicated... Okay yeah here and there, but if I play this everyday i will be more better"*.

Another participant addressed the importance of preserving knowledge by saying *"The San culture is very important to us, and therefore we need that our children and little children in the future have to know our culture. That's why we think that we should have a platform or view and filler in the VR that can represent the San culture. So that if all of us pass away, the children may know they doing things"*.

This was further supported by another participant who said *"These things as culture is very much important example the dancing, or other things. San culture is very important, that's why we think it should be reconstruct in VR. Dance has to be generated in systems for future generations. It is important for the San to also be educated, so in the coming future we can have a San person so he can be there with you guys who are operating or reconstructing and help and give the right information for those who are reconstructing the computer"*. This particular quote further supports the argument of safeguarding cultural heritage using VR as a viable option. Further, one participant said *"My grandfather was a traditional healer. So he pray to this type of medicine you see. Now today, we do not believe this but it was some of the things our elders were doing"*. During the trip the community informed us that they had turned to Christianity many years ago, which can explain why there were no references made to the cosmology during the play-through. Yet the VR as a potential future approach to disseminating some of the cultural heritage still present in the community was quite clearly commented upon.

A discussion on the possibilities of using VR followed in which different suggestions were made. Among others the elder were talking of a physical game were a self-constructed object is thrown in the air and caught upon decent, mentioning that this game is no longer played among the youth also for safety reasons. Thus the elders were eager to see this implemented as a VR game so their off springs could experience it. Similarly, it was suggested that the preservation of dances is important. The community promptly recorded specific dances to provide design inspiration and authentic material for the VR game designing students. Throughout this session those who had been trying the VR were also the most verbal, yet it did not hold the other community members from contributing.

5 DISCUSSION

5.1 Distinct Indigenous Community VR Experiences

Having introduced VR in an indigenous African community setting we observe the affects on user experience in terms of being collective rather than individual, the learning of what was assumed to be intuitive as well as the discrepancy between observed and self-reported user experience.

5.1.1 Collective Experience of Single-Player VR Game. The audience formulated a conspired community experience of the VR technology instead of an independent participant experience. The community found observing the VR in use as amusing as the actual usage of the technology. Surprisingly, the usability of the application grew from one participant to the next, as they formulated a kind of panel of participants that experienced the VR. This panel then feeds instruction to the current participant in their local language contributing to a collective learning.

5.1.2 Choices of Game Mechanics. Game mechanics, such as climbing a virtual ladder, are largely directed by the VR's inability to track foot movement and thus the interaction design is adapted to that. One might even state that the inability to track has derived a standard, which is not really intuitive. This particular implementation caused a lot of frustration to the participants as it was simply not intuitive to climb ladders using only ones' hands. Yet, in a VR and game saturated context (such as among European university students it was never challenged as a non-intuitive idea).

On a more general level, the ladder example shows how design and implementation of seemingly ordinary interaction shaped by the VR technology and our inability to predict this in advance, in the context reveals totally unexpected challenges. It is also a point of learning which now catapults back into reflections of the development process of the game, and hypothetically, which factors could a designer and developer predict?

On the other hand, besides this example and a few smaller challenges around picking up objects, it was quite remarkable how the VR interaction was very easily adopted by the community members. Contrary to learning experiences with other devices such as laptops. Having provided basic computer training to the community we have observed much more challenges in the use of symbolic tools such as the keyboard. The interaction in VR largely (despite the ladder) enabled bodily interaction, which was possible to learn and quite quickly enabled the participants to experience the game. In reflection, this more embodied element should be further enhanced through hand-tracking (controller-free), which was not considered at the time of development for the Quest.

5.2 Reflection on VR Technology Within a Remote Setting

Traditional VR use is carried out in predictable infrastructures, such as places with WiFi coverage, controllable light settings, feature rich spaces (such as at people's homes or in laboratories fitting the purpose of evaluating VR), and cleared tracking spaces not suddenly occupied by observers.

In areas with no usable structures to enable predictable tracking we recommend, pragmatically, to erect a large enough space such as a gazebo or investigating a combination of areas with detectable features and systems such as Infrared Illuminators to enable an IR-fill light being visible in the dark. These are merely practical matters of infrastructure.

Rather, we become reminded from experiences gathered through the trip that there can be quite a bit to learn about the additional barriers for VR 'in the field'. It reminds us that although technologies can tend to be considered from a deterministic view (see for example deliberations by Kaplan [15]), which focuses very much on how efficient, mobile or sophisticated they can be - and where the extreme view is that technologies are agents changing people and society. Just because technologies do not necessarily perform as well outside of the domains from which they are devised and made technically operable, does not mean that they cannot be useful, adapted and become familiar in new contexts, with other purposes. It makes it clear, also in the case of VR, that technologies must still be operated with people and be meaningful to people in human contexts. It is one lesson on how to reframe technologies outside the familiar contexts, it also transcends more common known barriers such as accessibility to internet, grid electricity, and we argue that bringing VR out of its comfort zone, brings us out of our comfort as well, and enables us to rethink new use contexts, also in more VR-friendly settings. After all, there are plenty of people in wide spaces in other places, such as in North America or Europe, who also live outside of the VR comfort zone and where designers, domain experts in collaboration must reframe what technologies can become.

5.3 Reflections on Dilemmas Embedded In Technology Familiarization

Exposing technology outside of its traditional settings naturally come with embedded choices, as they do in traditional settings. But in order to establish insights for others is an act of communication from those who created it, and what they deemed relevant as well as the technical affordance embedded by the technology itself.

Wall and Mosher call this *"representations as communication tools"* as the goal is: *"to facilitate communication and the iteration of ideas and communicate and put representations in a context for use information."*[34].

One cannot establish familiarization without communication, with the absence of choices - or dilemmas, which is perhaps a more accurate term. Including IP at the margin, is a higher level dilemma. It is before the existence of this study a political and ethical question of whether IP should be exposed to emerging technologies or not. However, within a society striving for inclusivity and equality it becomes a moral obligation to include the so far marginalized. From our perspective, it is the way they are included which is important. The VR game is an act of communication, a choice by us, into a space for others to see and comment upon - thereby establishing some common ground, which again is essential in CBCD. From here on we can begin to understand each other, the technology, and work forward. We made a deliberate choice to seek ways to include IP into forming technology, but they cannot form technology without knowing what it is. And as researchers, we cannot open our minds to new uses without having explored them contextually. On a lower level, there are plenty more dilemmas embedded.

5.3.1 Dilemmas Embedded in System Presentation. Upon figuring out what to use to showcase VR we could have chosen any of the games published (from downhill-skeeing to first-person shooters), or nothing, just explaining VR, which again is a construction - a system description not yielding a first-person experience. Thereby a dilemma between something relatable to them or not, or nothing. Yet technology without application is also quite difficult to understand (especially VR), thus we chose to develop a game which is a representation of something non-real; a mythological construct of which there is no existence of it besides interpretations. From this communication we learned about the options of how to introduce technology. In hindsight, in advance of the VR play-through, standing in the middle of the community during the Community Introduction, holding a headset, explaining about its functionality made absolutely no sense in a familiarization with technology perspective. It made sense to make the community and us familiarize with each other yet again, but made it no clearer to them what VR is for a *thing*. This method choice of technology introduction had an effect on the next phase which was for the community to try it out. To ease this transition, it could have been useful to demonstrate the system in a less overwhelming first time use-application.

In this way we learn from our actions, both the fact that the familiarization phase could be extended, but also that the community found it fun, and wanted to work on a way forward with VR and us. Working forward is meeting with the community again and begin discussing how one could co-design a stick-throwing game, a dance game or something totally different.

6 CONCLUSION

Having set out to explore possible opportunities for joint VR application design, the research centered on creating this experiential touch-point through a VR game called Termites of the Gods, as a way to enable learning and reflect the usefulness of VR as a potential approach to establish communication from IP to urban-living youths. This artifact-based learning approach [10] offered many insights, such as how to setup and facilitate VR studies in the field, how the experience of VR enabled the community to familiarise themselves with the technology, how VR became a collective learning process of familiarization, and how this familiarization enabled the community to direct future topics to collaborate on. In the closing meeting, interests in pursuing VR technology and relevant applications were discussed and it was agreed that dances and games are to be modeled for new VR interactions in the nearby future. Thus the introduction of an emerging technology, seemingly not affordable or immediately relevant, nor ready for independent deployment and use in this remote area, must be seen within the broader context of our long-term collaboration. From this point

starting a co-design approach with a premise of investigating indigenous peoples' agency in creating digital VR experiences for others and to contribute in shaping society at large has begun.

ACKNOWLEDGMENTS

We wish to thank the community of Donkerbos for their participation. We acknowledge the Medialogy M.Sc candidates from Aalborg University, Daniel Lindholm Feveile Petersen, Helena Esborn Hejendorf Hansen, and Marcus Bredahl Christensen, for their dedication in developing the prototype. We appreciate the field assistance from our local co-researchers Marly Samuel and Rosetha Kays. The initiative was supported by the Erasmus+ program as well as the local ICTechHub, seed funded by the Embassy of Finland.

REFERENCES

[1] Molefi Kete Asante. 1991. The Afrocentric idea in education. *The journal of negro education* 60, 2 (1991), 170–180.
[2] Edwin H Blake, William David Tucker, Meryl Glaser, and Adinda Freudenthal. 2011. Deaf telephony: Community-based co-design (case study). (2011).
[3] Tone Bratteteig. 1997. Mutual Learning. Enabling cooperation in systems design. *Procedings of IRIS* 20 (1997), 1–19.
[4] Margot Brereton, Paul Roe, Ronald Schroeter, and Anita Lee Hong. 2014. Beyond ethnography: Engagement and reciprocity as foundations for design research out here. In *Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems*. ACM, 1183–1186.
[5] Alan Cheng, Lei Yang, and Erik Andersen. 2017. Teaching language and culture with a virtual reality game. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 541–549.
[6] Michael Christie, Yiniya Guyula, Kathy Gotha, and Dhangal Gurruwiwi. 2010. The ethics of teaching from country. *Australian Aboriginal Studies* 2 (2010), 69–80.
[7] Eugene Ch'ng, Yiyu Cai, and Harold Thwaites. 2018. Special issue on VR for culture and heritage: The experience of cultural heritage with virtual reality: guest editors' introduction. *Presence: Teleoperators and Virtual Environments* 26, 03 (2018), iii–vi.
[8] Jia Tina Du and Jelina Haines. 2018. Working with Indigenous communities: Reflections on ethical information research with Ngarrindjeri people in South Australia. *Proceedings of the Association for Information Science and Technology* 55, 1 (2018), 794–796.
[9] Laurel Evelyn Dyson. 2004. Cultural issues in the adoption of information and communication technologies by Indigenous Australians. In *Proceedings cultural attitudes towards communication and technology*. Murdoch University, Perth, 58–71.
[10] Pascal B 'eguin. 2003. Design as a mutual learning process between users and designers. *Interacting with Computers* 15, 5 (2003), 709–730. From Computer Artefact to Instrument for Mediated Activity.Part 1 Organizational Issues.
[11] Arturo Escobar. 2020. *Pluriversal Politics: The Real and the Possible*. Duke University Press.
[12] Kileni Fernando, Tertu Fernandu, Simpson Kapembe, Kamati Isay, and Japeni Hoffeni. 2018. *A Contemporary Expression of the Namibian San Communities' Past and Present Sufferings Staged as an Interactive Digital Life Performance*. Springer Singapore, Singapore, 205–221. https://doi.org/10.1007/978-981-10-7697-8_13
[13] Stephan Gard, S Bucolo, and Theodor G Wyeld. 2005. Capturing Australian Indigenous Perception of the Landscape: Virtual environments with cultural meanings. In *Proc. 11th International Conference on Virtual Systems and Multimedia*. International Society on Virtual Systems and Multimedia, Ghent, Belgium.
[14] Naska Goagoses, Heike Winschiers-Theophilus, and Tariq Zaman. 2019. Community protocols for researchers: using sketches to communicate interaction guidelines. *AI & SOCIETY* (2019), 1–13.
[15] David M Kaplan. 2009. *Readings in the Philosophy of Technology*. Rowman & Littlefield Publishers.
[16] Maria Kauhondamwa, Heike Winschiers-Theophilus, Simson Kapembe, Hiskia Costa, Jan Guxab, Isay Kamati, and Helena Afrikaner. 2018. Co-Creating Personal Augmented Reality Accessories to Enhance Social Well-Being of Urban San Youth *(AfriCHI '18)*. Association for Computing Machinery, New York, NY, USA, Article Article 10, 10 pages. https://doi.org/10.1145/3283458.3283480
[17] Brett Leavy, Theodor Wyeld, Joti Carroll, Craig Gibbons, Brendan Ledwich, and James Hills. 2007. Evaluating the Digital Songlines game engine for Australian indigenous storytelling. International Society on Virtual Systems and Multimedia. http://hdl.handle.net/1959.3/54871
[18] Bilbie Pty Ltd. 2019. Virtual Songlines. https://www.virtualsonglines.org/
[19] Donovan Maasz, Heike Winschiers-Theophilus, Colin Stanley, Kasper Rodil, and Uriaike Mbinge. 2018. A Digital Indigenous Knowledge Preservation Framework: The 7C Model—Repositioning IK Holders in the Digitization of IK. In *Digitisation of Culture: Namibian and International Perspectives*. Springer, 29–47.
[20] Cristóbal Martinez, Randy Kemp, Raven Kemp, Joe French, and Robert Esler. 2014. Radio Healer: hacking the Wii remote to perform indigenous re-imagined ceremony. In *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium papers, and Keynote abstracts-Volume 2*. ACM, 171–172.
[21] Siyakha Mguni. 2006. Iconography of Termites' Nests and Termites: Symbolic Nuances of Formlings in Southern African San Rock Art. *Cambridge Archaeological Journal* 16, 1 (Feb 1, 2006), 53–71. https://doi.org/10.1017/S0959774306000047
[22] Maletsabisa Molapo, Melissa Densmore, and Limpho Morie. 2016. Designing with Community Health Workers: Enabling Productive Participation Through Exploration *(AfriCHI'16)*. Association for Computing Machinery, New York, NY, USA, 58–68. https://doi.org/10.1145/2998581.2998589
[23] Aske Mottelson and Kasper Hornbaek. 2017. Virtual Reality Studies Outside the Laboratory *(VRST '17)*. Association for Computing Machinery, New York, NY, USA. https://doi.org/10.1145/3139131.3139141
[24] Ingeborg Goll Rossau, Milo Marsfeldt Skovfoged, Jedrzej Jacek Czapla, Miroslav Kalinov Sokolov, and Kasper Rodil. 2019. Dovetailing: safeguarding traditional craftsmanship using Virtual Reality. *International Journal of Intangible Heritage* 14 (2019), 103–120.
[25] Amalia G Sabiescu, Salomão David, Izak van Zyl, and Lorenzo Cantoni. 2014. Emerging spaces in community-based participatory design: reflections from two case studies. In *Proceedings of the 13th Participatory Design Conference: Research Papers-Volume 1*. ACM, 1–10.
[26] Roland W Scholz. 2000. Mutual learning as a basic principle of transdisciplinarity. In *Transdisciplinarity: Joint Problem-solving among Science, Technology and Society. Proceedings of the International Transdisciplinarity 2000 Conference. Workbook II: Mutual Learning Sessions*. Haffman, Zürich, 13–7.
[27] Milo Marsfeldt Skovfoged, Martin Viktor, Miroslav Kalinov Sokolov, Anders Hansen, Helene Høgh Nielsen, and Kasper Rodil. 2018. The tales of the Tokoloshe: safeguarding intangible cultural heritage using virtual reality. In *Proceedings of the Second African Conference for Human Computer Interaction: Thriving Communities*. ACM, 1–4.
[28] Alessandro Soro, Wujal Wujal Aboriginal Shire Council, Jennyfer Lawrence Taylor, Michael Esteban, and Margot Brereton. 2020. Coding on Country *(CHI EA '20)*. ACM, New York, NY, USA, 1–8. https://doi.org/10.1145/3334480.3382992
[29] Alessandro Soro, Margot Brereton, Jennyfer Lawrence Taylor, Anita Lee Hong, and Paul Roe. 2016. Cross-Cultural Dialogical Probes *(AfriCHI'16)*. Association for Computing Machinery, New York, NY, USA, 114–125. https://doi.org/10.1145/2998581.2998591
[30] Jaakko Suominen and Anna Sivula. 2013. Gaming Legacy? Four Approaches to the Relation between Cultural Heritage and Digital Technology. *J. Comput. Cult. Herit.* 6, 3, Article Article 12 (Aug. 2013), 18 pages. https://doi.org/10.1145/2499931.2499933
[31] James Suzman. 2001. *An introduction to the regional assessment of the status of the San in Southern Africa*. Legal Assistance Centre Windhoek.
[32] Facebook Technologies. 2019. Oculus Quest. https://www.oculus.com/quest/
[33] Tomas Trescak, Anton Bogdanovych, Melissa Williams, and Terry Sloan. 2017. Capturing Aboriginal Heritage in Virtual Reality *(VRST '17)*. Association for Computing Machinery, New York, NY, USA. https://doi.org/10.1145/3139131.3141213
[34] Patricia Wall and Andrea Mosher. 1994. Representations of work: Bringing designers and users together. In *Proceedings of Participatory Design Conference*. Association for Computing Machinery, USA, 87–98.
[35] Robert B Welch, Theodore T Blackmon, Andrew Liu, Barbara A Mellers, and Lawrence W Stark. 1996. The effects of pictorial realism, delay of visual feedback, and observer interactivity on the subjective sense of presence. *Presence: Teleoperators & Virtual Environments* 5, 3 (1996), 263–273.
[36] Shelagh Willet. 2007. Khoe-San names (African click languages). *The Indexer: The International Journal of Indexing* 25, 4 (2007), C3–1.
[37] William Winn. 1993. *A conceptual basis for educational applications of virtual reality*. Technical Report. Human Interface Technology Laboratory, Washington Technology Center, University of Washington.
[38] Heike Winschiers-Theophilus and Nicola J Bidwell. 2013. Toward an Afro-Centric indigenous HCI paradigm. *International Journal of Human-Computer Interaction* 29, 4 (2013), 243–255.
[39] Heike Winschiers-Theophilus, Tariq Zaman, and Colin Stanley. 2019. A classification of cultural engagements in community technology design: introducing a transcultural approach. *AI & SOCIETY* 34, 3 (Sept. 2019), 419–435. https://doi.org/10.1007/s00146-017-0739-y