Designing video-mediated technologies to cultivate indigenous knowledge over distance

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Designing video-mediated technologies to cultivate indigenous knowledge over distance

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Abstract

Technology design influences what users know about the world, and how they construct that knowledge. This is especially true for technologies that underlie the communication and representation of information and knowledge. Relatedly, how designers understand and prioritise certain ways of knowing over others influences how technologies are designed for people within a given context. From these premises, this thesis investigates how video-mediated technologies may be designed to support transnationals in cultivating the indigenous knowledge (IK) of their homeland, while they live elsewhere in the world.

Through three field studies between Australia and Kenya, this thesis investigates how digital technologies currently used by indigenous members support or alienate the cultivation of IK, and how the design of video-mediated communication technologies in particular can be grounded in indigenous ways of knowing. In Study 1, I conduct field interviews with 8 Kenyan transnationals in Melbourne, Australia about the practice of their indigenous culture while in the diaspora, and the role that current digital technologies play in supporting them to do so. Next in Study 2, I travel to Kenya to conduct a field study of 10 video-mediated sessions between rural elders and remotely-located youth. Based on findings from Study 1 and Study 2, I generate design themes that guide the design and evaluation of Study 3. Here, I investigate the use of the new medium of 360° video-conferencing to connect learners of indigenous knowledge in Australia, with elders in rural Kenya.

Through findings from these studies, this thesis makes three contributions to technology research on indigenous knowledge. First, I propose a People-Place-Praxis lens as a productive conceptual framework in which to design for IK. The lens facilitates an understanding that aligns with indigenous ways of knowing; and motivates technology design in ways that support indigenous knowledge. Secondly, I demonstrate a way by which epicentres of indigenous knowledge can be extended through use of custom video-mediated sessions. This thesis makes explicit the need to design effective deployments of the technology, that is to design what I call ViMik sessions to effectively facilitate learners in the diaspora to cultivating IK from
indigenous epicentres. Lastly, this thesis extends knowledge on how to enhance the experience of ViMik sessions for learners, over distance. The approach involves supporting an individual-yet-communal experience of the ViMik session, and mediating a sense of mobility for the learners at the remote indigenous location. This thesis concludes with opportunities for future research in this area.
Declaration

This is to certify that:

i. the thesis comprises only my original work towards the PhD except where indicated in the Preface,

ii. due acknowledgement has been made in the text to all other material used,

iii. the thesis is fewer than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Kagonya Awori

October 2017.
Preface

Within my candidature I have published a number of peer-reviewed publications. They are listed below and additionally attached as Appendix B: Publications during candidature.


Acknowledgements

This thesis would not have been possible without the support and guidance of my faculty, colleagues, family and friends. I most sincerely thank my supervisors Frank Vetere and Wally Smith for directing, supporting and encouraging me throughout my candidature. Their insightful and fruitful discussions have shaped my PhD experience. I also thank Andrew Turpin and Justin Zobel for providing support and guidance during both formal and informal meetings.

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1 Introduction

1.1 Background

In February 2017, founder and CEO, Mark Zuckerberg, made public Facebook’s current agenda to “connect and save the world”, stating in part:

“Yet now, across the world there are people left behind by globalization, and movements for withdrawing from global connection…. As we’ve made our great leaps from tribes to cities to nations, we have always had to build social infrastructure like communities, media and governments for us to thrive and reach the next level. At each step we learned how to come together to solve our challenges and accomplish greater things than we could alone. We have done it before and we will do it again.” Mark Zuckerberg in (Wagner and Swisher, 2017)

While Facebook’s mission is commendable, the heralded trajectory from “tribes to cities to nations” ignores the fact that a number of non-Western modernities still identify strongly as tribes, and interestingly, the proliferation of cities subjugates their cultures and agency. Furthermore, the impulse to connect and save the world, raises questions on what logics (ways of knowing) and perspectives, inherent in Facebook design, will be used to save those “left behind by globalisation”. Consider how the use of the ‘friend’ metaphor on Facebook tacitly bestows North American notions of friendship and sociality regardless of local sensitivities and meanings of friendship among other societies (Kraemer, 2014). Among German
speakers for example, Kraemer (2014) details that there is a distinction between Freunde (close friends) and Bekannte (friendly acquaintances). Facebook user Cassius Erixon Fadlabi shares that in the Arabic language, there are 15 ways to define and therefore form a friendship.

The statement above exemplifies the tendency for realities outside the high-tech North being overlooked when agendas affecting them are set. Suchman (2002) observes that dominant technology companies often view technologies as commodities that can be cut loose from sites of production, and transported en masse to decontextualised users. Drawing from her experiences while working at a Fortune 500 company in the United States of America, she dissects the uneven power held between what she calls the hyper-developed countries of the high-tech North, and countries in the Global South (what are often referred to as developing countries). She states that this imbalance can be seen in how the former control the design and distribution of information technologies and, with little consideration of the realities and activities in the latter, flood them with “products, processes, and propaganda generated in the commercial, educational and governmental centres of the high-tech North”.

One of the impacts of this for countries in the global South in general and indigenous contexts in particular, is that the disregard of local knowledge traditions vis-à-vis dominant western ones conjures historical patterns. On the African continent, indigenous communities flourished in pre-colonial Africa, and formed the organised groupings of the continent’s inhabitants. Each of these organised groupings - also known as tribes or ethnic communities - have their own language, governing structures, knowledge processes and institutions, arts, trade structures and religious systems. In order to control the vast populace and take control of their resources and lands, colonising powers effectively plundered African societies for over 500 years – from slave trade voyages in 15th century to the independence of African countries in the 20th century (Obikili, 2016). During this colonial period, indigenous ways of knowing and being were structurally made to be inferior to colonial ones, which were created and centred in the West and institutionalised in these colonies. Today, colonial tropes still persist; uneven power relations between former colonising and colonised nations influence how government, education, trade, natural resources and even technologies

https://www.facebook.com/fadlabi/posts/10154940616701318
are managed globally (Ali, 2016, Irani et al., 2010, Mkabela, 2005, Taylor, 2011). In reference to design, Ali (2006, p.18) articulates the ongoing impact of colonialism by stating,

“Yet the modernity which colonialism engendered persists, albeit transformed under the condition of postmodernity, which has meant the persistence of certain “sedimented” colonial ways of knowing and being—that is, colonial epistemology and ontology—based on systems of categorization, classification, and taxonomization and the ways that these are manifested in practices, artifacts, and technologies.”

Thus, even as dominant technologies gain new places, the cultures, perspectives and logics inherent in their design threaten to totally or partially subjugate the foreign culture they find themselves in. Design becomes very critical in this era as it contributes to determining how current technologies work, what knowledges and cultures they mediate, and ultimately what knowledges and cultures they marginalise.

This thesis builds on the critical relationship between knowledge and design, particularly the role of technology design in the development of indigenous knowledge among transnationals. This thesis investigates African transnationals, who live away from indigenous epicentres but wish to develop their indigenous identity and culture while at their places of migration.

Interest in African transnationals is motivated by two agendas. First, transnationals have played important roles in advocating for a recentralisation of indigenous knowledge, culture and agency. One of the reasons for this is that the encounter between the migrants and the identities they find at the place of migration, births a retrospection of their own cultural background. For example, Ilmi (2012) describes that his experience of being an ‘other’ in Canada forced to him ask what it means to be Somali, and confront the struggles he had with his identity and indigenous self-love. The western hegemonic discourse and imagery he encountered about the Somali, scripted his community as uncivilised and ungovernable. He thus sought a holistic identity scripted from within his indigenous culture and lens. This drove him to seek ways to develop his Somali identity while in the diaspora, and encourage others to do so. Secondly, technology has been used to support transnationals in maintaining an anchoring to their places of origin and places of migration. For example, Indian migrants used a combination of Orkut and Facebook to compartmentalise their multiple cultural linkages (Binder and Sutcliffe, 2014); video and photo sharing and archiving on Facebook and myHeritage.com by Ghanaian transnationals in the UK (Ben Elul, 2014); and migrant Jamaican parents navigating the challenges surfaced when using mobile phones to care for their left-behind teens.
(Brown and Grinter, 2012). However, there is little research to indicate how technology supports African transnationals in nurturing IK while at their places of migration. The African transnational, in using current technologies to nurture an indigenous identity over distance, becomes central in understanding how current communication technologies mediate indigenous knowledge, and how they can be designed to support the development of indigenous knowledge.

1.2 Research problem

A number of technology projects investigate the ways in which technology can support indigenous communities in developing their indigenous knowledge (IK). Such projects have designed, redesigned or appropriated technology based on how they came to understand the ways of living and knowing of the communities they investigated, e.g., CARACAL (Rodil et al., 2012), the Mediated XicanIndio Resolana (Martinez et al., 2010), and Homestead Creator (Jensen et al., 2012b). These Human-Computer Interaction (HCI) projects are discussed in Chapter 2. However, these projects have mainly focused on supporting collocated indigenous members (often elders and youth) in developing IK. One of the motivations for this is that indigenous knowledge is cultivated in close association with indigenous epicentres, and involves bodily and collocated interactions with knowledge holders. Being on the ancestral lands, with the wider indigenous community is essential for cultivating indigenous knowledge. Indigenous transnationals - who are separated generationally or geographically from indigenous epicentres – therefore miss out on the social, physical and situated interactions that occur at these indigenous epicentres.

Yet, indigenous transnationals are interested in cultivating indigenous knowledge even while in the diaspora. Their interest presents an opportunity for communication technologies to support them in taking part in the social, physical and situated interactions that occur at indigenous epicentres. Additionally, given the critical relationship between technology design and knowledge, there is a gap in research on how such communication technologies can be designed in ways that support the cultivation of indigenous knowledge.
1.3 Aims and scope

This thesis responds to this gap and investigates how video-mediated communication technologies can be designed to support remotely-located transnationals in cultivating indigenous knowledge over distance, through mediated interaction with the wider indigenous community and indigenous epicentres. The choice to investigate video-mediated communication technologies is motivated by their ability to mediate live social, physical and situated interactions with indigenous epicentres. In other words, video-mediated technologies can potentially support remotely located transnationals in taking part in those social, physical and situated interactions at indigenous epicentres, that nurture IK.

The goal of this investigation is twofold. First, it is to understand how the technologies currently used by indigenous members support or alienate the cultivation of indigenous knowledge over distance. As discussed in section 1.1 above, the design and distribution of dominant communication technologies is often centred and based on perspectives and logics (ways of knowing) of the High-tech North. Yet, these technologies are flooded to users in the Global South, such as indigenous users. Use of these western-based technologies in indigenous contexts, has an impact on how indigenous knowledge is mediated, shared, stored and consequently developed. The first goal is to investigate and empirically observe how ways of knowing and sharing IK are alienated by the communication technologies used by African transnationals and in situ indigenous members. In other words, to generate insight on how “certain ‘sedimented’ colonial ways of knowing and being” (Ali, 2016) in current western-based technologies impact the cultivation of indigenous knowledge in this context.

The second goal is to investigate how the design of video-mediated communication technologies can be grounded in indigenous ways of knowing. This goal is informed by the critical relationship between technology design and the cultivation of indigenous knowledge. In this era, the design of information and communication technologies (ICTs) influences what knowledge sources are accessed, mediated and stored, and what knowledge-construction processes are supported (Verran, 2010). Every knowledge base, knowledge-based system or knowledge-level agent is based, implicitly or explicitly, on a particular understanding of the world to be represented (Gruber, 1995). In that way, technologies mediate or support knowledge, based on the conceptualisation of knowledge that they are designed from. Consequently, when mediating indigenous knowledge with technology, it is critical to ground technology design in an
understanding of indigenous ways of knowing, so as not to undermine IK. The second goal of this thesis is to investigate how indigenous ways of knowing can motivate technology research and design for this context (that is, for indigenous transnationals in the diaspora).

The overall research question guiding this investigation is:

How can video-mediated communication technologies be designed to support the cultivation of IK over distance?

To investigate this question, this thesis follows a research through design (RtD) methodology. My experience as a User Experience designer, prior to my PhD, drew me to this method as it allows me to apply user-centred design principles to this thesis, with the aim of generating knowledge about technology design for IK. The design process I follow in the three studies is guided by a user-centred design process (based on Norman and Draper (1986)), which involves the key stages of research → design → evaluation → repeat. Thus, the thesis begins by understanding how current digital technologies are used, or not used, by indigenous members to cultivate IK while away from, and at indigenous epicentres (Study 1 and Study 2). Then Study 3 redesigns and evaluates a video-mediated IK session based on design themes generated from Study 1 and Study 2.

The research methodology is guided by critical theory. The goal of critical theory is not only to understand the world, but to change it; to emancipate the disempowered, promote individuals freedoms, and to change the society and individuals to social democracy (Cohen et al., 2013). Critical theory pushes this thesis to examine the political and power imbalances that impact the nexus of technology design, indigenous communities and knowledge. Two forks of critical theory, post-colonial theory within HCI (Irani et al., 2010) and decolonial theory within HCI (Ali, 2016), inform this thesis. In particular, the former articulates the effects of colonialism, hegemonies and western/non-western power imbalances on design, while the latter additionally pushes for a centralisation of indigenous knowledge traditions when designing for indigenous community members.

Three field studies are conducted in this investigation. The first study explores the use and non-use of technology to cultivate indigenous knowledge while in the diaspora. This study is conducted with 8 Kenyan
women living in Melbourne, Australia. The study generates themes that describe users, interactions and techniques involved when cultivating IK at indigenous peripheries.

The second study builds on the first, and investigates the interactions and techniques that elders employ when sharing indigenous knowledge from indigenous epicentres, using current video-mediated communication technologies. This study is conducted as a field study in Kenya, and observes 10 sessions between indigenous elders in rural Kenya, and youth in urban centres in Kenya. Study 2 provides the thesis with a grounded understanding of the themes that are important to indigenous elders, and thus that technology must prioritise when supporting the cultivation of IK over distance.

The final study evaluates a novel medium, 360° video conferencing, for its potential to enhance the experience of African transnationals during a video-mediated session with in situ elders. This study is referred to as Study 3, and observes 6 sessions between elders rural Kenya and Kenyans in Melbourne, Australia. The design of Study 3 is based on themes that were generated in Study 1 and Study 2. In that way, this final study demonstrates how indigenous ways of knowing inform and guide technology design for this context.

Through these three studies, this thesis extends knowledge on how video-mediated technologies can be designed to support the cultivation of indigenous knowledge among dispersed members. This thesis asserts that doing so involves centralising indigenous ways of knowing, and taking seriously concerns that affect IK praxis in this research context. As provided by the thesis, these concerns are not only technological concerns; epistemological and ontological asymmetries between indigenous and western knowledge traditions have an impact on the mediation of indigenous knowledge with technology. As such, this thesis is an uncovering of what and how these issues affect the mediation of IK between dispersed members; and a response by demonstrating how indigenous ways of knowing can guide and motivate technology research and design.

1.4 Thesis overview

Chapter 2 – Literature review. This chapter provides the theoretical foundation of the thesis. It introduces the three areas that this thesis brings together namely, African transnationals, technology design and indigenous knowledge. Chapter 2 explicates the effect technology design has on the development of
indigenous knowledge, and additionally gives evidence that technologies can be redesigned, indigenised or designed anew to support IK. In response to the critical relationship between technology design and the development, this chapter proposes the People-Place-Praxis (P-P-P) of indigenous knowledge, which is a practical framework for engaging research and design in IK. The lens is used to identify asymmetries between western and indigenous knowledge traditions in so far as how they emerge in technology design. The chapter identifies gaps in HCI research on indigenous knowledge and uses these to carve out the thesis research questions.

Chapter 3 – Research design. This chapter outlines the research design of the thesis on three levels. The theoretical perspective driving the thesis is critical theory. The methodology used is research through design, which in turn shapes how I use the research methods in the studies. Study 1 uses field interviews; Study 2 is a field study; while Study 3 is a wizard-of-OZ study between elders in their natural settings and learners in a lab. The analysis methods used in the three studies are thematic analysis and video analysis.

Chapter 4 – Study 1 presents the first field study of the thesis. The aim of the study is to understand how transnationals nurture indigenous knowledge while in the diaspora, and the role technology plays in supporting them to do so. Through the people-place-praxis lens offered in Chapter 2, this chapter identifies eight techniques the participants used to sustain displaced practising of indigenous knowledge. These techniques involved both the use and the non-use of technology. From these techniques, the chapter generates three findings that inform Study 2 and Study 3. One is that participant youth have an interest in cultivating IK while in the diaspora. Secondly, participants prefer collocated and bodily interactions when learning and sharing IK, and lastly that participants have varied engagement with IK and this affects how they use technology to connect with IK.

Chapter 5 – Study 2 reports on a field study conducted in rural Kenya, where elders share everyday indigenous skills with remotely located learners during video-mediated sessions. By applying an indigenous lens to the interface of indigenous ways of knowing and western designed technologies, this chapter contributes an empirical understanding of the sort of interactions, behaviours and communication methods that are important when knowledge is dispersed from indigenous epicentres. Key interactions elders employ include using a second language to coordinate and perfect the video-mediated IK sessions on-the-
fly; use of a ‘moving classroom’ to accommodate place-based performance of knowledge among indigenous communities; and use of unplanned-yet-coordinated group teaching when sharing IK with the youth over distance.

**Chapter 6 – Study 3** reports on the third and final study of the thesis. Through partly-simulated, partly-live sessions between elderly women in rural Kenya and Kenyan transnational youth living in Australia, Study 3 evaluates the potential for a new, potentially suitable medium, to enhance the experience of a video-mediated IK session. The medium, which is a prototype of a 360º video conferencing platform, is evaluated across themes that emerge from Study 1 and Study 2. Through Study 3, this chapter proposes that mobility can be mediated for both local and remote participants without detaching them from their local environment, and that personal devices can be used by multiple collocated individuals to achieve an individual-yet-shared experience of a video mediated IK session.

**Chapter 7 – Thesis contributions.** The chapter provides a holistic discussion of the findings that the three studies have generated. These findings are synthesised into three contributions of the thesis that respond to the research question. This chapter provides an extensive discussion of how the thesis extends knowledge on the use of video-mediated technologies for the mediation of IK, and evidence of how indigenous ways of knowing can guide and motivate technology research and design. This chapter also points out some implications of the thesis findings on technology research and design for indigenous knowledge, particularly within HCI.

**Chapter 8 – Conclusion.** This chapter provides an overview of the thesis and sits it in within the broader concerns that are raised in Chapter 2. Here, the limitations of the thesis are also raised. This chapter also offers opportunities for extending the thesis contributions in the future.
2 Literature Review

2.1 Introduction

This chapter provides a literature review of the three major areas that concern this thesis: indigenous knowledge, African transnationals and technology design. This chapter also presents the People-Place-Praxis approach to design that is used to guide research and design in all three studies of the thesis. In section 2.5, this chapter discusses asymmetries between western and indigenous knowledge traditions and how these affect technology design for indigenous knowledge. Study 2 and 3 rely on these asymmetries to design their study setups. In section 2.3, this chapter reviews technology projects that have focused on supporting indigenous knowledge with technology. These projects provide the thesis with insights on how indigenous communities see and operate in the world, and how technology can be designed to accommodate their ways of living and knowing. Finally, the end of this chapter presents the research question that underlies this investigation, and briefly describes how each of the three studies of this thesis is guided by its own related research question.

2.2 The indigenous African transnational

In describing the African transnational, it is imperative first to outline the definition of transnational. A comparison to the term diasporan helps to elucidate the definition of a transnational. A diasporan is a member who has moved, or been forced to move, to another country to seek better or different opportunities (Vertovec, 1999). Literature has sought to delineate diasporans further by understanding them as per their sub-groupings. Pasura (2014) explains that classical theorists divide diasporans by their
regions of origin, and highlight the importance of associating country of origin with the definition of a diasporan. This produces for example, African diasporans as those who are from Africa and Italian diaspora as those from Italy. Modern theorists argue against the lumping of entire groupings as per origin, as this neglects important differences among them. For example, North African diasporans have stronger Arabic ties and influence compared to sub-Saharan Africans. Contemporary theorists take a different perspective altogether and argue that an association to land is not critical. Instead the formed identity holds credence. This gives opportunities to socio-cultural groupings that are forced to move due to political, social or cultural discrimination. The groupings of diaspora members that emerge from this line of thought include asylum seekers, homosexuals and minorities based on religion.

This thesis does not adopt the classical view, not that of the contemporary theorists. Instead, the definition of diasporan is viewed according to a connection to the homeland, where such a connection can be solid, ductile or fluid (Pasura, 2014). A solid homeland explains the role the diasporans play in the economic, political, social and cultural development of their countries of origin. In this case, diaspora members contribute to a particular territory. The ductile homeland gives rise to juxtaposed homelands as for example, done by the American Jews who have reduced their connection to Israel and have instead created virtual homes in the Americas. The liquid homeland occurs when diaspora members create “new deterritorialised identities and subjectivities” given that they have lost their solid homeland, such as the Roma (Gypsies), Caribbean peoples and religious diasporas (Pasura, 2014). Diasporic groups exhibit the three ideas of homeland variedly. That is, some may have a solid idea of homeland and thus maintain active ties with the activities and people at their country of origin, while other members may, over generations, form a ductile and then liquid association, or even deny an association to an “original” homeland completely. Despite the different perspectives, what is common among all diaspora is movement from one nation-state to another, and a strong, hidden, or unwanted association with the homelands.

**Transnationals** differ from the diasporans in that they maintain a connection to one of more nation-states. In that sense, a transnational is a type of diasporan but differs in the way they maintain active or regular social and cultural connections and linkages with both their places of origin and places of migration (Pasura, 2014). Their nationality transcends nation-state boundaries, given that they remain socio-culturally
anchored to more than one country. This thesis therefore describes an African transnational as a diasporan from the Africa region who maintains a solid association with the continent.

African transnationals maintain a relationship with their homelands through interrelated forms of economic, political, social and cultural ties (Vertovec, 1999, Pasura, 2012). Pasura (2012) illustrates that Zimbabwe’s large transnational community, with 3 million in the diaspora compared to 13 million in Zimbabwe, contributes remittances which in 2004, were more than the aid entering the country. As a whole, African transnationals remit US$ 50-150 billion dollars per year to the continent (Pasura, 2014). Moreover, transnationals also maintain a tie to the continent in other forms by extending their ways of living to the new places of migration. When studying transnationals in USA, Smith (2011) found that while Africans were the most proficient in English compared to other immigrant groups, they did not abandon their indigenous languages and customs when they arrived in the United States. Instead, the African transnationals sustained the practice of their indigenous culture while in the diaspora.

There are several motivations to practice one’s indigeneity while at the place of migration. The move itself for one causes a sense of longing for the old place. Akyeampong (2000) describes diaspora migrants as constantly mediating a lived tension, where they live in one place but desire another. He details that this tension is compounded when the place of migration may not be as imagined. Due to the combined consequence of the historical and continued subjugation of their knowledges, cultures and agency vis-à-vis the West, and the flooding of western ideals, products and hegemony in Africa, African locals view things from the West as better than their own. Thus, the shock of the transnational in finding that Western streets are not paved with gold exacerbates such a longing (Akyeampong, 2000).

Another motivation to learn or develop one’s indigenous identity is that the encounter between the migrants and the identities they find at the place of migration, births a retrospection of one’s own cultural background. As stated in Chapter 1, experiences of being an ‘other’ at places of migration, may motivate transnationals to reclaim a holistic identity scripted from within their indigenous culture and lens. For example, Ilmi (2012) describes that the western hegemonic discourse and imagery he encountered in Canada about his indigenous community, the Somali, scripted them as uncivilised and ungovernable. This
drove him to question his indigenous self-love, and seek ways to develop an identity of himself that was borne from within his indigenous culture and lens.

However, for transnationals to maintain an indigenous anchoring, the indigenous community needs to maintain its survival. Thus, another reason for transnationals to maintain an anchoring to places of origin is to support the survival of their indigenous communities. Thiong’o (1986) bemoans the occurrence of what he calls a cultural time bomb, where over time, indigenous communities have lost belief in their names, their language, their environment, their heritage of struggle, their unity, their capacities and ultimately in themselves. They view their cultures as inferior, and thus to be moved away from. Ilmi (2012) proposes that a solution to the cultural time bomb is a reconnection to indigenous cultures, knowledge and ancestral homelands. Thus, even as diaspora communities travel to other lands, Ilmi advocates for community members to engage their indigenous ways of knowing and being while at the new places. It is no wonder that key movements such as Garveyism by Marcus Garvey, and Afro-centricity by Molefi Kete Asante, were catalysed in the diaspora, and “travelled back to the continent” (Thiong’o, 2009). Afro-centricity advocates amongst other things that knowledge about African people and the continent must be centred on African perspectives, while one of the themes in Garveyism is reinvigorating a pride-in-self amongst Africans in the diaspora and on the continent (Chawane, 2016).

The three motivations outlined in the three paragraphs above underlie an interest from African transnationals in cultivating the ways of knowing of their indigenous communities while in the diaspora.

2.2.1 Indigenous communities

One of the most cited definitions of indigenous community in IK development literature, was supplied in 1982 by the then UN Special Rapporteur of the now defunct United Nations Working Group on Discrimination against Indigenous Populations (UNWGIDP), Mr. Jose Martinez Cobo.

“Indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed in their territories, consider themselves distinct from other sectors of the societies now prevailing in those territories, or parts of them. They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples in accordance with their own cultural patterns, social institutions and legal systems.” (Cobo, 1982)
Indigenous communities are defined on the basis of three characteristics; aboriginality to a certain land area; cultural distinction; and non-dominance in the country they reside in. However, the above definition best describes such communities in the Americas, Australia, New Zealand and Canada, where the first inhabitants of the land were largely displaced by the invading communities and are now a minority in their own lands. These include the Inuit of Canada, the Torres Strait Islanders of Australia and the Basques of France. When applied to the African continent however, the above definition of ‘indigenous community’ is contentious.

Ndahinda (2011) elucidates that both colloquially and in official fora, Africans and African heads of State view all descendants of the ethno-cultural communities that existed before European exploration, as indigenous to the continent. Similarly, in his 1999 report to the United Nations Sub-Commission on Prevention of Discrimination and Protection of Minorities, Special Rapporteur Alfonso Martinez maintained that African and Asian minority groups should not be categorised as indigenous since all African and Asian communities are ethnic or autochthonous groups (Martinez, 1999). His recommendation was however not adopted by the United Nations. Thus, even for the African context, the term ‘indigenous community’ is often used to refer to purportedly marginalised or non-dominant ethnic communities.

The contention is that awarding particular ethnic groups a stamp of ‘legitimate indigeneity’ distinct from other equally indigenous communities, has resulted in these particular groups claiming to be the official owners of land, resources and culture. Critiquing this selective adoption of an indigenous identity, Ndahinda (2011) offers that the continued use and promotion of the indigenous status, mainly by foreign non-governmental organisations, promotes a subjugation of indigenous ways of living and knowing. The Maasai of Kenya for example are a visibly culturally distinct tribe. Maasai communities have largely stuck to their indigenous ways of living and knowing compared to other Kenyan ethnic communities, most notably expressed through their unique dressing, pastoralist lifestyle and arts and crafts. Even today, male Maasai community members lead their cattle in between cars in the capital city Nairobi, and wear their traditional garb that consists of a red sarong, a spear and a beaded ochre wig. Consequently, their ways of living have been incorporated into the fabric of Kenyan identity. Their beadwork for example is considered a symbolism of not only their culture, but also of Kenya culture. Politically, culturally and economically the Maasai are by no means a minority (or marginalised) tribe in Kenya. Their population has increased eight
fold within the last century, they dominate livestock production in the country, and hold key political seats including Vice-Presidency between 1999 and 2002 (Ndahinda, 2011). At the same time however, the Maasai are listed by the UN-backed International Work Group for Indigenous Affairs\(^2\) as ‘indigenous’. A consequence of ascribing the stamp of indigeneity to only the communities that stick to their ethnic ways of knowing and being, like the Maasai, promotes an othering based on them sticking to their indigenous ways of living and knowing. Indigenous ways of living and knowing are scripted as inferior, in need of support from the West in order to survive and different from the norm - where the norm are the communities who embrace westernisation. This further debases indigenous ways of living and knowing.

The term indigenous also has negative connotations that arose during European invasion and colonisation. Ngugi (2001) explains that during the colonial era, indigenous people were described by the invaders using terms such as uncivilised, pagans, semi-intelligent or sub-human. Such dehumanisation was used as a means to justify European occupation of the lands and resources of indigenous communities. Though negative connotations of the term persist today, Ndahinda states that the reason the Maasai still cling to the title of indigenous is that the status provides an additional means of social, political and financial support from aid organisations.

Taking these contentious matters to consideration, this thesis adopts the use of the term indigenous, as opposed to other terms such as traditional or tribal, albeit with reason. Firstly, an indigenous community is generally understood by Africans as synonymous with traditional community, ethnic community or tribe. Thus, given that this thesis investigates African transnationals and in situ Africans, it becomes appropriate to use the term as understood by them. Secondly, use of the term broadens an understanding of the African context. Specifically, that meaning and use of the terms indigenous, indigenous knowledge and indigenous community are embedded with historical and current connotations that affect how to view and work with African communities. Accordingly, section 2.4 of this chapter will delineate an understanding of indigenous knowledge that can serve as a practical framework for Human-Computer Interaction (HCI) research and design. Lastly, current literature in HCI uses the term as a category and keyword in order to

delineate research with indigenous communities. Thus, by using the term this thesis aligns with such literature and at the same time broadens the scope of what constitutes indigenous research within HCI.

### 2.2.2 Indigenous knowledge (IK)

The definition this thesis takes on for indigenous community is a community that adapts to its continuously changing environments through living out and developing its indigenous knowledge. Indigenous knowledge, on the other hand, is local knowledge that is accumulated, retained and developed through time by the community. This knowledge includes the community’s unique languages, socio-economic skills, spiritual beliefs, systems of government, knowledge traditions, and socio-cultural and economic practices (Turpin and Matthee, 2015, Obomsawin, 2002). Indigenous knowledge is developed through members living in or indigenous to a particular geographic area (Grenier, 1998, Rao, 2006).

Indigenous knowledge provides several benefits to the indigenous community. Primarily, it is a form of identity and distinction for the community. Through his experiences Ilmi (2012) specifies that understanding indigenous ways of living and knowing allows an indigenous member to reclaim a holistic identity of themselves, scripted from within their indigenous culture and lens. Apart from providing socio-cultural identity, IK also provides geographical identity. This is due to the strong two-way relationship that indigenous knowledge has with the area from which it is developed. It is common for example, for towns or counties in Kenya to have a majority indigenous community. The naming of the respective town or county is often from the language of the dominant group. The place is associated with the community, and in turn provides a geographic identity to the community members.

Another benefit of IK is that it supports the community socially and economically. This is seen in how IK founds the community’s beliefs, health knowledge, human resources, indigenous technologies, learning institutions, farming practices, communication techniques, food technology, and arts and craft (Kaniki and Kutu Mphahlele, 2013). IK is also of advantage to other knowledge traditions and business practices, for

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example in medicine, mathematics, cosmetics and agriculture. Shea butter produced by rural women in Burkina Faso has been used by French multinational company L’Occitane en Provence, since the early eighties. L’Occitane only sources handmade Shea butter made through semi-artisanal techniques in order to preserve the indigenous ways of making the butter (Kamara, 2013); knowledge about techniques such as the bone-setting by the Funtua of Northern Nigeria, and about prescriptions such as found in the Geez, Amharic, and hieroglyphics scripts of Northeast Africa contribute to medicine; the use of a vigesimal system (based on 20 as opposed to decimal which is based on 10) by the Yoruba offers knowledge to Mathematics and Physics areas (Thomas-Emeagwali, 1993). These examples are a tiny peak of the vast rewards IK continues provide both indigenous and non-indigenous communities (see The History of Science in Africa⁴ for a summarised list of more examples and corresponding references). The benefits of IK have in turn promoted interest in using technology to support indigenous communities in cultivating their ways of living and knowing.

2.3 Technology projects concerned with IK

This section presents seven technology projects that have looked specifically at designing or redesigning technology to support indigenous ways of living and knowing. Also demonstrated is how indigenous communities appropriate technology to suit indigenous ways of living and knowing. These projects were identified by a keyword search on, or through the online database for HCI projects, HCI bibliography (http://hcibib.org/). HCIbib is hosted by ACM SIGCHI which is the Special Interest Group for Computer-Human Interaction (SIGCHI), under the Association of Computing Machinery (ACM). It lists HCI projects from all ACM supported conferences and journals worldwide, thereby providing a rich repository of academic work on IK.

The projects outlined in this section are selected because they investigated technology design by first understanding indigenous knowledge. In that way, these projects provide further insight on how

⁴ https://hssonline.org/resources/teaching/teaching_nonwestern/teaching_nonwestern_africa/ (Last accessed 7th June 2017)
indigenous communities see and operate in the world, and how technology can be designed to accommodate their ways of living and knowing.

2.3.1 Homestead Creator

Homestead Creator was a 3D scenario-based visualization tool that was developed during a three year longitudinal study with Herero tribe of Namibia (Rodil et al., 2011, Rodil et al., 2012, Jensen et al., 2012b). The study was motivated by the elders desire to generate and share their own content digitally in order to preserve and teach their IK; to unite tribe members; and to equip returning migrants with skills for life in the villages (Bidwell et al., 2011). Homestead Creator put this into effect by allowing rural elders to upload, organise and retrieve their own recordings of local stories and practices. They could then share these asynchronously with rural-urban migrants, collocated youth and even the researchers. It also allowed users to re-create their environment with familiar 3D objects.

A number of design factors were adapted into the prototype, based on learnings about Herero ways of knowing and living. For one, videos were embedded onto a 3D visualisation of the Herero village, and positioned at the point where the videos were filmed. Generic models of people were used in order to give flexibility to users in assigning meaning based on the context of place and activity (Rodil et al., 2011). The placing of videos according to where they were filmed, and allowing models of people to be added to those spots was based on how the Herero derive meaning of a place. Place is related to the activities and people on the place. For example, placing a medicine man at a particular spot, gives guidance to future users on what content they can search for from the videos embedded at that place. Furthermore, scenarios were created at the point where videos were embedded. They consisted of animated models of people and respective audio narratives. The scenarios provided additional information so as to limit multiple interpretations of what activities were taking place therein (Rodil et al., 2011).

Additionally, Homestead Creator did not prescribe paths between scenarios. Instead, it mapped paths followed by farm animals as an option for navigating the setting. This is based on previous findings that indicate that Herero locative and way-finding techniques are based on the social and temporal activities that occur at places (Bidwell et al., 2011). Evaluation of the prototype revealed that participants struggled to create a geo-spatial aerial view representation of their home setting. They preferred a first-person point-of-
view instead. The prototype therefore used front and tilted views in order for the participant to understand that the visualisation was a representation of their village (Jensen et al., 2012b).

Another key finding that was generated through the process of designing Homestead Creator, was uncovering a unique categorisation method used by the Herero community. Rodil et al. (2012) call this locational-relational categorisation. This is a place-based method of sorting where items and activities meaningful to a particular place were grouped together. Thus, a boy, cattle and kraal were grouped together given that a boy looks after the cattle at the kraal. When asked where to categorise a snake, participants mentioned that the snake would not be placed in any group given that it had no purpose on their lands. Another example is how they categorised a fence. The initial categorisation method used by the researchers placed a fence under the category ‘objects’. However, the elders asked the fence to be placed under the category ‘cattle’. This is because cattle are prized among the Herero, hence they asked for a category specifically for cattle. Also, since a fence surrounds the cattle, the Herero elders deemed that the fence be placed in the cattle category.

Based on learning that Herero’s unique categorisation scheme, the researchers worked with the elders to automate the addition of new graphical objects according to the Herero ontologies.

2.3.2 TAMI

TAMI stands for Text, Audio, Movies and Images. It is a fluid file management and database system that allows users to capture, store and use their own digital resources by way of a visual interface. TAMI was built with the Yolngu Aboriginal Australian community and designed to support the indigenous elders in inducting children into learning more about the place they derive their identity from, and the activities performed in place (Verran et al., 2007).

TAMI responds to a concern that when mediating IK, the use of digital technologies - oft embedded with western/scientific knowledge traditions - is detrimental to the growth of IK. Indeed, literature points out that when scientific processes are applied to IK, they tend to commodify and objectify IK (Agrawal, 2002, van der Velden, 2013, Winschiers-Theophilus and Bidwell, 2013, Ratuva, 2009). An example is the validation and abstraction processes performed during data storage. Agrawal (2002) finds that the validation process requires that IK is measured according to whether it meets scientific criteria, while abstraction requires that
those elements not found useful to science are excluded from storage. Thus rituals, words, movements, gestures, and actions which are part of a herb making process are discarded as non-essential metadata about the drug (Agrawal, 2002). In that way, scientific processes sieve out crucial processes that indigenous communities consider important.

Verran (2006) acknowledges this dilemma and proposes that the dissonance between scientific knowledge traditions of dominant technologies, and indigenous ways of knowing can support the performance of IK. Her position was borne out of her experience teaching Yoruba speaking children in rural Nigeria. She noted that bilingual children – who spoke both Yoruba and English – were much better at quantitative generalising than their monolingual compatriots who spoke only Yoruba. Furthermore, the bilingual Yoruba children were also ahead of their English-speaking age cohort in Australia. She ascribed this advancement to creativity the bilingual children developed due to their anchoring in two knowledge traditions: western based and indigenous. Ontics in Yoruba and English are profoundly different (she highlights some differences in her book, *Science and an African logic* (Verran, 2001). Verran suggests that the bilingual children developed new ways to deal with interruptions and non-coherences between the profoundly different English and Yoruba conceptual constructs. This resulted in them having the most advanced development of quantitative generalisation among the three groups of children.

Similarly, for the TAMI project, Verran proposes that using digital objects to do IK in place introduces dissonance that could drive the children and elders to create new technologically-supported techniques to do IK, in ways that make sense to them. However, the design of technology must be based on indigenous ways of knowing. Thus, while TAMI was built on a database, the design of its database was made ontologically flat so as not to impose a Western objectivist epistemology on the system.

The only a-priori categories in TAMI’s database were ‘text’, ‘audio’, ‘movie’ and ‘image’. This limited number of categories provided users with the flexibility to organise resources and metadata, and assemble and validate knowledge according to indigenous knowledge traditions. TAMI had only four a-priori structures as it was designed for collection of personal or personalised artefacts as opposed to the amassing of a vast repository of digital objects (as is the aim of databasing). Each TAMI user therefore manages their own small-enough/big-enough collection of digital objects, which are in turn significant to event- or place-
focused folders. Due to the smallness of the collections and user's knowledge of what is in the folders, the owner can mobilise the file and re-perform the people-place-praxis of knowledge. The result is that,

“Banal digital files re-emerge with almost unimaginable potency when configured in the right way by the right person at the right time…. we learnt to see the digital files not as containing knowledge (through the conventional practice of representation), but as artefacts of previous knowledge-making episodes that were being enlisted and configured for very lively conversations.” (Christie and Verran 2013, p. 309)

The process of locating meanings and workings of digital objects and databases in IK, is what Verran and Christie (2014) call ‘post-colonial databasing’. The goal of post-colonial databasing is to go beyond colonial archiving legacies and “focus on specific practices and engagements, orderings and framings, [of] collective memory making and knowledge generation in non-Western contexts” (Verran and Christie, 2014). It recognises that local knowledge-making and archiving practices using ICTs operate within particular histories and logics (ways of knowing). Allowing disparate knowledge traditions to work together is an aim of post-colonial databasing. This is done by ensuring not only how to connect western and indigenous knowledge, but also maintain the separations and distinctions between the two. This is important in order to avoid subverting indigenous knowledge. Post-colonial databasing involves finding out what indigenous digital objects are, what they do, what to do with them, how to store them, find them and put them together (Verran and Christie, 2014). One key difference is that instead of seeing databases as repositories, they emerge as additional sites of performance of knowledge (Verran et al., 2007, Pumpa and Wyeld, 2006).

Other key features of TAMI are that it was designed with Australian Aboriginal teachers, grandparents and parents; with and for people with little or no literacy skills; to support collective memory making with small personal collections as opposed to large anonymous ones; and to support users to design, manage, share and create their own digital archives (Verran, 2006). TAMI also allowed indigenous users to manage their own digital resources using a visual interface. Through TAMI, users were able to search, build presentations, upload, create metadata, view and amend data and categorise objects using drag and drop. Objects could be searched without metadata, or through flicking through the full set of object thumbnails.
2.3.3 CARACAL

The CARACAL system (Context-Aware Recording and with Automated Capture and Logging) is a context aware mobile device tool that was developed with indigenous elders from the Herero tribe in Namibia, to allow them to capture and map objects and places of importance (Jensen et al., 2012a). The rich data created from this process facilitated the reconstruction of the villagers' environment into a 3D visualisation, such as Homestead Creator.

CARACAL stemmed from research on the potential of using 3D visualisations to preserve local knowledge. Among the Herero, it is common for the youth to attend schools far away from the villages and only return during the holidays. This facilitates a detachment from the everyday cultural norms and context. CARACAL was designed to support elders in capturing landmarks and objects of importance and tag them with external sensors. The digital capture the local physical context enabled the creation of digital experiences of place, and thus a platform for the youth to learn and perform IK (Rodil et al., 2013a).

The aim of CARACAL was to create 3D visualisations of multiple villages. Initially, the tool was built for only the designers in the project to support them in collecting the rich data of the villages. This would allow the designer to have a toolbox of 3D objects, and use these to recreate, as realistically as possible, the villages being mapped. However, collecting multiple sets of rich data across the large villages proved to be a timely task. CARACAL was therefore designed to include the local community members. This inclusion of local members also ensured that local ways of knowing were embedded into the development and output of the tool.

CARACAL used the GPS, electronic compass, tilt sensor, camera and microphone of a mobile device to enable users to collect geospatial data and user generated meta-data. The geospatial data was saved in three forms: points, representing single point locations; paths, representing a trace of points signifying routes of importance e.g. animal paths; and areas, representing locations of importance enclosed by a number of points creating a polygon. Additional data that could be added included text, pictures, video and audio clips (Jensen et al., 2012a). Text could be added using tags, or freeform to provide names and descriptions of activities. Pictures and videos, in addition to providing visual information, allowed designers to simulate textures of facades. Audio clips recorded in-situ, were used to recreate a soundscape of the
village. The combination of annotated and tagged pictures, videos and audio clips collected from the villagers, provided the designer with a rich overview of the setting in general and places of importance in particular.

The design of CARACAL revealed insight into the ways of seeing and knowing of the Herero community. One key finding as the community members had an astute sense of detail regarding fauna and flora. They thus expected the visualisation to have the same details they perceived. These included specific animal details like the shape and direction of the ears and tails of animals, and tempo-spatial details like what the animals were doing across different locations and times of day. This led the designers to work out a trade-off with community members, and determine the most critical aspects of each landmark, fauna and flora that had to be modelled.

Additionally, it was revealed that participants did not understand the conceptual idea of points and the purpose of tagging places with metadata. The result of this was that a lot of the data they captured was not tagged, or multiple pictures of the same landmark were tagged multiple times (participants could not differentiate between taking a picture of a landmark from a distance and tagging the very same one from close proximity). This led the researchers to question the concepts of space and time that the participants used. They came to learn that participants perceived objects within a homestead as being at the same place, and those outside the homestead as being far away. They also learnt that the concept of time differed from Western concepts of time. Community members arranged their day according to the length of an activity. Thus, a new activity begins after the previous one has ended. E.g. while the researchers considered that a meeting should end because of the end of the time scheduled on the calendar, the locals viewed that the meeting should end after important matters have been discussed and key members heard. This finding motivated the designers not to use time as the separating factor of events or activities, when designing the database.
2.3.4 Indigenising Wikipedia

Gallert et al. (2016) explore ways to legitimise the use of oral citations in Wikipedia articles in order to foster content generation from African ethnic communities. In that way, indigenous communities could be directly involved in generating content about themselves through processes that align with their largely oral forms of knowledge construction and expression. Gallert and colleagues conducted a study with an elderly couple in eastern rural Namibia, where the couple was interviewed on white spaces (unknowns) about the Herero tribe. The elderly couple was chosen as they were recognised by their community as custodians of indigenous knowledge. The interview session also involved other members of the village who peer reviewed what was shared by the couple. Additionally, the presence of an English speaker from the community ensured that translation of the content by the researcher’s team was also peer reviewed. After translation, the interview was added to Wikipedia, with its references being oral citations of the video interview. Oral citations are references to information shared orally. Gallert and colleagues demonstrate use of an oral citation in a Wikipedia article they created, based on accounts from the couple. Below is an example of an oral citation from the project.

Festus Hijapendje; Olga Muhaindjumba Hijapendje and 2 others (11 October 2014): "Otjinene".
Narrative triggered by interview conducted in Otjiherero, translators: Gereon Koch Kapuire and 1 other. Ovaherero village elders and community members, Otjinene.

The study was motivated by the significant disparity in the amount of content on Wikipedia - the world’s largest encyclopaedia – between the Global South and the North. One of the major contributions to this difference is that the Global South has a majority of indigenous communities who largely express and develop literature orally. However, Wikipedia and its tools, processes and policies, suits written literature. As a consequence of its design, Wikipedia lacks content about the Global South, and more so lacks content about the Global South from people, perspectives and logics of, from and in the Global South. van der Velden (2013) argues that this is because its design does not allow indigenous communities to use their

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5 This is the title I have given the project since the authors have not named their project. Providing it with a name enables me to refer to it in an easier manner.

concepts and structures to tell a story and present their knowledge. The page template in particular focuses on details and analysis, and stories told in a linear fashion, both of which contrast with indigenous ways of storytelling which are circular. Gallert et al. (2016) also report that the first project to develop Wikipedia content solely from oral citations (see Prabhala (2011)), encountered opposition given that oral citations were not viewed as reliable as written ones.

The project pushes current dominant knowledge platforms to regard IK in the same light as scientific/western forms of knowledge development and expression. Also, the study sought to gain a better understanding of how indigenous knowledge can be represented on existing platforms such as Wikipedia, which are widely regarded as sources of legitimate knowledge. One of the learnings of the project was that the method of collecting the content was not without its challenges. Some of the questions about the time of past events revealed differences in how the researchers and the Herero community perceive time. For example, when asked when the Herero first settled on that land, the respondent replied, “A long long time ago.” To get a more concise time period, the elder described it in relation to other events which were before event A and after event B.

Another key learning was that future runs of the process would need to involve local members in content generation. The researchers initially conducted the interview themselves, then translated it to English, with reference to the video. While the translation was peer reviewed by Herero community members, a future aim of the project is to spur local members in recording and editing the content themselves, and thus curb the loss of IK due to translation and interpretation by outsiders.

2.3.5 Digital Songlines

Digital Songlines is a computer game developed for Aboriginal Australians to tell stories about their indigenous landscape and knowledge traditions (Pumpa and Wyeld, 2006, Wyeld et al., 2007). The game consists of a 3D responsive aboriginal landscape embedded with indigenous fauna and flora, and animated using sound, moving picture, and weather and daylight simulation. Additionally, the landscape is layered with collaborative and performative narrative (storytelling), containing information and practices about places on the landscape. At any point in the game, the user can access multiple songlines about the place they are in, with each songline offering a different perspective on the nature, activities, history, ownership
and relationship of the place, as per Australian Aboriginal knowledge. To win, users must reveal as much knowledge as they can about the place they are interacting with. Through the multi-layering of narratives, Digital Songlines provided a way for the community to store and develop IK, as well as participate in current community issues.

The virtual landscape of the game was designed to map with the actual physical landscape of Australian Aboriginal lands. For accurate mapping of indigenous land and artefacts (e.g. indigenous rock art) the game utilised satellite based geo-spatial data. This geo-spatial data included vector data representing trade routes (songlines), indigenous names of sites, hunting grounds, and fauna and flora.

The use of land to organise and access IK is a critical aspect of the Digital Songlines project. The choice to use land stems from a recognition that aboriginal knowledge is integrated into stories, lore, ceremony, totems, art and song, and conveyed from the sites of performance. The intertwining of people, place and performance make it complex to represent IK in a conventional database.

One way of representing this intertwined relationship would be to use relational schemas present in dominant databases. However, indigenous knowledge traditions would require the use of complex relational schemas and large sets of metadata, making data access complex. The second option would be to use ontologically flat databases with as few fields as possible such as the TAMI database described in section 2.3.1. The advantage of ontologically flat databases is that they accurately reflect the non-representational nature of Aboriginal knowledge. Additionally, this would place no pre-fixed ‘western’ relational categories in the database. However, their disadvantage is that it is difficult to query data given the few points of metadata. Given the difficulty in using a complex relational schema or using an ontologically flat database Pumpa and Wyeld (2006) propose that the most fitting solution is to use land as a way for to organise and access indigenous data objects and narratives. In Aboriginal knowledge, land is both the visualization of knowledge and the narratives of knowledge (Pumpa and Wyeld, 2006). Land had a pedagogical role in indigenous communities given that fact that IK is developed through their interaction with the land over years. Pumpa and Wyeld dwelled on the centrality of land, and used a visualisation of aboriginal lands as a way to organise and access indigenous knowledge objects. The visualised landscape provided the schema by which to relate data objects and their complex relationships. To cater to the
problem of accessing the data objects, users had to use to land to reveal content about it including activities that took place there, the people involved, and the fauna and flora therein.

Another critical requirement when designing for indigenous knowledge traditions is allowing performance. Tools based strictly on storytelling when sharing IK lack a way for users to perform IK. Digital Storylines sought to address this by placing users on the land, interacting with various storylines, actively unfolding knowledge through real-time narratives from elders and ancestral spirits of the landscape. Land was therefore also used as interface through which players could interact with the responsive landscape and multiple songlines. This maps with how the community performs indigenous knowledge on land. Through the use of land-as-an-interface, Digital Songlines provided a novel way to enable data to be accessed, stored, shared and performed according to Aboriginal knowledge traditions.

2.3.6 Mediated XicanIndio Resolana

The Mediated XicanIndio Resolana is a mixed reality interactive space where participants use digital media to discuss social and cultural topics according to indigenous Northern New Mexican customs and gestures (Martinez et al., 2010). The aim of the Mediated XicanIndio Resolana is to promote social justice awareness and discourse in middle and high school classrooms in North America. The motivation to base the project on XicanIndio (synthesis of Chicano and Native American culture) customs stems the team members being from those communities.

Traditionally, in New Mexican villages, resolanas are open air spaces that receive direct sunlight. Community members often assemble at resolonas to engage in community discourse. The Mediated XicanIndio Resolana is a physical social space where participants take part in discourse using tangible interfaces. They create their own tangible interfaces using rasquache practices, and follow Chican and Native American protocols to engage in three rounds of talks. Interaction protocols serve a dual purpose: as a functional interface to the underlying mediated system and as an access to the indigenous values encoded into the system. The physical space consists of a circular projection on the floor with unique markings for each participant designating where each should stand. All markings face inward; thus, all participants stand in a circle facing inwards. Also, a participant can only speak when they have the tangible rasquache interface,
and can use it to interact with images projected on the floor. Media projections can also be manipulated using symbolic and functional gestures.

The social, cultural and physical design and functionality of the Mediated XicanIndio Resolana was aimed to foster self-reflection, active listening, oration and storytelling (Martinez et al., 2010). Authors state that the motivation for making the indigenous system a mixed-reality interface as opposed to an advanced video conferencing system was that the latter does not allow for collocation, nor for learning through embodied and lived experiences. The tangibility of the system was a critical aspect for simulating indigenous ways of learning.

The process of designing the Mediated XicanIndio Resolana revealed learnings to the researchers. For one, the graphic design of the floor projection initially used human rights icons from the United Nations. These icons represented U.N’s recognition of indigenous peoples around the world. After conversations and critiques from the indigenous elders, they opted to use indigenous glyphs, instead of symbols created through western frameworks. It further suggested by community members that K12 children should create their own symbols, tangible interface and floor space designs. This would allow the children to encode the resolana with meanings relevant to their lives and perspectives.

The project was a partnership of Native American, Chicano, Ilocano, Euro-American and European members. In order to represent a XicanIndio partnership, the team had to infuse indigenous meaning into the project in ways that respected the multiple cultures present. For example, they initially built the resolana as a talking circle based on Native American customs. However, they learnt it was taboo to use a Native American Talking Circle because some Native American nations consider it a sacred ceremonial rite. They thus decided to fuse base the design on XicanIndio customs instead, where resolanas were used by the public. They also changed the design of the tangible interface from one based on a Native America talking stick, to one based on Chicano rasquache traditions. The Native American taking stick is considered a sacred implement while Chicano rasquache is based on re-using foreign artefacts to create new objects.

2.3.7 UVA

UVA, which is ‘where are you?’ in Mbeere language, is an indigenised Facebook group created by members from the Mbeere tribe in Mbeere, Kenya. UVA was created to share information to meet environmental
stewardship needs of the Mbeere village (Warrick et al., 2016). By ‘indigenised Facebook group’, Warrick and colleagues refer to how members adapted the social media space to match their indigenous ways of sharing information and interacting with others. This was carried out by infusing the social norms, social types, information value, information behaviour, boundaries and bridges of their indigenous community into the group.

While members in UVA came from various social types, such the newly arrived, wealthy landowners, the diaspora, the youth, women, and local teachers, the ones who had the most impact were the elders. By practising stewardship efforts on the lands they owned – which constituted a large chunk of the village - they had an impact on the activities performed in Mbeere. One of the indigenous social norms that UVA was adapted to support is the practice of Harambee. Harambee which means ‘all put together’, is an indigenous crowd sourcing ideology that became Kenya’s national motto at independence in 1963. Thus, in UVA, when a member puts up an activity such as planting tree as a particular area or contributing to a large-scale water project for the village, all members were expected to take part communally.

However, while elders contributed through text to UVA, it likely that more IK would have been shared had the group supported oral interactions. This was evidenced when the researchers asked a group of elders to respond to a piped water access problem that a group member had added to UVA. One elder proposed that to solve the man-made problem, they needed to seek the knowledge of the cattle; when he was younger he would follow the cattle’s safe walking paths to watering points where there were no crocodiles. Though his suggestion would have been considered impractical, it demonstrated an opportunity to bridge IK and other knowledge traditions when solving community issues.

From their ethnographic study of UVA and the Mbeere people, Warrick et al. (2016) state that the primary advantage of UVA to its members was in how it facilitated easy and direct access to indigenous and non-indigenous processes. UVA supported access to knowledge in ways that mapped to how indigenous community members access knowledge. IK is stored, developed and shared in people. To access IK, one must interact with a knowledge bearer. The UVA group mapped this way of knowledge sharing by providing members with direct access to knowledge bearers. What is key to note here is that members did not need to access IK stored in digital repositories managed by ex situ knowledge institutions or scientific
organisations, as is the norm when IK is recorded and archived. Instead, they used the group to interact
directly with knowledge bearers through their mobile phones. The social media group afforded some ways
of accessing knowledge that the Mbeere members preferred.

Additionally, UVA facilitated access to IK by accommodating communal participation. Indigenous ways of
crowd sourcing and participation such as Harambee were revived through UVA. Additionally, the slogan for
UVA is “Mbeere is yours, save it!” Ascribing ownership of the land to all members matched with pre-
colonial ownership amongst the Mbeere where clans communally owned the land they farmed. Current
laws give ownership to title deed owners. UVA attempted to both challenge and abide to boundaries by
encouraging community activity in public spaces, and individual replication of elders’ efforts on private
lands.

Lastly, UVA supported IK by facilitating equality of participation. Projects proposed to the group were not
ranked or categorised. They all received equal chance of involving members of the group. Such a way of
allowing any member to propose a project, and all projects equal chance of participation matched
“Harambee in its most indigenous form” (Warrick et al., 2016).

This project is an example of how members use the digital spaces at hand to share knowledge and manage
activities in the ways that they identify with. By indigenising a Facebook group, the Mbeere members of
UVA were able to involve various ages, roles and needs and fulfil individual and community objectives.
However, use of a Facebook platform had its limitations. Use of text and support for English meant that
when information was shared in Mbeere meaning was lost in translation given that Mbeere characters are
not on keyboards. Also, though literate, use of text limited further contribution from elders given that they
preferred to share IK orally.

2.3.8 Summary of technology projects on indigenous knowledge

The above projects designed, redesigned or appropriated technology based on how they had come to
understand the ways of living and knowing of the communities they investigated. Digital Songlines
introduced the use of land as an interface after taking seriously the dual function of the land as a
pedagogical tool and a schema for Aboriginal data objects. Homestead creator built on the Herero’s unique
locational-relational categorisation of objects to guide the categorisation scheme they implemented, while
CARACAL changed its design so as to involve the Herero community in creating their digital objects based on the way they viewed the world. TAMI built on a finding that ontic dissonance between western technology and indigenous knowledge traditions can motivate new ways of performing IK, and thus created an ontologically flat databasing tool for use by indigenous elders and children. The Mediated XicanIndio Resolana provides an example of a system that is based on indigenous ways of living and knowing, and designed for non-indigenous participants to use so as to engage with the indigenous community. It demonstrates that indigenous ways of knowing and being can inspire the development of new technology products for use within and without indigenous communities. UVA and Indigenous Wikipedia demonstrate how existing dominant technologies can be appropriated or redesigned to accommodate indigenous communities. In UVA, the Mbeere tribe indigenised Facebook to support community efforts, while Indigenous Wikipedia challenged Wikipedia's existing authoring and reviewing policies to include oral content created and reviewed by the Herero tribe.

The projects highlight the interactions, relationships and priorities particular to the communities investigated. Such as the importance of ancestral lands among Aboriginal Australian communities from the Digital Songlines and Homestead Creator projects; and the centrality orality plays in knowledge generation and dissemination among indigenous communities from the indigenous Wikipedia project. UVA demonstrates the importance of communal interaction, direct access to knowledge repositories (which in indigenous communities are the elderly), and equality in participation. All these ways to interact and know are important in indigenous communities. Meanwhile, the Mediated XicanIndio Resolona focused on supporting the performed ways of knowledge sharing among indigenous communities, and thus used collocated, physical and gestural interactions in the design of the space. These projects begin to illustrate how knowledge shapes technology design. They demonstrate that prioritising how indigenous communities view, create, share and store knowledge, impacts how and what is designed. Table 1 below provides a summary of all the projects discussed in this section.
<table>
<thead>
<tr>
<th>Project</th>
<th>Participants</th>
<th>Technology solution</th>
<th>Purpose and functionality</th>
<th>How the design was informed by IK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homestead Creator</td>
<td>Elders and collocated or returning youth.</td>
<td>A 3D scenario-based visualization tool</td>
<td>Upload, organise and retrieve self-created recordings of local stories and practices.</td>
<td>- Embedding videos in place supported the centrality of place and visual communication</td>
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<td></td>
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<td></td>
<td>Support elders in generating and sharing their own content digitally in order to preserve and teach their IK; to unite tribe members; and to equip returning migrants with skills for life in the villages.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- Scenarios additionally afforded oral interactions, ley among the Herero</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Locational-relational categorisation to afford their place-based view of the world</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Animal paths to map with their daily routine and organisational structure</td>
</tr>
<tr>
<td>TAMI</td>
<td>Parents, grandparents, teachers and the youth</td>
<td>Fluid file management and database system</td>
<td>Capture, store and use their own digital resources by way of a visual interface</td>
<td>- Ontologically flat database so as not to impose a Western objectivist epistemology on the system</td>
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<td></td>
<td></td>
<td></td>
<td>Support the indigenous elders in inducting children into performing IK in place.</td>
<td>- Use of a digital interface to accommodate the highly oral and visual users and low written literacy skills</td>
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<tr>
<td>CARACAL</td>
<td>Elders</td>
<td>Context aware mobile-device tool</td>
<td>To support elders in capturing landmarks and objects of importance, and tag them with external sensors</td>
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<td></td>
<td></td>
<td></td>
<td>Support elders in engaging returning youth in the everyday collocated norms that they miss out on when they are away from the village.</td>
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<td></td>
<td></td>
<td></td>
<td>- Improved visualisations in order to accommodate the Herero's astute sense of detail</td>
<td>- Not using time as a separating factor in databases given the ways the Herero sense of time and space differed from Western ones.</td>
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<tr>
<td>Indigenising Wikipedia</td>
<td>Knowledge keepers and sharers from indigenous communities</td>
<td>Video files and citation tools for Wikipedia</td>
<td>To foster content generation from African ethnic communities.</td>
<td>- Recording IK in situ</td>
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<td></td>
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<td></td>
<td>- Reviewing IK in situ and by indigenous members</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- Oral citations</td>
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<td></td>
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<td></td>
<td></td>
<td>- All the above align with oral forms of knowledge expression and generation</td>
</tr>
<tr>
<td>Digital Songlines</td>
<td>Elders and youth</td>
<td>A computer game</td>
<td>For Aboriginal Australians to tell stories about their indigenous landscape and knowledge traditions</td>
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<td></td>
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<td></td>
<td>- Land was used given the recognition that aboriginal knowledge is integrated into stories, lore, ceremony, totems, art and song, and conveyed from the sites of performance.</td>
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<td></td>
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<td></td>
<td>- Landscape is layered with collaborative and performative storytelling e</td>
<td>- Visual landscape mapped with the actual landscape of the community to support performance in place</td>
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<tr>
<td>Mediated XicanIndio Resolana</td>
<td>K12 children</td>
<td>A mixed reality interactive space</td>
<td>Participants use digital media to discuss social and cultural topics according to indigenous Northern New Mexican customs and gestures</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Used tangible and gesture interfaces to match the embodied and lived interactions highly used among the XicanIndio tribes</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Collocated space</td>
<td>- Redesigned the symbols and visual interface in order to abide with indigenous taboos and customs</td>
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<tr>
<td>UVA</td>
<td>Community members from the Mbeere village</td>
<td>An indigenised Facebook group</td>
<td>Share information to meet environmental stewardship needs of the Mbeere village</td>
<td>- Members highly regarded what the elders said on the group</td>
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<td></td>
<td></td>
<td></td>
<td>- Direct interaction with elders matched with how knowledge is accessed in indigenous setting. I.e. without passing through a gatekeeper or knowledge.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Supported communal participation thus supporting the indigenous harambee practice</td>
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</tbody>
</table>

Table 1: Summary of technology projects on IK that are discussed in Chapter 2
2.4 An indigenous lens to approach design

In this section I propose a lens for approaching design with indigenous communities that is based on indigenous ways of knowing. Through seven projects, the previous section gave evidence of how perspectives centred on indigenous ways of living and knowing led to new ways to support IK through technology design. Based on this, it can be surmised that to enable communities to develop their ways of seeing and knowing the world, their structures of knowledge construction and development need to be understood and reflected in the technologies they use.

As summarised in Table 1, these seven projects have designed, redesigned or indigenised technology based on an understanding of the ways of knowing and living of the indigenous communities they investigate. However, none of the projects provide a practical framework by which other research in IK could achieve similar goals. In line with this perspective, this section offers a comprehensive understanding of IK that informs how to approach and respond to the knowledge of indigenous communities. In so doing, this chapter proposes the People-Place-Praxis (P-P-P) lens. I offer that this lens is a practical framework for engaging research and design in IK. Three important foci are central to this lens: people, place and praxis. The next section expounds on how viewing people, place, and praxis as knowledge reflects indigenous ways of knowing.

2.4.1 People as knowledge

Indigenous communities adopt a communal perspective to how they are in the world. One way to describe this deep rootedness in community is ubuntu. While ubuntu as a word stems from African tribes found in Southern Africa today, it encapsulates the communal ethos that is practiced and encouraged across indigenous communities. Ubuntu translates to “a human being is a human being because of other human beings” (Letseka, 2012). The underlying premise is that the person is the community, and the community is the person. As described by African theologian and philosopher John S. Mbiti:

“Whatever happens to the individual happens to the whole group, and whatever happens to the whole group happens to the individual. The individual can only say ‘I am, because we are; and since we are, therefore I am’” (Mbiti 1990, p.106)
And by Kenya’s first president Jomo Kenyatta:

*According to Gikuyu ways of thinking, nobody is an isolated individual, or rather, his uniqueness is a secondary fact about him; first and foremost, he is several people’s relative and several people’s contemporary.* *(Kenyatta 1965, p.297)*

Ubuntu, with its primacy on connectedness and plurality, shapes how knowledge is viewed and constructed. Often, wisdom is described in terms of relationships with people and from connected perspectives. For example Bidwell et al. (2011) found that members of the Herero tribe in rural Namibia described their knowledge using real, metaphoric or prototypical examples, which always included relationships between people, or between people and artefacts or settings. Relatedly, knowledge is seen as being acquired by interacting with others. Ngara (2007) quotes the Shona proverb, ‘*kugara nhaka huona dzavamwe*’ which means ‘One knows how best to administer inheritance estates from observing others’.

His study with stone sculptures in Zimbabwe highlights an acclaimed stone sculptor who attributed his interest and success in the craft to his interaction with other prolific sculptors. This is because “learning for the African child is mostly peer oriented and participatory with less adult instruction … which is consistent with a generally collective African self-concept” *(Owusu-Ansah and Mji, 2013)*.

Ubuntu further defines how to relate with the community. Strong emphasis is on “compassion, justice, reciprocity, dignity, harmony and humanity in the interests of building, maintaining and strengthening the community” *(Letseka, 2012)*. The individual is not at the centre of the world, instead the community has primacy in terms of identity and knowledge *(Mkabela, 2005)*. In relation to this, the *indaba* principle relies on this communal structure when managing conflicts and accessing knowledge. Indaba views leadership as derived from experience and competence, and hence highly respects the elders of the community *(Newenham-Kahindi, 2009)*. Thus, while knowledge is seen as belonging to the entire community, access to knowledge and the enactment of knowledge varies depending on one’s role in the community.

The centrality of people has a consequence on how knowledge is constructed and shared among indigenous communities. Winschiers-Theophilus et al. (2012) noted this while designing Homestead Creator with the Herero tribe of Namibia. They provided a traditional healer and his apprentice with a camera in order to record their craft. In a later reconstruction of a traditional healing practice from the pre-recorded video, picture and audio files, the healer was asked to select the most relevant for teaching his craft. It was
observed that the healer selected only media files with him in it. His holistic view of what constituted knowledge of the healing process, included not only the plant (the medicine), and the patient, but also him, the healer. Knowledge is viewed as being shared, applied and contained in and through people. This has a consequence on the approaches that tend to make knowledge abstract and remove it from an identifiable voice/body.

Furthermore, the ‘I am because we are’ perspective recognises the role of the community and of the individual. Mosha (2000) explains that this worldview is based on an intrinsic unity between the individual and the community. Thus, encouraged is both a collective identity as member of society, and an individual identity as a unique individual. To navigate this hybridity of individuality and community, the ubuntu ethos is integrated into individual concerns. Among the Chagga of Tanzania for example, unique naming and blessing ceremonies are held for each child, while throughout their upbringing all children are encouraged to define themselves as members of the community. Another example surfaced through poetry are the renown poems of Shaaban Robert where he writes 100 verses to his daughter, and a separate 100 verses to his son, and through the 200 versus encourages them to uphold a sense of community (Mosha, 2000). A dual consciousness is upheld between one’s personal identity and responsibilities as an individual, and one’s communal identity as a member of their ethnic community and.

2.4.2 Place as knowledge

Indigenous knowledge is developed through members living in or indigenous to a particular geographic area (Grenier, 1998, Rao, 2006). In many instances, this geographic area is seen as the real or imagined ancestral homeland of the community, and is often located in rural areas of the country. These areas are considered the epicentre of the indigenous community given the high concentration of people from one ethnic community living their indigenous practices in situ. This thesis refers to these areas as the indigenous epicentres or ancestral lands of the indigenous community.

Ancestral lands are viewed as the origin or epicentre of the community, and provide a centrality to both those living on and off the land. Geschiere and Gugler (1998) find that the tie to ancestral lands is not only bound by geography, and it is not always dependent on personal choice. Community members who live outside the ancestral lands e.g. in a city or different country, still identify as belonging to them, even if they
have never set foot there. Transnationals for example, send remittances to the ancestral lands to fund various educational, social, cultural and political projects yet they live off the land (Geschiere and Gugler, 1998, Pasura, 2012). Okereafœzeke (2002) illustrates this complex tie to the ancestral lands by contrasting three successful Nigerian professionals from the same Igbo hometown in Nigeria. Two spent time a considerable time one summer at their ancestral home in Nigeria, contributing to the wellbeing of their community members by offering medical services for free. Both also built houses on the ancestral lands, despite residing in the US. In contrast, the third, a surgeon and equally as successful, is considered a failure by his indigenous community in Igbo because he has no home there, nor does he participate in the on goings therein.

Important to emphasise is that the ancestral land is viewed as a keeper of knowledge, with whom interactions are necessary in order to acquire that knowledge. By living on the land, and forming a relationship of respect with the land, indigenous communities acquire a depth of knowledge, first-hand in areas such as,

“agronomy (polyculture, natural pest control, microclimate management and soil regeneration); taxonomy; natural resource management (wildlife and agro-forestry systems); aquaculture (certain water purification technologies); animal husbandry; meteorology; human and veterinary medicine; plant, animal and human nutrition; mathematics; architecture; communications; social and consensus management systems; childhood development and education; and integrated ecology” (Rao 2006, p. 225)

The knowledge acquired through this holistic and complex relationship has been acknowledged as useful to various educational, economic and medicinal efforts. An example of socio-economic benefit is Uganda where in 2003, according to the World Bank, 80% of the country relied on traditional medicine, as opposed to western medicines (Weisheit and Moses, 2003) . This aided the local sector economically, given that indigenous medicinal plants, herbs and medicines were grown and consumed locally. In turn, use of indigenous knowledge and materials allowed the health system at the time to be less reliant on external sources such as multinational companies.

Relatedly, the ancestral land is a relational entity. Bidwell et al. (2008) highlight the interdependency between physical terrain and the ways of knowing, being and doing among Aboriginal Australians.
Aboriginal Australians use the term country to refer not only to the lands, but to a “view of life invested with copious ecological, genealogical and symbolic interconnections between people and places”. Indigenous peoples thereby experience changes in nature as changes in self (Bidwell et al., 2008). The Tzotzil of Polho, Mexico categorise their lands as warm farmland or cold farmland. However, while these categories speak to their differing landscapes and elevation, they also describe the land in reference to a healthy vs diseased human body. Thus, hot country and cold country describe a particular manner of human relationship with the land (El-Hani and Bandeira, 2008).

In summary, the ancestral land plays several roles: it offers cultural and geographical identity (Geschiere and Gugler, 1998); an active participant in the socio-physical interactions involved in knowledge construction (Bidwell et al., 2011); a keeper of knowledge with whom interactions are necessary in order to acquire that knowledge (Pumpa and Wyeld, 2006); a sacred gift to be cared for and respected; and a determinant of what and how knowledge interactions and exchanges can take place (Pumpa and Wyeld, 2006). Ancestral lands play a pedagogical role in the expression of indigenous knowledge.

2.4.3 Praxis as knowledge

Indigenous communities view meaning as gained through situated socio-physical interactions with nature, people and objects. Knowledge therefore, is not to be acquired, but it is to be lived (Boateng, 1983). Thus praxis - which refers to “the act of engaging, applying, exercising, realising, or practising ideas” - is a way of knowing.

This view of knowing through praxis is exemplified by a member from the Herero tribe in Namibia. When asked to identify his house from a bird’s eye representation of his village, the indigenous community member replied, “I have never been on my roof, so how should I know how it looks like?” (Jensen et al., 2012c). The respondent determined that he could not possibly know what his roof looked like because his body had never been on the roof. Knowledge of a place or activity was only possible by being in and interacting with that place, or actually performing that activity.

7 https://en.wikipedia.org/wiki/Praxis_(process)
Cultivating indigenous knowledge involves not only oral or written interactions, but also heavily relies on bodily literacies - movement, gesture, voice, dances, stories, performances, rituals, pitch, smell, texture, sound and role-based interactions (Bidwell, 2014). A study with the San of Southern Africa also demonstrates a high acuity in bodily and oral communication. When designing an application for San speakers to learn other San languages, Miller (2015) found that an audio application alone was not sufficient in supporting their needs; Naro and Ju‘hoan speakers have to see each other to understand what is being said given that they have highly developed visual grammatical cues. To pass down oral and bodily literature, elders engage the youth through social, situated and physical interactions. Fables are used as pedagogic devices to teach moral lessons; proverbs are used to communicate and validate indigenous procedures and beliefs across generations; secret societies are used to facilitate the initiation of boys and girls according to their age groups, roles and responsibilities within the community, while indigenous centres of education were used to develop knowledge for example the University of Sankore in Timbuktu, Mali which was built in the pre-colonial era by Mansa Musa (1312 – 1337), to teach theology and law (Zulu, 2006, Boateng, 1983, Mapara, 2009).

An example of an indigenous centre of education is the ‘fattening rooms’ of Southern Nigeria. Fattening rooms are educational camps for unmarried young girls, where over a period of between 3 - 12 weeks, they are taught homemaking and child rearing skills by their aunts and experienced women elders (Effiong, 2013). This rite-of-passage includes lessons on how to improve their domestic, interpersonal and socioeconomic skills, including craft making, trading skills, how to achieve sexual fulfilment, how to stimulate milk production for breastfeeding and how to identify and use herbal medicines. In these camps girls are also beautified to improve their health and appearance ahead of marriage and child bearing. Beautification treatments include massages, spa and body treatments, rubbing of lotions and use of herbal concoctions and oils. At the end of the camp, a celebration ceremony is conducted for the girls where they acquire a new status in society. Girls are presented with gifts from relatives, would-be suitors, well-wishers and loved ones (Effiong, 2013, Brink, 1989).

Elders and knowledge experts also passed down IK through apprenticeship sessions (Obidi, 1995, Argenti, 2002, Pearce et al., 2011). Obidi (1995) illustrates that among the Yoruba of Nigeria for example, children learned crafts, trades and professions directly from craftsmen and professionals through apprenticeship.
Parents were key in this process, as they studied their children in order to determine what craft would suit each child. Thereafter, the child spent extensive periods of time with the knowledge experts, until it was observed that child was ready to practice on their own. The end of an apprenticeship was signified by a ‘freedom ceremony’ hosted by the master, where apart from the consumption of food, drinks, kola-nuts and honey, prayers were said to bless the apprentice in his career (Obidi, 1995).

Written literature also existed among indigenous communities before colonisation. However, the development of written literature was significantly thwarted by the imposition and institutionalisation of European systems since the colonial era. Pre-colonial Africa shows clear evidence of written scripts. Zulu (2006) provides examples of these: the scripts of ancient Egypt hieroglyphic; the Meroitic and Coptic scripts of Nubia; the Amharic, Sabean and Ge’ez scripts of Ethiopia; the Berber and Carthaginian scripts of North Africa; the Arabic script of North, North-eastern and west Africa; the Swahili Perso-Arabic script of the east coast of Africa; the Nsibidi script of the Efik of Nigeria; the Mende script of Mali and Sierra Leone; the Moum script of the Moum of Cameroon; the Toma (aka Loma) and Vai scripts of Liberia; the Bete script of the Bete of Ivory Coast, the Akan script; and the A-ka-u-ku script invented by the Bamum around 1896 in Cameroon.

While these scripts are not widely in use, indigenous knowledges and cultures persist by virtue of being actively practiced and developed through time, and passed down through social, situated and physical interactions with community members.

2.4.4 Summary of the P-P-P lens

Based on relevant literature, section 2.4 has presented a perspective to knowledge construction, dissemination and development among indigenous communities. To note is that indigenous communities are not all similar, and consequently, not all forms and definitions of IK are identical. The inseparability of IK from the indigenous community carries with it the uniqueness of each of indigenous communities. The P-P-P lens does not overlook these acute differences among indigenous communities, nor does it encompass all aspects of indigenous knowledges. Instead, the P-P-P lens relies on some commonalities across the ways of seeing, being and knowing of indigenous communities, in order to engage a systematic design of technologies for their use.
2.5 Indigenous transnationals, the P-P-P lens and technology design

This section brings together the areas covered in previous sections that is, indigenous transnationals, the P-P-P lens and technology design. The nexus of these three areas articulates the focus of this thesis. Specifically, to understand how communication technology can be designed to mediate indigenous ways of knowing over distance.

Here, I expound on the relationship between technology design and the cultivation of indigenous knowledge, and why this is critical for this research context. In this era, technology design impacts how users know and construct knowledge. This position is based on a claim by Verran (2010) who, in an aptly titled keynote ‘Design as Knowledge/ Knowledge as designed’, put forward that currently, “design is taking over work that, through much of the 21st century, was done by epistemology”. Epistemology refers to the study of the nature of knowledge and how it is acquired (Crotty 1998, p.8). What Verran points out is that in this era, the design of information and communication technologies (ICTs) influences what knowledge sources are accessed, mediated and stored, and what knowledge-construction processes are supported. This is evidenced in how current systems of information access, sharing and construction are supported entirely or partially by digital technologies. Construction of knowledge is influenced by access to digital libraries. Participation in knowledge construction fora is influenced by computer literacy. The functionalities supported by mobile phones, mobile applications and social media shape how people relate to each other. News sites, social media sites and online encyclopaedias dictate how people perceive themselves (Fardouly et al., 2015, Grabe et al., 2008); what they know about the world (Das et al., 2013, Tkacz, 2007, Ford et al., 2013); and even influence who they vote for (Kim and Chen, 2016, Allcott and Gentzkow, 2017, Ferrara et al., 2016). Gruber (1995) highlights the impact of design on ontology by stating that “within artificial intelligence systems such as medical diagnostic tools, autonomous vehicle software and (soon) internet search engines... ‘what exists’ is straightforwardly defined as ‘that which can be represented’. ” Gruber explains that every knowledge base, knowledge-based system or knowledge-level agent is based, implicitly or explicitly, on a particular understanding of the world to be represented. In that way, technologies mediate or support knowledge, based on the conceptualisation of knowledge that they are designed from. Consequently, technology design influences what users know, and how they know.
Conversely and in addition to that, how designers understand and prioritise the ways of knowing of research context, influences how technologies will be designed for that context. Section 2.3 gave an overview of projects concerned with supporting IK with technology. These projects designed new or current technology based on how they had come to understand the ways of knowing of the communities they investigated. New design guidelines - unique to the indigenous communities investigated - emerged. For example, the locational-relational categorisation scheme implemented in Homestead Creator is different from what the researchers had initially designed. The Herero grouped ‘boy’, ‘cattle’, ‘kraal’ and ‘fence’ together because of their location and function in the village, and named that category ‘Cattle’ due to the importance of cattle in the village. On the other hand, one of the categories the researchers initially had was ‘Objects’ and they had placed ‘fence’ in that category. What I would like to emphasise from this particular example is how technology design influences knowledge development. The researchers had to change Homestead Creator to suit Herero ways of seeing in the world, because they noted that their epistemologies and ontologies conflicted with those of the Herero. By prioritising Herero epistemology and ontology, Homestead Creator functions as a tool that supports the community to develop its ways of seeing and knowing the world.

There are situations where the ways of knowing of indigenous communities are not supported in the technologies they use. This in turn undermines how and what indigenous communities know. For example, Wikipedia - which is the world’s largest reference website - lacks content by and from Africans, and overlooks the oral ways of knowledge development and construction popular in the Global South (van der Velden, 2013, Gallert and Van der Velden, 2015). A second example is given of Facebook, where an indigenised Facebook group supports members of the Mbeere tribe in organising social activities. However, the heavy support for English on the platform means that when information is shared in Mbeere language, meaning is lost in translation. Also, the use of text limits further contribution from elders given that they prefer to share indigenous knowledge orally (Warrick et al., 2016). It therefore becomes complicated for African modernities to develop in an era where the dominant ways to connect, ways to know, and sources of information, are western or western-centric. Indeed, there are certain “sedimented colonial ways of knowing and being” (Ali, 2016) that are embedded in the computer technologies designed in the high-tech
North and flooded to the Global South. As will be discussed in the sections below, such hinder the development of indigenous knowledge.

Bringing all the above together, technology design influences what users know about the world, and how they construct that knowledge, and relatedly, how designers understand and prioritise certain ways of knowing over others, influences how technologies are designed for a given context. Building on the criticality of this interrelationship, presented below are three asymmetries between western and indigenous knowledge traditions that problematise how indigenous users relate and know using digital technologies. They are: traditions of knowing (western vs indigenous); flows of knowledge (from urban/heterogeneous epicentres vs from rural/indigenous epicentres); and literacies of knowledge (written vs bodily & oral literacies). In explicating these, reference is made to the projects discussed in the previous section, and the P-P-P lens is used to surface conflicts and tensions in designing for indigenous communities through a western view of knowledge.

2.5.1 Traditions of knowing - western vs indigenous

Western and indigenous knowledge traditions each have their own structures and processes to define what they view as knowledge and what the knowledge construction processes involve. The differences between these two knowledge traditions offer different opportunities for design depending on how these differences are resolved.

Ontics are concerned with the nature and existence of reality. Ontology, from where ontics is derived, “deals with the nature of being, or what exists; the area of philosophy that asks what really is and what the fundamental categories of reality are” (Neuman, 2014). Epistemology refers to the process of understanding and explaining how we know what we know (Crotty 1998, p.3). The result of ontic and epistemic dissonance can result in design connection or design separation (Christie and Verran, 2013, Verran and Christie, 2014). Verran (2006) elucidates the ways in which these differences resulted in design connection. She detailed her experience in Nigeria where out of three groups of children, the children who were best in cognitive reasoning were the bilingual Nigerian children who were steeped in both knowledge traditions. Furthermore, from her time in Nigeria, Verran observed a Yoruba teacher explain number to Yoruba children, he introduced a number that was neither and both Yoruba and scientific. A new number
was created that fit within the grey middle of the two knowledge traditions, and the same time emerged from both traditions. Similarly, the TAMI project was both and neither indigenous nor scientific given that it used an ontologically flat database and a visual interface to support elders in performing IK on their lands.

While ontic and epistemic dissonance can result in a somewhat comfortable grey middle, the confluence of IK and western knowledge traditions can be irreconcilable (Verran and Christie, 2014). This is particularly seen in how indigenous and scientific cohorts determine knowledge as true. The difference in epistemologies is elucidated through the indigenous Wikipedia project by Gallert et al. (2016) that involves adding indigenous citations from the Herero community of Namibia to Wikipedia. In the indigenous Wikipedia project, knowledge experts were identified to give account of the history of the tribe, and their accounts were verified by other collocated community members. This is because indigenous communities view knowledge as true when it is performed and enacted in place, and witnessed and evaluated by other members of the community. In scientific fora, the process of determining knowledge as true would involve collecting data from the elders, evaluating the data at remote labs, and presenting the findings in papers and forums reviewed by domain experts who have likely never been to the village, nor belong to the Herero tribe. To a Herero community member, the scientific method is ungrounded and incomplete, and to an academic domain expert, the Herero method is unverified and thus unsubstantiated.

From these examples, both the design connection and design separation inspired technology design or redesign. TAMI chose used an ontologically flat database in order not to impose western schema, and a graphic interface to allow the indigenous users to engage through visual and oral literacies. The Indigenous Wikipedia project disrupts Wikipedia’s current content addition, verification and organisation models by incorporating oral citations and using indigenous ways of creating and verifying knowledge. What is critical to note here is that the encounter of western and indigenous knowledge traditions benefitted IK because in both projects, the researchers applied indigenous epistemologies and ontologies to their work. The outcomes benefitted IK because the research and design process was based on IK.

Alternatively, when not designed from indigenous ways of seeing the world, technology design disrupts IK. Projects designed specifically to facilitate the collection, translation, validation, preservation and dissemination of indigenous knowledge are unfavourable to its growth and sustenance. This is because the
implicit conceptualisation of IK in these approaches, dubbed the scientisation of IK by Agrawal (2002), tends to consider IK as a commodity that can be abstracted and decontextualized, and that its significance can be maintained outside of the socio-physical environment of the indigenous community. Thus, from more than 100 databases of Aboriginal ecological knowledge, none were used or managed by the indigenous Aboriginal communities (Verran and Christie, 2014). Approaches that tend to make knowledge abstract and remove it from an identifiable voice/body conflict with the perspective that indigenous knowledge is generated, stored and shared with and in people.

Contrasting the design approaches based on an understanding of IK and those based on the scientisation of IK underscores Verran (2010)’s claim that design has taken over the role of epistemology. In other words, the design of technologies used by indigenous communities has a consequence on the growth and development of indigenous ways of knowing. Thus, it is not a matter of whether the epistemic and ontological differences have consequences for IK, it is a matter of how we as designers respond to the dissonance.

2.5.2 Flows of knowledge – from urban/heterogeneous epicentres vs from rural/indigenous epicentres

The framing of Euro-American cities as the centres of global knowledge, innovation and capital - and the consequent flow of knowledge from these spaces - has adverse effects on indigenous knowledge.

Toffler (1981) describes three eras of human civilization; an agricultural society (the first wave), an industrial society (the second wave) and finally, an information society (the third wave). The third wave is believed to have begun circa the 1950s and is the wave of the current era. It is theorised that cities today should strive to become the information cities of the third wave in order to remain significant. ICTs are paramount to the creation of the information cities of the third wave, as they play a central role in mediating information across cities and countries.

According to Castells (2000), there are two primary constituents of information cities: they are characterised by the space of flows where information, capital, and power are the determinants of wealth; and exchange of information is both on a local and global level, hence the formation of “glocal” (global + local) cities. An information city utilises these qualities and as a result provides a suitable environment for
the growth of producer services, research centres, universities, libraries and administrative and political authorities, due to the ease of local and global exchanges of information. Between 2004 and 2006, the most productive cities in the areas of science and technology were London, the Tokyo/Yokohama region and the San Francisco Bay Area; these were considered the “top world cities of knowledge” (Guillain, 2011).

The result of this is that rural regions tend to be flooded with content from Euro-American centres, leading to competing indigenous knowledge and knowledge traditions being discredited vis-à-vis the more ubiquitous western/scientific knowledge (Ballantyne, 2002). Yet as discussed though the P-P-P lens, indigenous epicentres are often located in rural regions. Indigenous epicentres contribute products, knowledge, resources and labour, locally and globally, to various fields including technology, agriculture and medicine. A lack of recognition of these centres as legitimate undermines their agency.

In situ, the inherited or imposed aggrandizement of western over indigenous, or urban over rural perspectives affects how indigenous transnationals interact with indigenous knowledge. Ballantyne (2002, p.2) states that the bigger deterrent to knowledge generation in Africa is not the lack of ICTs to promote it, but rather how communities value their own culture, values, languages and traditions. Ngara (2007) bemoans that among African elites or urban Africans, the measurement of success is often by how far one moves away from their Indigenous culture. Thus, for example, while it is common for educators from formal learning institutions to be revered as experts e.g. teachers and professors, facilitators of indigenous learning like traditional healers, are dismissed as quacks and charlatans (Mushiba and Asino, 2015). Formal learning institutions, based on Western paradigms of knowledge centred in Euro-American epicentres, are considered superior to indigenous institutions based on indigenous knowledge. Even when technologies are designed to support African knowledges, Stam (2014) argues that they rarely consider the more problematic rural/indigenous perspectives. Urban centres are often prioritised over rural centres, and this further problematises access to and development of IK.

Ex situ, viewing Euro-American centres as centres of global knowledge, innovation and capital marginalises the realities, logics and perspectives at or from indigenous centres. Taylor (2011) critiques HCI’s drive to “repeatedly look further afield” but only frame such contexts as in need of advancement by Euro-American technology and design. He contemplates the inherent trouble in HCI of designing for non-Western contexts
from an understanding of how different they are from “neoliberal, Euro-American sensibilities”. Such a pursuit views “out there” from the perspectives “in here” (Taylor, 2011). This is problematic because perspectives about indigenous communities that are framed or controlled from Western epicentres contribute unhealthy perspectives for technology design. E.g. the development discourse, where the researcher designs from an assumption that the indigenous community is in need of development and would unquestionably benefit from western technologies (Irani et al., 2010). Or sugar thinking where researchers adopt an authoritative orientation and fail to sufficiently accommodate the indigenous community's perspectives (Rogers and Marsden, 2013). When working with indigenous communities, sugar thinking and the development discourse are undesirable because they tend to enforce a “compassion” mentality, whose motivation for technology design is “to compensate and overcome, rather than to innovate” (Rogers and Marsden, 2013).

Recognising indigenous epicentres as legitimate hubs of the third wave, advocates a move away from viewing indigenous communities as “other” groups in need of western technologies; saving them from under-development; or bringing them to the level of the developed western world. For indigenous contexts, the starting point in designing to meet their needs is to design technology that promotes the cultures, perspectives and logics at or from indigenous epicentres.

2.5.3 Literacies of knowledge - written literacy vs bodily & oral literacy

In indigenous contexts and technologies, the prioritisation of written literature over oral and bodily literature complicates the development of IK. This is because IK is performed knowledge, expressed primarily through oral, verbal and bodily interactions.

Bidwell (2014) explains that writing systems have an epistemic status in the West. Likewise, formal centres in Africa (such as academic and professional institutions grounded in western ways) privilege written literacy over oral literacy. This creates a tension between western education and indigenous education. Thiong’o (1986) aptly summarises this tension by stating: “The language of my education was no longer the language of my culture”. It is not that indigenous communities do not have or use indigenous written literature, section 2.4.3 offered examples of scripts from various African tribes, and African universities that share knowledge in writing. It is instead that oral and bodily literature is the main vehicle with which to
cultivate and share IK. Thus, oral and bodily interactions are highly advanced among indigenous communities. Recall for example that the visual grammatical cues used by San tribe, require that Naro and Ju’hoan speakers have to see each other in order to understand what is being said (Miller, 2015).

A dilemma occurs when oral cultures are translated through the logics of writing cultures. Bidwell (2014) explains that a grounding in writing cultures influences the way designers from such institutions observe, analyse and translate the needs of oral users. One of the results of this is that the skills of oral users may be overlooked given that they are not recognised as such by logics of writing cultures. To illustrate this point, I give the example of the eToro project with the indigenous Penan community (Siew et al., 2013). The project was motivated by the elders’ desire to pass on their indigenous toro practice to the youth. Toro is a knowledge sharing and mentoring activity that transpires over a journey. Elder community members groom younger ones in sustaining the Penan way of life. The toro journey is composed of six activities: leaving the village and heading into the jungle; finding a lush area with fruits, fish, trees and animals on which to settle; building temporary housing in the newly found area; extracting sago; cooking; fishing and/or hunting. The solution implemented by the researchers to meet the Penan’s need to continue the indigenous toro practice, was a knowledge management system that helps the elderly capture and preserve pictures, videos and data of the indigenous plants encountered during the journey. eToro was also used by external researchers and botanists to verify and classify the plant information captured by the elders. While a digital herbarium of indigenous plants may facilitate the sharing of plant knowledge between the elders and the youth, I argue that it will do little to pass on the toro practice to the youth, given that eToro overlooked the situated and socio-physical aspects of the Toro practice.

What this means for design is that mediating oral and bodily literacies differs significantly from mediating written literacy. A centrality on praxis understands that movement, gesture, voice, dances, stories, performances, ceremony, pitch, smell, texture, sound and role-based interactions are significant in knowledge creation, cultivation and sharing. This is seen in how Homestead Creator embedded scenarios and videos at the place of performance of the respective activity. Focus on using visual and audio forms to capture and share IK digitally, supported indigenous ways of performing knowledge in place. CARACAL afforded both textual and visual interactions. The mediated XicanIndio resolana on the other hand did not
use any textual interactions, and instead used gestural and physical interfaces to support learning through embodied and lived experiences.

When designing for indigenous communities, it is important to be aware of the literacies afforded by the solutions offered. While written literature is indeed an important avenue to document and learn about IK, the focus on praxis necessitates a support for the mediation of oral and bodily literacies. Designing to support high orality as opposed to designing to support low literacy reflects a more accurate understanding and view of indigenous knowledge.

2.5.4 Summary of the asymmetries

In using technology to support IK, it becomes useful to identify what some of the “sedimented colonial ways of knowing and being” (Ali, 2016) that problematise the development of IK are. Thus, this section has applied the P-P-P lens to identify three asymmetries between western and indigenous ways of knowing that impact IK. This section has highlighted asymmetries between traditions of knowing, flows of knowledge and literacies of knowledge.

The motivation for surfacing these asymmetries is to highlight factors that may impact how African transnationals cultivate IK over distance. The African transnational, in using current technologies to nurture an indigenous identity while away from the homelands, becomes central to understanding how current communication technologies support or alienate indigenous knowledge, and how new technologies can be designed or redesigned to mediate IK over distance. The P-P-P lens, as a framework for design, offers a starting point for investigating the design of technologies to support IK. Additionally, the asymmetries inform the thesis with epistemological and ontological issues that affect this research context. Giving this foundation, the next step is to describe how this thesis will carry out its investigation. The next section outlines the research gap and research questions for the thesis.

2.6 Research Gap and Research Questions

Projects discussed in section 2.3 have largely focused on supporting elders at indigenous epicentres share IK with collocated youth. One of the motivations for focusing on in situ elders and youth is that IK is tied to place; IK is cultivated through social, physical and situated interactions with collocated indigenous members, and in association with the ancestral lands. However, those living away from indigenous
epicentres, e.g. African transnationals, are also interested in developing IK. There is therefore opportunity
to use communication technology to facilitate diaspora African transnationals in taking part in the social,
physical and situated interactions at indigenous epicentres that cultivate IK. This thesis responds to this gap
by investigating how video-mediated communication (VMC) technologies can mediate the cultivation of IK
over distance. The choice to investigate video-mediated communication technologies is motivated by their
ability to afford visual and audio interactions over distance. The research question motivating this thesis is
‘How can video-mediated communication technologies be designed to support the cultivation of IK over
distance?

This question is answered through three studies, each with its own research question:

**Study 1**

Study 1 focuses on African transnationals in the diaspora. It consists of two parts:

- **RQ1a. In what ways do transnationals nurture indigenous knowledge while in the diaspora?**
- **RQ1b. What role does digital technology play in supporting them to cultivate IK?**

This question seeks an empirical understanding of how transnationals cultivate indigenous knowledge in
the diaspora. The question is broken into two parts in order to observe both the use and non-use of
technology when cultivating IK. RQ1a investigates the social, technical and cultural conditions that influence
transnationals in nurturing IK in the diaspora, while RQ1b looks for spaces where technology does not
sufficiently support participants. RQ1a and RQ1b investigate the current needs in this context, and
consequently a grounded indication of which interactions to investigate further.

**Study 2**

Study 2 focuses on elders at indigenous epicentres. The term elder refers to the participants at indigenous
epicentres, and learner refers to the remotely-located transnationals. The research question guiding Study 2
is:

- **RQ2. What interactions do elders at indigenous epicentres, employ when sharing IK with remotely-
  located learners?**
The purpose of this question is to surface culturally influenced interaction techniques that elders use when they share IK. The previous sections have highlighted the critical role elders play in fostering IK; elders are often the holders of IK, and thus sources of legitimate knowledge about the indigenous community. Study 2 investigates how elders share IK with remotely-located learners over VMC technologies.

**Study 3**

Study 3 evaluates the potential of a new technology medium, 360° video-conferencing, to mediate IK. First, Study 3 generates design themes based on Study 1 and Study 2. It uses these themes to design a 360° video-mediated session that enhances the experience of remote learners when they engage with elders. Secondly, Study 3 evaluates the technology setup vis-à-vis the design themes. The research question for Study 3 is:

*RQ3. In what ways does 360° video conferencing enhance the experience of remote learners during a video mediated IK session?*

RQ3 interrogates how use of 360° video conferencing enhances the experience of learners during a video-mediated session.

### 2.7 Conclusion

Technology design influences knowledge development. This is especially true for indigenous knowledge that is little understood or considered in the design of dominant ICT technologies, even when these technologies are directed at indigenous contexts. In order to cultivate indigenous knowledge, it is important to use a lens located in indigenous ways of knowing and seeing the world. This chapter therefore proposes the P-P-P lens to approaching design. By putting forward a lens that reflects indigenous ways of knowing, this chapter provides the thesis with an orientation from which to investigate how to video-mediated technology can be designed to mediate indigenous ways of knowing over distance. Focus is on understanding how transnationals (Study 1) and elders (Study 2) currently practice IK using technology, and design and evaluate a video-meditated setup based on themes grounded in indigenous ways of knowing (Study 3). The next chapter, Study Design, describes how the thesis is executed.
3 Research Design

3.1 Introduction

This chapter explains how the research of this thesis is designed to effectively investigate questions of cultivating indigenous knowledge over distance. Recall that the thesis investigates the nexus of three areas: indigenous knowledge, technology design and African transnationals. The goal uniting these three areas is to understand how video-mediated technologies can be designed to support the cultivation of indigenous knowledge over distance. To that end, particular research methods are used to facilitate data collection and data analysis for the three studies outlined in the previous chapter. Carter and Little (2007) advocate that the methods applied to any research endeavour should be aligned with a methodological framework. This chapter therefore outlines the methodology that guides the three studies, and additionally discusses critical theory, which is the theoretical perspective that informs the methodology and the methods. Critical theory “goes beyond surface illusions to uncover the real structures in the material world in order to help people change conditions and build a better world for themselves.” (Neuman, 2014). Section 3.2 expounds on post-colonial and decolonial theory, which are two branches of critical theory that shape the process and output of this thesis. The research methodology applied to this thesis is research through design. Section 3.4 elaborates how a research through design methodology shapes the research conducted in the studies. Throughout the studies, thematic and video analysis methods are used to analyse the research data. Section 3.4.2 elaborates on the definition and process of these qualitative analysis methods, and their application in Study 1, 2 and 3.
3.2 Critical theory

Critical theory has its foundation in ideas set by Karl Marx who espoused that those who hold economic hegemony are able to shape the perceptions and viewpoints of those who do not (Crotty, 1998). Bardzell and Bardzell (2013) articulate critical design as a research process “aimed at leveraging designs to make consumers more critical about their everyday lives, and in particular how their lives are mediated by assumptions, values, ideologies, and behavioural norms inscribed in designs.” Feenberg points out the interplay of politics, knowledge and technology by stating:

“What is the role of politics in the transformation of technoscience? Despite ritual disclaimers, the critique of scientific-technical rationality appears to lead straight to political control of research not just through familiar external manipulations such as grants, but far more profoundly at the level of fundamental epistemological choices.” (Feenberg 2002, p.139)

In this thesis, I use critical theory to examine the impact of technology design on the cultivation of indigenous knowledge. As highlighted in the previous chapter, technology design is critical in this era given that it controls access to and use of information and communication sources, knowledge-generation processes, and users and uses of information products (Verran, 2010, Gruber, 1995). One critique to technology design however, is that it marginalises non-Western knowledges and realities given that it is often centred on or from Western contexts and perspectives (Suchman, 2002, Irani et al., 2010, Merritt and Bardzell, 2011). Technologies used by indigenous groups to access IK, are not designed to mediate IK in ways that are productive to the indigenous groups. Examples include technology projects for IK that rely entirely on relational databases (Bidwell et al., 2008, Pumps and Wyeld, 2006, Agarwal et al., 2009), dominant knowledge platforms such as Wikipedia (Gallert and Van der Velden, 2015), and global technology projects intended for developing countries such as the One Laptop per Child project (Kraemer et al., 2009). Critical theory pushes this thesis to examine the political and power imbalances that impact the nexus of technology design, indigenous communities and knowledge.

One of the assumptions of critical theory is that ideas are mediated by power relations in society; what is presented as ‘fact’ is intertwined with the self-interest of dominant groups (Neuman, 2014). Chapter 2 provides the P-P-P lens which is enmeshed in indigenous ways of knowing, and goes on further to use this lens to surface three asymmetries between western and indigenous knowledge that affect the IK (see
section 2.5). A critical theory approach surfaces these asymmetries and moreover, uses them to inform the design of Study 2 and Study 3. Thus, these studies design and evaluate a video-mediated session that: privileges logics, realities and perspectives at or from indigenous epicentres; pushes for indigenous ways of knowing particularly by mediating bodily and oral interactions; and uses the encounter of western technologies and the IK context to gain new understandings of indigenous communities.

Critical theory questions currently held values, ideas, truths and assumptions, and examines how these have brought particular social groups to powerlessness and others to power (Gray, 2014). Given its socio-political focus, researchers have used critical theory to investigate IK. Smith (2000) for example, adopts critical theory in her research with her indigenous community, the Maori, given its emancipatory goal for oppressed, marginalised and silenced groups. She states that “critical theory held out the possibility that, through emancipation, groups such as Maori would take control over their own lives and humanity”.

Under the umbrella of critical theory sits post-colonial theory (Cohen et al., 2013). Post-colonial theory examines the domination of western values, discourses, ideologies and knowledges, the de-legitimation of non-western ones, and the effects these have on the lived experiences of individuals and societies (Cohen et al., 2013). Post-colonial critique challenges discourses that see uneven and unequal development in the modern world as normal, and that neglect the different, often subjugated, histories and realities of nations, races, communities and peoples (Bhabha, 2004). Bhabha explains that post-colonial theory resists nativist pedagogies that set up the relation of Third World and First World in a binary structure of opposition. He states that post-colonial analysis instead recognises the complexity of the cultural and political boundaries that exist between the western/non-western spheres.

In HCI, post-colonial computing recognises that all design practice and research is culturally located and power-laden; thus the technologies that HCI investigates, designs and redesigns, are artefacts laden with cultural encounters (Irani et al., 2010). Post-colonial HCI is not about former colonies rejecting technologies from colonial powers. This view is problematic and antithetical because primarily, such a clear separation does not exist. Technology is not purely from the West; the design, generation and production of technologies from the west, would not be possible without labour and minerals from former colonies (Irani et al., 2010). Post-colonial HCI recognises that colonial tropes exist in technology design, and these
undermine the role played by the formerly colonised/indigenous groups (Irani et al., 2010, Merritt and Bardzell, 2011).

However, post-colonial theory in HCI has been criticised as being a Eurocentric critique to Euro-centrism; it fails to engage the knowledge paradigms (including the language and terms) at non-western societies, yet it claims to examine them (Ali, 2016). Moreover, as proposed by Ali (2016), post-colonial theory has shifted focus from locations and institutions to individuals and their subjectivities. Such critiques have given rise to decolonial theory. In computing, the “decolonial option” advocates for the building of “computing systems with and for those situated at the peripheries of the world system, informed by the ways of thinking and knowing (epistemologies) located at such sites, with a view to undermining the asymmetry of local-global power relationships, and effecting the decentering of Eurocentric/Western-centric universals.” (Ali, 2016).

This thesis does not ascribe strictly to either post-colonial or decolonial theory, but is instead informed by both theories. As demonstrated in the next two paragraphs, this thesis is motivated by research and researchers who directly ascribe to a post-colonial approach, and by those who directly ascribe to a decolonial approach.

Post-colonial literature that informs this thesis includes work by Verran and Christie (2014) who introduce post-colonial databasing. Their work on TAMI (see section 2.3.2) illuminates how the cognitive dissonance between current western technologies and IK can be used to redesign existing technologies through an indigenous lens. Similarly, in articulating post-colonial HCI, Irani et al. (2010) offer that new knowledge can emerge when cultures interact. Thus, while western technologies may alienate certain ways of knowing or being of indigenous communities, such an encounter benefits Study 2. The tensions that emerge in the study, serve as a way to identify what interactions are key when designing to support elders in sharing IK over distance. Additionally, post-colonial literature informs how current technologies are used and investigated in all the three studies. That is, Study 1 uses the P-P-P lens to investigate how current technologies support or alienate the cultivation of IK; Study 2 uses the dissonance between the western technologies used and IK to uncover new knowledge on how elders share IK over distance; while Study 3 prioritises context-specific themes when using a new “western” technology to improve the experience of the ViMik sessions.
The “decolonial option” as articulated by Ali (2016), motivates a critical examination of the definition and use of the term ‘indigenous’ in Chapter 2. As a result, this thesis adopts the definition of indigenous community as is understood colloquially by in situ Africans. Reasons provided for using this definition are stated in section 2.2.1, one being that the term ‘indigenous community’ is generally understood by Africans as synonymous with traditional community, ethnic community or tribe. Thus, given that this thesis investigates African transnationals and in situ indigenous Africans, it becomes appropriate to use the term as colloquially understood by these two groups. Additionally, decolonial computing pushes for a decentralisation of Western-centric universals at non-western sites. This is especially critical for this thesis given that it examines the use of video-mediated technologies when cultivating IK between indigenous and western epicentres. As a result, this thesis proposes and uses the P-P-P lens to motivate design in ways that epitomise indigenous ways of knowing. Renown African decolonial thinker, Ngugi wa Thiong’o informs much of the P-P-P lens through his works Decolonising the mind : the politics of language in African literature (Thiong’o, 1986) and Something torn and new : an African renaissance (Thiong’o, 2009).

In summary, in contrasting decolonial with post-colonial theory, the former pushes for empowerment of formerly-colonised societies through emancipation from formerly-colonising ideas, knowledges and products. A decolonial endeavour is centred in, or springs from formerly-colonised sites. The latter on the other hand, is an articulation of the effects of colonialism, hegemonies and western/non-western power imbalances, and as critiqued, uses the tools, language and systems at hand (which are often western-centric ones) to advocate for emancipation. In that way, this thesis uses a post-colonial stance to reach a decolonial ideal. The genesis of this combined approach is recognising that a clear line does not exist in terming a technology as western or non-western, but at the same time, new technologies can be designed from non-western knowledge. Former colonies, whether by merit (they are sources of raw materials, labour and ideas), by buying power (they are markets for finished products from the West), or interest, have the option to use, create and redesign technologies (whether indigenous or western) to serve their cultural and situated contexts. Thus, there is need to move away from: viewing indigenous communities as “other” groups in need of “other” technologies (Irani et al., 2010, Marsden et al., 2008), saving them from under-development (i.e. “designing to overcome”(Rogers and Marsden, 2013)), or bringing them to the level of the developed western world (i.e. “designing to compensate”(Rogers and Marsden, 2013)). Instead - and in
line with a decolonial agenda - technology should be designed or redesigned to meet the needs of indigenous communities, i.e. “designing to innovate” (Marsden et al., 2008, Rogers and Marsden, 2013). This design process should privilege the ways and knowledges of the community under study. In recognition of this combined critical perspective, this thesis offers not only insight on indigenous members share knowledge using technology, but also insight on how video-mediated technology can be designed, redesigned or extended, to support knowledge from indigenous epicentres.

3.2.1 Reflexivity

One aspect proposed by critical theory is a reflexive-dialectic orientation. Neuman (2014) offers that a reflexive-dialectic orientation uses both subjective and objective insight to inform research. Such an orientation values knowledge as a process that integrates making observations, reflecting on them and taking action. This orientation pushes me to acknowledge what I bring to this thesis.

As a Luhya, (one of the indigenous tribes in Kenya) I am an ethnically an outsider to the Kikuyu and Giriama communities I investigate in Study 2 and 3. Also, being a middle-class urbanite from Nairobi, and at the same time studying in Australia carries with it an assumption that I am of the West or a “born-town” (one who knows little about their indigenous anchoring because they are born in an urban area). In the least, that my African-ness has been tainted vis-à-vis the rural participants I investigate. Yet, at the same time, I am an insider. As a Kenyan, I am from the country of the communities I study in Study 1, Study 2 and Study 3. And as a Kenyan transnational, I identify with the research participants in Study 1 and Study 3.

Additionally, living as a minority in Australia and previously in USA and Europe, has developed my critical theory perspective to knowledge. I am the “other”, as described by Taylor (2011) and Irani et al. (2010), and it is my experience of being the other that motivates me to investigate “othered” perspectives in technology design. This thesis, and the context it investigates, is more than an objective study to me. Studying this context objectively goes hand in hand with a subjective introspection of the indigenous knowledges that have been outside my “born-town” world. I have been largely unfamiliar with my Luhya ways of knowing, due to the inherited or imposed aggrandizement of western over indigenous, and urban over rural perspectives (see section 2.5.2).
I also acknowledge that critical theory assumes that “mainstream research practices are implicated, even if unconsciously, in the reproduction of the systems of class, race and gender oppression” (Neuman, 2014). Indeed, while this thesis investigates and extends knowledge on technology design for IK, it is in a form of knowledge that is accessible and immediately beneficial to the academic centres I am tied to, more than it is to the indigenous communities I study.

I view these explicit and implicit tensions as beneficial to this thesis. In all studies, I embrace my role in the research process, and acknowledge that subjectivity (that of the research participants and my own) is part of the process necessary to extend knowledge of, and for, this context.

### 3.3 Research through Design (RtD)

A methodology is a plan of action that provides the rationale for the choice of methods, and the form by which they are used (Crotty 1998, p.3). The overall research methodology this thesis applies is research through design (RtD) which is an “approach to conducting scholarly research that employs the methods, practices, and processes of design practice with the intention of generating new knowledge” (Zimmerman and Forlizzi, 2014). In the context of design, RtD aligns with critical theory in how the primary outcome of the design process is knowledge, and not a design product (Bardzell and Bardzell, 2013). Zimmerman et al. (2010) provide a number of themes that motivate RtD. A key theme is that it is a holistic approach that integrates knowledge from several disciplines. Another is that it is an iterative approach that involves reframing the problematic situation and designing towards a preferred future. This desire for a better future also aligns with critical theory, which demands for a better society, and sets up ways by which to achieve the imagined better society (Bardzell and Bardzell, 2013). RtD implores researchers to be active and intentional constructors of the world they desire (Zimmerman et al., 2010).

RtD employs methods from design practice, in order to generate knowledge (Zimmerman et al., 2010). My experience as a User Experience designer, prior to my PhD, drew me to this method as it allows me to apply user-centred design principles to this thesis, with the aim of generating knowledge about technology design for IK. The design process I follow in the three studies is guided by a user-centred design process (based on Norman and Draper (1986) ), which involves the key stages of research -> design -> evaluation -> repeat. Thus, the thesis begins by understanding how current digital technologies are used, or not used, by
indigenous members to cultivate IK while away from, and from indigenous epicentres (Study 1 and Study 2). Then Study 3 redesigns and evaluates a video-mediated IK session based on design themes generated from Study 1 and Study 2.

I use RtD as a way to extend how HCI investigates IK within indigenous contexts. That is, not only in consideration of technological factors, but also of ontological and epistemological factors. Thus, in Study 2 I design a ViMik session, and use this to generate insight for technology design for IK. A ViMik session is designed to support the traditions, flows and literacies of indigenous knowledge. Study 2 then uses the ViMik session as a tool for investigation, in order to generate insight on how video-mediated technologies can be designed to further support traditions, flows and literacies of indigenous knowledge. Though Skype and iPads are used in the ViMik sessions, the goal is not to understand their use in this context, nor their appropriation by the users. Instead, they are used to surface culturally influenced ways of interaction that persist among the users, despite the introduction of a foreign medium of communication. In that way, Study 2 generates findings that are inspired by an understanding of the elders and their context, in order that these findings motivate the enrichment of the ViMik sessions.

Study 3 redesigns and evaluates the ViMik session. I chose RtD for Study 3 for reasons similar to why I chose it for Study 2. Key of them being that it is an “an inquiry process revolving around the making of a product, service, environment, or system..” (Zimmerman et al., 2010). RtD generates new knowledge about the context through design. In Study 3, I generate knowledge about IK by redesigning the ViMik sessions based on findings from Study 1 and Study 2. The iterative approach encouraged by RtD facilitates the use of findings from Study 1 and Study 2, to design Study 3. In Study 3, I enhance the ViMik session with a new medium, 360º video conferencing. I then use the 360º ViMik sessions to generate insight on how the experience of learning IK can enhanced for learners.

RtD provides this thesis with a holistic approach that accommodates knowledge generation with research participants (e.g. as done in the Maypole RtD project (Giller et al., 1999)), and integration of knowledge from multiple disciplines (Zimmerman et al., 2010). In this thesis, in as much as I am the main designer and researcher of the studies, I involve local researchers in investigating the research context and reviewing Study 2 and Study 3 findings. Also, the thesis is informed by other disciplines apart from Human-Computer
Interaction, for example by authors in African Studies such as Mapara (2009) and Ilmi (2012), and those from anthropology such as Brink (1989) and Prabhala (2011).

3.4 Choice of research methods

A research method is a way of actualising research. Particular data collection and data analysis methods are used in the three studies. This section provides a description of the methods that are used and reason for their use. To begin with, this section differentiates data collection methods from data analysis ones. Data collection methods are used primarily to record research data so as to enable the researcher to manipulate the data at a later time. The data collection methods that are used in this thesis are field interviews and field studies. These are explained in detail in section 3.4.1 below.

Data analysis methods on the other hand provide a way for the researcher to comb through the data, identify patterns and then make sense of those patterns. Often, in qualitative research, the end goal is to come up with themes that provide insight on what was observed in the field. To facilitate this goal, thematic analysis and video analysis methods are used to analyse research data. These are described in section 3.4.2.

3.4.1 Data collection

Study One: Field interviews

The purpose of the field interview is to obtain real world descriptions of the phenomena in question, that will inform the researcher’s needs (Brinkmann, 2014). In Study 1, interviews are used to generate accounts of IK experiences with indigenous transnationals. The purpose is to generate insights on the praxis of IK at indigenous peripheries, based on participant accounts. The interview method is suitable for Study 1 given that it is a study intended to provide an initial direction for the next studies. Study 1 helps refine the focus of the thesis, and narrow the area of investigation for Study 2 and Study 3.

In Study 1, I use semi-structured interviews where, the researcher is guided by prepared questions but also accommodates the interviewee’s spontaneous descriptions and narratives (Brinkmann, 2014). As mentioned beforehand, this thesis adopts critical theory perspective informed by decolonial and post-colonial theories. Thus, the interview questions for Study 1 are intended to surface, not only the technical
aspects of technology use that affect IK, but also the socio-cultural ones that challenge the use of technology to cultivate IK in the diaspora.

Loosely, the structure of the interview used in Study 1 starts with asking background questions, i.e. name, age, profession, length of time lived in Melbourne and last time in Kenya. Though the study investigates indigenous communities, I deliberately avoid asking the participants their tribes, as the focus of this thesis is not supporting particular indigenous communities or particular indigenous knowledges, but instead, supporting indigenous communities in general in cultivating IK over distance.

The sections of the interview that follow are under the headings ‘Understanding current performance of IK’, ‘Motivation and challenges’, ‘Specifically relating to practice that was transported e.g. traditional bride prep ceremonies’ and ‘Parallel activity and technology’. These questions touched on various aspects of the IK praxis in the diaspora so as to provide multiple areas of common ground with the interviewee and thus spur conversation. My role as a fellow Kenyan greatly contributes to how the interviews are carried out. Participants are able to use Kiswahili, our national language; refer to commonly understood socio-cultural realities of Kenya; and even deviate to topics not related to the study but useful in building rapport.

While interviews allow research participants to voice their experiences themselves, they have been critiqued for supporting individualist subjectivity in a research study. Brinkmann (2014, p.1009) states that interviews are not neutral. By capturing interviewee’s opinions, experiences and attitudes, they reinforce particular ways of being human. He provides alternatives to the critiques of interviews by advocating that interviews be viewed not simply as sites for collecting reports, but as a form of situated interaction that produces localised experiences of the particular phenomena. This view of interviews reinforces the use of interviews for Study 1, given that the study seeks perspective of IK praxis in the diaspora. Critical theory embraces the value of implicit and explicit knowledge. In fact, given that the participants are transnationals, it is their implicit and explicit experience of transnationalism that Study 1 seeks to understand, in relation to IK praxis. A research interview provides the means by which such insight can be generated from Study 1.
**Study Two: Field research**

Field research involves directly observing and participating in small-scale social settings, most often in the researchers’ home culture (Neuman, 2014). Field research seeks to study phenomena in their natural settings as opposed to contrived, invented or researcher-created settings. Field research is therefore a suitable research method for Study 2 because knowledge can be generated about IK, through direct involvement from research participants, and engagement with indigenous epicentres. Thus, in Study 2, I travel to Kenya, my home country, to observe elders at their ancestral homes.

Neuman (2014) explains that another aspect of field research is that it seeks to combine multiple perspectives present in the field. This may involve switching from the participants’ perspective of the state of the world to the researcher’s own perspective. Moreover, field research admonishes the researcher to refrain from imposing an outside point of view to the research participants, and to notice both explicit and implicit aspects of culture. My role therefore switches from researcher to co-researcher, and to more of a learning role than a testing role. As discussed above (section 3.2.1), throughout the thesis, I acknowledge that the research context is one which is tied to my identity and background. This has a bearing on how I carry out my research. In Study 2, the field research site I have chosen is Kenya, given that I am familiar with the country, people and Kenyan ways of life. This has eased my field research, especially when it comes to gaining access to the field and maintaining relations with research participants and the local researchers.

**Study Three: Wizard of Oz**

In Study 3, I use a new medium, 360º video-conferencing, to enhance the experience of a group of learners during the ViMik sessions. I chose a Wizard of Oz method for Study 3 because 360º video-conferencing is currently not supported by existing video-conferencing platforms. A solution for evaluating this new medium with the research participants is to simulate the experience.

A wizard-of-Oz study is one where participants are led to believe that they are interacting with a computer system, when in fact the interaction is manipulated by a human-operator, a wizard (Dahlbäck et al., 1993a). In earliest accounts of its use, Wizard-of-Oz studies have primarily been used to understand dialogue in computer-human interactions (Dahlbäck et al., 1993a, Fiedler and Gabsdil, 2002). In HCI, wizard-of-studies have gained steady growth since the 1970s and have been used across a wide range of domains.
In Study 3, the wizard-of-Oz method is used to animate the 360° video-conferencing prototype setup, so that it appears live to the learners. To facilitate this, the first step involved making 360° videos. The local researcher conducted sessions with the elders and recorded videos of them cooking and weaving at their home in Kenya, using a 360° camera. These videos are then presented in the ViMik sessions as live 360° videos. To facilitate the appearance of live sessions, elders and I act as wizards during the sessions. Elders participate in the ViMik sessions through only live audio channels. Thus, while the 360° videos are played to the learners, elders speak over the pre-recorded videos in present tense and first person, to give the illusion that the activity they are performing in the video is happening at the time the learners are watching it.

Secondly, during the ViMik sessions, I use software called Watch2gether, which allows me to synchronise video playback on the learners’ devices. In that way, the pre-recorded videos started playing on both the learners’ devices at the same time. During the study, I also discreetly communicate with the local researcher so that she starts the video on the elders’ end at the same time as I start the learners’.

The RtD approach informs how I conduct this study. Thus, though I design a setup using a novel medium, the purpose of Study 3 is not only to evaluate the medium but also, through the process, to generate knowledge about 360° VC in this context, and insight on how the experience of the session is enhanced by enriching particular interactions between dispersed members.

Use of this partly-live and partly simulated study presents several advantages to Study 3. Namely, it provides the benefits of control for the purpose of a focused study; it allows an investigation of a technology before it becomes available; and lastly, use of pre-recorded 360° videos has enabled learners to watch high resolution (4K) 360° videos, a feat that had not been possible when the local researchers and I had attempted to stream 360° video live, over the low internet bandwidth of the elders’ rural setting. The use of high quality videos enables a richer experience and investigation of Study 3.

3.4.2 Data analysis

Thematic analysis

Thematic analysis which is a qualitative research method for identifying, analysing and reporting patterns in data (Thomas and Harden, 2007, Braun and Clarke, 2006). Thematic analysis is used to analyse data in all the
three studies of the thesis. In Study 1, only thematic analysis is used, while in Study 2 and Study 3, it is used in combination with video analysis.

Braun and Clarke (2006) advocate for the declaration of the choices a study makes when applying particular types of thematic analysis. Consequently, the next four paragraphs outline how this thesis defines and uses some key concepts from Braun and Clarke (2006), that underlie thematic analysis.

What counts as a theme? Study 1 applies some flexibility in determining the extent to which a recurring pattern in the data constitutes a theme. No quantitative measure, or quantitates threshold is applied in this process. Instead, in all studies, what counts as a theme is a pattern of data that: informs or challenges what is known about the research context (based on Chapter 2); and that is based data items that were reported or observed repeatedly from different research participants during the research studies.

A rich description of the data set, or a detailed account of one particular aspect? All the studies provide a rich description three themes that relate to most of the data set, as opposed to describing themes that reflect the entire data set.

Inductive or theoretical thematic analysis? Braun and Clarke (2006) offer that there are two way to identify themes through thematic analysis. In an inductive approach (bottom-up), themes are strongly linked to the data, and may have little relationship to the questions that the researcher asks. On the other hand, a theoretical approach is driven by the researcher’s theoretical or analytical interest in the research area. Theoretical thematic analysis provides “less a rich description of the data overall, and more a detailed analysis of some aspect of the data.”(Braun and Clarke, 2006). In all three studies, theoretical thematic analysis is used. This facilitates the use of the P-P-P lens. First, the P-P-P lens is used to come up with the research questions in all the studies. Theoretical thematic analysis provides that the data is strongly linked to the research questions asked. Secondly, data is analysed and reported as to how it relates to the P-P-P. For example, in Study 1, the eight techniques that were generated from the data, are presented according to how they facilitate a connection to people, to place or to praxis. Consequently, Study 1 themes inform the ways by which participants interacted with each other, with the ancestral lands or how they lived out IK in the diaspora (section 4.4).
Semantic or latent themes? Thematic analysis generally identifies themes either on a semantic level or a latent level. A semantic level focuses on the explicit meanings of data found in participants’ accounts. The latent level goes beyond the surface or semantic level, and looks for underlying assumptions, ideologies and meanings of the data. The three studies generate latent themes that aim to explain the reason for the patterns observed in the data. Broader meanings are generated in order to explain patterns in the data. For example, Study 2 uses the P-P-P lens to analyse the findings and surface behaviours and interactions of the elders. In addition to that, the Goffman lens (Goffman, 1959) is used in one of the findings to understand why elders use their indigenous languages during the sessions. Study 3 observes research participants and finds that 360° video-conferencing facilitates a new interaction, apparent mobility, due to how participants report a feeling of moving around in the remote place.

Based on these decisions, I find that thematic is a suitable method for this thesis because it supports use of other theoretical frameworks in the analysis process. In the Study 1 and Study 2, I was able to combine the use of the P-P-P lens in the analysis process, while loosely following the steps provided for conducting thematic analysis. A more detailed description of how I applied thematic analysis in Study 1 is in 4.2.3, while for Study 2 and 3 – which also use video analysis – are in sections 5.2.3 and 6.2.6 respectively. Moreover, thematic analysis facilitates the generation of explanations for what is observed in the studies. This process is very important for this thesis because observations of participants do not provide a holistic understanding of the context. The generation of latent themes on the other hand, allows me to gain insight on which behaviours, interactions or activities, particular to this research context, can motivate technology design for IK.

**Video analysis**

The analysis techniques used in Study 2 and 3 are video analysis and thematic analysis. Video analysis is a qualitative research method which focuses on how participants produce and respond to facial gestures, gaze, bodily posture, artefacts, the environment as well as verbal language. By virtue of recording studies visually and auditorily, and then observing them critically and repeatedly through video recordings, video analysis allows the researcher to take the vocal as well as the oral and bodily interactions seriously (Bloor and Wood 2006, p.184).
Study 2 and Study 3 use video analysis to comb through the data for instances where the themes for the respective study occurred. Study 2 was guided by the P-P-P lens, while Study 3 was guided by the themes of presence, personalisation and mobility. Data that surfaced from these themes was then coded, and then themes were generated from these coded items.

The method used to generate themes from the coded items was informed by thematic analysis, while the method used to analyse video data, add generate codes was facilitated by video analysis.

Video analysis is suitable for Study 2 and 3 because elders and learners use social, bodily and physical interactions to when living out IK. During analysis of Study 2 and Study 3 data, the video analysis method ensured that text was not separated from the actions captured in the video data. Therefore, instead of solely transcribing the verbal details of the videos, focus was on adding subtitles or annotations to the videos. That way, data analysis reflects the manner in which indigenous knowledge is expressed - not only verbally but also through non-verbal sounds, ululations, silences, clicks, mime, and body and gestural movements (Bidwell, 2014) - ensuring that the process does not prioritise verbal communication over bodily and oral communication.

Furthermore, video analysis has been recommended for studying learning contexts such as the one observed in Study 2 and Study 3, which involves complex interactions among groups. Such interactions can be easily missed in direct observation given the number of people involved and their complexity (Garcez et al., 2011). It is thus a suitable analysis method for Study 2 and Study 3 which both observe groups of research participants.

3.5 Summary

This chapter has presented the research methods and methodology that guides this thesis. Specifically, I apply a research through design methodology to the three studies, and use field interviews and field evaluations to collect data. In Study 3, I use a Wizard-Of-Oz study to connect elders in their natural settings and learners in a lab. This chapter has presented the rationale for selecting these methods. Detailed descriptions of how I carried out the research methods are provided in each study chapter.
This chapter has also provided the theoretical perspective that informs my methodology and consequently, motivates my research in the field. Critical theory – informed by post-colonial and decolonial theories motivates this thesis to aspire towards the type of work where prioritisation of the ontologies and epistemologies of specific user groups, motivates technology design to develop their ways of knowing (Salmond, 2012, Ali, 2016). This chapter has demonstrated how the theoretical perspective, research methodology and research methods are integrated, and has thus provided a strong research foundation for the thesis.

The next three chapters provide detail on how Study 1, 2 and 3 are conducted, and the knowledge they generate to answer the thesis research question.
4 Study one: Understanding how transnationals nurture indigenous knowledge while in the diaspora

4.1 Introduction

This chapter presents the findings of Study 1, a field interview study with 8 Kenyan transnationals in Melbourne, Australia. The aim of the study is to understand how transnationals nurture indigenous knowledge while in the diaspora, and secondly, the role that current digital technologies play in supporting them to do so. Study 1 uses the P-P-P lens offered in Chapter 2, to surface the less visible, but more significant, influence of people, place and praxis when cultivating indigenous knowledge. Findings from this study contribute to the thesis by providing evidence of the kind of interactions and technologies that transnationals use to cultivate IK from afar, and thus highlight opportunities that Study 2 and Study 3 can investigate. Two research questions guide this investigation: in what ways do transnationals nurture indigenous knowledge while in the diaspora; and what role does digital technology play in supporting them to cultivate IK?

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This chapter begins by outlining the motivations for this study. Thereafter, section 4.2 details the study design of this study, explaining how field interviews were conducted with the 8 research participants. Of note is that the interviews were conducted at the houses or offices of the participants in order to glean a sense of their everyday activities. To analyse the research data from these interviews, thematic analysis method is used together with the P-P-P lens. From this exercise, 8 techniques are generated that relate to participants’ use and non-use of technology to connect with their indigenous community, ancestral lands, and participate in indigenous ceremonies. Finally, section 4.4 presents the findings of the study, and these are under three themes. These themes provide the thesis with evidence of current needs in this context, and consequently a grounded indication of which technologies or interactions to investigate further.

**Background**

Transnationals maintain a dual anchoring to both places of migration and places of origin. The focus of this study is on African transnationals who despite being geographically or generationally separated from their indigenous community and homelands, maintain interrelated forms of economic, political, social and cultural ties with their homelands. However, there is little research on how existing digital technologies can support members who wish to cultivate IK over distance. Focus has been on supporting elders in rural homelands in recording or sharing IK before it dies with them. Examples of such projects are Homestead creator that was designed to support elders from rural Namibia to generate and share their own content digitally (Rodil et al., 2013b); Digital Songlines which was designed for Aboriginal elders and teachers to share IK with youth (Pumpa and Wyeld, 2006); TAMI that was designed with elders from the Yolngu Aboriginal Australian community to support them in inducting children into learning more about the place (Verran et al., 2007); and CARACAL with community members from the Herero tribe in Namibia to capture and map objects and places of importance (Jensen et al., 2012a). These projects mainly focused on elders as the primary users of the systems, or involved only other collocated community members e.g. the youth or teachers. Study 1 differs from these projects by focusing on transnationals, who live away from indigenous epicentres, and still wish to sustain IK. Study 1 aims to surface the techniques and interactions used by those in the diaspora, and thus uncover opportunities to support them with digital technologies.

Study 1 also aims to uncover the role that current digital technologies play in cultivating IK in the diaspora. There are examples of how indigenous communities in Africa are using digital technologies to sustain
indigenous practices. Ebony TV, an African television house, created a reality show of the fattening rooms of South Nigeria. The show, titled Fattening Room⁹, is described as giving a modern twist to the age-old Efik tradition. Traditionally, during fattening rooms, unmarried young girls are taught homemaking and child rearing skills by their aunts and experienced women elders (Effiong, 2013). During the show six female participants are “fed, pampered, and taught the necessary skills for maintaining a happy relationship by a wise matriarch”. The six participants are from six different African countries, and they all travel to Calabar, Nigeria an ancestral homeland of the Efik community who still uphold the practice. The video show serves two purposes: widely disseminating knowledge of the practice to a global audience, and secondly supporting performance of an indigenous practice using current technologies. To do this however, required the six participants to take part physically, at Efik ancestral homelands, and with elders the show sustained the fattening room tradition. Study 1 is interested in finding out which and how digital technologies currently support those who live in the diaspora in similarly taking part or learning about indigenous knowledge. The study also investigates how current digital technologies fail to support indigenous transnationals in cultivating IK, and thus provide opportunities for Study 2 and Study 3 to investigate.

By focusing on remotely-located learners of IK, this chapter responds to a gap in research on how IK can be nurtured over distance. Additionally, Study 1 examines not only how transnationals use technology to nurture indigenous knowledge, but how they cultivate IK without technology. To ground this investigation within a framing that motivates IK, Study 1 adopts a P-P-P lens (People-Place-Praxis) lens. The lens holds that indigenous knowledge is expressed, developed and retained, in, with and through people, place and praxis. Study 1 uses this lens to analyse the research data and highlight how current digital technologies foster (or fail to foster) engagement among indigenous community members; situated interactions in or with their indigenous epicentres; and the living out of indigenous skills and practices in the diaspora. The next section details how Study 1 was conducted, and how the P-P-P lens is used to analyse the data.

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4.2 Study method

Study 1 consists of field interviews with 8 Kenyan women living in Melbourne, Australia. The qualitative study investigates indigenous members attempting to cultivate IK away from their distant homeland. Use of a qualitative research method in this study is important in generating insights from a small sample group. Being a Kenyan woman myself, the sentiments, understandings and familiarity I had with the participants enriched the collection, analysis and synthesis of data. For example, interviews were conducted both in English and Kiswahili, following a norm amongst Kenyans to code-switch between the two languages. Using these two languages interchangeably allowed for colloquialisms, phrases, sayings, and commonly understood norms to be expressed by the participants and understood by me without the need for translation. Bidwell (2014) highlights the dual challenge of translation that western researchers have when working with communities “out there”. This involves having to translate between the languages spoken and between the genres of written interview and oral report. My position - as adept in the languages of the participants and their multiple forms of oral expression, and in the process of academic research and reporting - eased the generation of nuanced user requirements. The next sections describe the participants, data collection and data analysis in more detail.

4.2.1 Participants

All participants in the study are Kenyan women aged between 25 and 60. The choice to study women is twofold. Primarily, it is as a respect for cultural norms among ethnic communities, where roles and access to certain information are gender-based. Being a Kenyan woman myself, I chose to access and observe the roles that women access. While the communities may allow researchers to observe or access knowledge that they are not privy to, it is more respectful to follow their customs and thus facilitate a good relationship with the research community (Peters et al., 2014). Secondly, conducting the study with women facilitates wider and easier access to participants and the activities under investigation. I was also familiar with the structure of Kenyan society and its bearing on the participants, together with the nuances of navigating a diaspora life away from Kenya. Existing relationships with technology research organisations in Kenya, and the ease of access to participants for future studies further motivated an interest in the Kenyan diaspora.
All participants have lived in Australia for between three and fifteen years, are either employed or owned their own businesses, and are multilingual speaking at least English and Kiswahili. Table 3 briefly presents the demographic profiles of the eight participants.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (yrs.)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann</td>
<td>25 to 30</td>
<td>Social worker; Has lived in Australia for 6 years; Last visited Kenya 10 years ago.</td>
</tr>
<tr>
<td>Shangazi</td>
<td>55 to 60</td>
<td>Nurse and business owner; Married with two children aged 25 and 29; Lived in Australia 15 years; Last visited Kenya in March 2014. Visits each year.</td>
</tr>
<tr>
<td>Baraka</td>
<td>25 to 30</td>
<td>IT consultant; Lived in Australia 3 years; Has not visited Kenya since being in Australia, plans to travel at the end of the year.</td>
</tr>
<tr>
<td>Lucy</td>
<td>40 to 45</td>
<td>Teacher; Married with two children aged 7 and 16; Lived in Australia for 8 years; Last visited Kenya 10 years ago. Visits Kenya about every decade.</td>
</tr>
<tr>
<td>Senge</td>
<td>40 to 45</td>
<td>Trainer, Business owner; Married with two children who are in their early twenties; Has lived in Australia for 10 years; Last visited Kenya 3 years ago.</td>
</tr>
<tr>
<td>Mariamu</td>
<td>40 to 45</td>
<td>Business owner; Married with three children (16 – 27 years of age); Has lived in Australia for 12 years; Last time in Kenya was in January 2014, visits approx. every 1.5 years.</td>
</tr>
<tr>
<td>Dada</td>
<td>35 to 39</td>
<td>Accountant; Married with three children, all under 8 years of age; Has lived in Australia for 8 years; Last visited Kenya 3 years ago.</td>
</tr>
<tr>
<td>Binti</td>
<td>25 to 30</td>
<td>PhD student and lecturer; Has been in Australia for over 5 years; Last visited Kenya a year ago.</td>
</tr>
</tbody>
</table>

Table 2: Summary of participants for Study 1 (all names are pseudonyms)

To recruit the participants, the study was initially advertised on social media pages, mainly Australian based Facebook groups with ‘Kenya’ in their title and popular Kenyan diaspora forums e.g. Mwakilishi.com. However, this recruitment method was not productive, nor was reaching out on Kenyan forums and mailing lists. Subsequent approaches involved advertising the study to Kenyan acquaintances in Melbourne, who in turn recruited friends from the wider Kenyan community. Recruitment for the study was therefore mainly by snowball sampling, resulting in half the participants knowing each other. This proved advantageous in that the stories that recurred in the data were enriched and clarified through multiple viewpoints.

4.2.2 Data collection

Interviews were held at the homes or offices of participants, and were carefully arranged at a time that was convenient for them. Each session consisted of a one-on-one interview that lasted between 30 minutes to three hours. Semi-structured interviews were used to guide the study sessions. This involves using a list of prepared questions, but allowing for changes in sequence and wording of the questions as suits the situation (Patton, 2002). A sample interview guide is available as Appendix A.
During the sessions, a Samsung Galaxy S6 was used to audio record the interviews. In addition, handwritten notes of each session were made. Pictures of traditional artefacts were also taken to glean a richer understanding of how products of IK are transported and developed in places of migration.

4.2.3 Data analysis

The method used to analyse data is thematic analysis as described in the previous chapter (section 3.4.2). Braun and Clarke (2006) provide a series of steps to conduct thematic analysis. The first step is to familiarise oneself with the research data. This requires repeated reading of the data while taking notes of initial ideas or codes. Data transcription is conducted in this first stage. In Study 1, this first step involved listening to the audio recordings and going over field notes. Interviews in all the studies were conducted in both English and Kiswahili, since the research participants are multilingual. All data recordings were translated and transcribed except for passages of study-irrelevant speech.

The second step is to generate initial codes. Codes identify a feature of the data that is interesting to the researcher. Braun and Clarke reinforce that it is an essential part of analysis as it provides a way to organise the data into meaningful groups. Study 1, use the P-P-P lens to analyse the study. I therefore combed through the data for instances where participants reported: face-to-face meetings with members of their ethnic or national community (People); visiting or engaging with their ancestral home, or a place where an indigenous practice is performed (Place); and lastly, adopting or carrying out practices that embody and depend on IK in the diaspora (Praxis). The data items that emerged from this exercise were then coded.

The next phase is generating themes from the research data. Themes differ from codes in that they are broader and consist of collated coded data. Analysis involves combing through codes to identify how they are related. Related grouping of coded date form themes. Additional tools can be used to jot down themes including descriptive notes, models or mind-maps. In Study 1, the themes that were generated related to how participants engaged with the P-P-P of IK. This phase generated 8 techniques used by the research participants to cultivate IK in the diaspora. Additionally, in line with the P-P-P lens, the techniques were grouped according to how they facilitated a connection to people, to place or to praxis. Though all techniques relate in some sense to combinations of people, place and praxis, they are discussed as falling principally under one of them. These are presented in section 4.3.
The fourth phase of thematic analysis is reviewing themes. In this phase, the candidate themes that emerged in phase three may be discarded, combined or split into separate themes. Two levels of review are involved in this phase. Level one involves reviewing the themes vis-à-vis the contained coded extracts to confirm that they form a coherent pattern. If they do not, then the themes are either reworked or discarded from analysis. The second level involves reviewing the themes vis-à-vis the entire data set to confirm that the thematic map reflects meanings evident in the data. Braun and Clarke advise that at the end of this phase, the themes, how they relate to each other and the overall story they tell, should be clear.

In Study 1, the 8 techniques that were generated were iteratively analyses into bigger themes that answer the research question. The 8 techniques were useful in organising and presenting the research data. Bigger themes however, were generated to inform the next study. Four themes were generated from the 8 techniques surfaced by Study 1.

The fifth phase is defining and refining themes where the essence of the themes are identified and explained. This involves ensuring the themes are concrete accounts of atomic findings in relation to the research questions. Themes are described for what they and what they are not. Naming of the themes also occurs in this phase. In Study 1, the four themes were described in relation to the 8 techniques.

The final phase is producing a write-up of the thematic analysis. The write-up in a way to present the data that portrays the merit and validity of the analysis. The write-up should “provides a concise, coherent, logical, non-repetitive, and interesting account of the story the data tell – within and across themes.” (Braun and Clarke, 2006). Extracts from the data can also be included in the write-up to reinforce the report. A good analytic narrative provides not simply a description of the data, but makes an argument in relation to the research question(s). A write up of the themes that emerge from the study is presented in section 4.4.
4.3 Findings

The two research questions that guided this investigation were:

- RQ1 In what ways do transnationals nurture indigenous knowledge while in the diaspora; and
- RQ2 What role does digital technology play in supporting them to cultivate IK?

In attempting to surface the ways in which the participants use technology, Study 1 reveals spaces where technology did not sufficiently support participants. This next section thus attends mainly to RQ1, and highlights eight techniques used by the research participants to cultivate IK while in the diaspora. These techniques are presented according to how they facilitate a connection to people, to place or to praxis. To note is that while these techniques are highly relevant to the circumstances and intentions described by all participants, not all reported using them. This section consists of four parts. The first three discuss the eight techniques as per how they connected the participants to people, place and praxis, and the final section discusses how technology supports participants in nurturing IK over distance.

4.3.1 Connecting to People

The first category of techniques for sustaining IK in the diaspora is concerned with how participants connected with other community members both in Australia and in Kenya. The techniques below centre on physical meetings with members of the participant’s ethnic or national community. In these techniques, participants found it vital to engage with community members through face-to-face collocated interactions. As per the participants’ experiences, discussed under three techniques below, these face-to-face connections had to be arranged, negotiated between the parties involved, and at times were difficult to attend. Nonetheless, they were considered vital for a number of reasons. For one, sessions with other Kenyans, e.g. Kiswahili lessons for children, instilled pride in the parents in being active purveyors of indigenous knowledge. Moreover, physical meetings were considered more respectful when meeting with elders from ethnic communities, or when participating in rare but significant cultural events such as weddings. Relatedly, given that some participants felt that they had lost touch with their indigenous roots, the physical presence of a member from Kenya provided an authentic source of knowledge to IK ceremonies in the diaspora. In terms of technology use, it emerged that while computer mediated interactions were used, they were often considered unsatisfactory in replacing physical meetings, and were thus used to support or extend connections after face-to-face interactions had occurred.
**Physical meetings among learners**

One of the techniques for sustaining IK through people is to create spaces and events to interact and learn about Kenyan culture. Four participants - *Mariamu, Shangazi, Lucy* and *Senge* - were involved in launching and running a language school in Melbourne for children from the Kenyan community to learn Kiswahili. The school doubled up as a space of social interaction, where the children could meet, engage and practice their language, and it gave the parents another reason to meet with each other. *Shangazi* expressed pride in setting up a regular language school, as it was a visible means of passing “something down” to their children. She also noted that the school served as a physical avenue to her childhood as it reminded her of the Kiswahili poems she used to sing while in East Africa.

One of the reasons children were motivated to attend the Kiswahili school was to develop the culture they represented. A quote here from *Mariamu* about her daughter illustrates this:

> “Like my daughter goes here to Red Roses High School\(^{10}\) where every year there is a cultural day. She represents Africa. So always, that day she has to wear Africa. And sometimes she is Africa alone, in a school …… So in her mind she is reminded over and over again, ‘you are from Africa’. So whether she wants it or not, as much as she will most likely eventually assimilate into the Australian [culture] as they grow older.. at the moment they assimilate to Australia as Kenyan-Australians. First of all, they will be Kenyans, and then Australians. So they just have to keep that connection [to Kenya] otherwise they get lost. Because they can never be fully Australians, they will always be Kenyan-Australians. So, they have to be both.” *Mariamu.*

However, due to time and other commitments, there was difficulty in ensuring children regularly attended the Kiswahili classes. To make up for this, *Dada*, extended the Kiswahili lessons at home by encouraging her children to watch *TingaTinga* tales, a Kenyan-produced animation based on African folklore and artwork ([www.tingatingatales.com](http://www.tingatingatales.com)). Though *TingaTinga* is available in both English and Kiswahili, *Dada* insisted that her children watch the Kiswahili version in order that they practice speaking the language at home, and with each other. Physical meetings with learners formed collocated spaces where participants could pass

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\(^{10}\) Not the real name of the school
on IK to their children, in ways that reflected the face-to-face, group sessions of their indigenous communities.

**Cultural apprenticeships**

A related technique for connecting to people can be described as cultural apprenticeships. Here, members arrange to meet physically for the teaching of specific traditional knowledge. A frequent site for this kind of exchange was during learning of highly bodily tasks, such as the preparation of traditional meals. The stories below exemplify this:

*Quote 2*

“One of my friends said that before she leaves Melbourne in two weeks she has to come over for me to show her how to cook chapatis. I told her I could explain it to her over the phone but she has refused! I have explained to her before how to do it over the phone, but she said every time she tried cooking them, they were hard. So, she insists on coming to do it with me.” Shangazi

*Quote 3*

“So, there are some things [my children] really appreciate. Like at least they can make sukuma wiki, nyama na ugali. In fact, when our son makes that, everybody says ‘Make it for us!’, because he does it very well. So sukuma wiki, nyama na ugali yake, no one makes it like him… My son just observed and learnt how to cook the traditional food better than me!” Senge

Shangazi and Senge both met physically with friends and family respectively, in order to teach the cooking of Kenyan food through a ‘learn by doing’ approach. Shangazi highlighted an attempt to use a phone call to teach the making of the dish, but it was deemed insufficient by the learner. She therefore opted for face-to-face meetings. In addition, these practical sessions served as special sites for the teaching of “traditional values”. Ann mentioned that her aunt coupled the cooking of intricate traditional foods with storytelling, thereby using the cooking activities as prompts or as reference points to contextualise values from their ethnic community. To her, nurturing an indigenous identity was not only reserved to skill and language acquisition, but was also about having an alternative reference point for everyday questions and activities. Ann explicates this desire to know the ways of living of her community, through her experience below:

*Quote 4*

“I want to know the roots. Our roots, back at home. I don’t feel bad that I cannot speak my ethnic language. I don’t have sleepless nights about it. But when I am asked about my ethnic background, I can’t say anything, and that is why I feel as though I lack and I would love to
know more about that. Growing up, we weren't exposed to that... the things I do right now, would they be accepted? Would the elders give me a leso at my wedding?” Ann

According to Ann, her ethnic community, the Taita, only give a leso (a clothing item similar to a sarong) to women who are considered honourable by village elders or community members. While Ann acknowledged her indifference to knowing or speaking her ethnic tongue, she still desired approval from her elders. Cultural apprenticeships therefore served as opportunities to know about the ways of life particular to the Taita.

**Flying in experts**

The converse of learning from others in the diaspora is to arrange for visits from those at the places of origin. Mariamu and Lucy revealed instances where elders, religious leaders and ethnic community members from Kenya, were flown out to Australia in order to chaperon a traditional ceremony.

**Quote5**

“I hadn’t paid attention to what the songs meant when I attended weddings in Kenya. At my wedding here, we had a lady from Kenyan who taught us the traditional songs of my tribe. Her and my mum arranged us accordingly, as per our customs, and we performed the traditional ceremony of wooing the bride out of the house... The Kenyan community in Melbourne was very excited. I did not realise they miss such things.” Lucy

**Quote6**

“We were haggling about how many goats we have to be given by the groom’s family. I mean it is just fun for us because we really don’t know what is supposed to be done, but once in a while we get a mzee (old man) from somewhere to come and you know, guide us on how many goats and what the significance of that is and all that. So, we are now going through the process of a traditional Kikuyu wedding.” Mariamu

Here, knowledge experts were sought and brought in to guide the performance of a traditional ceremony given that they were seen as legitimate holders of indigenous knowledge. While there were alternatives to obtaining this information (in Quote7 Mariamu reported that she did a bit of Googling first), there was a preference to have a person from the community present. The presence of a person to inquire and learn from, unburdened the participants of the responsibility of managing a traditional ceremony that they felt they were not properly acquainted with.
4.3.2 Connecting to Place

This group of techniques focus on connecting to the ancestral home, place of origin or place of performance of the traditional ceremony. The connection to place transpired in three ways. The first is a physical transportation to place executed by visiting the homeland; Mariamu travels to Kenya to meet the elders at the ancestral home. The second avenue to connect to place is explored by Senge, who ‘transported’ her home in Kenya to Melbourne. Her way of connecting two places evokes approaches used in augmented reality. Finally, in the third option, Baraka connects to a remote location through a mesh of live video, text and audio channels, coupled with a synchronised performance of activities taking place at the remote location. The three techniques are discussed in more detail below.

Visiting the homeland

Participants maintained connections to Kenya and to their ancestral homes, primarily through regular trips to those physical places. The need for these trips went beyond visiting friends and relatives, and included the need to connect with the people at the places of IK. This was sometimes fuelled by a need to connect with the legitimate sources of IK, where in addition to people, place was also considered a source of IK. Mariamu’s experience exemplifies this:

Quote7

We did a bit of Googling, my husband and I, but we did not get much from there about our ethnic community. So, we have purposed that next time we go to Kenya we have to look for old men, old Kikuyu men to explain to us those processes because we realise we do not know them.” Mariamu

Such a meeting needed to be face-to-face given the importance of the people to be met, i.e. the elders of the village. Moreover, non-verbal interactions and feedback between the Mariamu, her husband, the elders and the environment, constitute the learning that takes place in these physical encounters with knowledge bearers. Thus, Mariamu preferred physical meetings with the elders given the wealth of learning it would offer, and an opportunity to sustain a relationship with the elders and her village.

Extending places of origin

A connection to ancestral place was also maintained in the country of migration of the participants. I refer to this as extending the place of origin, where practices and ceremonies considered central to one’s
indigenous identity are lived out at the place of migration as they would have been at the place of origin. Senge explains this below:

“*Australia feels more or less like Kenya. After some time, you forget that you are not in Kenya. I practice [my culture] every day because I eat Kenyan food ... If it is praying I pray daily, if it is going to church, I still do it here. It actually feels more or less like Kenya. Like going to work at 9, leaving at 5. Except now when you look around and you realise the environment is different... praying, chatting, cooking chapati, cooking mukimo, cooking sukuma wiki. Or I just do. I have brought my Kenya here.*” Senge

By sustaining practices and relationships from her indigenous background in Melbourne e.g. food, language, religious practices, community and radio, Senge was able merge her connection to Kenya with her current physical place. She juxtaposed her indigenous practices from her place of origin to her place of migration.

**Being there through digital connectivity**

From the interviews, it emerged that digital technologies were used as a kind of secondary connection to place. This was reported in the use of, for example, phone calls, Skype calls, WhatsApp groups, diaspora forums and Facebook pages.

“To keep in touch with Kenya and what is going on, I check Facebook and the home country news stations like KTN, and I also watch YouTube channels from Kenya to see what has happened.” Binti

While these technology-mediated ways always involved connections to people, and very often to practices as well, it was clear in the testimony of participants that part of the value was in connection to the places of IK. For example, in one reported case, to create a more immersive sense of 'being there', multiple channels of connection were used in tandem. Baraka watched a one-way live feed of a wedding ceremony online. SMS messaging was used to communicate with her family members present at the wedding, while she watched them via live-stream. Additionally, she performed actions in unison with the wedding attendees, despite a 10-hour time difference. Therefore, Baraka prepared her meal in Melbourne, but only ate when those at the wedding ate. During the sections of the traditional wedding that involved singing and dancing, Baraka sang and danced along to them. Throughout, she exchanged text messages with her mother, who
would respond via text or gestural cues when saw knew she could be seen by Baraka over the one-way live video feed.

4.3.3 Enacting Praxis

The third category of techniques for sustaining IK in the diaspora is concerned with the direct adoption of practices that embody and depend on IK. Two techniques emerged here that point to how participants purposed to practice an indigenous skill or perform an indigenous ceremony in Australia, or in anticipation of moving to Australia. Their experiences highlight that life events are strong motivators for transnationals to reinvigorate their indigenous anchoring; and that the lack of access to indigenous people and tools at the place of migration motivates transnationals to sharpen existing or learn new indigenous skills before they leave the place of origin.

Pre-learning indigenous practices

This technique occurred before participants left Kenya, in anticipation of the scarcity of their IK at the place of migration. The act of pre-learning among transnationals was surfaced by Mariamu’s experience of relocating to Australia with her young daughters.

Quote

“I am undoing my hair now so that it can be redone by a friend, into an African hairstyle I like. I used to do this for my daughters when they were younger... I learnt it in Kenya because I knew I was moving here. And here, the salons do not know what to do with our hair.”

Mariamu

What is additionally interesting here is the bodily literacy Mariamu acquired in order to braid hair. She had to learn by doing, and learn from friends conversant with hair braiding. After some years in Australia however, Mariamu stated that because she no longer did her daughters’ hair as they preferred hairstyles reflective of their new environment. She felt that she had since forgotten the indigenous skill, given that the bodily literacy of hair braiding could not be sustained without doing.

Re-enacting Traditional Ceremonies

Once in the diaspora, a key technique in which IK is nurtured through focus on praxis is the re-enactment of traditional ceremonies. Participants used online searches to source detailed information about how to perform them. However, the internet was largely perceived as lacking in legitimate sources. Consequently,
information was sourced from peers, or notable books written about pre-colonial Kenya, the period before
the western colonisers’ subjugation of indigenous ways of knowing and living. These provided reference
points from which traditional ceremonies were re-enacted into the life events of the participants, e.g. birth
ceremonies and weddings. Dada’s experience is detailed below:

Quote1
“When he was born, the men did the itega (A traditional ceremony to celebrate the birth of a
baby) for him. We got a goat, which is apparently supposed to be cooked by the men only. So,
my friends and I just sat here while the men were cooking and doing everything. I did not even
know that having men cook for us is a traditional thing! Some people had been reading the
book Facing Mount Kenya, and that is how they became aware of how things used to be done
before... One of the guys had a lot of notes about it. I do not know whether my husband
recorded it but he read chronologically what used to happen when a woman gives birth, and
what the village women do, and what the midwife does and how she lets people know
whether it is a boy or a girl... So, we re-enacted all that.” Dada

The re-enactment of ceremonies was motivated by life events. These ceremonies allowed participants to
take part in indigenous activities they seldom would perform otherwise, and gave them valid reason to
enact their indigenous identity at the place of migration. Participants went to great lengths to learn and
carry out the indigenous ceremonies as would have been done in Kenya.

4.3.4 Role of technology in supporting IK

This section explores the role that digital technologies play in supporting the participant to cultivate IK.
Attending to RQ2 highlighted a multitude of social media applications and communication tools
participants used to connect with their Kenyan and/or indigenous background. Common communication
technologies were WhatsApp, Viber, Skype, phone calls, country based forums, YouTube and email. They
attended to connecting to people, place and praxis in various ways. One of the ways was in how
communication technologies supported participants in connecting to people and praxis, without the need
to visit Kenya. Lucy and Ann exemplify this.

Quote12
“I am so embarrassed. The last time I was in Kenya was in 2004, and the last time I was there
was in 1994. Look, my mum was here in 2012, and I think when you mentioned technology has
really improved. Say with my mum I can call her anytime, and sometimes with my sister we
can Skype. It has brought us closer so we don’t feel the need really to go home.” Lucy
“I miss the songs, the Kenyan songs. Like the clip Chao sent on the WhatsApp group, I think heh kanisani and the way people lilililili, ululate, for me that is the best thing, lilililili. Uhm, for me it is the small things that make Kenya, Kenya. But do I feel homesick, no. Could I go another five years without visiting home? yes.” Ann

This demonstrates that while some participants felt the need to travel back to Kenya to cultivate IK because technology was not sufficient, others like Lucy and Ann saw technology as sufficient in nurturing their anchoring to Kenyan practices and community members.

Another way that technology was used was in keeping in touch with the change of indigenous practices. YouTube, Facebook groups and Kenyan online news sites were important in supporting participants in staying up-to-date with everyday affairs and practices.

“To keep in touch with Kenya and what is going on, I check Facebook and the home country news stations like KTN, and I also watch YouTube channels from Kenya to see what has happened.” Binti

“The one they do the other day and tourists come to watch, it is a big thing. They say it is a tourist attraction. It is even on YouTube! They even slap the boys, ahhhh, some cultural things, if they do not have meaning, should be taken out.” Senge

“I have brought my Kenya here... I try not to miss out. I watch news every evening through the KenyaMoja. It is very very good. It has all the videos of the latest things happening in Kenya. And they do it every day. It has KTN, NTV, Citizen and Nation, and other smaller ones. It is very good.” Senge

“I use Facebook groups to keep up on news and events.” Dada

As is demonstrated above in Senge’s comment, YouTube videos about indigenous skills in Kenya gave her an indication of how some customs had changed or not. In Quote 15 above she refers to a traditional ceremony for young boys from her community. While she supports the ceremony, she felt that certain elements of it needed to be taken out. She used YouTube to access news about the practice and keep up with its developments.
YouTube videos were also used as tools for learning. As mentioned earlier, Kenyan-produced animations were used by Dada to extend the Kiswahili lessons her children attended on weekends and teach African folklore. As illustrated below, Shangazi’s niece and Baraka used YouTube to learn how to cook Kenyan foods.

Quote8
“I have a niece and, my brother’s daughter... she is so good in that. I am like Jeez, how do you do this? She just retrieves it online, and she will do it” Shangazi

Quote9
“So, I looked up the recipe, and I got the recipe from a Kenyan recipe place. So, it was not even like just normal recipes on Google, not it was a Kenyan woman who had that site.” Baraka

What is clear from these particular accounts is that participants sought out certain videos based on the authors of the content. That is, Dada watched animations from Kenya, while Baraka sought out a recipe from a particular Kenyan woman.

In summary, digital technologies were used to keep up with news and activities, learn new skills and languages, organise and participate in life events with other Kenyans, and crowd source information about a particular ethnic community or a particular practice. The next section provides further insight on the findings, and details how they progress the thesis.

4.4 Discussion

Study 1 is an investigation with 8 Kenyan women in Melbourne, Australia, to understand the role technology plays in supporting transnationals to nurture indigenous knowledge while in the diaspora. While the study focused on only a small group of Kenyan women, it offers a window into understanding the challenges faced by globally dispersed cultural groups who desire to develop IK at their places of migration. By revealing the ways by which they live out IK, Study 1 provides evidence of current needs in this context, and consequently a grounded indication of which technologies or interactions to investigate further.

Study 1 applied the P-P-P lens to analyse and translate the data. Thus, this study looked for the ways in which participants sought out face-to-face meetings with members of their ethnic or national community (People), how they engaged with the ancestral home, place of origin or place of performance of indigenous
practice (Place), and how they adopted or carried out practices that embody and depend on IK (Praxis).

Through a people-place-praxis view of IK, eight techniques for sustaining IK were identified from the group of diaspora Kenyans. They are:

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Technologies reported</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Addresses RQ1 and RQ2</strong></td>
<td><strong>Addresses RQ1</strong></td>
</tr>
<tr>
<td>People</td>
<td>Animations and movies</td>
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<tr>
<td>Physical meetings among learners</td>
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<td>Cultural apprenticeships</td>
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<td>Flying-in experts</td>
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<td>Place</td>
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<tr>
<td>Visiting the homeland</td>
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<tr>
<td>Extending places of origin</td>
<td>Kenyan news and music media, Facebook, Viber</td>
</tr>
<tr>
<td>Being there through digital connectivity</td>
<td>News stations, YouTube channels, SMS, video streaming, Skype</td>
</tr>
<tr>
<td>Praxis</td>
<td></td>
</tr>
<tr>
<td>Pre-learning indigenous practices</td>
<td></td>
</tr>
<tr>
<td>Re-enacting traditional ceremonies</td>
<td>WhatsApp groups, online searches,</td>
</tr>
</tbody>
</table>

Table 3: Techniques and technologies used to cultivate indigenous knowledge in the diaspora

As shown in Table 3 above, most of the eight techniques involved at least some use of digital technologies of connectivity, though some do not. RQ1 was addressed by surfacing the 8 techniques, and in turn within those techniques the role of technology was highlighted, thus answering RQ2.

From the table, techniques such as cultural apprenticeships, flying in experts, visiting the homeland, and pre-learning reflect the strong reliance on physical and bodily interactions when living out IK. Additionally, techniques such as physical meetings among learners, extending places of origin and being there through digital connectivity draw attention to the kinds of technologies currently used by transnationals in nurturing IK, such as videos, online streaming and group chat. Both the use and non-use of technology surfaced by these techniques give an indication of which gaps can be investigated further, and which technologies to explore. The remainder of this section critically examines the implications that emerge from these techniques, and how they inform the next study.
4.4.1 Participant youth are interested in cultivating IK in the diaspora

One of the motivations for using technology to store IK has been from a concern that the youth are disinterested in nurturing or identifying with their indigenous culture. Section 4.1 mentioned projects such as Homestead Creator and TAMI which have focused on supporting elders in recording IK before they die with the knowledge. In this study however, what emerged was an opposite sentiment from the youth; a desire by some younger participants (aged <30 years) and the children of older participants (reported indirectly), to learn about their ethnic background and to live out aspects of their culture.

A key driver of this interest was a feeling of having “missed out” on aspects of their ethnic or national background due to, surprisingly, an influence from their parents. For example, one of the participants, Ann mentioned that when growing up in Kenya, her dad required the family to speak only English in the house, in order to prepare them to live outside the country. She therefore missed out on learning key aspects of her mother and father’s cultural heritage due to not knowing their respective ethnic languages. Also, due to negative connotations appended to African culture vis-à-vis Western culture, and a desire to fit into the new society, Shangazi and Lucy reported that often, newly emigrated Kenyan parents would deliberately facilitate a loss of use of ethnic languages amongst their children.

Another motivation was to learn more about the identity the transnational realises they represent, once at the place of migration. For instance, Mariamu narrated how her daughter’s interest in Kenyan culture was fuelled by a realisation that she was different from her classmates, while Binti realised she knew little about ‘authentic’ Kenyan cuisine when her non-Kenyan friends quizzed her about it. Mariamu’s daughter enrolled at the Kiswahili school while Baraka sought out Kenyan recipes online. This sentiment reinforces literature cited in chapter 2 where Ilmi (2012) stated that his experience of being an ‘other’ in Canada forced him ask what it means to be Somali, and confront the struggles he had with his identity and indigenous self-love. The pursuit of Somali dhaqan philosophies (Somali ways of living and knowing) was motivated by a desire to reclaim a holistic identity scripted from within his indigenous culture and lens.

Similar to this, another motivating factor for cultivating a Kenyan identity was a need to belong. Lucy illustrates this need to belong from the experience of her nephew, who had to show that he spoke his ethnic tongue fluently in order to get approval from his future mother-in-law. The desire to prove he was a
“true” Kikuyu, catapulted him to learn the Kikuyu language from his fiancé. Lastly, younger participants sought IK in order to learn particular skills. Baraka sought out YouTube videos so as to learn to cook a Kenyan meal she had missed. While though Ann had no interest in returning to Kenya, she used WhatsApp to keep up with traditional ceremonies and learn more about her indigenous background.

In summary, participants’ accounts highlight two key themes. One is that while the younger participants had varied motivations to cultivate IK, what was common in all their accounts was that they attempted to revive the praxis of IK in one way or the other. Secondly, as noted in 4.3.4, participants used technology to support them in living out IK while at peripheries of IK. Common platforms used were WhatsApp, Viber, Skype, phone calls, YouTube and email. These were used to facilitate various interactions, for example finding out what locally unavailable item could be replaced in a traditional recipe; organising life events with other Kenyans e.g. birthdays and weddings; keeping up with news via Kenyan YouTube channels and online newspapers; learning Kiswahili and African folklore via Kenyan-produced animations; and crowd sourcing for information about a particular ethnic community or a particular practice. While these technologies were found useful, participants described workarounds and techniques they had to employ for sustaining IK, that go beyond what is readily possible with these technologies of connectivity. This observation motivates a need to understand how technology can further support transnationals in learning, practising and sharing IK while in the diaspora.

4.4.2 Bodily and collocated interactions are preferred when learning or sharing IK

One of the biggest gaps that technology mediation could contribute to is the continued desire and reliance on collocated meetings. Such meetings, that underpinned techniques like apprenticeships and pre-learning, allowed learners to acquire knowledge through bodily interactions. Study 1 participants engage in activities such as cooking intricate dishes and hair dressing which involve knowledge in the form of feel of the food or hair, smell of the food, rhythm of hand movements when plaits hair and change of texture of the food while it is cooking. Their engagement in these activities reveals a preference for learning by doing, and learning from collocated interactions. For example, Shangazi attempted to use phone calls to give instructions on how to prepare traditional foods. However, she expressed difficulty in translating bodily literacies into audio - a form afforded by phone calls. In another account, Mariamu ensured she learnt how
to braid hair while she was in Kenya, in anticipation of using the skill in Australia where African hair braiders are rare.

Moreover, participants make great attempts to meet face-to-face with doers of IK by engaging in physical meetings among learners, cultural apprenticeships, visiting the homeland, flying in experts and re-enacting traditional ceremonies. For example, Mariamu was involved in a dowry ceremony for her niece that required her to fly from Melbourne to Adelaide (approximately 1000 km part) thrice, to meet the families of her niece’s fiancé. Mariamu had previously understood the dowry ceremony as about selling the bride. However, by taking part in the ceremony and having to physically meet the groom’s family, she learnt otherwise. Traditionally, the groom was not allowed to pay the full price at once. He was meant to do so bit by bit every year to ensure the families of the couple met regularly. Dowry serves as a way for the families to sustain a relationship throughout the marriage of their children. Participation in the dowry ceremony prompted Mariamu to travel to her home in rural Kenya, so that she could understand the dowry ceremony from the perspective of “the old men of the village”.

When travel is not possible or desired, participants use technology to connect with sources of IK. Communication technologies were used largely to facilitate searching, and often a kind of crowd sourcing for resources on IK, through platforms like WhatsApp and Facebook. Similar to Williams et al. (2008), this study surfaced that “communication technologies are also information technologies”. This means that the technologies used for communicating with other people e.g. WhatsApp and Facebook, were seen as sources of IK given that they facilitated direct communication with bearers of indigenous knowledge, or links to those who are. What stands out from participants’ accounts is the combined use of live streaming and synchronised participation to connect remotely to an ongoing indigenous ceremony. Baraka used props available to her to participate in the wedding ceremony she was viewing via a live stream. Two-way communication was facilitated by phone messaging, which proved ideal for the context because it did not disrupt the activities at the place of performance, and it supported a one-to-one intimacy. This viewing, augmented with two-way communication and synchronous participation of live activities, gave Baraka a feeling of “actually being there”.

Participants’ accounts underlie a preference for collocated and physical interactions when learning or sharing indigenous skills. Specifically, using learning-by-doing approaches and meeting face-to-face with holders of IK. The impact of this finding on the thesis is that it narrows the focus from video-mediated technologies in general to video-mediated sessions. The sessions will provide a way for face-to-face (live) interactions to be mediated, and support learning through bodily interactions despite participants being remotely-located. To investigate this further, the next study observes how elders share IK skills with remotely-located youth during video-mediated sessions. Chapter 5 discusses the next study.

4.4.3 Participants have varied engagement with IK

The flying in of experts, planned physical encounters and re-enacting traditional ceremonies highlight differences in experience and praxis of IK among the participants. Lucy for example, felt that she had lost touch with her indigenous roots and was not familiar with the praxis of her indigenous culture. Thus, during her wedding Lucy flew in experts from her village in Kenya to be authentic sources of the traditional wedding ceremony that took place. Shangazi on the other hand, maintained an active connection to her ethnic background by visiting Kenya regularly and engaging in the teaching of Kenyan culture in Melbourne. She expressed pride in setting up a Kiswahili language school in Melbourne, as it was a visible means of passing “something down” to their children.

Meanwhile, Senge nurtures her connection to the ancestral lands from a distance. She extends her place of origin by living out IK in Australia as she would have in Kenya. The technique she uses informs previous literature on how indigenous communities maintain a connection to their indigenous lands, while in the diaspora. That is, while indigenous community members may not desire to live on the ancestral land, or to return to the ancestral land, the ancestral land travels with them. In that way their identity as an indigenous community member is maintained ex-situ. As highlighted by Englund (2002),

*This reaction to the question of ‘return’ may indicate how meaningless the very idea of ‘return’ is. Despite their spatial mobility, most migrants have not ever ‘left’ their mudzi, the home village, to which they could in any meaningful sense ‘return’. (Englund 2001, p. 146)*

The three examples above of Lucy, Shangazi and Senge illustrate that transnationals employ different ways of connecting with their wider community members (People), their ancestral lands (Place) and the living out of indigenous ceremonies and practices (Praxis). This chapter proposes that one of the reasons for this
is that they have varied engagement with IK. They relate and identify with IK differently, and thus engage with IK differently. For example, compare Shangazi who travels to Kenya every year, and Lucy who travels once in a decade. This affects how they use technology when engaging with IK. Section 4.3.4 highlights that Lucy found technology sufficient in supporting her engagement with Kenyan practices and community members, yet other participants saw the need to travel back to Kenya to cultivate IK because technology was not sufficient.

From these participant accounts, this chapter offers that supporting transnationals in cultivating IK from afar needs to consider that they engage differently with IK, and this may influence what or how they use technology. While indigenous communities are largely communal, Study 1 offers that the balance between mediating IK practices for the group and at the same time for the individual should be a significant consideration for the next chapters. Particularly, an investigation of how technologies of exchange can accommodate different engagement with IK among indigenous transnationals. Chapter 6 explores this further.

4.5 Summary

Through a people-place-praxis lens, this chapter identifies eight techniques Kenyan transnationals use when nurturing indigenous knowledge in the diaspora (summarised in Table 3). From these, three findings emerge that guide the next studies. Firstly, participant youth are interested in nurturing IK in the diaspora. Thus, the next study will focus on indigenous youth as learners of IK, as opposed to transnationals in general.

Secondly, bodily and collocated interactions are preferred when learning or sharing IK. Based on this, the next study observes how elders share indigenous skills (which are traditionally shared in collocated settings) over distance. Study 2 examines elders in rural Kenya share everyday indigenous skills with remotely-located learners during video-mediated sessions. A motivation for using video-mediated technologies in Study 2 is that they afford visual and audio communication, which is important when mediating bodily and collocated interactions over distance.

Thirdly, participants have varied engagement with IK. This provides an opportunity for technology to support dispersed transnationals in customising their experience of IK when they take part in group
sessions. Study 3 investigates how technology can facilitate a sort of personalisation, or flexibility during these group technology-mediated meetings.
5

Study two: Understanding how elders share indigenous knowledge over distance

5.1 Introduction

This chapter reports Study 2, a field study conducted in Kenya that observes elders share indigenous skills with remotely-located youth over 10 video-mediated IK sessions. While Study 1 has provided insight from field interviews, Study 2 proposes and uses video-mediated IK (ViMik) sessions to gain an understanding of the sort of interactions employed by elders when sharing indigenous knowledge over distance. The research question guiding this study is: ‘What interactions do elders at indigenous epicentres, employ when sharing IK with remotely-located learners?’

This chapter begins by providing an overview of projects in HCI that have similarly designed technologies that support elders in sharing IK. Section 5.1.1 also details how Study 1 influences the focus of this chapter. Particularly, this study focuses on diasporan youth as learners of IK given finding 4.4.1 from Study 1 which highlights that participant youth are interested in nurturing IK. Secondly, this study examines elders in rural Kenya share everyday indigenous skills over video-mediated sessions, given finding 4.4.2 from the previous

chapter that highlights that participants prefer to meet face-to-face, and use bodily interactions when learning or sharing IK. Video-mediated technologies are used in this study given that they afford visual and audio communication between dispersed members.

In section 5.1.2, this chapter proposes a ViMik session, which differs from a generation video-mediated session in how it is designed to investigate and support the cultivation of IK. Section 5.2 presents the study setup, detailing how these ViMik sessions were setup, investigated and analysed. Of note is the field research method used in this study. In this study, I travel to Kenya, my home country, to observe elders at their ancestral homes. This form of field research facilitates an empirical understanding of ways of sharing IK, through direct involvement with research participants, and engagement with indigenous epicentres. Sections 5.3 and 5.4 respectively, present the findings from this field study, and a discussion of themes that are generated from the findings.

5.1.1 Background

HCI literature provides examples of projects aimed at understanding how elders use technology to share IK with the youth. Rodil et al. (2012) designed a 3D scenario-based visualization called Homestead Creator with elders from the Herero tribe of Namibia. One of the motivations for developing the tool was to support elders in equipping returning migrants with life skills for the village (Bidwell et al., 2011). It was thus designed to support rural elders in sharing IK asynchronously with rural-urban migrants, collocated youth and even the researchers. From this study, researchers learnt a unique data categorisation scheme used by the Herero, and built a new automated data sorting tool based on Herero ontologies. Another example is the Traditional Knowledge Revival Pathway Project (TKRP) which was a 5-year project developed by Kuku-Thaypan elders of North Queensland, Australia. TKRP was designed to support elders in sustaining their knowledge after they die, and preparing the next generation for the future (Bidwell et al., 2008). IK was collected as video recordings which were then translated, merged, categorised and stored in the Awu Laya Traditional Knowledge database as documentaries. Three documentaries resulted from the project and these were made publicly accessible online. Given that the elders created and managed the video themselves, one of the benefits of the project is that it created additional channels for income-generation and ownership of IK.
While both the above are notable examples of how research with elders has supported a transfer of IK to younger generations, Homestead Creator and TKRP used asynchronous communication between the users, or relied on collocated participation. Other technology projects dealing with IK have also focused on collocated participants or used asynchronous video communication e.g. Digital Songlines (Pumpa and Wyeld, 2006), CARACAL (Jensen et al., 2012a) and TAMI (Verran et al., 2007) which are detailed in Chapter 2. Based on findings from the previous study, Study 2 differs from these projects in two ways. First, its users are remotely-located; in situ elders are in rural Kenya while learners are in urban and peri-urban towns Kenya. Secondly, Study 2 looks at the use of synchronous video-mediated communication between the elders and the youth. Additionally, based on finding 4.4.1 and 4.4.2, Study 2 observes how the elders share practical skills with the youth. These include making traditional meals, grinding and thrashing maize, weaving a basket and making coconut oil.

Literature provides examples of projects that have similarly used video-mediated technologies between elders and youth. The Tanami Network was built by three indigenous communities in Australia and emulated Aboriginal communication patterns. It thus set the ancestral lands as the epicentre of the network, with information emanating from the Aboriginal settlements located in rural areas, to urban centres in Australia such as Alice Springs, Darwin and Sydney (Ginsburg, 2012). Another project that similarly sought to achieve this flow of knowledge is mentioned by Christie and Verran (2013). In this project, Dhänggal, an Aboriginal Australian taught remotely-located children around the world, from her home in Melville Bay in remote East Arhem Land, Australia. Dhänggal used digital technologies to do this, specifically a digital camera, a Skype connection and a computer. She would sometimes stand on the beach and through storytelling, narrate Aboriginal folklore, beliefs song and dance, introduce her family or explain and demonstrate the history of ‘country’. Note that Dhänggal, though in remote Australia, saw herself as epistemically unequal to the children in the remote ‘modern world’, and thus used the platform to teach them “who they really were”. Dhänggal felt that as long as she was on Aboriginal lands, she could help the children. Her presence on ancestral lands was intertwined with the indigenous knowledge she shared with the children. Study 2 builds on these two projects by providing further insight on how elders share practical indigenous skills over distance.
5.1.2 A ViMik (video-mediated IK) session

With the aim of grounding research in ways that motivate the development of IK, this thesis uses ViMik sessions to investigate Study 2 and Study 3. This chapter proposes a ViMik session, which differs from a general video-mediated session due to how it responds to asymmetries between western and indigenous knowledge. Three asymmetries, (described in Section 2.5), are considered in the design of the ViMik session. The next three paragraphs explain how these asymmetries motivate the construction of a ViMik session.

i. Traditions of knowing (western vs indigenous)

Firstly, a ViMik session involves elders at indigenous epicentres as teachers and managers of the sessions, and involves participants at indigenous peripheries as the learners. By supporting a flow of knowledge from in situ elders, the ViMik session promotes the knowledge traditions at or from indigenous epicentres. This is crucial for this context because, as highlighted in Chapter 2, the flow of knowledge from western epicentres, and the view of these epicentres as global centres of power, challenges the use and valuation of IK. In African countries, rural regions are often flooded with content from Euro-American centres, which leads to indigenous knowledge and knowledge traditions being discredited vis-à-vis the more ubiquitous western/scientific knowledge (Ballantyne, 2002). ViMik sessions are designed to enforce flow knowledge from indigenous epicentres, so as to study how such a flow of knowledge can be enhanced by video-mediated technologies.

ii. Flows of knowledge (from urban/heterogeneous epicentres vs from rural/indigenous epicentres)

Secondly, a ViMik session uses existing technologies to surface and respond to the dissonance between western and indigenous knowledge traditions. Thus, when the technologies in use hinder or challenge IK praxis, the ViMik session is used as a way to surface how this occurs, and from the gaps identified, inspire technology design or redesign. In Study 2, the ViMik session surfaces what indigenous members attempt to do with the technologies in use and fail, and uses these gaps to redesign Study 3 to better support the indigenous users. Study 2 uses Skype and iPads in the ViMik sessions. This study however, is not an evaluation of Skype and iPads, nor of their use in an indigenous context. Instead, they are used as tools to identify dissonance when elders share IK over new, foreign mediums.
iii. Literacies of knowledge (written vs bodily & oral literacies)

Lastly, the ViMik session prioritises the mediation of oral and bodily literacies. This means that the use of movement, gesture, voice, dances, stories, performances, ceremony, pitch, smell, texture, sound and role-based interactions are encouraged during the sessions. Study 2 supports these literacies by allowing elders to share IK as they would naturally, even when those ways differ from the technologies provided.

In summary, Study 2 builds on findings from Study 1 and previous literature to gain an understanding of the interactions that elders at indigenous epicentres employ when sharing indigenous skills over distance. Use of ViMiK sessions facilitates this investigation. The next section discusses the research methods used to observe Study 2.

5.2 Study method

Study 2 was an observation of 10 ViMik sessions between elders from two ethnic communities in rural Kenya, and youth from urban towns in Kenya. In each session, elders shared an indigenous practice or skill with remotely-located youth. In total, the study consisted of 19 elders and 26 learners. The term elder refers to the participants, on the tribal homelands, who facilitated and managed the sessions, and learner refers to the diasporan youth.

The study was carried out on two sites with elders from two ethnic communities in Kenya. The first part of the study was in Ganze, a small rural village in Coastal Kenya dominated by the Giriama community. Ganze is approximately 500km from Nairobi, the capital city of Kenya, and has a population of approximately 10,000 inhabitants. The second site was Limuru, a small peri-urban town approximately 30km from Nairobi, with a population of 5,000 inhabitants, most of who are from the Kikuyu community.

The first site Ganze, incurred regular drops in internet connectivity, subsequently hampering participation and observation of the video-mediated sessions. A second site, Limuru, was chosen for the study, as it was closer to Nairobi, Kenya’s capital city and thus better serviced by internet service providers. Moreover, motivated by one of the findings from Study 1 where the participants organised collocated group learning sessions for their children, there was interest in observing how video-mediated sessions would play out when multiple remote learners take part. At the second site therefore, both learners and elders took part in
the sessions in groups. This facilitated an observation of how the sharing of IK occurs in multi-instructor, multi-learner video-mediated sessions.

![Figure 1: Locations of sites for Study 2](image)

**Site 1: Ganze (Giriama community)**

Seven sessions were run in Ganze. In each session, an elder demonstrated a Giriama activity to the learners over a Skype video call. The choice of activities to demonstrate was decided by the local researcher - who was from the same clan as the elders - and the elders. All 7 sessions are summarised in Table 4. All sessions were conducted in Kiswahili, the national language of Kenya, which was spoken and understood by all participants and researchers. As will be reported, elders often switched to their ethnic tongue, Kigiriama, during the sessions. Each session lasted between ten minutes and half an hour, and every session was video recorded.

**Site 2: Limuru (Kikuyu community)**

At the second site, Limuru, a group of 3 elders from the Kikuyu tribe engaged learners over three video mediated sessions. Learners participated in groups of 5 – 7, from a room at a user experience design firm in Nairobi. Figure 2 shows the setup of the study. All sessions were conducted in Kiswahili, which was spoken
and understood by all participants and researchers. Elders here also regularly switched to their ethnic language, Kikuyu, during the sessions. Table 4 below contrasts the two sites of the study.

<table>
<thead>
<tr>
<th>Location of elders</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of elders</td>
<td>Ganze</td>
<td>Limuru</td>
</tr>
<tr>
<td>Elder participation</td>
<td>1 primary elder, 2 – 6 secondary elders</td>
<td>3 primary elders</td>
</tr>
<tr>
<td>Locations of learners</td>
<td>Nairobi (500km from Ganze) Kilifi town (35km from Ganze)</td>
<td>Nairobi (30km from Limuru)</td>
</tr>
<tr>
<td>Languages</td>
<td>Kiswahili, Giriama</td>
<td>Kiswahili, English, Kikuyu</td>
</tr>
<tr>
<td>Learner participation</td>
<td>Took part individually (one learner per session)</td>
<td>Took part in groups of 5 to 7</td>
</tr>
<tr>
<td>Number of Sessions</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Activities and elders who conducted them</td>
<td>i. Kukandika (patching a wall) by elder Asha ii. Kulima (digging) by elder Dada iii. Kupika (cooking a traditional meal) by elder Binti iv. Kusaga (grinding maize) by elder Kaho v. Kutwanga (pounding maize) by elder Hamsa vi. Makuti (making a roof tile) by elder Dekeza vii. Mafuta ya nazi (making coconut oil) by elder Zubira viii. Kulima (digging a farm and planting) by elders Shiko, Njeri and Soni ix. Kupika (making a traditional meal) by elders Shiko, Njeri and Soni x. Kiondo (making a traditional basket) by elders Shiko, Njeri and Soni</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Summary of participants for Study 2 at both Limuru and Ganze (all names are pseudonyms)

In terms of the technological setup of the study, elders at both sites used an iPad2 (iOS 8.3) and Skype video conferencing software (Skype for iPad version 4.19). Ganze learners used their own laptops or phones and Skype, while Limuru learners participated in a room setup with a 40-inch television connected to a laptop with Skype installed. Figure 2 below illustrates the setup for elders and learners in the Limuru study (site 1).
Figure 2: (a) Elders in Limuru demonstrating how to dig. (b) Room from where Limuru learners took part in the sessions.

5.2.1 Participants

The elders lived in rural and peri-urban villages in Kenya, were between the ages of 30 and 65, and were from the Giriama and Kikuyu ethnic communities of Kenya.

Recruitment of elders for the Ganze study was facilitated by the local researcher, who knew them personally. Elders in Ganze were compensated with lesos which are traditional sarongs that the Giriama, and many other African ethnic communities, use as part of their everyday garb. The choice to compensate elders in Ganze with lesos instead of other means was motivated by their significance in the Giriama community. In the previous chapter, one of the participants Ann, spoke of her desire to receive a leso from her community members at her wedding, as it was a sign that she was respected by fellow members.

Elders for the Limuru study were recommended to the local researcher by word of mouth, and were compensated with Kshs. 500.

All learners were between the ages of 21 and 35, and from various ethnic communities. Learners for the Ganze study were either in Nairobi or Kilifi, and were recruited via cold calls and snowballing. They were not compensated.

Learners for the Limuru study were from Nairobi. They were recruited via flyers from AkiraChix (www.akirachix.com), an information technology training centre in Nairobi for young women. They were also not compensated.
To facilitate recruitment of the elders and running the study at the elders’ homes, two local researchers were engaged; one at Ganze and one at Limuru. Both local researchers were paid for their time and assistance in the sessions.

As highlighted in Table 4, the sessions consisted of primary and secondary elders. The primary elder was the elder chosen to be the main performer of activities, while the secondary elders assisted the primary elder in conducting the sessions. Additionally, there were other members of the community present at the sessions who were not part of the study. That is, they were neither learners, primary elders or secondary elders. These participants are referred to as secondary participants. They include neighbours, friends and the elders’ children.

Like in Study 1, all elders and learners (except for one learner) were women. The choice to study women is primarily out of respect for cultural norms among ethnic communities, where roles and access to certain information are gender-based. Moreover, conducting the study with women facilitated wider and easier access to participants and the activities under investigation given that I am a Kenyan woman myself. The one exception was in session (ii) in Ganze where the learner was a male; the initial learner did not turn up for the study and another learner had to be quickly sought.

5.2.2 Data collection

Data was collected in the form of video, notes and audio clips. All sessions were audio and video recorded in order to provide comprehensive data for analysis. In Ganze, a video camera and phone were used to record the elders’ activities. Sessions held when the internet connectivity was poor were also recorded. Such sessions, with limited connectivity were carried out via telephone call, thus there was only live audio communication between elders and learners. The elders’ end was still video recorded despite the lack of live video communication between participants.

In Limuru, elders were video recorded using a video camera. A video camera was also set up in Nairobi to record the group of learners. Additionally, brief post-study interviews were conducted with both elders and learners, to elicit their feedback about the sessions. Interviews were audio recorded via a phone.
5.2.3 Data analysis

Analysis involved three phases; a video annotation phase, a data review phase and a data synthesis phase. In the video analysis phase, NVivo software was used to review all the video and audio recordings. Annotations consisted of descriptive accounts of the observations, insights and questions made about the sessions. Additionally, participants’ quotes were translated and included in the annotations.

It is important to note here that not all the audio data was translated. At both sites, all participants were conversant with at least two languages. They switched between these languages depending on who they wished to address. Parts that were in the ethnic languages of the elders (i.e. in Kikuyu or Kigiriama) were not translated as these were understood as not being intended for the ears of the audience. Instead this language switching behaviour was noted as a finding, and it later emerged as one of the key learnings from this study. This will be discussed later in the chapter (section 5.4.2).

In the second phase, data was examined through a People-Place-Praxis lens. Therefore, annotations and the raw video data were analysed, taking note of instances where participants interacted with each other, how they interacted with and navigated through the place of performance, and the physical and social interactions that constitute the activities they were carrying out. Also observed is how participants did, or did not, interact with and around the technologies used for the study. The study examined how the participants viewed, managed, ignored or negotiated with the technologies, making sure to capture these for each video session observed. This review phase further enriched the annotations that were generated in phase one, which was useful for a highly nuanced synthesis of the study.
How did the participants interact with the artefacts in the space?

- Secondary Participants watched, mostly stationary. The teacher plastered the wall.

The artefacts were:

- Plastering a wall with mud that had just been collected.
- Using a hoe and the wall of the house to teach the student how to plaster.

The lesson was done at the place of Kilifi. It was a practical lesson. The lesson was about realising it.

How were the technologies in use appropriated to support the lessons?

- The teacher understood that she was teaching to a student remotely located. And thus looked to the screen when she wanted to engage the student.
- The holders undertook their role as the holder. But the iPad holder, who had unknowingly blocked the camera.
- Internet connectivity was not good. This prompted participants to check on the student, by asking “can you hear me?”, whenever there was a prolonged silence from the student. Even on occasions when the student was online but just silent. (1:09)
- The iPad was carried by someone else. The Secondary Participants were excited by the technology, they were happy to press the button when the researcher told them to.
- When the researcher told them to. The Secondary Participants were new to the iPad. eg the iPad was carried by someone else.

Research Questions - People

- How did People materialise? Describe the people and how they interacted with each other?
- Secondary Participants mainly observed.
- There was one teacher, one iPad holder and five Secondary Participants. The researcher was a go-between to the teacher and student, say when the instructions could not be heard by the student. The student was a 30th year old female living in Kilifi.
- The teacher was the only one teaching the student.

Research Questions - Place

- How did Place materialise? Describe the place. How did the participants interact with the place?
- The lesson was done at the place of performance. The lesson was about plastering a mud hut. Thus the teacher had the lesson outside, at one of the mud huts in the boma, and on an existing wall.
- Secondary Participants became more active around the session location, at will.
- Secondary Participants watched, mostly stationary. The teacher plastered the wall.

What went right?

- The participants (teacher and Secondary Participants) were new to the iPad. eg the iPad was carried by someone else.
- The participants (teacher and Secondary Participants) were new to the iPad. eg the iPad was carried by someone else.
- The participants (teacher and Secondary Participants) were new to the iPad. eg the iPad was carried by someone else.

What went wrong?

- There was one teacher, one iPad holder and five Secondary Participants. The researcher was a go-between to the teacher and student, say when the instructions could not be heard by the student. The student was a 30th year old female living in Kilifi.
- There is another participant. You can hear the ‘matriarch’ instructing the teacher on what to explain/what not to forget.
- There was one teacher, one iPad holder and five Secondary Participants. The researcher was a go-between to the teacher and student, say when the instructions could not be heard by the student. The student was a 30th year old female living in Kilifi.
- There was one teacher, one iPad holder and five Secondary Participants. The researcher was a go-between to the teacher and student, say when the instructions could not be heard by the student. The student was a 30th year old female living in Kilifi.
- There was one teacher, one iPad holder and five Secondary Participants. The researcher was a go-between to the teacher and student, say when the instructions could not be heard by the student. The student was a 30th year old female living in Kilifi.
- There was one teacher, one iPad holder and five Secondary Participants. The researcher was a go-between to the teacher and student, say when the instructions could not be heard by the student. The student was a 30th year old female living in Kilifi.

Roles of secondary participants:

- Off topic
- Instructing the teacher on what to explain/what not to forget
- Meanwhile, Student was a 30th year old female living in Kilifi.
- There was one teacher, one iPad holder and five Secondary Participants. The researcher was a go-between to the teacher and student, say when the instructions could not be heard by the student. The student was a 30th year old female living in Kilifi.

Describe how they interacted with the tools?

- The teacher understood that she was teaching to a student remotely located. And thus looked to the screen when she wanted to engage the student.
- The holders undertook their role as the holder. But the iPad holder, who had unknowingly blocked the camera.
- Internet connectivity was not good. This prompted participants to check on the student, by asking “can you hear me?”, whenever there was a prolonged silence from the student. Even on occasions when the student was online but just silent. (1:09)
- The iPad was carried by someone else. The Secondary Participants were excited by the technology, they were happy to press the button when the researcher told them to.
- When the researcher told them to. The Secondary Participants were new to the iPad. eg the iPad was carried by someone else.
- The participants (teacher and Secondary Participants) were new to the iPad. eg the iPad was carried by someone else.

Describe the artefacts?

- Plastering a wall with mud that had just been collected.
- Using a hoe and the wall of the house to teach the student how to plaster.
- The lesson was done at the place of Kilifi. It was a practical lesson. The lesson was about realising it.
The final phase was synthesis. Annotations, insights, observations and questions were collected, in order to draw out emergent themes and issues. Common themes were then identified across the findings, with regular reference to the video data for clarification. These themes and issues were then analysed vis-à-vis existing work in HCI, providing a way to sieve out the themes that were still nascent. Additionally, emergent themes were reviewed by the local researchers from Ganze and Limuru. This key step in the synthesis was done in order to build on emergent themes and encompass the insights from the participants’ viewpoint. Analysis was conducted in Kiswahili and English. Parts in Kiswahili were later transcribed and translated to English. The next section presents the findings of the study, with the emergent themes discussed in the following section.

5.3 Findings

This section presents findings from each of the sessions in Ganze and Limuru. The findings consist of annotations generated during video analysis, and are presented as descriptive bullet points of the interactions that occurred in the sessions. To give structure to the findings this section is presented according to the six data analysis questions discussed in the previous section. These questions offered a standardised way to record field data and generate themes. Findings from Ganze will be presented first, followed by those from Limuru.

5.3.1 Site 1: Ganze

i. Kukandika (patching a wall)

*Describe the people and how they interacted with each other?*

There was one elder, one iPad holder, one learner, a matriarch and seven secondary participants. The matriarch is one of the secondary participants but differs in her role in the community. Among some ethnic communities in Kenya, extended family members live together in large estates called bomas. A boma typically consists of a number of houses of related family members on the same compound. The wife of the most senior in the boma is the matriarch.

In this session, the primary elder, elder Asha, instructs the learner by facing the screen and talking to it, lifting the tools to the learner, and pausing as she talked – possibly as a way to keep the learner engaged/elicit feedback. Elder Asha also communicates regularly with the secondary participants and the
matriarch, in Kigiriama, their indigenous language. The matriarch in turn often instructs the elder on what to explain to the learner and what not to forget to mention. When interacting with the learner, elder Asha is happy to receive more questions, often asking the learner, "Another one?"

The learner asks questions based on what she has just observed. When the learner asks a question, she asks it in a tune that was similar to the elders. Coastal communities, like the Giriama, 'sing' when they speak. The learner sometimes mimics this 'singing' when she speaks to elder Asha.

At one point in the study, the learner informed the elders that there was something blocking her view of the session. It was in fact the iPad holder who had unknowingly blocked the camera with her fingers. On one occasion, the iPad holder responds to one of the learner’s questions. This was the final question of the session, which was also an invite to the learner to visit the home.

During the session, secondary elders mainly observed what was going on. They also spoke among themselves, sometimes about topics not related to what was going on the session. Secondary participants were mostly children under the age of 18, who were of primary school age. There were four girls and a boy. They also engaged with the learner, e.g. by often asking her, "Can you see me?"

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?

The participants in Ganze (all elders and secondary participants) were new to the iPad. For example, the iPad holder blocked the camera with her finger without realising it. Elder Asha understood that she was teaching someone remotely-located, and thus looked to the screen when she wanted to engage the learner. Apart from that, the orientation, position and distance of the iPad were not her concern.

The secondary participants were excited by the technology, they were happy to press the button when the researcher told them to. One of the secondary participants undertook the role of iPad holder, but due to her newness to the tech, did not handle the iPad in a way that would have been best for the learner. The learner had to point out when she needed the view to be changed, e.g. by saying "Something is blocking my view." On other occasions, the iPad holder had to turn the iPad to check whether the learner was still on.
Secondary participants played with the screen when the internet dropped. They had just learnt how to restart a video call on Skype, so when the call dropped, they tried it again without being prompted. After the call dropped, one of the secondary participants pointed to the screen and then walked off. He was frustrated that the call kept of dropping. When the call dropped, four secondary participants gathered around the device and ‘tinkered’ with it. They instructed each other, in mother tongue on what to do, or not do, with/near the iPad. Also, when the call dropped, some secondary participants repeated the elder Asha’s question to the learner, since the learner was not responding. Even though they looked at the screen, they were unaware that the call had dropped. Generally, among the secondary participants, those who directly interacted with the iPad were more positive towards it than those who did not. E.g. the boy who pointed to iPad and walked off did not seem pleased about the iPad that kept freezing.

Since the internet was shaky, the researcher switched from using Skype to using a phone. Thus, the learner and the elder communicated via phone, on speaker mode. The iPad holder maintained her role by holding the phone up to the elder. Elder Asha looked at the phone while talking to it.

**Describe the place. How did the participants interact with the place?**
The lesson was done at the place of performance. The lesson was about plastering a mud hut. Thus, the elder had the lesson outside, at one of the mud huts in the boma, and on an existing wall. Secondary participants watched, mostly stationary while elder Asha plastered the wall. Later in the session, secondary participants moved in, out and around the session location, at will. During this time, they became more active, with one scraping for more earth, presumably so that she can add to the mud being used in the lesson.

**Describe the artefacts. How did the participants interact with the artefacts in the space?**
Elder Asha used two buckets, a hoe and the wall of a house to teach the lesson. She used the hoe to dig the earth. She used the bucket to transport the mixture to the exterior wall of a house next to the entrance of the boma. She then patched the wall.

**Describe praxis? How were indigenous practices carried out/taught/explained?**
The session was about plastering a wall with mud that had just been collected. Elder Asha was the only one teaching the lesson, and she handled all the tools herself. She began by mixing mud, water and other materials at one spot in the boma, then placing the mixture in a bucket. Elder Asha then walked with this
bucket to a wall some few metres away. Here, she scooped little mounds of the mixture and patched a dent on the mud wall.

**ii. Kulima (digging)**

*Describe the people and how they interacted with each other?*  
Session consisted of researchers, elder Dada, the learner, an iPad holder, secondary participants and 5-7 secondary elders. In this session, the learner was a male. This was because the initial learner did not turn up for the study and another learner had to be quickly sought. The learner engaged elder Dada in several questions mostly after the digging demonstration was over. Elder Dada seemed shy, intimidated by the learner, or his questions. There was a bit of an awkward moment because the questions were personal but not intrusive. However, the lesson went on.

As in the previous session, secondary participants were mainly children under the age of 18. They mainly observed the elder. The iPad holder repeated questions to elder Dada when she had not heard clearly from the learner. The iPad holder also 'instructed' the elder to say, "Pleasure meeting you!" to the learner, though the iPad holder was much younger than the elder.

*Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?*  
Elder Dada spoke into the iPad to answer questions. One of the secondary participants held up the iPad for her while she dug and answered questions.

*Describe the place. How did the participants interact with the place?*  
Secondary participants moved about the space, as elder dug the land.

*Describe the artefacts. How did the participants interact with the artefacts in the space?*  
Elder Dada used a hoe to dig a piece of land. She dug for about 10 to 15 minutes of the session.

*Describe praxis? How were indigenous practices carried out/taught/explained?*  
Elder Dada dug the land as she explained to the learner how to dig, how to plant, when and how to harvest and what tools to use.
Describe the people and how they interacted with each other?
The session consisted of two researchers (the local researcher and I), elder Binti, one learner, the iPad holder and 4 secondary elders. Elder Binti was very engaging and interactive. She also expected the same type of enthusiasm from the learner. She would often engage the learner by asking, “If you can see me, then what am I doing now?”

Other prompts that Elder Binti would use include "I am cooking sima, can you see me?", "Hello?!", "Can you see me? What am I doing?"

Elder Binti often communicated with the secondary elders during the session. When she did she used Kigiriama language. At one point the learner asked her for the name of the instrument that she was using. Elder Binti turned to the secondary elders and asked them this, using Kigiriama language. The matriarch would sometimes answer the learner’s questions, though she was seated at a distance from the setup.

Elder Binti would repeat to the learner what the matriarch had said, add would add more details to the explanation. Conducting the sessions was a collaborative effort involving both the elder Binti and secondary elders.

The learner was engaging and cheerful. She was active in the lesson and asked many questions. The lesson had some shared humorous moments, for example the learner found the cooking utensils of the elder quite funny-looking. Also, in this session, the local researcher was the iPad holder.

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?
The iPad holder moved when the elder moved, to ensure the learner could see the lesson. However, I often had to confirm that elder Binti was in the learner’s field of view. This involved asking elder Binti whether what she could see on the Skype screen, was what she wanted to show the learner. There was a moment when the video had to be off on the learner’s side. However, elder Binti did not know that the learner could not see her.

Given the several internet drops by this point in Study 2, participants, even those new to Skype, knew what the ringing tone meant that the call had dropped due to an internet fail. The internet connectivity also restricted one part of the session; the elder had wanted to move to another spot so that she could
demonstrate how to set and serve the traditional meal. However, the session could not move there because of network connectivity (I feared it would drop).

**Describe the place. How did the participants interact with the place?**
The lesson was a cooking lesson, teaching the learner how to cook a traditional meal called *sima*. The session took place at an outside cooking spot which consisted of three stones and firewood. The cooking spot also consisted of chicken running around, strong wind and earthen ground – a scene very different from the learner’s home in the city.

**Describe the artefacts. How did the participants interact with the artefacts in the space?**
The cooking lesson involved several artefacts that contributed to the Giriama way of making the meal. The elders ensured they had those traditional artefacts for the session, even though they themselves did not use them every day. One of the artefacts was even used as a decoration instead of a cooking item.

About six artefacts were taught to the learner. Elder Binti explained each artefact she was going to use to the learner. She did this by holding it up to the iPad and then giving a brief description of what it was and what it was used for. At one point in the session, a secondary participant brought a Giriama stool to elder Binti so that it could be shown to the learner. The stool gave the elder Binti an opportunity to explain Giriama culture, in terms of wedding ceremonies. Elder Binti did this by acting out how she sat on the stool during her wedding ceremony, and took part in a traditional blessing ceremony with her husband.

**Describe praxis? How were indigenous practices carried out/taught/explained?**
Sitting, standing and walking were some of the actions that took place to cook the meal. Movement during the session was mainly around the cooking spot. Another performance that occurred was the demonstration of the blessing ceremony. The elder demonstrated, practically, how she sat on the traditional stool when she was getting married.

**iv. Kusaga (grinding maize)**

**Describe the people and how they interacted with each other?**
The Kusaga session consisted of two researchers, elder Kaho, a learner, iPad holder, matriarch and 4 secondary elders. The iPad holder during most of this session was the local researcher. She was familiar to the participants and spoke Kigiriama. During the session, there was regular conversation between her and
elder Kaho, to ensure that elder Kaho could see herself in the screen while she was being recorded. These conversations happened in Kigiriama.

Secondary elders also engaged with elder Kaho in Kigiriama, probably suggesting tips to furnish the lesson. Conversation among the elders, matriarch and iPad holder was mostly in Kigiriama. For example, the matriarch explained to the iPad holder, in Kigiriama, how the grinding maize was traditionally carried out.

In general, the lesson was very fluid and amorphous. More secondary elders came in and become part of the lesson. The lesson evolved as it grew. Also, despite only an audio channel, the learner asked questions during the session. Her questions, and feedback from her to the elders, progressed the lesson.

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?

Due to internet connection problems, this session had to be improvised. Thus, the learner listened in via phone, and the lesson was video recorded using the iPad. Despite this, the learner and elder interacted well. Participants accommodated the failure of the internet e.g. on occasion, a secondary elder would explain to the learner what was happening since the learner could only hear what was going on. Though the net failed, the elder went on as if the learner was watching her.

Elder Kaho was new to the technologies used in the study, thus the local researcher had to remind her to address the screen. Despite these reminders, elder Kaho moved freely around the kitchen. Her movement was not constrained by the field of view of the iPad. It appeared as if she considered that (video framing) the responsibility of the iPad holder. Elder Kaho simply focused on lesson delivery. The iPad holder voiced trouble with managing the video. As demonstrated below:

iPad holder: "I want to turn the screen my way so that I can see what I am recording"
Researcher: "Yeah, but the elder also needs to see herself [on the screen], so that she can see what the learner is seeing."

Describe the place. How did the participants interact with the place?
The main activity was grinding maize using a grinding wheel. Elder Kaho sat on the floor grinding, while the iPad holder stood to video record the session. Secondary elders gathered around, mostly out of the Field of view of the iPad. The lesson was conducted indoors, in a kitchen. Elder Kaho moved freely around the kitchen. Her movement was not constrained by the field of view of the iPad.
Describe the artefacts. How did the participants interact with the artefacts in the space?
Equipment used in this session included a mat, a grinding wheel, hammer, pestle and the cooking area,

Describe praxis? How were indigenous practices carried out/taught/explained?
The lesson was on how to grind maize using a grinding stone, though this traditional practice has been overshadowed by the use of posho mills. The elders do not carry out kusaga often, though they have the tools to do so and they consider the maize from their grinding at home healthier than the one from the posho mills. Storytelling about past activities also emerged from the task at hand.

v. Kutwanga (pounding maize)

Describe the people and how they interacted with each other?
The Kutwanga session consisted of elder Hamsa, two secondary participants, one learner, iPad holder and researchers. At the beginning of the session, Elder Hamsa and the secondary elders took some time to discuss how they would conduct the session. This conversation was in Kigiríama. The result of this conversation was that one secondary elder pounded the maize with the elder Hamsa, while the others took part by singing along with them. The singing provided a tempo to the pounding. Meanwhile, the learner interacted through smiles, squints and nods but these are not seen by the elder who is busy pounding.

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?
The iPad was carried by one of the secondary elders. She was new to the tech and was more engaged in the in-situ activity, than in video management. The iPad holder held the iPad at 'tummy height'. This was a good height in order for the elder to look straight at the learner.

The elder’s actions could not be fully viewed by the learner because of poor internet connectivity. However, the video quality on the elders’ end was very good thus they could see the learner clearly. This led the elder to assume that the learner could see the entire process, artefacts and all. However, the learner could not see clearly, and that greatly affected her participation and engagement in the lesson, and in turn greatly affecting the perception the participants had of the learner.

Describe the place. How did the participants interact with the place?
The lesson took place outside in the middle of the boma, under a tree. There was a lot going on - chicken walking around, children watching, a number of research participants including elder Hamsa, the assistant
researcher and the iPad holder. The sounds from the chicken around added to the context of the place. Chicken pecked at the maize chaff that came from the grounding. Also, the sound from the grounding was very rhythmic.

**Describe the artefacts. How did the participants interact with the artefacts in the space?**
The elders used a pestle and mortar to pound the maize. For the pounding, elders changed into different garments probably so as not to dirty the clothes they had on.

**Describe praxis? How were indigenous practices carried out/taught/explained?**
The main activities taking place were singing and pounding of maize grain. After very couple of rounds of pounding, elder Hamsa sieved the grounded flour and separated out the husks. While she was doing this, the second pounder continued to pound the maize in the mortar.

**vi. Makuti (making a roof tile)**

**Describe the people and how they interacted with each other?**
Session consisted of elder Dekeza, a learner, iPad holder, researchers and 5 secondary elders. Elder Dekeza often muttered to secondary elders in Kigiriama about the iPad and the learner. At one point, when the learner took a long time to respond, elder Dekeza wondered what was going on. She asked,

> “Can you see me? Why are you not speaking my sister?”

She had not realised that the Skype call had in fact dropped. Lack of or slow feedback from the learner affected the lesson. To stimulate conversation, Secondary elders asked elder Dekeza questions. They also helped manage the session; at one point, elder Dekeza instructed a secondary elder to bring a branch from a particular tree so that she could show it to the learner.

During the session, the iPad holder occasionally gave tips on what the elder should do to ensure she was within the field of view.

**Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?**
Due to internet connection problems, the researcher and assistant researcher would sometimes play the role of learner. Then when the remote learner would resume, the lesson resumed with her. Moreover, the responsibility of manoeuvring the iPad - so that it displayed to the learner what the elder Dekeza was demonstrating - was left entirely to the iPad holder.
Describe the place. How did the participants interact with the place?
The makuti session was carried out outside in the open, at the centre of the boma. Secondary elders sat on the floor, on stools or stood. Elder Dekeza sat on a mat while making the makuti.

Describe the artefacts. How did the participants interact with the artefacts in the space?
The artefacts used in this session were a basin, palm leaves, rope and mat. Elder Dekeza used the palm leaves and rope to make makuti, which are roof tiles. At the beginning of the session, Elder Dekeza described the artefacts she was using, but she did not hold them up to the camera. She assumed the learner could see everything. Later in the session though, she lifted artefacts to camera. She also pointed to a tree in the distance to show where the palm leaves she was using came from.

Describe praxis? How were indigenous practices carried out/taught/explained?
The lesson was about making makuti, which are roof tiles used in making traditional houses. Additionally, elder Dekeza also demonstrated how to make hair the Giriama way, and how to dance a traditional Giriama dance. For the session, Elder Dekeza dressed into a traditional *hando* skirt, an outfit that is worn without any top. In other words, she was bare chested. She danced for the learner to show how she used to dance when she was younger. At the end of the session, secondary elders and researchers clapped for the elder after she performed a dance.

In this session, elder Dekeza also used storytelling to share her experiences of being a Giriama dancer. She also explained the benefits of the mnazi tree as she made the makuti.

vii. Mafuta ya nazi (making coconut oil)

Describe the people and how they interacted with each other?
This session consisted of elder Zubira, an iPad holder, the two researchers and 5 secondary elders. As the session progressed, secondary elders were involved in deciding how it should be conducted. This involved conversing with each other, while elder Zubira grated the coconuts. In the end, the matriarch gave direction on what should be done in the lesson.

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?
In this session, the iPad holder was a young boy. His posture suggested he was not enjoying the task of managing the camera. He held it low so as to orient it towards the elder who was seated on the ground. At
one time the iPad holder stood up to stretch (he was previously crouching). He was holding the iPad in a position that was not comfortable to him.

It was observed that the iPad holder was unaware that his finger was blocking the camera.

Asst. researcher: Can you see yourself?

Elder: No, I cannot see myself.

(Asst. researcher checks and then removes iPad holder’s fingers from blocking the camera).

In this session, there was no live call due to internet issues. The main researcher informed the participants that despite the lack of live video, the recorded video would be shown to the learner. Elder Zubira explained to the screen what she is doing, as if it was a live session.

Describe the place. How did the participants interact with the place? 
The session took place both outside under a tree and indoors in the kitchen. The outside area had chicken clucking around and a gentle breeze. Secondary elders often had to shush the chicken away so as to avoid them from disrupting the session.

The indoor area was a kitchen. The same one used for the Kusaga session. When elder Zubira was in the kitchen, she lit a fire in order to produce the oil she was trying to make. This made the kitchen very smoky. I had to stand outside for a major part of the session because of the smoke. The research participants were not as disturbed by it.

Describe the artefacts. How did the participants interact with the artefacts in the space? 
Artefacts used in this session include a mbuzi, stools, cooking area and a pot. A mbuzi is a traditional piece of equipment that is used to shred coconuts. It resembles a stool with a long rough surface on one side. To use it, elder Zubira sat on it and then used the rough edge to shred the coconuts.

Describe praxis? How were indigenous practices carried out/taught/explained? 
The main activities that took place in this session was elder Zubira using the mbuzi to shave coconuts. She also moved into the indoor kitchen to cook the shavings order to obtain oil. She then moved back outside to cool the oil and bottle it. Elder Zubira handed the oil to me as a gift.
5.3.2 Site 2: Limuru

viii. Kulima (digging a farm and planting)

Describe the people and how they interacted with each other?
Learners in this study were a group of five girls. There were three primary elders, two researchers, three secondary participants and a participant who was the liaison between the elder and two researchers (a local researcher and I). She will be referred to as the director. The director spoke to the elders in Kikuyu, instructing them on where to move while they conducted the session, and what to mention in the session.

Interaction between learners and elders happened in two modes: while they dug; or while they paused specifically to answer questions. Such interactions also involved multiple languages. For example, when asking a question, one of the learners switched from Kiswahili - which the language that the entire audience could understand - to Kikuyu, which only the elders could understand. She then translated her question to one of the learners. One of the elders replied in Kiswahili, then interacted with another elder in Kikuyu.

As the session progressed, learners interacted amongst themselves. They discussed what they have just learnt from the elders, asked each other questions and even corrected each other’s comments on the session.

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?
The elders focused on digging while they listened to the learners. One of the secondary participants (the one closest to the iPad) engaged directly with the learners. After digging, the elders huddled around the iPad to continue answering questions from the learners.

Describe the place. How did the participants interact with the place?
Learners were seated in a room watching the lesson while elders were outdoors, on a garden. This session is illustrated in Figure 2.

Describe the artefacts. How did the participants interact with the artefacts in the space?
In this session, the main artefacts in use were hoes. Elders used hoes to demonstrate how to dig a garden.

Describe praxis? How were indigenous practices carried out/taught/explained?
The main activity was digging which was done by all three elders. They also explained what they had planted on the garden.
ix. Kupika (cooking a traditional meal)

Describe the people and how they interacted with each other?
This Kupika session consisted of the three primary elders, five learners, three secondary participants, and two researchers who managed the session. Learners mainly participated by asking questions. At one point, three learners had to repeat the same questions thrice. This was because the elders could not hear them clearly, probably due to the distance between the learners and the computer they were using for the Skype call. Elders relied on questions from learners, in order to progress the session.

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?
At the beginning of the session, the Skype call was unclear. Learners conversed amongst themselves about that and assigned one of them to fix it. Also, it was difficult for the learners to determine which, or how many, of them, the elders could see. The statement below illustrates this,

Learners: "Were we being seen, or is it just these three who could be seen?"

This is probably because they could not see the picture in picture window on a Skype video interface, which displays to the local viewer, what the remote viewer is seeing. The learners were too far from the screen to see the small window clearly.

Describe the place. How did the participants interact with the place?
This session was conducted outdoors. The scene is a boma of three houses in a peri-urban town. The boma is green and fertile. There is also a cow shed in the boma.

Describe the artefacts. How did the participants interact with the artefacts in the space?
Elders used cooking utensils to boil the ingredients and then mash them into mukimo.

Describe praxis? How were indigenous practices carried out/taught/explained?
Elders demonstrated how they made mukimo, a traditional Kikuyu meal made from a number of vegetables including but not limited to pumpkin leaves, potatoes, beans, and a variety of spices. To make mukimo, the vegetables are cooked separately, and then mashed into a semi-solid state. Mukimo is a popular dish among the elders’ tribe. Elders demonstrated how to cook and mix the ingredients, then how to mash them into mukimo.
Describe the people and how they interacted with each other?
Three elders ran the class, five learners took part remotely, three secondary participants watched, two researchers managed the session. The role of iPad holder was shared between the researchers. In this session, all learners spoke Kikuyu, which is the language of the elders. The local researcher and secondary participants also spoke Kikuyu. The entire conversation switched to Kikuyu after one learner asked a question in Kikuyu. Through these conversations, elders found out that one of the learners' grandparents is their neighbour. They invited the learner to visit them the next time she was in the area.

On several occasions the elders encouraged the learners to ask them questions.

Elders: “ASK!” “More questions?” “Are you satisfied?”

Elders also asked learners questions. The questions were about what they had just taught the learners.

Elders: Now do you know how to make a kiondo?

Learners (in unison): Yes

Describe how they interacted with the technology. How were the technologies in use appropriated to support the lessons?
Teaching was conducted by the three elders at the same time. There were multiple voices and multiple teaching interactions at the same time. The three steps of the process were demonstrated in parallel. The iPad holder moved around to capture all the elders, and had to orient the iPad accordingly by bending forward in front of the elders. Elders in turn leaned into the iPad when talking to the learners. In this session, the Director also chirped in to teach, however she was out of view due to the orientation of the iPad.

Describe the place. How did the participants interact with the place?
Elders are sat outside, around the iPad, demonstrating various skills that Kikuyu women did / do.

Describe the artefacts. How did the participants interact with the artefacts in the space?
Artefacts used here were ropes made of sisal, three traditional baskets known as kiondos and pieces of string. Another artefact that resembles a tray, was later introduced towards the end of the session when the session switched to talking about marriage ceremonies. Elders explained how the artefacts they were
using were made, and what they are used for. Elders often had to discuss amongst themselves, when they could not remember the Kiswahili names of the artefacts.

**Describe praxis? How were indigenous practices carried out/taught/explained?**

The session was about how to weave a *kiondo*, which is a Kikuyu basket. Elders also demonstrated how to make rope from sisal. One of the elders used the *kiondo* to talk about her wedding and explain how the *kiondo* is used during marriage ceremonies. The elder asked one of the secondary participants to bring in another artefact usually given as a gift in weddings. At this point in the study, the lesson switched to storytelling about traditional Kikuyu weddings.

### 5.4 Discussion

The research question guiding Study 2 was *what interactions do elders, at indigenous epicentres, employ when sharing IK with remotely-located learners?* Applying the P-P-P lens to the data was useful in surfacing interaction techniques of importance to the participants as they engaged with one another and with the environment. The persistence of these culturally influenced ways of interaction, despite the introduction of a new, foreign medium of communication, surfaces four dominant themes to consider when nurturing of IK over distance. Thus, while Skype and iPads were used in this study, applying an indigenous lens to the encounter of western technologies and indigenous contexts surfaced what the elders attempted to do with existing western-centric technologies and failed, and more interestingly what they attempted to do despite the technologies' limited affordances for their context. Using the P-P-P lens to observe technology use among the research participants, emerged implications for design that stem from an indigenous way of looking at the world. This involved being attentive to how indigenous elders engaged with other collocated members; how they engaged with remote learners; how they imbued past or seldom practiced ‘traditions’ into these ‘modern’ video-mediated sessions; and how tools and situated actions at the ancestral home were communicated over distance.

Of note is that though the elders had not participated in Skype sessions before, the audio and video channels of the ViMik sessions made it easy for them to get used to the new experience of video conferencing. No elder expressed hesitation when participating in the live video sessions. Instead, in both Ganze and Limuru, elders expressed interest in carrying out more sessions. Elders saw the video mediated sessions as an opportunity to connect with youth in urban centres and to display their rich culture widely.
The interaction with the youth was the highlight of the sessions, for elders felt that their culture was being appreciated. Furthermore, conducting the sessions provided a way for elders to revive some indigenous practices that they otherwise rarely performed. What follows are four mechanisms employed in these elder-learner interactions when sharing indigenous skills over video-mediated technology.

5.4.1 Elders share IK through unplanned-yet-coordinated group sessions

A key observation from this study was that although the sessions were not extensively pre-planned (that is the content was not prepared in advance nor were the sessions previously rehearsed), they involved a carefully coordinated performance among the elders. Unlike the typical pattern of online classrooms where a single instructor directs a class for the watching students, there was an ongoing multiplicity of coordinated instructions from all the elders involved in the study. In the following analysis of this, the elder chosen to be the main performer of activities is referred to as the primary elder, and the others are secondary elders.

In Ganze, Site 1, all elders and the local researcher, who was from the same ethnic community as the elders, decided on what indigenous skill would be demonstrated for each session. Further, the most competent or most experienced elder was assigned as primary elder for their respective session. The primary elder’s main responsibility was to share one indigenous skill with the learners. Interestingly, what was observed is that while only one primary elder was assigned to carry out a session, in all sessions secondary elders played key roles in conducting the session. For example, during the Kukandika, Kusaga and Kutwanga sessions the secondary elders advise the primary elder in Kigiriama about the content of the session, while in the Kupika session, the matriarch instructed the elder on what to do and what not to forget. She also replied to the learner’s questions. Secondary elders switched between being observers of the session and being directors of the session. When secondary elders felt that an action or information had been left out by the primary elder, they instructed her accordingly, or corrected the mistake.

In Limuru, the sessions differed from Ganze in that all elders conducted the sessions together. Thus, all the elders were primary elders. In the kiondo session for example, the elders demonstrated the art of basket making to the remote learners. The three primary elders conducted three tasks in one session by demonstrating all the three stages of basket making at once and showing how each fit into the other. Elder
Soni begun by demonstrating how to twist a rope, then Elder Shiko showed the finished basket in order to explain what the ropes would eventually become. Shortly after, Elder Njeri displayed a basket with a hole, and a secondary elder then demonstrated how to carry the basket. Elder Njeri then detailed how to weave a basket, demonstrating it practically by fixing the hole in the damaged basket, while Elder Soni twisted more rope. Figure 4 demonstrates the simultaneous conversations.

![Figure 4: Elders in Limuru (site 2) demonstrating how to make a kiondo (traditional basket)](image)

The group teaching style of presentation and demonstration used was carried out simultaneously and yet in a manner that was sequential. This allowed the learners to see the end from the beginning, and the interrelationship of the end, the beginning and the process. This chapter proposes that this in turn accommodated the different levels of basketry proficiency, whether real or imagined, of the learners. A design opportunity here would be to support each learner in focusing on their preferred aspects of the video session while in a group session.

The unplanned sessions reiterate the ways of knowing among indigenous communities. As discussed in section 2.4.3 - Praxis as knowledge, an indigenous way of knowing views meaning as gained by being in, and interacting with the world. Knowledge of a place or activity is only possible by being in and interacting with that place, or performing that activity. This view of knowledge surfaced in how elders shared knowledge with the youth during the sessions. Elders at both sites did not pre-plan the sessions, they performed the
knowledge inherent in their bodies and gained through lived socio-physical interactions with nature, people and objects. This was evident in how they chose who to conduct the sessions. In Ganze, those known to be good in carrying out the skill, were chosen as primary facilitators of the respective session. In Limuru, while the three elders shared skills they were all conversant with. Re-enactment and the reliance on bodily literacy reaffirm the importance of mediating bodily and physical interactions when learning, expressing and developing indigenous knowledge over distance.

Additionally, questions from the learners were important in adding to the content and direction of the sessions. The kupika session in Ganze (session ix) was about cooking and serving a traditional meal known as ugali. While the elder cooked the meal, she sat on a stool indigenous to the Giriama community. The learner in that study noticed the stool and inquired after its name in the Kigiriama language. The primary elder went on to explain how the stool is also used in traditional wedding ceremonies, and demonstrated how she sat on it during her own marriage ceremony. She also demonstrated the actions performed while she and the groom sat on the stools; for example, as demonstrated in Figure 5, how blessings were poured around them by their parents. This shift in content occurred after a query from the learner. In fact, as demonstrated in the Kiondo session in Ganze (session x) elders relied on questions from the learners to furnish the sessions. This chapter proposes that the active engagement of learners in the sessions contributed to the re-enactment of IK.

![Figure 5: Elder in Ganze (site 1) demonstrating her wedding ceremony while she conducts session (iii)](image-url)
Other examples of how the sessions encouraged the re-enactment of IK among the elders, was session vi, Makuti, which was about making a roof tile. During the session, the elder additionally incorporated a traditional dance performance that she used to conduct when she was younger. For this performance, she changed into traditional garb – garb which she would otherwise rarely wear. Secondly, session ii was on how to grind maize using a grinding stone. The elders consider the maize from their grinding at home healthier than the one from the posho mills. However, the practice has been overshadowed by posho mills thus they rarely grind maize themselves. Session iv (Kusaga) served as a reminder of the benefits of previously performed IK activities (i.e. grinding maize at home), while session iv (Makuti) gave the elder an excuse, and an audience, to perform the indigenous practice again.

5.4.2 Elders manage group-teaching through use of private backchannels

Study 2 draws attention to the sorts of activities that take place in indigenous homelands, and the highly socio-physical ways employed by elders when sharing these activities with the youth. In the sessions of this study, enactment emerged as a way for elders to practically demonstrate indigenous activities. Enactment emulates indigenous ways of sharing knowledge such as field journeys, learning camps and apprenticeship sessions where, through collocated sessions, indigenous elders teach by demonstration, and the youth learn by doing. For example, among the Ulukhaktok of Canada, elders use field journeys to teach the youth indigenous ways of fishing, duck hunting and camping (Pearce et al., 2011), while the Annang of Nigeria enrol young girls at learning camps known as ‘fattening rooms’ where they are taught homemaking and child rearing skills by their aunts and experienced women elders (Brink, 1989). What stands out in Study 2 is how enactment was managed as a group. Elders had no formal lesson plan, and no planned entry or exit cues, yet they conducted the sessions as a group.

To coordinate the group teaching of these sessions, elders took advantage of their multilingual capabilities. Kenya has over 70 tribes, each with their own distinct languages. Additionally, the national language in Kenya is Kiswahili, while the official language is English. For the average Kenyan knowledge of at least 2 – 3 first languages is the norm, and the exposure to multiple languages begins in the home. According to the sociologist Erving Goffman (1922 – 1982), all human action is carried out as a performance; our roles in everyday life consist of acts and interactions which shift depending on our audience (Goffman 1959). During the performance of life, one prepares themselves, rehearses and corrects others in the backstage. The
secrets of the performance, when carried out jointly with others, are discussed openly backstage – hidden from the audience (Goffman, 1959). This lens can be applied to how elders interacted amongst each other while conducting the sessions. Multiple languages can be used for various purposes and in these sessions, elders switched to their tribal tongue in order to create private spaces for session development and coordination. In other words, to ensure competence and correctness of the skills being shared, elders used their indigenous languages as a backchannel to correct and coordinate their group performance on the fly.

In Ganze, it was observed that secondary elders corrected, added to and reaffirmed the primary elder while she was still on the stage. That is, while still in full view of the audience. Since there were no formal entry or exit cues between the elders, on-the-fly correcting and readjusting occurred when secondary elders felt that crucial information or actions had been left out. It was crucial to the elders to put forward a correct performance and thus demonstrate their competence to the learners. To achieve backstage openness with the elder and at the same time privacy from the audience while on stage, secondary elders switched to their ethnic language when communicating with the primary elder. Switching to a language not understood by the learners created a backstage where the elders could privately develop the session, without having to leave the stage.

While in all the sessions in Ganze the elders’ ethnic language was not understood by any of the remote learners, in two sessions in Limuru, some of the learners were from the same ethnic community as the elders. Here, what was noted was the way in which learners also switched between the backstage and front stage. Thus, when the elders switched to Kikuyu, their ethnic language, the Kikuyu speaking learner would assist them in defining or translating a term to the non-Kikuyu speaking learners. Communicating in multiple languages enabled Kikuyu speaking learners to become remote co-facilitators of the sessions.

The Goffman lens was valuable in understanding why the elders switched languages during the sessions, and surfaced how elders, and recruited learners, undertook impression management through manipulation of the front and back stage regions of their performance. From this observation, a possible design recommendation would be to support learners who did not understand Kikuyu or Giriama with translation technologies. However, the impulse to translate is one that may not benefit this context and injure the growth of IK. To draw a parallel, Lingel et al. (2014) discuss the use of code switching by bilingual
transnationals in New York, as a way to reveal content only to the intended subset of their Facebook friends. However, Facebook recently introduced a translation feature for public posts that automatically translates posts to the readers language (Nieva, 2016). Indeed, translation has some benefits but it also debases code-switching and similar appropriations made by multilingual transnationals when managing their multiple anchorings. Similarly, the desire to put forward a refined enactment of IK, which is provided by using a language-access backchannel to coordinate group teaching, may be compromised by translation. While there are benefits to translation even as concerns learning IK, the backchannel was a key way for IK to be developed and revived among the elders and remote learners. This tension inspires new ways to examine, and therefore design for, multilingual contexts.

5.4.3 Elders use a moving classroom to share IK

What also emerged from Study 2 is that instead of performing all activities at one spot, elders preferred to carry out the sessions where the activities would normally occur. Thus, in Ganze for example, outdoor activities like wall patching (Kukandika) and maize threshing (Kutwanga) were performed outdoors, while indoor activities like grinding maize (Kusaga) and cooking (Kupika) were performed indoors.

In addition to place, movement was also significant in the sessions; movement across place - whether indoors, outdoors, or between both - formed part of the indigenous activity. In making coconut oil in Ganze for example, the first task of husking and grinding a coconut, was carried out in the open, the second task of cooking the oil was carried out indoors in the kitchen, and the last task of cooling and bottling the oil was carried out outdoors. It was necessary to move between the indoors and outdoors to perform the task of making coconut oil. In Limuru, as the elders dug the garden, they shared knowledge on the crops, how to move while digging, harvest cycles and the importance of the foods they planted. Moving across the land formed part of the indigenous activity, and through these mobile and physical interactions, indigenous knowledge was shared. To capture all activities for the remote learners, the local researchers carried the iPad, following the elders as they moved (as shown in Figure 2b). The addition of an iPad-holder in this study was done to promote place-based praxis and sharing of IK. Similarly, Homestead Creator (Rodil et al., 2012, Rodil et al., 2013b) and Digital Songlines (Pumpa and Wyeld, 2006) – discussed in chapter 2 – took seriously the role of place. To facilitate the view of knowledge as place, Digital Songlines introduced the use of land as an interface after taking seriously the dual function of the land as a pedagogical tool and a
schema for Aboriginal data objects, while Homestead creator built on the Herero’s unique locational-relational categorisation of objects to guide the design of a location-based categorisation scheme.

However, despite including the iPad holder, not all aspects of the moving classroom could be adequately mediated. For example, the learner’s visibility of the session was impacted by movement. Elders would inadvertently move out of focus of the camera, as they assumed the iPad’s field of view was wide enough to display their entire work area. Noting this, elders were briefly trained on how to check the iPad screen in order to see what the learners were seeing. However, given the mobility in the session, and thus a constantly varying distance between them and the screen, elders were not always able to clearly see the screen. Moreover, elders were more concerned with what they were demonstrating to the learners, than with what the learners could see.

It was also found that the participants’ experience of the session was influenced by the changing physicality of the environment. For example, in the session where the elder demonstrated how to make coconut oil, the indoor kitchen used was dark and smoky while the outdoor area was bright and sunny. For the collocated participants, it was observed that the change in lighting and feeling of the place contributed to learning about the different activities taking place. However, during the post-interviews, a comment from the learners was that darkness and smoke only served as impediments to their visibility of the session. This speaks to the fact that the environments of the elders and learners differed significantly. Specifically, elders were mostly outdoors and highly active while learners were indoors and mostly sedentary. The moving classroom emerged as vital to the construction and performance of indigenous knowledge.

However, elders found it troublesome to manage an iPad while carrying out the sessions in a moving classroom. Thus, to accommodate the mobile, physical and interactive nature of the sessions without disrupting the performance of the elders, the task of managing the video mediated session had to be removed from the elders. The role of iPad holder was thus created, and their task was to move, position and orient the iPad so that the remote learners could see what the elders needed them to see, and the elder could see what they wanted the learners to see. The role was carried out by either the researchers, or secondary participants, thus allowing the elders to perform activities as they would ‘naturally’, that is, without having to manage a device. Given that Skype for iPad (version 4.19) uses only the front facing
camera for both video input and output, the iPad holder had to hold the iPad with the front camera facing the elders, to ensure the elders and learners could see each other. This is shown in Figure 2 (a) and Figure 5.

A number of interaction challenges were observed through the iPad holder’s role. The first was in anticipating how to hold or orient the device in order to continually capture the elders’ movements. There was regular communication between the iPad holder and the elder. This communication was however often disruptive; the elder would have to shift attention away from the learners and to the holder in order to direct him/her. The switch from remote learners to collocated iPad holder broke the flow of the session. Secondly, the iPad holder’s experience of the video mediated session was limited by his/her role. The iPad holder had to juggle between taking part in the session and managing the device. This left little room for the iPad holder to actively participate in the highly social and physical sessions. A trade-off emerged; better iPad management meant less participation in the ongoing sessions. Lastly, a related challenge and one that recurred often was in allowing the iPad holder to see what they were showing the remote learner. Given that the screen faced away from the holder, the iPad holder could not see what he/she broadcast to the learners. This meant that iPad holder had to ask the researchers and secondary elders to check the iPad screen and confirm what was being displayed to the learners.

Given these challenges, the iPad holder’s role was highly unpopular amongst the participants. Participants either handed over the role to someone else, or they completely forgot about holding the iPad and participated more in the in situ sessions. The iPad holder was forgotten because their role did not allow participants to fully engage in the live sessions. Yet it was absolutely necessary because without an iPad holder, there would be limited interaction and engagement between the remote learners and the elders. The reliance on mobility in the sessions, coupled with the difficulties experienced by the iPad holder, emerged as a central theme in the study. The moving classroom was vital to the construction and performance of indigenous knowledge. The elders’ mobility supported collocated interaction with in situ members, engagement with the lived-in environment and constituted the movements necessary to carry out indigenous activities. These interactions with people, place and performance were part of the IK been shared with the remote youth. Mobility for elders entailed being hands-free and being nonchalant about how the technologies mediated audio-visual information to the youth.
5.5 Summary

By applying the P-P-P lens to the interface of indigenous epistemologies and western designed technologies, this chapter contributes an empirical understanding of the sort of interactions, behaviours and communication methods that are important when knowledge is dispersed from indigenous epicentres. Central themes emerge that inform the next study. Firstly, in situ elders share IK through unplanned-yet-coordinated group sessions. Secondly and relatedly, elders use a private backchannel among themselves to coordinate and perfect the ViMik sessions on-the-fly. Given the importance of these two themes, an interaction to be supported in Study 3 is the use of a private backchannel among elders and co-facilitators. Lastly, a moving classroom is essential when sharing IK from indigenous epicentres. In a moving classroom, the measurement and scenery of the class are in constant change, leading us to imagine what VMC technologies will be limited in mediating a constantly changing landscape, and thus which VMC technologies could afford such flexibility. The next chapter uses these three themes to motivate a redesign of the ViMik session. Study 3 evaluates the potential for a new medium, 360º video-conferencing, to enhance the experience of the ViMik sessions for learners. The following chapter details Study 3.
6

Study three: Using 360° video-conferencing to enhance the experience of ViMik sessions for learners

6.1 Introduction

This chapter reports on Study 3 which observes pairs of learners in Australia, engage in ViMik sessions with a group of elders in Kenya. The setup designed in this study uses a new medium, 360° video-conferencing, to enhance the experience of learners during the ViMik sessions. Particular themes emerging from Study 1 and Study 2 are used to focus the design and evaluation of the setup. The research question guiding this study is ‘In what ways does 360° video conferencing enhance the experience of remote learners during a ViMik session?’

As a starting point, this chapter begins by generating design themes from the two previous studies. To recap, Study 1 interviews 8 Kenyan transnationals living in Australia, and gains insight on how they cultivate IK in the diaspora, and the role technology plays in supporting them to do so. Three findings emerge that shed light on how transnationals maintain their indigenous practices with, or despite the limitations of, current communication technologies. They are: participant youth are interested in nurturing indigenous knowledge; bodily and collocated interactions are preferred when learning or sharing IK; and participants have varied engagement with IK.
Study 2 is a field study that investigates how elders share indigenous skills with remotely-located youth during a ViMik session. By observing 10 ViMik sessions between elders in rural Kenya, and youth from urban towns in Kenya, Study 2 generates three findings that describe the sort of interactions, behaviours and communication methods that are important to elders when they share knowledge from indigenous epicentres. They are that: elders share IK through unplanned-yet-coordinated group sessions; elders manage group-teaching through use of private backchannels; and that elders use a moving classroom to share IK.

In this chapter, I synthesise these findings from Study 1 and Study 2, and generate design themes from them. The three themes that I generate from Study 1 and Study 2 are presence, personalisation and mobility. They form the framework by which Study 3 will design and evaluate a video-mediated platform to support transnationals in cultivating IK over distance.

Note that, while supporting mobility concerns the elders, it is a key theme for Study 3 because elders found video-framing a burden (finding 5.4.3). They prefer to be video-framing-free while conducting the ViMik sessions. Consequently, a key focus for Study 3 is to enhance the ViMik session in a way that the task of video-framing is shifted to the learners. The next section further explains how each of these three themes was derived from Study 1 and Study 2, and additionally how these themes inform the design of Study 3.

Table 5 lists findings from Study 1 and Study 2 and additionally presents the design themes for Study 3.
### Table 5: Design themes guiding Study 3

<table>
<thead>
<tr>
<th>Study One</th>
<th>Findings from Study 1 and Study 2</th>
<th>Explanation</th>
<th>Design themes for Study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant youth are interested in nurturing IK</td>
<td>While previous HCI projects have been motivated by the need to store IK due to disinterest from the youth, Study 1 uncovered a desire by younger participants (aged &lt;30 years) and the children of older participants (reported indirectly), to learn about their ethnic background and to live out aspects of their culture while in the diaspora.</td>
<td>Presence: Support remotely-located learners in engaging with or at indigenous epicentres</td>
<td></td>
</tr>
<tr>
<td>Bodily and collocated interactions are preferred when learning or sharing IK</td>
<td>Participants from Study 1 preferred to engage with community members through face-to-face interactions such as physical meetings among learners, cultural apprenticeships, visiting the homeland, flying in experts and re-enacting traditional ceremonies. During these sessions, they preferred to learn or share practical IK skills through bodily interactions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participants have varied engagement with IK</td>
<td>Participants’ accounts reiterated that indigenous transnationals have diverse experiences of IK and thus engage with IK variedly. Thus, while indigenous communities are largely communal, they are made up of individuals who have varied experience and exposure to IK.</td>
<td>Personalisation: Support learners in customising their experience of the group IK sessions.</td>
<td></td>
</tr>
<tr>
<td>Study Two</td>
<td>In situ indigenous elders share IK through unplanned-yet-coordinated group sessions</td>
<td>Sessions from Study 2 revealed that elders preferred to share IK with direct or indirect involvement from other collocated elders. Furthermore, sessions were not pre-planned. Elders had no formal lesson plan, and no planned entry or exit cues, yet they conducted the sessions as a group.</td>
<td></td>
</tr>
<tr>
<td>Elders manage group-teaching through use of private backchannels</td>
<td>It was observed that elders used indigenous languages to coordinate, add to and readjust the sessions on-the-fly. This created a backchannel where they could privately refine the session amongst themselves.</td>
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<td></td>
</tr>
<tr>
<td>Elders use a moving classroom to share IK</td>
<td>What also emerged from Study 2 is that instead of performing all activities at one spot, elders preferred to carry out the sessions where the activities would normally occur. Movement across place, whether indoors, outdoors, or between both, was part of the indigenous activity being shared.</td>
<td>Mobility: Support hands-free, video-framing-free mobility for elders</td>
<td></td>
</tr>
</tbody>
</table>
6.1.1  Design themes

**Mobility**

The first design theme for Study 3 is mobility. Study 2 identifies the ‘moving classroom’ (finding 5.4.3), which involved carrying out indigenous activities in the place where they would normally occur, despite the field-of-view limitations of the iPad camera. Movement around the indigenous home was part of the indigenous activities. For example, when making coconut oil in Ganze, the primary elder carried out the first task of husking and grinding a coconut out in the open. She then performed the second task of cooking the oil indoors in the kitchen, while the last task of cooling and bottling the oil was conducted outdoors. Throughout the sessions, the activities were not modified to account for the iPad’s field-of-view limitations. The role of iPad holder was introduced to ensure that the ViMik sessions accommodated their mobility. The unpopularity of the iPad holder role surfaced that elders perceived device handling and frame management as a burden to their performance of the sessions.

Building on this, a focus for Study 3 is to support hands-free mobility across indoor and outdoor spaces, without imposing demands on the elders to manage video framing. Supporting mobility will: facilitate the performance of IK skills as per the elders’ ways of knowing and living; and allow the learners to learn, not only the technical aspects of the skills being demonstrated by the elders, but also the social and situated aspects of the IK skills. The first design theme for Study 3 is therefore supporting hands-free, video-framing-free mobility for elders.

VMC literature highlights other contexts where the mobility of local participants benefits remote participants. Greef et al. (2016) for example, investigated the design of a live video conferencing system that would facilitate tourists in sharing experiences with people with mobility restrictions. Kim et al. (2014) used a mobile phone and shoulder-mounted smartphone to support the hands-free sharing of video information from a mobile user (nomad) to a sedentary user (couch potato).

For this study, one way to support the mobility of local participants is to use cameras that require limited handling, and at the same time capture a wide field of view so as to better support the moving classroom.
Presence

Presence emerged as a design theme through findings from Study 1. Three techniques from Study 1 describe the ways by which participants connect to their indigenous home or to a place where an indigenous ceremony is taking place. The first technique is travelling physically to the homelands in order to meet face-to-face with indigenous elders. For example, Mariamu travelled to her home in rural Kenya, so that she could understand the dowry ceremony from the perspective of “the old men of the village”. The second avenue was explored by Senge, who ‘transported’ her home in Kenya to Melbourne. She perceived the diaspora as an extension of her homeland and thus carried her Kenyan ways of living in Melbourne, as she would have in Kenya. Lastly, the third technique is to use communication technologies to facilitate presence at a remote place. Baraka used her television and an internet connection to take part in a remote wedding ceremony via live-stream. Two-way communication with her family members at the wedding was facilitated by phone messaging. Phone messaging was ideal for the context because it did not disrupt the activities at the place of performance, and it supported a one-to-one intimacy with her family members. Additionally, Baraka performed actions in unison with the wedding attendees, e.g. eating when they ate, despite a 10-hour time difference. This viewing, augmented by two-way communication and synchronous participation of live activities, gave Baraka a feeling of “actually being there”.

Examples in VMC literature of how technology has mediated a feeling of being at a particular remote place include Neustaedter et al. (2016) who used robots to allow remote participants to watch presentations and mingle with attendees at an academic conference, and Tele-tourist which supports immobile users in visiting places such the zoo through video interaction with a mobile user (Greef et al., 2016). Study 3 builds on this work and techniques from Study 1 and 2. This chapter seeks VMC technologies that can support transnationals in being present at the indigenous home of the elders in ways that consider the other design themes in tandem (e.g. supporting mobility, which requires technologies that allow elders to be hands-free and management-free). The second design theme is therefore, supporting remotely-located learners in engaging with or at indigenous. Study 3 seeks to enhance a feeling of “actually being there” by enriching the visual and auditory experience of the indigenous home over distance.
Personalisation

Participants in Study 1 gave account of seeking IK while in Australia. What the study found is that their reason for doing so varied from a passing curiosity, to a strong interest in sustaining active IK praxis. Lucy for example, felt that she had lost touch with her indigenous roots and was not familiar with the praxis of her indigenous culture. Thus, during her traditional wedding in Australia, Lucy flew in experts from her village in Kenya to guide and conduct the ceremony. Shangazi on the other hand, maintained an active connection to her ethnic background by visiting Kenya regularly, and was important in setting up a Kiswahili language school in Melbourne.

Study 2 took note of the way by which the group teaching style of presentation and demonstration used by the elders was carried out simultaneously and yet in a manner that was sequential. Thanks to this style of teaching, learners were able to see the end from the beginning, and the interrelationship of the end, the beginning and the process. This is demonstrated in how elders taught the learners how to weave a kiondo, which is a traditional Kikuyu basket. As discussed in section 5.4.1, the three primary elders all demonstrated three different stages of basket making concurrently, and showed how each fit into the other. Study 2 proposes that this teaching style accommodates the different levels of basketry proficiency of the learners.

Note that to coordinate the group teaching of Study 2, elders took advantage of their multilingual capabilities. Elders switched to their indigenous language so as to create private spaces where they could develop and manage the sessions. The advantage this provided is that they did not have to leave the stage, nor use additional devices to access the backchannel. They simply used a language not understood by the learners. When some learners understood the elders’ language, they became remote co-facilitators of the sessions and provided support to other learners. Study 3 seeks to sustain the use of the backchannel. Given that elders developed a way to interact through the backchannel, the design solution here is not to design a solution. Use of the backchannel will be supported by the setup, given that the elders will still be able to switch to their indigenous language during the ViMik session.

Summarising the above, Study 1 and Study 2 raise two related considerations for Study 3. One, there is a variation in interest, familiarity and engagement with IK among transnationals. Secondly, the unplanned-yet-coordinated group teaching style of the elders involves the demonstration of different sets of activities.
at once. A design opportunity here would be to support each learner in focusing on their preferred part of the learning session. Translating these considerations into design inspires Study 3 to think of ways to support transnationals in creating a personalised experience of the often group IK sessions. Thus, the final design theme for enhancing the ViMik session for Study 3 is to support learners in customising their experience of the group IK sessions.

One way to support a personalisation is to facilitate learners in controlling their audio-visual experience of the ViMik session. Recall that in Study 2, the collocated learners interacted with the elders in Limuru through a Skype video call displayed on a television screen. This setup displayed the same scene of the elders’ end to all the learners, yet their familiarity, interest and engagement with the elders’ language, environment and activities varied. It is in this restricted experience of the scene, imposed on the learners, where a new technology could offer a solution. Could individual control over what to see and focus on, facilitate custom experiences for collocated learners?

### 6.1.2 Omnidirectional (360°) video

Among the technologies that could potentially address these three design themes is a new medium, 360° video conferencing (360°VC). 360°VC relies on the use of omnidirectional video (ODV), also known as 360° video. An omnidirectional video is created either from a single 360°camera with curved lenses/mirrors, or multiple cameras that capture different parts of the same scene and then these images are stitched together to form a 360° image of the scene (Bleumers et al., 2014). This affords a 360° view of the captured scene from a single viewpoint, allowing the viewer to move the video left, right, up or down, as the video progresses, thus allowing them to control what they see in real time (Bleumers et al., 2014). Additionally, 360° cameras capture high resolution video (for example the VSN V.360 captures up to 6480 x 1080 HD video), support surround audio, and are usually portable, dustproof and waterproof.

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12 [https://vsnmobil.com/products/v-360/](https://vsnmobil.com/products/v-360/)
To gain the omnidirectional experience afforded by 360° video the viewer can either pan the device along an X-Y axis, or drag the image with a finger while the device is stationary. Figure 6 illustrates how to interact with a 360° video.

Figure 6: Ways to interact with a 360° video (a) pan the device and (b) drag the image while the device is stationary

Given its functionality, use of 360° video is gaining popularity in entertainment, surveillance and education. For example, the Australian news network Seven News, live-streamed certain sports events from the 2016 Olympic Games in 360° through 7RioVR2016, their freely available virtual-reality mobile application; artist Bjork reportedly produced the first ever album in 360° video in the same year (Ellis-Petersen, 2016), while in 2014, Virtual Reality company Jaunt produced a 360° cinematic video of a concert by music artist Sir Paul McCartney. Relatedly, between 2015 and 2016, top social media sites YouTube and Facebook introduced the sharing of 360° videos on their platforms, thereby promoting use and interest of ODV in the home.

HCI literature provides some projects that have investigated 360° video. A study by Tang and Fakourfar (2017) investigated how groups of people experience these 360° videos when physically collocated. The study involved a virtual tour of a campus with 16 pairs of users watching a 360° video together. One of the participants acted as a guide, giving a verbal tour of the campus in sync with the 360° video, while the second participant acted as a tourist. A finding from this study that offers guidance to this chapter is the viewing preferences of participants was an even split. That is, half preferred to pan the device as

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demonstrated in Figure 6a, (they were on swivel chairs and thus they changed their body orientation in order to do so); while the other half preferred to drag the video as demonstrated in Figure 6b. The main concern about panning on a swivel chair was that it was unnatural and caused some dizziness. Another observation from this study is that use of the 360° video gave the tourist agency in directing their shared experience. Also, the study found that participants employed workarounds when one missed the reference or when joint reference failed. These included mimicking the body orientation of the other, pointing to the direction on the other’s device, and using landmarks to offer directions. Finally, though participants were free to use the same device in order to facilitate joint reference, none chose to. They preferred the freedom of independent viewing that 360° video offered. However, Tang and colleagues offer that while participants enjoy their own view, this may be problematic for larger groups where joint referencing is important, for example, when a teacher guides a group.

Corbillon et al. (2017) investigated the occurrence of head movements when participants watched 360° video on head-mounted displays. Through a study with 59 users recorded while watching five 70 second-long 360° videos, they produce a dataset of head movements that can help researchers understand 360° video consumption. Meanwhile, Lin et al. (2017) investigated the effectiveness of different Focus Assistance techniques for viewing 360° videos. Focus Assistance techniques cater to the unique challenge that 360° video present where viewers have to manipulate the video in order to continuously focus or re-focus on the intended target. In their study, participants used Samsung Gear Virtual Reality headsets to watch two pre-recorded 360° videos: one of a skateboarder and the other of a tour of Amsterdam. Their study considered the ways by which auto-pilot and visual-guidance techniques can support 360° viewers in mitigating the challenges of continuous focus and intended target. Continuous focus occurs when a 360° viewer loses track of a fast-moving target, and therefore must drag the video to keep up. E.g. while watching the skateboarder move across large spaces. Intended target occurs when the viewer is ‘forced’ to focus on one aspect on the 360° video, yet they are interested in observing other elements of the video. In Auto Pilot, view of the target was automated, while in Visual Guidance, a visual indicator informed the user about which direction to flip the video. Lin and colleagues found that that most participants considered both Auto-Pilot and Visual Guidance as beneficial ways to improve focus when watching both the tour and the sports video. Another finding from their study that sheds insight to this chapter is that when watching the
tour video, participants who valued the narrative of the video preferred the precision of Auto-Pilot, while those that valued freedom in exploring the 360° video preferred Visual Guidance.

Similarly, Rui et al. (2001) investigated user interface issues and systems implications that arose when 360° videos were used to capture office meetings. Through a lab study, participants were asked to watch pre-recorded 360° videos of a small group meeting, and make a hiring decision based on that video. The study found that participants preferred a user interface which displayed all participants at the meeting, as opposed to only the speaking participant. They compared this finding to live meetings, where remote audiences prefer to see all meeting participants in order to gain a global context. Relatively, during the study, users most preferred to have two simultaneous windows: one with a 360° panoramic image of the entire meeting, and as second window where the user would control who would be viewed in the main window. They attribute this to how the human vision system utilises both peripheral and fovea vision to monitor the global environment and the object of interest. In terms of 360 viewing preferences, the study found an even split between participants who liked to control the camera and those who preferred computer-controlled viewing. This finding is similar to Lin et al. (2017) who found variety in participants’ focus assistance preferences.

Study 3 extends research on the experience of 360° video, particularly on 360° video-conferencing among groups of dispersed users. While, to my knowledge, there is no HCI literature on the experience of 360° video-conferencing, the projects above have provided insight on the advantages and challenges of using 360° video. For one, the content of the video and the personal preferences of the viewers influence the preferred focus assistance technique. Lin et al. (2017) found that when watching the tour video, participants who valued the narrative of the video preferred the precision of Auto-Pilot, while those that valued freedom in exploring the 360° video preferred Visual Guidance. Additionally, Tang and Fakourfar (2017) offer that collocated participants preferred to use their own devices when watching 360° video. This guides this chapter on how to setup Study 3, which will also involve multiple collocated participants.

A key interest in some of the projects above is the focus on the use of head-mounted displays, i.e. the studies by Corbillon et al. (2017) and Lin et al. (2017). Study 3 is instead interested in incorporating engagement with the other collocated members and the ancestral lands. Use of headsets - particularly
during a video-mediated session - may hinder face-to-face engagement between elders and learners, and hinder a live experience of the elders’ home. The study by Tang and Fakourfar (2017) also preferred not to use head-mounted displays given that they were observing collocated members experience 360° video together. One key difference from Tang and Fakourfar’s study is that one participant was familiar to the area, and hence acted as a guide, while the other was a tourist. Study 3 differs in how it will observe collocated participants (who are both unfamiliar with a remote place), interact live with remotely-located “guides” (in our case, the elders).

6.1.3 360° video for a ViMik session

Section 6.1.1 proposes three themes that guide the design and evaluation of Study 3. By considering these themes, section 6.1.2 identifies 360°VC as a suitable tool for enhancing a ViMik session for learners. This section brings the two previous sections together and examines the potential benefits of 360° video vis-à-vis the proposed design themes. The end of this section will propose the prototype that will be used for Study 3.

To begin, Table 6 below lists the design themes and identifies properties of 360° video that potentially mediate each respective theme.

<table>
<thead>
<tr>
<th>Design themes</th>
<th>Supportive functions of 360° video</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence: Support remotely-located learners in</td>
<td>· Captures high resolution video</td>
</tr>
<tr>
<td>engaging with or at indigenous epicentres.</td>
<td>· Supports surround audio</td>
</tr>
<tr>
<td></td>
<td>· 360° field of view</td>
</tr>
<tr>
<td>Personalisation: Support learners in customising</td>
<td>· Supports video management for each remote viewer thus learner has control of their audio-</td>
</tr>
<tr>
<td>their experience of the group IK sessions.</td>
<td>visual experience of the session</td>
</tr>
<tr>
<td>Mobility: Support hands-free, video-framing-free</td>
<td>· Stand-alone camera; does not require carrying</td>
</tr>
<tr>
<td>free mobility for elders</td>
<td>· Dustproof and waterproof camera</td>
</tr>
<tr>
<td></td>
<td>· 360° field of view</td>
</tr>
<tr>
<td></td>
<td>· Supports remote video-framing thus burden of video management is shifted to the learners</td>
</tr>
</tbody>
</table>

Table 6: 360° video for ViMik sessions
As indicated in the table above, 360° video provides functions suitable for meeting the design themes. The 360° field of view is the primary beneficial feature of an omnidirectional camera. The potential advantage this provides a ViMik session is that it supports elders’ mobility across large spaces. By placing the camera on the ground, an elder can move freely around the home and still be within the field of view. The 360° field of view may also enrich a feeling of presence at the elders’ home. As stated in previous HCI literature on 360° video, manipulation of video across a 360° plane - whether on a mobile device or on a head-mounted display - provides viewers with a more immersive experience compared to 2D video on the same devices (Tang and Fakourfar, 2017, Kasahara and Rekimoto, 2015). Supporting mobility and presence provides benefits to participation, given that the enhanced social and situated experience of the home provides additional context for learners to engage with.

Another key benefit of 360° video is that it supports remote video-framing. The burden of framing management can be shifted to the learners, and therefore provide hands- and video-framing-free mobility for elders. Personalisation can be facilitated by allowing multiple collocated learners to control their own framing of the video. Learners can each view the 360° video on their personal devices, and thereby control their own audio-visual experience of the session. Previous literature corroborates this. In their study, Tang and Fakourfar (2017) found that use of the 360° video gave the tourist agency in directing their shared experience of group sessions. Collocated participants preferred to use their own devices, even though sharing the device would have been better for building a common viewing experience.

Other beneficial properties of the camera include high resolution 360° video and surround audio. These can foster a rich experience of the remote environment and activities therein, thereby supporting participation and presence. Furthermore, the dustproof and waterproof qualities of the camera are an advantage here given that IK sessions sometimes occur outdoors.

**Solution for Study 3: 360° video conferencing**

While the use of 360° video potentially benefits presence, personalisation and mobility, learning IK over distance necessitates the mediation of these themes during face-to-face interactions with the elders and their environment. Chapter 2 highlights that IK persists by being actively practiced and developed through time, and passed down through social, situated and physical interactions with community members. To
support learners in cultivating IK over distance, it is necessary to maintain these live interactions during an IK session. Given this, the solution proposed for Study 3, is to use 360° video conferencing to enhance the experience of learners during a ViMik session. Figure 7 below illustrates the solution.

The platform proposed for Study 3 consists of VMC devices at both the elders and learners end.

At the elders’ end are a 360° camera, shanga phones and a tablet stand.

**The 360° camera** records 360° video of the environment and the elders, and streams it live to the learners. The 360° camera can be placed on the ground or on the tablet stand. The portability of the camera allows the elders to move it around when they move indoors and place it anywhere in the room they are in.

**The tablet stand** displays a video-feed showing the learners. It consists of 3 tablets setup up facing outwards. The purpose of the tablets is to provide a video-feed of the learners. What is important to note here is that elders will view a 2D video feed, while learners will have the 360° viewing experience. This is because Study 3 is focused on the learners’ experience. Thus, 360 viewing will be facilitated for only the learners’ end.

**The shanga phones** enhance the auditory and visual experience of the learners. A shanga is the Swahili word for necklace. The shangaphone is a set of microphones and miniature speakers that are embedded

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**Figure 7: Enhancing a ViMik session using 360° video-conferencing**
onto a necklace and worn around the neck. The shangaphone supports elders’ mobility; it allows them to move outside the audio range of the tablets, or field-of-view of the 360° camera (e.g. by moving indoors), and still maintain interaction with the learners.

At the learners’ end are mobile devices and speakers with surround sound.

**The mobile devices** facilitate the 360° viewing experience of the learners. The 360° video feed is displayed on these devices, and learners can interact with it by either dragging the video, or panning the device. An objective here is to use devices that the participants would typically have, e.g. a mobile phone, laptop or tablet. Devices on the elders’ and learners’ end will be connected through VMC software to facilitate a video-conferencing experience.

**The surround speakers** in the room enhance the auditory experience of the learners. The surround speakers are connected to the mobile devices via Bluetooth connection. This mutes the sound on the mobile devices, making the speakers the only source of sounds from the 360° video.

**Off-the-shelf VMC software** is used to facilitate a 360° video conferencing experience between learners and elders, that is, 360° video conferencing for the learners and 2D conferencing for the elders.

At the time of carrying out Study 3, no commercial video-conferencing technologies supported 360° video conferencing. Several video-conferencing technologies were tested. Namely, Skype, Oovoo, Google Hangout and Vesee. These platforms displayed 360° video as a panorama to the learners, i.e. the elders’ environment was displayed on a 180° plane, making it impossible for the learners to navigate the video as a 360° sphere. These platforms thereby could not offer an omnidirectional experience for the learners. A related challenge that emerged while testing commercial video-conferencing technologies is that the high bandwidth of 4K required to display a 360° video affected the quality of the video call. As a result, the IK sessions suffered regular internet dropouts greatly interrupting the experience and continuity of the sessions. The solution for these two challenges was to simulate a 360° video-conferencing session using pre-recorded 360° videos, over a partly-live partly-simulated setup.

The simulation was facilitated by the pre-recorded videos. The 360° camera was used to record the elders cooking a traditional Kikuyu meal, and weaving a Kikuyu basket. The pre-recorded videos were then used in the research sessions, with learners being informed that they were in fact live. To promote the belief of a
live session, elders were also used as wizards; they talked over the videos in first-person, acting as if they were conducting the activities at the time of the sessions. As will be detailed in the next section, learners took part in the sessions using personal devices. To synchronise playback of the 360° video on both their devices, I used a browser software known as Watch2gether (www.watch2gether.com). Watch2gether allows remotely-located participants to watch videos in sync. Use of this software additionally facilitated the simulation of a live session.

The live interaction was mediated by a Skype connection between elders and learners. Only a live audio interaction was supported given that the pre-recorded 360° videos were presented to the learners as live videos. Figure 8 below illustrates the prototype setup used in Study 3.

Note that shangaphones were not included in the setup. While the shangaphones are a novel and potentially suitable medium for the context, time constraints limited their production in time for implementation in the field. Given this, the in-built microphones in the iPads and 360° camera were instead used to mediate audio from the elders.
6.2 Study method

The research question guiding this study is ‘In what ways does 360° video conferencing enhance the experience of remote learners during a ViMik session?’ To evaluate the proposed 360°VC setup for IK, 6 research sessions were conducted between two elderly women in rural Kenya and two Kenyan diaspora youth living in Australia. In these sessions, elders shared practical skills and information from their indigenous community.

The setup used in the study is partly-live and partly-simulated so as to simulate a new medium, 360° video-conferencing. This form of research is called the Wizard of Oz technique, where a not-yet-developed system is presented as fully functional to participants. In the technique, researchers play the role of wizard, where they discreetly manipulate physical and digital elements of the system so that it appears fully functional to the research participants (Dahlbäck et al., 1993b). An advantage to Study 3 is that participants had experienced neither 360° live streaming nor 360°VC before. Thus, there were limited expectations on how the session should run. This in turn facilitated belief that the Wizard-of-Oz sessions were indeed live.

In total nine sessions were carried out. However, in one of the sessions, one of the learners failed to show up for the study. The study was carried out but the data was not analysed given that the aim was to observe multiple learners. Two pilot sessions suffered multiple internet connectivity issues and other technical hiccups. They were used to inform the study and improve how the sessions would be carried out. Out of the nine sessions therefore, data was analysed from only six sessions as these were conducted as per the intended research protocol. This chapter therefore reports on data from six sessions.

6.2.1 Technologies deployed

The study was carried out across two locations: at a lab in Melbourne, Australia and at the home of the elders in Limuru, Kenya.

The setup at the elders’ end consisted of two iPads (iPad2 with iOS 8.3) and a VSN Mobil V.360° camera (http://vsnmobil.com/products/v-360). The camera was used to record 360° footage of elders performing tasks around their home, while the tablets were used to facilitate a Skype session with the learners.
On the learners’ end, used were two tablets, audio speakers, and the pre-recorded 360° videos. This equipment was set up in a lab that was arranged to resemble a typical Australian living room. Study 3 observed learners in a lab as opposed to at their homes, because this provided a controlled environment within which to conduct the Wizard of Oz study. Furthermore, to standardise Study 3, participants both used tablets as opposed to mobile phones or laptops given that they have larger screens thus increasing picture clarity, and support touch functionality which is essential when manipulating a 360° video. Figure 9 below illustrates the study setup.

![Study setup](image)

**Figure 9**: (a) Study setup on learners’ end. (b) Learners participating in Part 1 of the study. (c) 360° video of Part 1 where elders are preparing a traditional meal indoors.

### 6.2.2 Creating the 360° videos

To build the 360° videos, the local research assistance met with the elders over two sessions. During these, the elders conducted two IK sessions where they were cooking a traditional meal and making a traditional basket. The local research assistant used the VSN Mobil V.360 camera and its Android application to record the elders.
After that, the videos were sent in mp4 format to Australia over Google Drive for processing. I used the VSN Mobil V.360 Desktop application to convert the mp4 files into a 360° readable format. These were then uploaded to a YouTube account. Links to the YouTube video were added to a Watch2getha account in order to facilitate synchronous viewing among participants. During each session, I used the private Watch2getha account to control the viewing experience of the learners. Watch2gether did not work in the iPads we used, thus to sync viewing with the elders, the local researcher and I communicated via WhatsApp or discreetly via phone.

6.2.3 Participants

Throughout the study, I worked with two local researchers in Kenya who took turns in managing the study at the elders’ end and collecting data.

In each of the sessions, two learners and two elders took part. The two elders were elderly women from Kenya’s largest ethnic community, Kikuyu, who live in Limuru, a semi-rural town in Central Kenya. They were both over seventy years of age and identified strongly with their tribe and its ways of living. The same elders conducted all the sessions of the study, contributing to consistency throughout the Wizard-of-Oz study. Elders were fluent in Kiswahili (the national language of Kenya) and Kikuyu (their ethnic language), and understood English (the official language of Kenya). The elders recruited for this study had participated in Study 2. They were contacted to participate again given their familiarity with the researchers. As compensation, elders each received between KES 500 - 800 for each session they conducted.

<table>
<thead>
<tr>
<th>Session 1</th>
<th>Tawi; Chama</th>
<th>Elder Wanja</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 2</td>
<td>Nana; Halua</td>
<td>Elder Nimo</td>
</tr>
<tr>
<td>Session 3</td>
<td>Zani; Tesi</td>
<td></td>
</tr>
<tr>
<td>Session 4</td>
<td>Shamaya; Benta</td>
<td></td>
</tr>
<tr>
<td>Session 5</td>
<td>Kale; Shangwe</td>
<td></td>
</tr>
<tr>
<td>Session 6</td>
<td>Pendo; Asante</td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Summary of participants for Study 3 (all names are pseudonyms)
The learners were all Kenyan diaspora women living in Melbourne, Australia. They were between the ages of 20 and 35, and from different Kenyan ethnic communities. In total 12 learners took part in the study. All learners spoke at least two languages: English and Kiswahili. Recruiting learners was a more difficult task than recruiting elders, given that the study required female diaspora Kenyans who are fluent in Kiswahili and whose availability matched with another learner (two learners per study were needed). Moreover, given the seven-hour time difference between Kenya and Melbourne, learners had to be available at 5.30pm which was a favourable time for both ends. Recruiting female Kenya transnationals in Australia, who met these specific criteria, was challenging and time consuming. Nonetheless, recruitment was conducted via Facebook adverts, word of mouth, posters in public University spaces, advertising on African-Australian Facebook groups and pages, and snowballing. As compensation, learners each received an AUD 30 gift card and a Kenyan bracelet.

In line with previous studies, I worked solely with women given my role as a Kenyan female researcher, and to abide with cultural norms.

All sessions were conducted in Kiswahili, which was a common language across elders, learners, research assistants and the primary researcher. On occasion, elders would switch to their ethnic language, Kikuyu, when they noticed that both learners in the session were also from the Kikuyu tribe.

6.2.4 Research protocol

Each session consisted of two parts. Part 1 simulated live 360° streaming (with no audio communication), and Part 2 simulated 360°VC (with full two-way audio communication).

The study was broken into two parts in order to examine how the setup supports the different ways by which the youth learn from elders during collocated IK sessions. As discussed in the literature review, methods such as apprenticeship and educational camps (e.g. fattening rooms) are used by the youth when cultivating IK. Apprenticeship involves spending a considerable amount of time with knowledge experts - observing them, interacting with them and learning by doing (Obidi, 1995); while during fattening rooms women take part in practical lessons such as craft making, trading skills, making of natural medicines and beautification treatments (Effiong, 2013, Brink, 1989).
Study 3 mimics two ways that a learner engages with elders during such IK sessions. One way a learner can take part is by primarily observing the elders. Part 1 of this study therefore simulates live 360° video streaming where remote learners watch elders live, with no communication between them. A second mode of interaction for learners is to watch the elders and take part in discussions about the activities being demonstrated. Consequently, Part 2 simulates a live video-conferencing session with two-way audio communication where learners not only observe elders but also take part in discussions.

Table 8 below contrasts the different configurations of Study 3. Further description is outlined in the subsequent sections.

<table>
<thead>
<tr>
<th>Description</th>
<th>360° video (pre-recorded)</th>
<th>Communication medium</th>
<th>Participants</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>0'40'' - elders picking vegetables from their garden</td>
<td>None</td>
<td>Elders &amp; learners</td>
<td>Observing elders</td>
</tr>
<tr>
<td>Part 1</td>
<td>360° video only 5'47'' - elders cooking a Kikuyu traditional meal</td>
<td>None</td>
<td>Learners only</td>
<td>Observing elders</td>
</tr>
<tr>
<td>Part 2</td>
<td>360° video + live audio 7'30'' - presentation of the meal, tasting the meal and serving it to their children</td>
<td>Live audio</td>
<td>Elders &amp; learners</td>
<td>Observing elders and discussing</td>
</tr>
</tbody>
</table>

Table 8: Overview of the testing phases of Study 3

**Training**

This preliminary part of the study was a training session. On the elders’ end, elders were taught how to use the iPad and were shown how 360° videos worked in order that they could see what the learners would see. The local researcher was responsible for setting up and managing the Skype session for the elders.

On the learners’ end, learners were taught how to drag a 360° video using the devices availed to them. A 360° training video was created from a 40 second clip of one of the elders picking vegetables from her garden.

**Part 1: 360° video only**

Part 1 was conducted at only the learners’ end. In this session, learners watched a 5-minute, 47-second clip of the elders cooking a Kikuyu traditional meal. Learners were informed that the video they were watching was in fact live - elders were cooking the meal as they watched but could not hear or see the learners. The scenario below was used to paint the scene to the learners:

*You have never been to your ‘home country’ but you are interested in learning more about your cultural background. You come across a 360° video live stream of your grandmothers*
making a meal back at home. The live stream shows what is actually happening in real time. At the end of the video, you will need to explain to me what you learnt or observed from the video. Feel free to interact with the 360° video as you have been shown in the training session.

Part 1 investigated the ways in which the setup mediates learning for learners when the main activity is observing elders. This is similar to interactions that occur during apprenticeship sessions where the learner begins by mainly observing the elder. Part 1 therefore simulates live 360° video streaming where remote learners watch elders live, with no communication between them. After this part, an interview was conducted with the two learners.

**Part 2: 360° video and live audio**

This second part of the session involved a 360° pre-recorded video and live audio communication with the elders. In this video, the elders continued to prepare the same traditional meal in Part 1, but had moved outdoors. The video was 7 minutes 30 seconds long and consisted of them finalising the presentation of the meal, tasting the meal and serving it to their children.

In this session, learners and elders watched the pre-recorded videos simultaneously but there was no video connection between them. Instead, only an audio connection was used, through which the elders explained what they were doing in the video. Furthermore, elders were asked to narrate their actions in the video in first person and present tense to further simulate a live session.

To maintain the illusion that the sessions were live, or had just happened, learners were informed that while they were being interviewed, the elders had continued cooking. Therefore, the video was not live but delayed live. It was also explained that the ‘delayed live’ and internet connectivity issues caused the audio and video to be out of sync. The truth however was that the video and audio were out of sync because the video was pre-recorded and the audio was live. The following instructions were given to the learners:

You have never been to Kenya and you have recently become interested in learning more about your culture and also practising your culture here in Melbourne. You have been invited to take part in a live session with your grandmothers from Kenya, where they will share experiences, skills and knowledge about your tribe. The main skill being shared here is how to prepare a traditional meal. Due to the time we have taken for the interview, there will be a slight delay in the live video. The audio is live but the video is slightly delayed.
When you take part in these sessions, feel free to ask questions about the meal, the place, the tools used, and your grandmothers’ experiences, so that you can learn as much as possible about your tribe and their cultural practices. At the end of the video, you will need to explain to your sister what you learnt or observed from the video. I will ask you to share this with me at the end of this session.

Part 2 aimed at observing how the 360° video-conferencing setup mediated an IK session where learners are mainly watching an activity and interacting only verbally with elders. Also after Part 2, an interview was conducted with the two learners and with the elders. However, given that the elders were the same throughout the six sessions, full interviews were conducted with them only after the first three session.

At the end of Part 2, participants were debriefed about the session, and given the option to interact with each other over a live Skype connection.

6.2.5 Data collection

Data was collected through interviews and observations of the sessions. Interviews were conducted with learners and elders after each study part. Therefore, per session, learners were interviewed three times, and elders were interviewed twice. However, given that the elders were the same throughout the six sessions, full interviews were conducted with them during only the first three sessions.

All sessions and interviews on the learners’ end were video-recorded using a tripod camera. On the elders’ end, the local researcher audio recorded only the first three sessions, and used a mobile phone to do so.

6.2.6 Data analysis and synthesis

The method used to analyse the data was thematic analysis. The first step involved watching all the video data from the sessions. The Marker function in Adobe Premiere, was used to annotate relevant sections of the video data with one or more of the following codes: Interaction with device, Quote from participant, Interesting observation and Design suggestion. Each coded item was further annotated with a brief paragraph elaborating why it was significant, or if the coded item was a ‘Quote from participant’, it was translated and transcribed verbatim. Figure 10 illustrates the process.
The data that emerged from this exercise was exported to a spreadsheet on Microsoft Excel, where coded items were grouped into the study's three design themes. Therefore, each insight, quote, interaction and design suggestion (shown in Figure 11 as ‘A’) was grouped according to how it related to presence, personalisation and mobility. Thematic analysis (described in Chapter 3, section 3.4.2) was used to facilitate this process.

<table>
<thead>
<tr>
<th>Description</th>
<th>Theme</th>
<th>In</th>
<th>Out</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 IN: swiping while elder teaches. Looking around the environment.</td>
<td>mobility</td>
<td>00:01:12:15</td>
<td>00:01:12:15</td>
<td>P01_P02</td>
</tr>
<tr>
<td>Q: &quot;We could not see exactly what they were doing while making the loops...we were so off&quot;</td>
<td>mobility</td>
<td>00:03:38:00</td>
<td>00:03:38:00</td>
<td>P01_P02</td>
</tr>
<tr>
<td>39 Fi: Because of the activity at hand, the focus switched from the environment to what was being done.</td>
<td>mobility</td>
<td>00:05:56:24</td>
<td>00:05:56:24</td>
<td>P01_P02</td>
</tr>
<tr>
<td>Q: &quot;If there was a way to zoom in on exactly what they were doing. How could they do that? how could they correct us earlier on? Because of the wrong timestamp.&quot;</td>
<td>mobility</td>
<td>00:06:44:04</td>
<td>00:06:44:04</td>
<td>P01_P02</td>
</tr>
<tr>
<td>40 Fi: &quot;Zoom in &quot;</td>
<td>control</td>
<td>00:06:57:09</td>
<td>00:06:57:09</td>
<td>P01_P02</td>
</tr>
<tr>
<td>Q: &quot;I even forgot about the 360, I was completely focused on the environment.&quot;</td>
<td>mobility</td>
<td>00:09:17:01</td>
<td>00:09:17:01</td>
<td>P01_P02</td>
</tr>
<tr>
<td>Q: &quot;My use of the 360 reduced from session 1 to 3.&quot;</td>
<td>mobility</td>
<td>00:09:17:01</td>
<td>00:09:17:01</td>
<td>P01_P02</td>
</tr>
<tr>
<td>Q: &quot;I think it is more important when you cannot hear them. You are trying to find out more for yourself, because you cannot ask them...The more you open up communication, the more...&quot;</td>
<td>mobility</td>
<td>00:09:17:01</td>
<td>00:09:17:01</td>
<td>P01_P02</td>
</tr>
</tbody>
</table>

Figure 11: Screenshot of structure used to analyse Study 3 data
Audio recordings of the interviews were also analysed. This audio data was mainly of the elder’s interviews, given that all learners’ interviews were video-recorded. The researcher listened to the audio recordings, and transcribed data that informed the themes identified. These were synthesised together with the research data from the videos.

The final stage was synthesis, where each of the four groups of data was further analysed. Descriptions that emerged from the findings within each group were written, and then these were broken down or combined into more comprehensive clusters. Clusters were discussed between myself and my supervisors, and then sent to the research assistants in Kenya for additional insight.

### 6.3 Findings

During the interview sessions, all 12 learners reported a very positive experience of the 360° nature of the video mediated sessions, and the sense it conveyed of the remote location. Learners also commented very favourably on the unexpected clarity of the videos and highly appreciated the warmth and enthusiasm expressed by the elders. Their feedback about the sessions provided evidence that the simulation worked.

In this section, participant observations and comments are described as per how they arose in each part of the investigation, and additionally by how they relate to the three design themes driving this study. The next section, section 6.4, will then discuss how the findings relate to, or shed insight on the three design themes.

#### 6.3.1 Part 1: Simulating 360° video streaming

In Part 1, learners watched a live stream of the elders cooking a Kikuyu meal. Part 1 investigated the ways in which the setup mediates learning for learners when the main activity is observing elders. This is similar to interactions that occur during apprenticeship sessions where the learner begins by mainly observing the elder. Part 1 therefore simulates live 360° video streaming where remote learners watch elders live, with no communication between them. Given that live 360° video streaming was new to all the participants, evidence was gained about the nature of their first-time immersion in the experience, and how their experience of the IK session was influenced by aspects of the technology.
Mobility

During the interviews, all 12 learners reported that one of the most exciting aspects of the session was that they could, as described by Zani, “zoom around”. According to the learners, dragging the 360° video created a sense of being at the home of the elders. The comments by Kale and Zani below summarise this experience,

“I felt like a child in the corner and I could look all around me at the people, and see what is going on. I could hear the sounds, the chicken clucking... it was very authentic.” Kale

“It is good. You can go through the whole kitchen and see what is going on. You are not limited to only one view.” Zani

As with Zani above, Shangwe and Pendo also described their experience using spatial terms or phrases that expressed a sense of mobile presence at the remote location,

“I turned around and saw where the beans are.” Shangwe

“I am sitting here [in the remote place] and looking around”. Pendo

Other comments from the participants that relate to mobility are listed below:

"It felt like you are there. It is clear and the camera moves around so you can move around.” Kale

Presence

The visual and exploratory experience provided by the 360° video had a strong emotional effect on some learners, given that they were watching a typical rural home which resembled the ancestral home or way of life of their own grandparents. During all interview sessions, learners mentioned that the sessions made them homesick, or want to prepare a Kenyan meal. Often the interviews would deviate into broader discussions about Kenyan culture, the experience of being a Kenyan diaspora in Australia, how learners prepared certain foods, or tips on where to get a Kenyan product in Australia.

"When you are here for such a long time, you just forget. It is good to actually connect, see what people are doing...it's a bit of home.” Halua

"Cucus (grandmothers) are the best." Shangwe
Further, it was observed that while the 360° video gave the learners an immersive experience of the remote environment, learners were interested in a closer view of the activities or artefacts in the setting. In all sessions, one or both learners mentioned that they wanted to find out exactly what the elders were cooking in the pot. As summarised by Kale,

“If I could have zoomed into the pot now that would have taken [my 360° experience] over the top.” Kale

To find out what was in the pot, it was observed that learners would ask each other what they thought was in the pot, or attempt to zoom in to the pot, or ask the elders in Part 2.

Other comments relating to presence are below:

“Because it is live and you can spin, it is more exciting.” Shangwe

**Personalisation**

It was also observed that some learners appeared to apply a singular focus to their experience of the session; either conversing with the elders, exploring the new aspects of the environment and ignoring the familiar, or alternatively engaging mainly with the familiar aspects. For example, in one of the studies, Zani, who was unfamiliar with the elders’ culture, focused more on the meal being cooked. Her co-learner Tesi, who was familiar with the elders’ culture and the meal being cooked, explored the unfamiliar parts of the elders’ environment instead of focusing on the meal. In another study, Shangwe, whose indigenous language is similar to that of the elders, forgot to interact with the 360° video due to being engrossed in the conversations.

“I didn’t flick. I forgot! I was so engrossed that I did not move around. I was listening to the elders’ conversations, they were [sometimes] speaking in Kikuyu and I could understand. They were really trying to make it an authentic experience of the session. I was into that and I did not flick.” Shangwe

### 6.3.2 Part 2: Simulating 360° video conferencing

For Part 2, the elders had moved outdoors. They continued to prepare the same traditional meal in Part 1, and performed additional activities such as finalising the presentation of the meal, tasting the meal and serving it to their children. In this part, pre-recorded 360° video was used, together with live audio from the
elders. Part 2 was aimed at observing how the 360° video-conferencing setup mediated an IK session where learners are mainly watching an activity and interacting only verbally with elders.

**Presence**

In Part 2, it was observed that in all sessions, one or both learners began by dragging the 360° video to take in the details of the new environment. Thereafter, learners would mostly centre on the elders and interact with them via the live audio. This observed fixation on the elders was interrogated further during interviews, and two main reasons were given for not dragging the 360° video; the dullness of the environment and the presence of a live channel. As summarised by Shamaya and Nana respectively,

"I noticed the central part is where there is more happening. So, I moved the 360° a bit but stuck mostly to the centre... You have to have [more] activities to cover the whole. There is nothing more to watch on the side." Shamaya

"I think it is more important when you cannot hear them. You are really trying to find out more for yourself, because you cannot ask them...The more you open up communication, the less you have to look, you can simply ask them. It is better when you cannot communicate." Nana

Additionally, and in relation to how they interacted with the elders and the environment, the live audio was appreciated by some learners as it provided a channel for the learners to engage with the elders. As demonstrated by the comments below:

"It is nice that you can spin but also listen so you can still pay attention...you are not detached." Kale

"It felt a lot like we were wherever they are...in Limuru..Being able to talk to them and ask questions." Nana

"It is interesting that we are both seeing the same thing, and they can explain what they are doing." Benta

In relation to how field of view afforded by the camera affected their immersive experience, the data surfaced attempts by the learners to view the elders’ end in “complete 360°”. The VSN V.360 camera used in this study captures a 360° horizontal field of view, but only a 60° vertical field of view. This results in a cut-out view of the sky and the earth. In other words, the ground and the sky are replaced with a black border.
as shown in Figure 12 below. This was not popular with some learners. While viewing the video, Nana and Tesi flicked vertically because they expected a 360° vertical field of view. Nana mentioned that she did not like the black bottom and top of the video, as she expected a complete spherical view of the scene. Comments from other participants are below:

"I tried to zoom in out of reflex." Kale

"Live video is closer. 360 is too far." Benta

“YouTube video is clear and directed and zoomed in, that is the advantage it would have over this." Shangwe

![Figure 12: 60° vertical view of the VSN V.360 camera](image)

Other comments that relate to presence are below:

“I know how their yard looks like...where they hang the clothes...you literally see the full environment” Kale

"You are getting the full experience. It is what it is. Authentic." Shangwe

**Personalisation**

In Part 2, more instances were observed where learners in the same session interacted with the 360° video in contrasting ways. For example, Tesi swiped throughout and continuously, compared to Zani who swiped intermittently. Additionally, interview sessions at the end of Part 2 revealed instances where one learner had noticed something that the second learner in the same session had not. For example, Asante noticed that the kitchen was separated from the house. She asked the elders about this, and the session switched from teaching about cooking to teaching about how the Kikuyu community traditionally built houses.
6.4 Discussion

Study 3 used two configurations to evaluate the ways in which the use of live 360° video supports presence, personalisation and mobility for remote learners when cultivating IK over distance. Part 1 simulated live 360° video streaming where remote learners watched elders live with no communication between them; while Part 2 simulated a live 360°VC session with only two-way audio communication, where learners observed elders and take part in verbal discussions. Three design themes, emerging from chapter 4 and 5, focused the study. In this section, learnings from the 2-part study are discussed under how they respond to the three design themes.

6.4.1 The 360° ViMik session mediates a feeling of apparent mobility for remote learners

As discussed in Chapter 2, indigenous knowledges and cultures persist by virtue of being actively practiced and developed through time, and passed down through social, situated and physical interactions with community members. In Study 2, hands-free mobility and movement across place emerged as a key way to facilitate such interactions. In a moving classroom, the measurement and scenery of the class are in constant change, leading us to imagine what VMC technologies will be limited in mediating a constantly changing landscape, and thus what VMC technologies could afford such flexibility. Consequently, mediating mobility emerged as one of the design themes by which to evaluate the potential for 360°VC to enhance the experience of the ViMik session in Study 3.

Through a 360° field of view, this study illuminated how a feeling of mobility in the local environment can also be facilitated for remotely-located participants during a video conferencing session. As planned in the study, the fixed 360° camera allowed the elders to move freely both indoors and outdoors, with hands free. What was unexpected, however, is that the remote learners perceived that they could also move around the elders’ environment. This was evidenced in part 1 where learners used spatial terms to describe their experience of the remote place; e.g., Shangwe stated “I turned around and saw where the beans are.” Moreover, they spontaneously spoke of themselves being positioned within the remote environment e.g. Pendo stated “I am sitting here [in the remote place] and looking around.” In other words, manipulating the 360° video by dragging the screen evoked a feeling of moving around in Limuru, Kenya, yet the learners were seated on a couch in Melbourne, Australia.
However, the study revealed that supporting hands-free video-framing-free mobility during a ‘moving classroom’ is still a challenge. As previously reported in chapter 5, when conducting video mediated IK sessions with remote youth, elders preferred to carry out the sessions where the activities would normally occur. Thus, outdoor activities like basketry and maize threshing were performed outdoors, while indoor activities like grinding maize and cooking *irio* were performed indoors. In this study, a challenge in supporting this moving classroom was observed when making a 360° video of the Elder Wanja teaching viewers how to milk a cow. Elder Wanja began by cutting grass from their farm, walking with the grass to the cowshed, feeding the cow, milking the cow, walking to the kitchen with the fresh milk, making the tea in the kitchen, and lastly drinking the tea outside the kitchen. This ‘moving classroom’ still required significant management and handling at the elders’ end; the local researcher had to carry the 360° camera around with her in order to adequately capture the activities conducted by the elders.

However, an implication of supporting apparent mobility is that it may affect elders’ privacy. The experience of creating the 360° videos in Study 3 raises other insights about the physical and social dimensions of the 360° camera. 360°VC faces typical video-conferencing challenges such as the negotiation of private and public boundaries, notions of awareness and visibility, and the sharing of practical skills (see O’Hara et al. (2009)). Future applications and developments of 360°VC need to consider visibility and privacy when mediating mobility for elders and learners.

6.4.2 The 360° ViMik session facilitates an individual-yet-communal experience of the session

One of the themes used to evaluate this study, was the potential for 360°VC to facilitate a personalised experience for learners during a group IK session. To examine this, learners (from the pilot session) were initially given one tablet to share, with which they could control the 360° image projected on a television. The intention here was to investigate how multiple learners might cooperate in managing a 360° VMC session. However, the sharing of one device inhibited interaction greatly, with learners not wanting to be “boss” over control of the device. During the pilot session, it was observed that the use of one control device between two learners, hindered interaction with the 360° video. Given this observation, participants in subsequent sessions were each given a personal handheld device to use. The study by Tang and
Fakourfar (2017), described earlier in section 6.1, also found that participants preferred their own devices when viewing a 360º video in pairs.

From this study, the use of individual devices revealed the potential for 360º video to simultaneously support an individual-yet-communal experience of an IK session. This emerged through the separate visual and auditory experience a 360ºVC session enabled. Each learner could independently control what they saw, vertically and horizontally, and therefore they saw different things and had an individualised experience of exploring the scene. But at the same time the group of learners all heard the same sounds coming from the environment regardless of where they were looking. Therefore, they had a shared soundscape and thus a communal experience of place in this modality.

When learners and elders interacted in part 2, the visual and auditory modalities contributed to a complex co-creation of the IK session from both ends. On the one hand, the elders crafted the session: they arranged and managed what the learners saw and heard during the session. On the other hand, each learner crafted their own visual inspection of the scene. This independent exploration varied from learner to learner, and was influenced by factors such as their own familiarity with the language and culture of the elders, their engagement with the elders’ control of the session, their comfort with the technology, and their overall interest in what was being shown. By giving elders control of the content of the session, and learners more control of visual experience of the session, 360ºVC allowed both the learners and elders to craft the session on the go, and customise their experience. For example, in Part 2, after dragging the video, Asante noticed that the kitchen was separated from the house. She asked the elders about this at the end of the session (when they interacted over a live Skype channel). The elder then explained how the Kikuyu community traditionally built houses. In this way, Asante contributed to the content of the session for her whole group of learners. This observation supports findings from chapter 5 which highlight that indigenous elders often create learning sessions on the fly. Elders prefer not to have a set ‘curriculum’, and instead rely on other elders and responses from the learners to shape the lesson as it unfolds. The independent visual inspection of the scene afforded by 360ºvideo on individual devices seemed to facilitate the learners in shaping the course of their learning sessions. This finding also shed insights on how the experience of 360º video-conferencing differs from the experience of communal 360º video-watching. Tang and Fakourfar (2017) and Lin et al. (2017) note that the freedom to control video framing is a challenge
when watching a tour videos because the participant may miss out what the tour guide is showing. However, this thesis proposes that such freedom is beneficial in the context of learning and sharing IK because it allows learners to contribute to the content being shared by the elders, and allows the elders to add more to their sessions.

From the sessions, personalisation can be seen to occur in two ways: on an individual level the learner controls what she sees and shapes her experience of the group session, and on a group level, the learners can influence the direction of the IK session based on how they engage with the visual modality, and thus customise the group session. This emerges as one of the key merits of 360°VC that can be exploited further. For example, to enhance personalisation, more control options can be provided to the remote users – e.g. allowing them to save their 360° session, pause the video, take a picture of the remote place, or annotate the 360° video.

6.4.3 The 360° ViMiK session mediates a feeling of presence through exploration and communication

As mentioned earlier, supporting a feeling of closeness to the people and activities at the ancestral home or a feeling of being in the ancestral home, i.e. mediating presence, is likely to aid the nurturing of IK for diaspora members. The 360° sessions facilitated a diaspora encounter where the learners engaged with each other, with the elders, and with their own indigenous anchoring. This was evidenced in Part 1 where due to the experience provided by the 360° video learners mentioned that the sessions made them homesick, or want to prepare a Kenyan meal.

One phenomenon that recurred throughout the study was that exploration of the scene using the 360° video controls was less in Part 2. When further investigated, an interesting relationship between exploration of the scene and communication with the elders emerged. When learners were asked to compare Part 1 (360° video only) and Part 2 (360° video and live audio), most learners felt that Part 2 gave a better sense of being there than Part 1, given that Part 1 involved no interaction with the elders. For those learners, a sense of presence was not just about immersing learners in the elders’ visual world, but depended also on providing direct interaction with the elders and engaging with their ongoing activities. Recognition, by the elders, of the learners’ presence in the remote place further enhanced the learners’
feeling of being there. This observation confirmed initial expectations about the session: that Part 2 would provide a stronger sense of being there than Part 1.

However, going against expectation, for some participants this effect was reversed. For some learners, a lack of a communication channel in Part 1 created a greater feeling of being there. The lack of communication encouraged them to explore and discover the remote place themselves, leading to a stronger sense of presence. Moreover, the use of a personal device and the ability to control one’s own framing of the scene provided a way for the learners to gain knowledge about the remote place in their own individual way. In Part 2, these learners explored the environment less, given that communication with the elders served as an alternative to exploration. That is, instead of dragging the video to investigate they would instead ask the elders.

In the spaces where these two media (visual and auditory) were viewed as complementary, the auditory communication channel allowed learners to remain aware of the ongoing activities in session while independently exploring the environment. Exploration stimulated communication and vice versa; learners inquired about the various artefacts they had seen as they flicked around, and on the flipside, elders would ask the learners whether they had seen a particular artefact or person thereby prompting them to flick the video. When the two were perceived as competing, communication hindered exploration. The conclusion from these observations is not whether communication or visual exploration offers a better sense of presence, but instead that communication may augment or hinder 360° exploration. Given the range of possible future uses of 360°VC, communication and exploration offer two options for how a feeling of presence can be augmented depending on the context of use. This finding is similar to that found by Lin et al. (2017) where participants who valued narrative while watching a 360° video of a tour preferred an auto-controlled viewed of the target, while those that valued freedom in exploring the 360° video preferred Visual Guidance.

6.5 Summary

Based on Study 1 and Study 2, three design themes were proposed and used to design and evaluate Study 3. These design themes are presence, personalisation and mobility. From this investigation, it has emerged that 360° ViMik sessions afford a unique sense of mobility for remote learners. Learners perceived that
they were “moving around there”, yet they interacted with the remote location through 2D devices. Using 360° video, mobility during a video mediated IK session can be facilitated for both learners and elders, without detaching them from their local environment. Secondly, 360° ViMik sessions facilitate a personalised-yet-communal experience. Being in the same physical space, sitting side by side and being able to see what the other learner is seeing, facilitates a shared experience; while an individual control of the same 360° video facilitates a personalised experience. Learners had control over what they could see vertically or horizontally, yet auditorily, they were all experiencing the session in sync. Thirdly, one of the ways 360° ViMik sessions uniquely mediates a feeling of presence is by providing users with flexibility and control in exploration and video framing. However, Study 3 also showed that, for some learners, communication between them and the elders hindered their exploration of the scene.

These three findings shed light on how technology, when designed from an understanding of indigenous epistemologies and ontologies, can motivate IK praxis at indigenous peripheries. The next chapter presents the contributions of the thesis, based on this and other findings that emerged from all the three studies.
7 Thesis Contributions

This chapter presents the contributions of this thesis, which extend knowledge on how video-mediated technology design can support transnationals in cultivating IK at their places of migration. This involves supporting transnationals—who are separated generationally or geographically from indigenous epicentres—in taking part in the social, physical and situated interactions that occur at these indigenous epicentres. Given the critical relationship between technology design and knowledge (as discussed in section 2.5), this also involves designing technology in ways that support, and not undermine, indigenous ways of knowing.

The research question guiding the thesis is, ‘how can video-mediated technology be designed to support the cultivation of IK over distance?’

The literature review highlights that indigenous knowledge is cultivated by being actively practiced over time, through social, situated and physical interactions with community members at or from indigenous epicentres. Therefore, the thesis has sought to inform how technology design can support such social, situated and physical interactions of IK, when indigenous members live away from indigenous epicentres.

Three studies are carried out to respond to the research question. All three studies generate findings that in turn underlie the thesis contributions. In this section, I first review these findings, and in the following sections (7.1 to 7.4) I discuss the three thesis contributions.
**Study 1: Understanding how transnationals nurture indigenous knowledge while in the diaspora**

Through field interviews with 8 Kenyan transnationals living in Melbourne, Australia, Study 1 identifies techniques that participants use to cultivate IK while in the diaspora. Study 1 provides the thesis with an understanding of the kinds of behaviours, interactions and challenges that indigenous transnationals experience when nurturing IK over distance. From the indigenous transnationals investigated, Study 1 found that:

**Section 4.4.1 Participant youth are interested in cultivating IK in the diaspora**– While previous HCI projects have been motivated by the need to store IK due to disinterest from the youth, accounts from Study 1 revealed that the youth participate in physical meetings with other learners, look for YouTube videos from particular indigenous members, share IK through WhatsApp and Facebook groups and use live streaming and SMS communication to participate in indigenous ceremonies over distance. This demonstrates a desire by younger participants (aged <30 years) and the children of older participants (reported indirectly), to learn about their ethnic background and to live out aspects of their culture while in the diaspora.

**Section 4.4.2 Bodily and collocated interactions are preferred when learning or sharing IK**– Participants prefer to engage with other indigenous transnationals through face-to-face interactions such as physical meetings among learners, cultural apprenticeships, visiting the homeland, flying-in experts and re-enacting traditional ceremonies. Though used, computer mediated interactions were often considered unsatisfactory in replacing such meetings, and are used to support or extend bodily and collocated interactions.

**Section 4.4.3 Participants have varied engagement with IK** – The research participants, who are indigenous transnationals, have diverse experiences of IK and thus engage with IK variedly. This influences how they cultivate IK in the diaspora. While some actively and regularly taught indigenous languages and skills in the diaspora, others had to involve members from Kenya to orchestrate IK ceremonies due to their unfamiliarity with IK praxis. Thus, while indigenous communities are largely communal, technology design needs to consider individual preferences and exposure to IK when mediating IK praxis.
Study 2: Understanding how elders share indigenous knowledge over distance

Study 2 uses Skype and iPads to observe elders in rural Kenya share IK with remotely-located youth during 10 ViMik sessions. By applying the P-P-P lens to the interface of indigenous epistemologies and western designed technologies, Study 2 provides the thesis with an empirical understanding of the sort of interactions, behaviours and communication methods that are important to elders when knowledge is dispersed from indigenous epicentres. The four themes that emerge are below.

Section 5.4.1 Elders share IK through unplanned-yet-coordinated group sessions – Sessions from Study 2 reveal that elders preferred to share IK with direct and indirect involvement from other collocated primary and secondary elders. Furthermore, though sessions were not pre-planned - elders had no formal lesson plan, and no planned entry or exit cues - they conducted the sessions as a group. To manage the sessions, elders relied on communiqués with each other and feedback from the learners. The content they shared emerged from knowledge in their bodies (bodily literacy) and gained through lived socio-physical interactions with the world.

Section 5.4.2 Elders manage group-teaching through use of private backchannels - Elders demonstrate their competence to learners by creating a backchannel where they privately refined the session, without having to leave the stage. Indigenous languages are used to coordinate, add to and readjust the sessions on-the-fly. Access to these language-bound interactions is limited to only the collocated elders and remote co-facilitators (learners who also understood the language).

Section 5.4.3 Elders use a moving classroom to share IK - Instead of performing all activities at one spot, elders prefer to carry out the sessions where the activities would normally occur. In that way, the sessions take place in a moving classroom. When the role of iPad holder was introduced to manage a moving classroom, it was highly unpopular. This reveals that supporting mobility for elders entails them being hands-free and management-free during the ViMik sessions.

Study 3: Using 360° video-conferencing to enhance the experience of ViMik sessions for learners

This last study focuses on enhancing the experience of learners during a ViMik session using 360° video-conferencing (360°VC). Three themes, which emerged from Study 1 and Study 2, are used to guide the
design and evaluation of Study 3. Generally, the use of 360° video-conferencing has a positive impact on the learners' experience of the ViMik sessions. The themes below emerge from Study 3.

**Section 6.4.1** The 360° ViMik session mediates a feeling of apparent mobility for remote learners – Study 3 sessions reveal that 360°VC affords a unique sense of mobility for remote participants. Learners perceived that they were “moving around there”, yet they interacted with the remote location through 2D devices. Atop supporting elders’ mobility - and thus the performance and sharing of indigenous knowledge from indigenous epicentres - supporting the learners’ apparent mobility enhanced their engagement with elders’ home.

**Section 6.4.2** The 360° ViMik session facilitates an individual-yet-communal experience of the session - The use of individual devices reveal the potential for 360° video to support both an individualised and a communal experience. Each learner could independently drag the 360° video and therefore manage their individual exploration of the scene. At the same time, both learners had a shared soundscape, and thus a communal experience of place in this modality. By giving elders control of the content of the session, and learners more control of visual experience of the session, 360°VC allowed: both the learners and elders to craft the session on the go (communal experience); and learners to personalise their experience (individual experience).

**Section 6.4.3** The 360° ViMik session mediates a feeling of presence through exploration and communication – While 360° VC mediates a feeling of presence by providing learners with flexibility and control of video framing, communication with elders also influences their feeling of presence. For some learners, a lack of communication with elders encouraged them to explore and discover the remote place themselves, leading to a stronger sense of presence. For other learners, communication with the elders stimulated exploration, leading to a stronger feeling of presence than when there was no communication. When communication and 360° exploration were perceived as competing, exploration increased a feeling of presence. When they were viewed as complementary, communication increased a feeling of presence.

**Summary**

Three studies have been designed to answer the thesis research question. The first study is an investigation of current behaviour among transnationals. The second study is an investigation of elders’ teaching
practices during a ViMik session, while the third is a design and evaluation study aimed at improving the experience of learners during ViMik sessions. These three studies generate knowledge on the technical, methodological and socio-cultural themes to consider when mediating IK praxis over distance. This section has listed the novel contributions of each study. The next section discusses thesis contributions based on these. The three novel contributions are:

- A framework for design that is grounded in indigenous ways of knowing and living
- A way to extend indigenous epicentres using video-mediated communication technologies
- A twofold approach to enhancing the experience of group IK sessions for remotely-located learners

### 7.1 A framework for design that is grounded in indigenous ways of knowing and living

This first contribution of this thesis is the P-P-P lens, which is a productive framework for technology research and design on IK that is grounded in indigenous ways of knowing. This thesis proposes that the P-P-P lens facilitates data analysis in ways that align with indigenous ways of knowing; and secondly motivates technology design in ways that cultivate IK. The next sections justify this contribution.

#### 7.1.1 The People-Place-Praxis lens as a tool for data analysis

This thesis offers that the P-P-P lens provides a systematic way to comb through research data and surface the less-obvious but relevant social, situated and physical aspects of technology engagement for this context. This is especially fundamental when designing to support knowledge cultivation for indigenous communities, because when scientific knowledge is applied to technology design, they tend to commodify and objectify IK (Agrawal, 2002, van der Velden, 2013, Winschiers-Theophilus and Bidwell, 2013). Agrawal (2002) finds that scientific validation processes require that IK is measured according to whether it meets scientific criteria, while scientific abstraction requires that those elements not found useful to science are excluded from storage. In that way, scientific processes sieve out crucial aspects necessary for the praxis and survival of IK. The P-P-P lens responds to this problem by providing a way to identify necessary aspects of IK that would otherwise be overlooked during data analysis. Through the lens, Study 1 analysed the data for ways in which participants sought out face-to-face meetings with members of their ethnic or national
community (People), how they engaged with the ancestral home, place of origin or place of performance of indigenous practice (Place), and how they adopted or carried out practices that embody and depend on IK (Praxis). In Study 2, the lens investigated how elders spoke with other elders, how they spoke with other learners and how learners spoke to each other during the group sessions (People). It observed how elders interacted with place; how they moved, how they used artefacts, how they talked about place, how they arranged themselves in the place, and how they interacted with the place (Place). The P-P-P lens also investigated how the elders carried out IK praxis; particularly how they shared IK skills to the remotely-located learners (Praxis). The result of this IK-focused analysis is that findings generated from Study 1 and Study 2 describe not only technical themes (e.g. finding 5.4.3), but also attend to the social, situated and physical themes that are necessary for cultivating IK (findings 4.4.1 – 4.4.3, 5.4.1.1, 5.4.2). The P-P-P lens is also used to surface asymmetries between indigenous and western knowledge traditions. The lens looks at three areas that concern these knowledge traditions. It examines how indigenous communities (People), indigenous epicentres (Place) and ways of knowing and being of indigenous communities (Praxis), play out within dominating western knowledge traditions. Three asymmetries are discussed: traditions of knowing (western vs indigenous); flows of knowledge (from urban/heterogeneous epicentres vs from rural/indigenous epicentres); and literacies of knowledge (written literacy vs bodily & oral literacy). These three asymmetries have a bearing on how IK is mediated and supported by current technologies, given that these technologies are often designed based on western knowledge traditions. The impact of surfacing these asymmetries is that it motivated the design of the ViMik (video-mediated IK) session, discussed further in contribution 7.2. The creation of the ViMik session, plus the emergence of themes that centralise IK, is evidence that the P-P-P lens is a productive analytical tool for supporting IK.

The P-P-P lens also responds to a gap in HCI research for IK, where there are limited frameworks for HCI design that are centred on indigenous ways of knowing. To my knowledge, the P-P-P lens is the first such framework in HCI. Chapters 2 highlights a number of HCI research projects that design, redesign or appropriate technology based on an understanding of the ways of knowing and living of the indigenous communities they investigate. A detailed summary of these projects in provide in Table 1. However, none provide a practical framework by which other research in IK could achieve similar goals. The P-P-P lens fills this gap by providing three pillars by which to observe, analyse and translate research data. These three
pillars - people as knowledge, place as knowledge and praxis as knowledge – motivate a focus on a triad of interactions (social, situated and physical interactions) that provide new knowledge about indigenous ways of knowing. For example, through the framework, Study 2 surfaces the moving classroom (finding 5.4.3) – which differs from traditional classrooms in western institutions that are often indoors, have one instructor, and rely on verbal and written literature. Additionally, Study 1 finds evidence that the dual consciousness of indigenous communities has an effect on how they engage with IK in the diaspora (finding 4.4.3), while Study 3 designs a platform that supports this dual consciousness of individuality and communality. This insight challenges projects in IK that focus on mediating only the communal nature of indigenous communities.

7.1.2 Influence of the P-P-P lens on technology design for IK

This thesis proposes that the P-P-P lens guides technology design in ways that cultivate IK. Chapter 2 highlights that indigenous knowledge is cultivated by being actively practiced over time, through social, situated and physical interactions with community members at or from indigenous epicentres. In response, the P-P-P lens pushes design to focus on two aspects that are important when cultivating IK, especially over distance. The first aspect is mediating social, situated and physical interactions. Study 3 provides evidence that the P-P-P lens generated themes that support these interactions. The theme of mobility emerged from taking note of the spatial properties of the moving classroom in Study 2 (Place). The theme of presence emerged from observing the ways in which learners’ participation in Study 2 influenced the content and breadth the sessions (People and Praxis). Personalisation was motivated by Study 1, which highlighted that transnationals have varied experience and encounters of IK (People and Praxis). In other words, application of the P-P-P lens in Study 1 and Study 2 facilitated design themes for Study 3 that guided technology design to cultivate IK. The second aspect is designing technologies that cultivate knowledge at indigenous epicentres. The P-P-P lens does this by pushing technology design to support members from indigenous communities in engaging with one another (People); in maintaining an identity with the ancestral lands and activities therein (Place); and in developing IK through bodily interactions, face-to-face sessions and enactment of IK skills (Praxis). This is demonstrated in the use of the ViMik session in Study 2 and Study 3 to study and then enhance engagement between in situ elders and remotely-located youth, and to support
elders and learners in sharing and learning IK over distance. The P-P-P lens contributes to work that moves beyond collecting and preserving IK, and into supporting the cultivation of IK.

The impact of the P-P-P lens is that it facilitates the type of work where prioritisation of the ontologies and epistemologies of specific user groups, motivates the support of their ways of knowing (Salmond, 2012, Ali, 2016). An example of such work is Indigenous Wikipedia (Gallert et al., 2016, Gallert and Van der Velden, 2015) and UVA, an indigenised Facebook group (Warrick et al., 2016) that were discussed in the literature review. These examples demonstrate work in HCI that centralises knowledge systems that are currently considered as “other” vis-à-vis dominating ones. The P-P-P lens contributes to this work by providing a systematic way to investigate indigenous contexts; and secondly, redesign or design current and new technologies that benefit these contexts.

7.1.3 Practical implications

Use of the P-P-P lens may have an impact on dominant platforms. For example, Study 2 highlights that the introduction of automatic translation features on Facebook’s timelines would impact how the elders develop and share IK. This is because the elders in Study 2 relied on their indigenous language to perfect their group teaching. Indeed, translation has some benefits but it also debases code-switching and group-teaching used by multilingual transnationals and indigenous elders when managing their multiple audiences. While there are benefits to translation even as concerns learning IK, the backchannel was a key way for IK to be developed and revived among the elders and remote learners. This tension inspires dominant technologies to understand and therefore design for, their multilingual users. The P-P-P lens provides a way to identify and articulate how global platforms affect indigenous ways of knowing and being. It consequently provides a way to decentralise these global platforms for the benefit of indigenous users.

7.1.4 Limitations of the P-P-P lens

While a useful framework for design, the P-P-P lens has its limitations. For one, it is not based on a comprehensive understanding of all indigenous communities. The P-P-P lens was based on literature that looked at indigenous communities primarily from African countries and Australia. Even then, indigenous communities are different; the inseparability of IK from the indigenous community carries with it the
uniqueness of each community. Consequently, even the communities that this thesis examines may have different views of what forms IK, and what ways of knowing encompass their IK. Thus, the P-P-P lens relies on some commonalities across the ways of being and knowing of some indigenous communities, in order to engage a systematic design of technologies for their use.

Relatedly, the P-P-P lens does not encompass all aspects of indigenous knowledge. Indeed, the definition of IK is itself problematic (Agrawal, 1995, Kincheloe and Semali, 1999). This thesis acknowledges that varied views of IK exist, and responds by providing a view of IK that can motivate how to design technologies for indigenous communities. The P-P-P lens focuses on three aspects of IK – people, place and praxis. However, other aspects of IK may need to be considered when designing particular technologies for indigenous communities.

### 7.2 A novel way to extend indigenous epicentres using video-mediated communication technologies

This thesis contributes a novel way to extend indigenous epicentres through the use of video-mediated IK sessions. This is two-part contribution that proposes the ViMik (video-mediated IK) session; and that the ViMik session extends indigenous epicentres.

#### 7.2.1 A ViMik session

An important contribution of this thesis is the ViMik session. ViMik sessions are used in Study 2 to investigate how elders share IK form indigenous epicentres, and Study 3 enhances the experience of ViMik sessions using 360ºVC. This thesis offers that a ViMik session is a type of video-mediated session that is designed to support the cultivation of indigenous knowledge. This involves mediating indigenous ways of sharing, storing and developing the knowledge at or from indigenous epicentres. Three asymmetries (detailed in section 2.5) guide the design of the ViMik section. As a result, a ViMik session involves elders at indigenous epicentres as teachers and managers of the sessions, and participants at indigenous peripheries as the learners. Secondly, it uses dominant technologies to investigate indigenous contexts in order to motivate design. Verran (2006) highlights that ontic dissonance between western technology and indigenous knowledge traditions can motivate new ways of performing IK with these technologies. In this thesis, a ViMik session is used to surface what indigenous members attempt to do with the current
technologies and fail, and uses these gaps to motivate technology redesign. Lastly, ViMik sessions prioritise the mediation of oral and bodily literacies, based on the view that IK is performed knowledge, expressed primarily through oral, verbal and bodily interactions. During the sessions, elders were encouraged to share and enact through ways that align with indigenous knowledge traditions.

A primary benefit of the ViMik sessions is that they motivate the ways of knowing and living at indigenous epicentres. An indigenous epicentre is the geographic area believed to be the real or imagined ancestral land of a particular indigenous community. Indigenous epicentres constitute a majority of people from a particular ethnic community, practising indigenous ways of living, being and knowing in situ. A number of HCI projects discussed in Chapter 2 (see Table 1), were designed to support elders in cultivating IK with collocated and returning youth. For example, Homestead Creator created 3D scenario-based visualization tool for elders to generate and share digital IK content, while Digital Songlines designed a computer game for Aboriginal Australians to tell stories about their indigenous landscape, and perform knowledge traditions. ViMik sessions have the same aim of cultivating IK at indigenous epicentres, but differ from these projects in how they do so. ViMik sessions cultivate IK by motivating in situ elders to enact IK. This is done by facilitating the flow of knowledge from indigenous epicentres, to centres that have been seen or scripted as better, such as urban or western centres. This is critical for this context because it responds, in a practical way, to the subjugation of indigenous knowledge. Chapter 2 highlights that the inherited or imposed aggrandizement of western knowledge over indigenous knowledge (Ilmi, 2012, Akyeampong, 2000), and urban perspectives over rural ones (Stam, 2014, Ngara, 2007) affect how indigenous members value IK. In fact, Ballantyne (2002) highlights that the bigger deterrent to knowledge generation in Africa is not the lack of communication technologies to promote it, but rather how communities value their own culture, values, languages and traditions. The ViMik sessions provide a useful way to motivate IK praxis at indigenous epicentres, by supporting the flow of knowledge from indigenous epicentres to western epicentres; and by involving indigenous elders as the managers and sources of knowledge. Study 2 connected elders to youth in Nairobi and Kilifi (urban towns), and Study 3 connected elders to youth in Australia (western country). Comments from elders in Study 2 and 3 warrant this design decision; elders expressed happiness that their culture was being appreciated by urban/diasporan youth. Interaction with
the youth was the highlight of the sessions, as it motivated the elders to enact the sessions, and additionally perform indigenous activities that they otherwise rarely did (section 5.4.1).

Another benefit of the ViMik sessions is that they provide insight on how bodily and oral interactions occur when IK is shared over distance. Such insight is important because IK is mainly passed down through oral and bodily literacy; fables are used as pedagogic devices to teach moral lessons; proverbs are used to communicate and validate indigenous procedures and beliefs across generations; secret societies are used to facilitate the initiation of boys and girls according to their age groups, roles and responsibilities within the community; while indigenous centres of education such as learning camps and apprenticeship sessions, share knowledge mainly through learning-by-doing approaches (Zulu, 2006, Boateng, 1983, Mapara, 2009). Due to the centrality of oral and bodily literacy among indigenous communities, projects in HCI have used audio, video and tangible interfaces to afford oral and bodily communication between members. For example, Mediated XicanIndio Resolana used a mixed reality interactive space (Martínez et al., 2010), TAMI (Verran et al., 2007) optimised the search of indigenous digital objects on its system, primarily through visual search, while CARACAL (Jensen et al., 2012a) was a tool for designers and elders to collect rich data for the production of 3D visualisations of Herero villages. The ViMik sessions contribute to such work by using a 2D video-conferencing platform in Study 2 to generate insight on the oral and bodily interactions that elders use when sharing IK over distance. Three themes are surfaced in Study 2 that inform the thesis (sections 4.4.1-4.4.5). Additionally, the ViMik sessions use a 360ºVC medium in Study 3 to enhance spatial interaction between remote learners and the indigenous epicentres (section 6.4.1), and to enhance oral and visual interaction between participants (section 6.4.3).

Lastly, the ViMik sessions generate insight on how dissonance between western and indigenous ways of knowing can inform design, particularly where distance is involved. The view that dissonance can inform design is proposed by Christie and Verran, who highlight that ontic and epistemic dissonance can result in design connection or design separation (Christie and Verran, 2013, Verran and Christie, 2014). While Verran (2006) illuminates some ways in which these differences result in design connection, there is little HCI research on this particularly when indigenous members are dispersed. This thesis informs this gap in two areas based on the P-P-P lens. The first area concerns knowledge as people. The literature review highlights that indigenous knowledge traditions verify knowledge with collocated members; knowledge is true when
other present at the site of knowledge performance verify it as true (Gallert and Van der Velden, 2015, Gallert et al., 2016, Verran and Christie, 2014). To an academic domain expert, the indigenous method is unverified and unsubstantiated because it does not involve scientific evaluation in labs and external reviews. While to an indigenous member, the scientific method is ungrounded and incomplete because it is verified by experts who have not witnessed the knowledge event (Gallert et al., 2016). Study 2 surfaces elders’ preferences when constructing knowledge through their knowledge traditions. Particularly, that elders prefer privacy when verifying knowledge among themselves (section 5.4.2); and secondly, when the technology setup does not allow them to verify in private, they adopt the use of the language-bound backchannels (section 5.4.2).

The second area concerns knowledge as place. Ancestral lands are considered a source, keeper and determinant of indigenous knowledge (Bidwell et al., 2011, Pumap and Wyeld, 2006). Study 2 generates insight on how the ViMik sessions limited elders’ interaction across the lands (section 5.4.3). As a result, the choice to use 360ºVC in Study 3 was motivated in part by how much it supports elders’ mobility on the ancestral lands. What is interesting here is that the dissonance between the elders’ ways of knowing and the Study 2 setup, led to new knowledge about 360ºVC. Study 3 surfaces novel design themes for this context, such as apparent mobility (section 6.4.1), and individual-yet-communal experience of the session (section 6.4.3). These are discussed further in sections 7.3 and 7.4.

7.2.2 ViMik sessions are extensions of IK epicentres

This thesis offers that ViMik sessions are extensions of indigenous epicentres. The ViMik sessions of Study 2 and Study 3 provide a place where elders enact and share IK while at indigenous epicentres, and simultaneously involve remotely-located learners in those situated interactions. This claim is important because it drives attention to the environments where indigenous community members meet, interact, enact and share IK. The ViMik session is a place of IK praxis that is neither in situ nor ex situ, but both, and it is this placement in both that makes it an extension of indigenous epicentres. On one end, the elders were at the IK epicentres, interacting with the lands, people and artefacts therein. Their situatedness on the indigenous epicentres was critical for the ViMik sessions. However, the elders were also in the ViMik sessions. The ViMik session was where they met with the learners, and as demonstrated earlier, it is this interaction with the learners that motivates their enactment of IK. On the other end, while the learners
were remotely-located in Limuru, Ganze or Melbourne, they were also in the ViMik sessions. Learners participated by watching the elders and conversing with them. Their participation influenced how the sessions transpired since the elders heavily relied on input from them in order to progress the sessions (sections 5.4.1 and 6.4.2). Learners’ participation in Study 3 was enriched by using 360ºVC. This is demonstrated in how 360ºVC facilitates apparent mobility, which facilitated more conversation about the elders’ home, and in turn supplemented the content of the sessions (section 6.4.1). 360ºVC also facilitates personalisation, allowing each individual learner to focus on parts of the session that were interesting to them and thereby spur conversation between learners and with the elders (section 6.4.2). ViMik sessions extend indigenous epicentres by being a place where elders can cultivate IK in situ, and remotely-located learners can take part in these IK activities.

One of the benefits of being located on the lands and in the sessions, is that the ViMik sessions provide the elders with a situated-ness in place while they interact with urban/diaspora learners. In other words, the sessions provide a place where lack of computer literacy, the rural/urban imbalance of resources and internet connectivity, and perceptions that undermine rural life (issues very real to them), do not deter them as they share IK. Christie and Verran (2013) highlight Dhänggal, an Aboriginal Australian elder in remote Arnhem Land, who used digital technologies to teach students around the world “who they really are”. Dhänggal explained that being in place and connected to Arnhem Land, allowed her to be confident in who she was and what she shared; as long as she was in place, she could supplement non-indigenous students with IK. I propose that similarly, the ViMik sessions centre elders in place while they engage with urban/diasporan youth. This is demonstrated in how in Study 2, while elders had not participated in Skype sessions before, none expressed hesitation when participating in the ViMik sessions. Instead, elders expressed interest in carrying out more sessions. Elders saw the ViMik sessions as an opportunity to connect with youth in urban centres and to display their rich culture widely. The ViMik sessions are extensions of indigenous epicentres because they provide elders with a situated-ness in place that motivates the enacting and sharing of IK at and from these epicentres.

7.2.3 Practical Implications

The first implication of ViMik sessions is that they provide transnationals with new ways to support the growth of indigenous communities. Transnationals have historically played important roles in supporting
IK, including through movements such as Garveyism and Afro-centricity which were catalysed in the diaspora and “travelled back to the continent” (Thiong’o, 2009). One of the motivations behind these movements is to respond to what Thiong’o (1986) calls the ‘cultural time bomb’, where over time, indigenous communities have lost belief in their names, their language, their environment, their heritage of struggle, their unity, their capacities and ultimately in themselves. Ilmi (2012) proposes that African transnationals can respond to the cultural time bomb while in the diaspora. This is by reconnecting with their indigenous cultures, knowledge and ancestral homelands. This thesis proposes that ViMik sessions provide transnationals with a practical and productive way to respond to the cultural time bomb. ViMik sessions can provide a way for transnationals to engage with the wider indigenous community and ancestral lands, and through such interactions cultivate IK at the indigenous epicentres and in the diaspora.

Another implication of the ViMik sessions is that they exemplify how technology can support those at indigenous epicentres in directly managing and potentially benefiting from their IK. Indeed, IK literature highlights that often technology interventions produce various benefits from IK-- ceremonial, scholarly, scientific, national, entertainment – but often at the expense of the indigenous community who retain little agency in the process (Agrawal, 2002, Ratuva, 2009). Worse still, examples are given of how the communities do not use the technologies designed for them, e.g. Verran and Christie (2014) found that out of more than 100 databases of Aboriginal ecological knowledge, none were used or managed by the indigenous Aboriginal communities. I propose that future improvements on the ViMik session can spur ownership, agency and even monetary gain for indigenous communities. This is because the design of the ViMik session attends not only to technical concerns that hinder the cultivation of IK, but also the epistemic and ontic concerns that affect IK. However, a consideration to be made is how to setup the sessions. In Study 2 and Study 3, the researchers were primarily involved in setting up and troubleshooting the ViMik sessions for the elders. To promote agency at indigenous epicentres, the ViMik sessions need to be redesigned so as to facilitate elders in setting them up and running them independently.
7.3  A twofold approach to enhancing the experience of group IK sessions for remotely-located learners

The final contribution of this thesis is a novel way to enhance the experience of remotely-located participants by supporting an individual-yet-communal experience of the IK session, and secondly, by mediating mobility for local learners at the remote indigenous epicentres. The next sections articulate these two novel themes, and justify their use in this context.

7.3.1 Facilitating an individual-yet-communal experience of group sessions

This thesis argues that while it is important to prioritise the communal nature of indigenous communities, it is equally essential to mediate individual experiences of IK. This is because supporting an individual-yet-communal experience of group sessions promotes learners’ engagement with IK. The basis of this claim is the P-P-P lens, which highlights the dual consciousness encouraged among indigenous communities (see section 2.4.1). Chapter 2 discusses the communal ethos of Ubuntu, where the community is at the centre of one’s personhood (Letseka, 2012, Mbiti, 1990, Kenyatta, 1965). What is often overlooked is that an important aspect of the sense of community is that it is integrated with a sense of individuality. A dual consciousness of one’s personal and communal identity is encouraged. The strong sense of community shapes one’s ethos, while their individual skills and interests drive their roles and responsibilities in the community (Mosha, 2000). The studies provide evidence of the occurrence and importance of individual experiences of IK. Study 1 demonstrates that engagement with IK varies across participants and influences how often they relate with their indigenous community, how they carry out indigenous ceremonies and their involvement in living out or seeking IK while in the diaspora (section 4.4.3). Study 2 highlights that this individual relationship with IK has an impact on how the ViMik sessions transpire. Familiarity with the language or content of a particular session, contributed to some learners being co-facilitators of the sessions. In Study 2, when the elders switched to the Kikuyu language, the Kikuyu-speaking learners would assist them in explaining the session to the non-Kikuyu speaking learners. Knowledge of the Kikuyu language enabled some participants to switch roles from learners to co-facilitators of the sessions (section 5.4.2). Study 2 also highlights that the contingent teaching method used by elders allowed learners to engage with different aspects of the session based on how familiar they were with the skill being demonstrated. In one of the sessions, learners could view the entire process at once, and at the same
interrogate the particular step they were interested in (section 5.4.1). In summary, Study 1 and Study 2 articulate that participants have varied knowledge of IK (e.g. knowledge of language and skills), and secondly, this has an impact on how they engage in IK sessions.

The benefit of designing to support an individual experience of group sessions is that it motivates the praxis of IK, particularly when members are dispersed. The effect on IK praxis is demonstrated in how this individual experience influenced the breadth and content of the sessions. At the end of part 2 of Study 3, participants were allowed to communicate over a live Skype channel. Learners would talk to each other or to elders about the aspects of the session that were individually appealing to them. These conversations would often motivate further conversation on IK practices and further re-enactment of IK by the elders.

Similarly, after part 1 of Study 3, all learners mentioned that the sessions made them homesick, or want to prepare a Kenyan meal. Interview sessions often deviated into extensive discussions about Kenyan culture, the experience of being a Kenyan in Australia, tips on how to prepare certain Kenyan foods, or directions on where to get a Kenyan product in Melbourne. Use of 360° video in Study 3 allowed learners to focus on different aspects of the ViMik session, depending on their own familiarity with the language and culture of the elders; their engagement with the elders’ control of the session; their comfort with the technology; and their overall interest in what was being shown.

This contribution sheds insight on how the experience of 360° video-conferencing differs from the experience of communal 360° video-watching. Tang and Fakourfar (2017) and Lin et al. (2017) note that the freedom to control video framing is a challenge when watching a tour videos because the participant may miss out what the tour guide is showing. However, this thesis proposes that this unshared focus proves advantageous in a group learning environment such as a ViMik session, as the different learners inquire about different aspects of the environment, and thus increase the breadth of the IK session. In other words, the video flexibility of the 360° video allows learners to customise their visual experience of the group session and this motivates further enactment and storytelling in the sessions.

7.3.2 Facilitating learners’ apparent mobility at indigenous epicentres

This thesis asserts that supporting learners’ apparent mobility is beneficial because it enriches their visual and spatial experience of indigenous epicentres. The need to support learners in managing their video-
framing emerged from the moving classroom. A moving classroom occurred in Study 2 due to elders’ spatial movements as they shared IK skills with remotely-located learners; elders enacted IK activities where they would naturally occur. Through the moving classroom, Study 2 provides insight on how local video-framing and handling impact the experience of the remotely-located learners. In Study 2, the limited field-of-view of the iPad cameras often resulted in the elders being out of the viewing frame of the learners. Learners had to rely on secondary elders to correct the framing. This often involved disrupting the ViMik session in order that learners and secondary participants could make decisions on how to position the iPad camera. Additionally, the role of the iPad holder was unpopular among the secondary participants. Thus, the iPad was regularly handed over to other participants, which in turn resulted in further disruption of the session. Due to this observed negative impact of video-framing on the sessions, a primary reason for using the 360° camera used in Study 3 was its potential to support learners in managing their own video-framing. During the 360VC sessions, learners could control their video-framing, focus on the aspects of the session that were interesting to them. What was not expected was that remote video-framing also mediated a feeling of mobility for the learners; dragging the 360° video evoked a feeling of moving around in Limuru, Kenya, yet learners were seated on a couch in Melbourne, Australia. In turn, learners’ engagement with the indigenous epicentres was enhanced.

7.3.3 Practical implications

The two approaches above share a commonality; they both design to support less-considered aspects of indigenous communities. Through designing for personalisation this thesis demonstrates that individual technologies can be used to support an individual-yet-communal experience of an IK session. The setup used in Study 3 supports group-to-group participation, while affording an individual experience of the group session. Secondly, Study 2 and previous literature such as Winschiers-Theophilus et al. (2012) and Bidwell and Winschiers-Theophilus (2012) have highlighted that indigenous elders find the handling of mobile devices a deterrent to their teaching of IK. This thesis informs this finding by demonstrating how immobile devices can mediate mobility. Study 3 uses an immobile device - a stand-alone 360° camera - to mediate both the elders’ and learners’ mobility.
7.4 Summary of contributions

This thesis has investigated how technology can be designed to support indigenous transnationals in cultivating indigenous knowledge while away from indigenous epicentres, and in ways that align with indigenous ways of knowing. The research question that has guided this investigation is ‘How can technology be designed to support transnationals in cultivating indigenous knowledge over distance?’

The thesis has responded to the research question through the three studies discussed in chapters 4, 5 and 6. The first study has explored the use and non-use of digital technologies by African transnationals when cultivating IK in the diaspora. This offers direction on what interactions and users to focus on when IK is nurtured from the peripheries. The second study built on the first, and has investigated the interactions and techniques that elders employ when IK is shared from indigenous epicentres. This gives a grounded understanding of the themes that technology must prioritise when nurturing IK over distance. The final study has evaluated a novel 360° video conferencing platform for its potential to mediate IK. The setup was evaluated across themes borne out of Study 1 and Study 2. Insights from Study 3 provide evidence that an indigenous lens can motivate the design of new technologies for IK, and the consequences of the redesign can provide benefits to IK.

Through the three studies the thesis makes three contributions:

- The People-Place-Praxis lens, which is a framework for design that is grounded in indigenous ways of knowing and living,
- ViMik sessions, which facilitate the extension of indigenous epicentres over distance, and
- A dual approach to enhancing the experience of video-mediated IK for remotely-located learners by mediating both apparent mobility and an individual-yet-communal experience of a group session.

The contributions of this thesis not only guide how to approach design, but they inform previous assumptions about working with IK communities. The use of mobile technologies for example is often centralised in HCID contexts, yet as this thesis has demonstrated, mobile technologies are limited in mediating critical interactions for IK. Furthermore, research has often focused on the communal nature of indigenous communities from a limited understanding of how this communal nature transpires. By
highlighting the dual consciousness of personhood, this thesis demonstrates that personal devices can be used to support group interaction and personalisation. Additionally, the contributions emphasise that technology design can only benefit indigenous communities when a grounded view of indigenous knowledge is upheld. The two-way relationship between knowledge and technology design cannot be overlooked. This thesis asserts that the People-Place-Praxis lens is important when supporting the development of IK, and that indigenous epicentres can be extended through use of ViMik sessions.
8 Conclusion

8.1 Summary of the thesis

This thesis has investigated the design of video-mediated communication technology in order to support remotely-located transnationals in cultivating indigenous knowledge over distance, in ways that are aligned with indigenous ways of knowing. The motivation for this thesis is the two-way relationship between knowledge and technology design. In this era, design is taking over the role of epistemology (Verran, 2010); the design of information and communication technologies (ICTs) greatly influences what knowledge centres are accessed, and what knowledge construction processes are supported. Every knowledge base, knowledge-based system or knowledge-level agent is based, implicitly or explicitly, on a particular understanding of the world to be represented (Gruber, 1995). Moreover, the design of these ICTs is situated; ICTs are embedded with logics (ways of knowing), realities and perspectives of the designers involved, and the environments from where they are designed (Suchman, 1987). The concern of this thesis is that the technologies used in indigenous contexts lack a consideration of their epistemologies. Suchman (2002) highlights that technologies from institutional, organisational and governmental centres of the high-tech North, are often flooded to the Global South with little consideration of the cultures, perspectives and logics therein. Largely, global technology goals or policies - structured in the high-tech North; embedded in dominant technologies; and distributed en masse to the global South - have negative impacts on the development of indigenous knowledge.
This thesis builds on this two-way relationship between knowledge and design. Specifically, that technology design influences what users know and how they construct knowledge, and relatedly, that how designers understand and prioritise particular ways of knowing over others, influences how technologies will be designed for particular contexts. This thesis examines the role that current technologies play when African indigenous members cultivate indigenous knowledge over distance. It also generates knowledge on how an indigenous view of knowledge can guide the research and design of video-mediated technologies that support indigenous ways of knowing.

As a starting point, this thesis proposes a lens for technology research and design that is based on indigenous ways of knowing. The People-Place-Praxis lens offered in Chapter 2 is based on the view that knowledge is developed, shared and stored over time through situated face-to-face interactions with people and indigenous epicentres (which are the real or imagined ancestral lands of an indigenous community). The P-P-P lens views People as knowledge, Place as knowledge and Praxis as knowledge. This triad view of knowledge asserts that cultivating IK involves supporting social, situated and physical interactions among members, and in close association with indigenous epicentres. Across the three studies, the P-P-P lens for design was used to develop research questions, analyse and translate findings, and motivate design themes. The P-P-P lens is one of the three contributions of this thesis, and has been discussed in section 7.1. This thesis has proposed, and provided evidence that the P-P-P lens is a productive framework for technology research and design for IK. One of the ways it does this is by providing a systematic way to analyse research data, and surface the less-obvious but relevant social, situated and physical aspects of technology engagement. This is especially fundamental for this context because when scientific processes are applied to IK, they tend to commodify and objectify it (Agrawal, 2002, van der Velden, 2013, Winschiers-Theophilus and Bidwell, 2013). Another importance of the P-P-P lens is that it responds to a gap in HCI research for IK, where there are limited frameworks for HCI design that are centred on indigenous ways of knowing. To my knowledge, the P-P-P les is the first such framework in HCI. Additionally, the P-P-P lens provides a way to design technologies that are based on the ways of knowing at indigenous epicentres. It does this by pushing technology design to support members from indigenous communities to engage with one another (People); in maintain an identity with the ancestral lands and
activities therein (Place); and in develop IK through bodily interactions, face-to-face sessions and doing IK (Praxis).

Study 1, which is the first study in this thesis, used the P-P-P lens to investigate how African transnationals learn, share or enact IK while in the diaspora, that is, away from indigenous epicentres. Study 1 examined how African transnationals connect to IK with or without technology. Interest was in surfacing the gaps that digital technology currently does not fill and thereby highlighting the interactions that the next studies can investigate.

The importance of Study 2 and Study 3 is that they use ViMik sessions to investigate, and then enhance IK sessions between in situ indigenous elders and remotely-located learners. This thesis offers that a ViMik session is a type of video-mediated session that is designed to support the cultivation of IK. What is important about ViMik sessions is that they prioritise the asymmetries surfaced in the literature review (section 2.5). This thesis contributes that ViMik sessions are extensions of indigenous epicentres. This contribution has been presented in section 7.2. This thesis argues that ViMik sessions provide a place where elders can perform and share IK while at indigenous epicentres, and simultaneously involve remotely-located learners in those situated interactions. They also provide elders with a situated-ness in place, as they share IK over distance. Providing elders with a geographical centeredness while in technology mediated sessions, boosts their confidence to share IK.

Study 3 generates three findings from observing Kenyan transnationals in Australia take part in 360° ViMik sessions with elders in Kenya. Use of a novel medium, 360° video-conferencing (360°VC), was motivated by its potential to mediate themes generated from Study 1 and Study 2. These themes are presence, personalisation and mobility, and were generated as a result of applying the P-P-P lens to Study 1 and Study 2. In that way, the first two contributions of this thesis which are the P-P-P lens and the ViMik session, lead to the thesis’ last contribution. This thesis contributes a novel way to enhance the experience of remotely-located participants by supporting an individual-yet-communal experience of the IK session, and secondly, by facilitating apparent mobility at the remote indigenous epicentres. The importance of enhancing the visual and spatial experience of learners through this dual approach is that it facilitates an immersive and personalised way to engage with indigenous epicentres and activities therein.
In summary, this thesis set out to answer the research question: *how can video-mediated technology be designed to support the cultivation of IK over distance?* The investigation of this research question was motivated by the impact of technology design on knowledge access and generation, particularly in the context of indigenous knowledge. Three contributions have been generated, based on findings from all the three studies. First, this thesis contributes the P-P-P lens as a productive framework for technology design that is grounded in indigenous ways of knowing and being. Secondly, this thesis proposes ViMik (video-mediated IK) sessions, and asserts that they are a novel way to extend IK epicentres. This benefits African transnationals who are interested in nurturing IK from afar. Lastly, this thesis proposes two novel design themes for enhancing the experience of remotely-located participants during video-mediated IK sessions: an individual-yet-communal experience of the IK session, and secondly, apparent mobility at the remote indigenous epicentres. Through these three contributions this thesis asserts that technology design benefits indigenous communities when a grounded view of indigenous knowledge is upheld. Additionally, this thesis demonstrates that indigenous ways of knowing can motivate research and (re)design of new technologies. The two-way impact of knowledge and technology design cannot be overlooked particularly for this context.

### 8.2 Limitations of the thesis

This thesis has certain methodological and practical limitations that may have had an impact on the findings. I will draw on two here and justify how these limitations were responded to. The first limitation of this investigation is that I was the sole researcher for the research and analysis work. This may have contributed a view of the data that was informed by my subjective perspectives of the research context. However, as mentioned in Chapter 3, a critical theory perspective to knowledge advocates for a reflexive-dialectic orientation, which uses both subjective and objective insight to inform research Neuman (2014). I therefore consider my role in thesis as part of the offering of this thesis. My being Kenyan, a Kenyan transnational and a member of an African tribe, makes this thesis more than an objective study to me. Thus, while I was the sole researcher, I propose that my direct relationship and identity with the research context, critically informed the thesis. As noted by Donna Haraway, “I will critically analyze, or ‘deconstruct’ only that which I love and only that in which I am deeply implicated” (Haraway 1997, p.151).

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Additionally, to support a perspective of the study that was from the participants and previous literature, I involved local researchers, external reviewers and my supervisors in reviewing my research findings. Feedback from local researchers was especially important given that they were in the field with me.

Another limitation of the thesis is the number of study participants particularly for Study 1 and 3. In Study 1, I interviewed 8 women and in Study 3, I analysed data from six out of the nine sessions that were conducted. While small studies, the qualitative approach used in this thesis facilitates a rich analysis of the research participants, and provides a method by which to extend knowledge on this context. For my analysis I used thematic and video analyses. These were beneficial to my study as they allowed me to analyse not only what was mentioned by participants, but what they did. In line with my critical theory perspective, this thesis however acknowledges that different findings and themes may emerge if these studies involved more people, different sites, or were conducted with different sets of research participants.

8.3 Future work

The studies, their findings and the thesis contributions reveal some opportunities for future work. This section highlights two areas that future research can extend for this context.

8.3.1 Incorporating indigenous artefacts into ViMik sessions

The scope of this thesis has been on designing video-mediated technologies that support the cultivation of IK over distance. An opportunity for future work is enhancing ViMik sessions with products of IK. What this means is that ViMik sessions can support elders and learners in learning about physical and digital artefacts over distance. The motivation for this proposition is technology projects that have focused on collecting and preserving IK by building repositories of indigenous languages, arts, stories, pictures, etc. While this thesis does not necessarily endorse such a view of IK (i.e. that it is sustained through collection and preservation), it sees opportunity in incorporating the use of existing digital IK repositories into ViMik sessions. A research opportunity here is to investigate how to incorporate archived digital IK products in live ViMik sessions, in ways that develop IK. This could mean designing systems that allow elders and learners to interact with each other and with the archived artefacts, in order to create new artefacts.
8.3.2 Fostering learning through ViMik schools

Indigenous knowledge is cultivated through learning by doing approaches (e.g. fattening rooms (Effiong, 2013) and apprenticeships (Obidi, 1995, Argenti, 2002)). To emulate these, session Study 3 was broken into two parts, each observing different modes of interaction. Part 1 simulated live 360° video streaming where remote learners watch elders live, with no communication between them. This was to support one of the ways a learner can take part in IK sessions which is by mainly observing the elders. Part 2 simulates a live video-conferencing session with two-way audio communication where learners not only observe elders but also take part in discussions. This supported a second mode of interaction for learners which is watching the elders and taking part in discussions about the activities being demonstrated.

This thesis provides that a third interaction can be investigated in the future. Where, the study would simulate an apprenticeship session where both elders and learners engage in an indigenous activity together, over distance. This would allow learners to engage in an IK session by additionally performing the activity that the elders are demonstrating. Future research in video-mediated IK can investigate how the learning and sharing of physical skills can be mediated over distance. Such work can provide knowledge on how ViMik sessions can serve as ‘online indigenous knowledge schools’ where indigenous communities can continue to develop their ways of being and knowing, through enhanced support of oral and bodily literacies.

8.4 Conclusion

As dominant information and communication technologies extend to new contexts, it becomes important for designers to consider the effects of their use on knowledge. This thesis has examined the role that video-mediated technology can play in supporting diaspora transnationals in cultivating indigenous knowledge over distance. The thesis underscores a key point through the contributions it makes. That indigenous ways of knowing can motivate HCI research and design; and this benefits the cultivation of knowledge at or from indigenous epicentres. This thesis has proposed and used the People-Place-Praxis lens to design, analyse and motive technology design. Additionally, the ViMik session, which is based on prioritising indigenous ways of knowing, has extended knowledge on video-mediated indigenous knowledge, and generated insight on the possibilities of a new medium, 360° video conferencing. Two novel design themes – apparent mobility and an individual-yet-communal experience of the indigenous
knowledge session - have been surfaced by using 360° video conferencing in this context. To my knowledge, this is the first study in HCI that has investigated 360° video conferencing.

In closing, through these three studies, this thesis has extended knowledge on how video-mediated technologies can be designed to support the cultivation of indigenous knowledge over distance. This thesis has demonstrated that so doing involves centralising indigenous ways of knowing, and taking seriously concerns that affect the cultivation of indigenous knowledge in this context. As provided by the thesis, these concerns are not only technological concerns. Epistemological and ontological asymmetries between indigenous and western knowledge traditions have an impact on the mediation of indigenous knowledge with technology. As such, this thesis is an uncovering of what and how these issues affect the mediation of indigenous knowledge among dispersed indigenous members; and a response by demonstrating how indigenous ways of knowing can guide and motivate technology research and design.
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Appendices

Appendix A: Interview questions for Study 1

THE UNIVERSITY OF MELBOURNE
DEPARTMENT OF COMPUTING AND INFORMATION SYSTEMS
Example of interview questions for research participants

PROJECT TITLE: UNDERSTANDING THE ROLE OF PEOPLE, PLACE AND PRACTISE IN LEARNING ENVIRONMENTS OF INDIGENOUS COMMUNITIES

INVESTIGATORS: Assoc. Prof. Frank Vetere (principal researcher), Dr. Bjorn Nansen (co-researcher), Kagonya Avori (student researcher)

Preliminary Questions

Name
Community
Age group
  • 18 to 30
  • 31 to 45
  • 46 to 60
  • Over 60
Profession
How long have you been in Melbourne?
Within that time, when is the last time you were in Kenya?

• Is there anything you miss about Kenya?
• How do you cope/make up for those things you miss?
• (If communication is mentioned) What are your sources of information to keep up with what is going on?

Understanding current performance of IK

• Let’s talk about your ethnic community. When is the last time you practised something from your community?
• Tell me more about that. What did you do? Motivation for doing it? Where? Who was there? Time? Time to prepare?
• How did you know that it is from your community? Who taught you? How?
• Do you do that here in Melbourne? Tell me about the last time you did that here in Melbourne. Sources. People. Tools used. Technology used. Task performed.
• Have you ever shared the practice with those who have not attended? How did you do it?

Motivation and challenges

• What motivated you to continue with this practice even when you are away from your ancestral home?
• What are the challenges you have faced in trying to sustain the tradition away from the ancestral home and the wider community?

Specifically relating to practice that was transported eg traditional bride prep ceremonies
• What do you think about traditional marriage ceremonies? E.g. ngurarios.
• What are some of the traditional marriage ceremonies from your community?
• Have you heard of bride preparation practices? What do you think about them?
• Have you attended one? Tell me about it.
• What did you like about the ceremony? What was memorable about the ceremony?
• What did you dislike about the ceremony?

Parallel activity and technology
• How was your marriage ceremony?
• How did you get info on how to be a wife? Where from?
• What do you refer to now?
• What communication tools do you use?
• Have you ever shared the events of the ceremony with those who have not attended? How did you do it?
Appendix B: Publications during candidature

What Indigenous Knowledge is not - an introductory note
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University of Melbourne
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Despite increased recognition of indigenous knowledge (IK) by technologists, there is little consensus on a definition of IK and often classification of IK involves one or more misconceptions. This note discusses three frequent mismatches that arise in common definitions of IK.

Defining IK as separate from scientific knowledge
Consider Richard Turere, a young boy from the nomadic Maasai tribe of Kenya. Richard hails from and lives in a nomadic Maasai community that still practices their traditional ways of life and knowing. According to the Maasai, cattle are a gift from their god, Enkai handed to them directly from heaven. This makes cattle a highly prized and sacred possession. From between the ages of six and nine, Maasai boys are tasked with herding their father’s cattle. Richard faced one major problem as a cattle herder; attacks on the cattle by lions, especially at night. This problem led him to seek a way to protect his father’s cattle from the lions.

Richard had two main strengths; a basic knowledge of electronics from opening up and reconstructing his mother’s radios, and noticing that when he circled the cattle ranch with a torch at night, his motions would scare off the lions. Through trial and error, Richard eventually came up with a battery powered contraption of bulbs that would light up consecutively around the cattle enclosure. This sequential lighting simulated Richard’s movement around the cattle shed with a torch, forming a sufficient way to scare off the lions. He named his invention Lion Lights. Richard shared his invention with others in his village, including a grandmother who used it to protect her cattle from attack. (Turere, 2013)

If indigenous knowledge is, as Warren (1991) describes, ‘non-western’ knowledge, then classifying Lion Lights into one of either is two types of knowledge is problematic. On the one hand, Richard utilised the technologies of lighting and electricity, that emerge from knowledge classified as scientific, to build a localised electronic contraption and therefore Lion Lights is a product of scientific knowledge. On the other hand though, the traditional practices the Maasai uphold on religion and cattle herding, plus their historical interaction and knowledge of lions, were passed down to Richard as part of his Maasai culture. These led him to create Lion Lights. It can therefore be posited that Lion Lights is a product of indigenous knowledge because Richard hails from and lives in an indigenous community. The third option is that Lion Lights is a product of both western and indigenous knowledge. The questions that arise then are, where is the divide
between these knowledge systems and which knowledge system is used to make the distinction? (see: Bidwell, 2014)

A critical analysis of indigenous and western/scientific knowledge across three themes – substantive, methodological and epistemological, and contextual – reveals that no clear divide exists between the two knowledge groups (Agrawal, 1995). Furthermore, and ironically so, defining IK vis-à-vis the much more widely practised and accepted scientific knowledge, serves to subjugate the former to knowledge source inferior and in need of legitimisation by the latter (Agrawal, 2002). Instead of defining IK based on its contrast to Western Science, IK should be defined and valued for its own merit, validity and legitimacy, and especially from the perspective of indigenous persons. (El-Hani and Souza de Ferreira Bandeira, 2008, Düncker, 2002, van der Velden, 2013, Verster et al., 2007).

**Viewing IK as autonomous**

The 'scientisation' of IK, as described by Agrawal (2002), is a process that involves: the identification and separation of useful bits of IK from the rest; the testing, validation and abstraction of these useful bits; and finally their electronic dissemination and storage. For example,

> "Rituals, words, movements, gestures, and actions that may be the concomitant of the administration of a herbal medicine or drug in an indigenous practice can be divested and discarded as not being part of the canon of the usefulness of the herbal medicine or drug." (Agrawal, 2002)

This understanding of IK as separable from the people, environment and practices of the indigenous community it serves, transforms it to solely a source of scientific knowledge as opposed to an alternative way of knowing. Consequently, under this perspective, storage of IK in museums and other ex-situ depositories is incorrectly regarded as imperative to the saving of IK, yet IK is created, shared and stored in and through indigenous people and embedded in their activities and environment.

An indigenous community persists as such by adapting to its continuously changing environments, while retaining or refining its IK. Decentering the embedded connection IK has to the indigene serves to strip it of the very characteristics that make it indigenous (Agrawal, 2002).

Linguists acknowledge this phenomenon with dead languages. A language becomes dead/extinct

> "when it no longer has native speakers… (and the fact that) in some cases, … (it) may continue to find some use as a ceremonial, literary, scholarly, or, most especially, religious language" (Trask in Alghazz, 2013).
Likewise, once applied outside of the indigenous community and their environment, IK can serve various benefits – ceremonial, scholarly, scientific, national, entertainment – but often at the expense of the indigenous community (Rattuva, 2009).

Suffice it to say, this does not mean that IK should not be stored electronically or ex-situ, but instead highlights that preservation, manipulation and access must be owned and controlled in-situ (physically or virtually) by the indigenous community itself.

**Viewing indigenous communities as dissimilar**

While IK is a “complete body of knowledge, know-how and practices maintained and developed by peoples through generations” (Lodhi and Mikiulewks, 2010), its inseparability from the indigenous community carries with it the uniqueness of each of these communities. The temptation to treat these differing IKs as the same, often leads to the “copy-pasting” of research, design and development approaches across dissimilar indigenous communities, and likely failure of subsequent projects (Bidwell et al., 2008). Instead, differences among indigenous communities should be recognised and suitable research, design and development efforts applied to each. While indeed there may be similarities among indigenous communities, IK projects must also consider their unique differences, and ensure that the similarities and differences between communities and knowledge systems are identified and defined through those knowledge systems.

**Conclusion**

This note highlights three aspects of indigenous knowledge that technologists should consider when approaching “intersection” between knowledge systems. Firstly, there is no clear western/indigenous knowledge dichotomy; secondly, that the scienciation of IK may prove most harmful to its sustenance, and thirdly, that despite the grouping of indigenous knowledge, there exist vast differences between indigenous communities. Future work in exploring these three aspects further should include highlighting research that supports the practice and control of indigenous knowledge by indigenous communities.

**References**


Transnationalism, Indigenous Knowledge and Technology: Insights from the Kenyan Diaspora

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ABSTRACT
Our paper investigates how current digital technologies are sufficient, or insufficient, in supporting Kenyan transnationals in practising indigenous knowledge. We first outline a view of indigenous knowledge, and then apply it to a study of Kenyan diasporas living in Australia. The findings are framed as nine techniques for sustaining displaced practising of indigenous knowledge. These appropriations suggest directions for technology innovation, providing design considerations for technologies that translate, formulate and support indigenous knowledge in transnational contexts.

Author Keywords
Traditional knowledge, indigenous knowledge, Transnational HCI,

 ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Transnational HCI is principally concerned with how technologies are designed, used and appropriated across different geographies and cultures [24, 20]. Related to this, but with a different focus, studies of indigenous knowledge (IK) within HCI investigate technologies that support indigenous communities in sustaining their ways of living and knowing when they are physically or generationally separated from their indigenous land and wider community (e.g. [14, 21]). In this paper we explore the nexus of these two areas and investigate how existing digital technologies support transnationals in sustaining their IK. Based on previous research that highlights the inconsistencies that arise when indigenous knowledge systems are designed from western logics [6, 27], we posit that an understanding of the transnational indigenous user of technology offers a valuable perspective on how technology can connect or marginalise users with indigenous ways of knowing. We investigate how existing technologies connect or isolate indigenous transnationals wishing to sustain indigenous knowledge in a diaspora community.

Our approach is to start by proposing a definition and perspective on indigenous knowledge. We then apply this lens to generate findings from an ethnographic study conducted with Kenyan transnationals in Australia. Based on these findings, we develop insights for the HCI community in the following ways: articulating a nexus between indigenous knowledge and transnational HCI, and thereby articulating a focus on the indigenous transnational user, offering an indigenous lens to technology design that can be used as a framework to motivate IH research and design, and identifying gaps that technology can fill in order to better support the practise of indigenous knowledge among indigenous transnationals.

BACKGROUND
Technology and transnationalism
Transnational HCI concerns the ways ‘social and cultural interconnectedness and mobility across space, time and geography’ impact technology use and design [24]. Areas of investigation include observing how pervasive and ubiquitous technologies gain new forms and uses when transported to new places (e.g. [15]). Significant theoretical questions have been raised about how transnationals appropriate technology, and the interplay of new technologies with mobility, hybridity, identity, culture, and local-global interconnectedness[24]. These studies offer insights into how to design for people who are highly mobile, and yet remain ‘anchored’, culturally and socially, both to their countries of migration and their countries of origin [29].

Specific projects in transnational HCI have examined, for example: the use of mobile technology by Thai retirees across distributed homes in different countries [29], the use of technology by diaspora Ghanaians to connect with foreigners in the diaspora [7]; how Kenyans use technology to communicate within rural, urban, peri-urban and diaspora settings [20]; and, how online gaming in urban China becomes socially and culturally situated [15].
Bridging Communities

Technology and Indigenous Communities

In a different area of research, a variety of technologies, e.g. [17, 25], have been designed specifically to facilitate the collection, translation, validation, preservation and dissemination of indigenous knowledge (IK). While this produces valuable records, the approach has often been criticized as being unfavourable to IK's growth and sustenance [22, 28]. Agrawal [1] and others argue that the attempt to collect and preserve IK assumes that IK is easily 'collectable' and 'preservable'. This 'scientizing' of IK tends to consider IK as a commodity that can be abstracted and decontextualized, and that its significance can be readily maintained outside of the socio-physical environment of the indigenous community.

This is not to deny the significance of archiving. For example, the preservation of audio recordings of endangered languages, the storage of video archives of ritual ceremonies, or the creating a digital herbarium of an indigenous people's flora are all important. These become collections that can be retrieved, studied or referred to; and additionally be actors in the future generation of IK. However, they are not the entirety of IK; nor are they immediately valuable to indigenous communities themselves. There is therefore an opportunity and a need for technology design to move beyond managing indigenous data, and into supporting the nurturing of IK.

Indigenous Data and Indigenous Knowledge

In the field of knowledge management in western organisations, collections of images, numbers, words and sounds arising from observation or measurement are most accurately considered as data, where data is understood in contrast with more meaningful information and knowledge [13]. When such collections are derived from indigenous communities, this paper similarly refers to them as Indigenous data. While indigenous data is important and serves various purposes - scholarly, ceremonial, scientific, commercial, and entertainment - it is primarily an abstraction at a particular time and location. In contrast Indigenous knowledge arises from social and physical interactions amongst the people, and with their environment. Indigenous knowledge is retained and refined through time by an indigenous community in order to sustain its unique identity. This knowledge makes up the community's ways of being, living and knowing[4, 21].

While this view of knowledge as being social, materially grounded and situated, is not new to ICT [12], few IK technologies reflect this perspective. Nevertheless there are a few notable examples of technologies that attempt to cultivate indigenous knowledge, such as mobile knowledge sharing platform that allows in situ community members to create a media-rich visual representation of their environment [14]; a reality game that allows users to practice indigenous knowledge within digital representations of their indigenous environment[21]; and the use of indigenous objects to enable the learning of IK within a mixed-reality space[18].

It is within this shift – from preserving indigenous data to cultivating indigenous knowledge – that this paper positions itself. This shift not only views knowledge as a social, physical and situated process but also aims to mediate the indigenous ways of interacting with, developing and negotiating knowledge. We explore these issues in the context of a diaspora community, where cultural dispersion and social isolation often exacerbate the challenges of practising IK. But first we clarify our perspective on indigenous knowledge.

THE THREE 'P'S OF KNOWLEDGE

In developing a view of IK, it is important to emphasize that it does not stand in opposition to scientific/ western knowledge. In a critical analysis of this supposed dichotomy, Agrawal [1] contrasts the two knowledge groups across three themes - substantive, methodological/epistemological, and contextual - and concludes that no clear divide exists between them.

Also, while IK can be viewed as a 'complete body of knowledge', know-how and practices maintained and developed by peoples through generations[17], its inseparability from the indigenous community carries with it the uniqueness of each of these communities. Indigenous communities are not all similar, and consequently, not all forms and definitions of IK are identical.

Additionally, IK may be viewed as both a product of the knowledge of an indigenous community, e.g. indigenous languages, artefacts and practices, and as an understanding how knowledge is created, shared, stored and developed among indigenous communities. IK brings an indigenous perspective to how we approach and respond to knowledge, particularly the knowledge of indigenous communities. Our intention is to understand how an indigenous view of knowledge may influence the design of technologies intended for indigenous users. We begin by exploring an indigenous view of knowledge that proposes three important 'po-person, place and practice'.

Practice as knowledge

According to epistemologists applied by indigenous communities, knowledge is acquired through lived experiences and primarily involves face-to-face interactions with other people [19]. Meaning is gained through situated socio-physical interactions with nature, people and objects. These interactions are not only oral or written, but bodily - movement, gesture, voice, dances, stories, performances, rituals, pitch, smell, texture, sound, role-based interactions etc. This view echoes the phenomenological view of knowledge as embodied - meaning is gained by being in and interacting with the world, the mind game relating of the world by virtue of the body being in that same world [8].

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Bridging Communities

This indigenous epistemology is well illustrated in a study involving a 3D visualization tool with an indigenous community in Namibia [14]. When asked to identify his home from a bird's eye representation of his village, one respondent replied, "I have never been on my roof, so how should I know how it looks like?" The respondent determined that he could not possibly know what his roof looked like because his body had never been on the roof. Knowledge of a place or activity was only possible by being in and interacting with that place, or actually performing that activity.

People as knowledge

Many indigenous communities apply the aphorism "We are what we are" to the way they live, be and know, the individual is not at the centre of the world, instead, the community has primacy in terms of identity and knowledge [15].

Knowledge is seen as belonging to the entire community. However, access to knowledge and the enactment of knowledge varies within and between communities. Some community members have privileged access to certain knowledge depending on their role within the community. For example, among the Mutsu, the role of "official knowledge bearer" is assigned to particular members [16]. This means that members of the Mutsu tribe have the responsibility to convey these living repositories of knowledge in order to learn particular skills, histories, and practices. Another example is from the Penan community, where the youth embarked on knowledge-sharing journeys with the elderly in order to learn essential life skills like cooking, hunting, and fishing [17]. In rural Namibia, villagers often described their wisdom in terms of social relationships with key members of their community [18].

For these indigenous communities, knowledge is viewed as being shared, applied, and contained in and through people. This has consequences on the approaches that tend to value knowledge abstract and remove it from an identifiable vessel body.

Place as knowledge

The relationship that indigenous communities have with their ancestral place of settlement (i.e. the land on which they believe they first settled) is paramount in understanding indigenous knowledge. For example, it is common in African countries for each ethnic community to have a clearly identifiable land area from which they believe to have originally settled. In many instances, the ancestral land of an ethnic community remains the land on which it is the largest occupant of in the country. These spaces therefore become rich environments of indigenous knowledge due to the high concentration of people from one ethnic community, living their indigenous practices in situ. Even community members who live beyond ancestral lands (e.g. within a city) may still maintain a connection to the ancestral land, and this connection is "resilient, highly variable, with dynamics of its own, and not just dependent on personal choice" [19].

The relationship to the ancestral home is transcendental and perpetual, and facilitates an understanding of a community's ancestral land as more than a place of settlement. Instead, the ancestral land plays several roles: it is a place of identity [11], an active participant in the socio-cultural interactions of the community as an actor in the process of knowledge construction [20], a keeper of knowledge, with whom interactions are necessary in order to acquire that knowledge [21], a sacred gift to be cared for and respected, and a determinant of what and how knowledge interactions and exchanges can take place [22].

The ancestral place acquires a pedagogical role in their expression of indigenous knowledge.

A STUDY OF TRANSNATIONALISM, INDIGENOUS KNOWLEDGE & TECHNOLOGY

To explore the significance of the P-P-P view of IK, as described, we conducted an ethnographic field study of 8 Kenyan diasporans living in Melbourne, Australia. The aim was to study people in a geographical dispersed diaspora while attempting to practice IK from their distant homeland. This provided a site of study within the nexus of transnationalism and IK. The focus, for each participant, was on understanding how transnationalism challenges the way indigenous knowledge is practiced in the diaspora, and on how technologies play a critical role in negotiating these challenges.

We are interested in how technologies are culturally appropriated, specifically how "people adapt and make technology their own," and the new ways in which technology gains meaning depending on the social, political, and economic context [16]. Cultural appropriation does not merely examine how western technologies are domesticated in their indigenous cultures, but in the ways that technology is framed and articulated, that is, transformed, not as a technical artifact but as a cultural object [16].

While a diaspora community is different from an indigenous community, we applied our P-P-P lens to study Kenyan transculturalists for three main reasons. Firstly, we are interested in matching an investigation of IK with a view that reflects an indigenous epistemology. Previous researchers [27] and [6] have highlighted the inconsistencies that arise when IK systems are designed from western logic. We therefore find it fitting to apply an indigenous view of knowledge (the P-P-P lens) when investigating the existence of IK by indigenous communities. Secondly, as previously stated, transnational HCI allows us to examine how information flows might connect or isolate developed and developing nations [29].

We were therefore motivated to investigate how current technology connects or isolates members from developing nations who live in developed nations, and yet desire to maintain an active connection/identity to their countries of origin.
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origin. Lastly, we intend that investigating a diaspora community offers insight into how, and why, IK is practised when community members are separated physically or geographically, from both their ancestral home and the wider ethnic community.

For these reasons, we conducted a study with Kenyans living in Melbourne, Australia. Our goals for research were threefold: to understand the motivations for sustaining IK in the diaspora, to understand the workarounds employed by participants when attempting to sustain IK, sometimes during interaction with the people and places of their homeland. The identification of relevant elements in the data was motivated by asking how the development of IK related to people, place and practice.

Under these three foci, we identified nine techniques for sustaining IK used by these Kenyan diasporans. The techniques all relate in some sense to combinations of people, place and practice, but we present them here as falling principally under one of those themes. The techniques identified were considered by the researchers as being highly relevant to the circumstances and intentions described by all participants, though not all reported using them.

Method

We conducted interviews with eight Kenyan women living in Melbourne, Australia. Our choice to investigate women was motivated by a report for the customs of the traditional communities we intended to study. In indigenous communities, access to knowledge is often gender-based. Our primary researcher (the first author in this paper) is a woman thus to study only allowed wider and easier access to both participants and the activities under investigation.

Our primary researcher is also Kenyan, and familiar with the structure of Kenyan society and its bearing on our participants. Our existing relationships with technology research organisations in Kenya, and the ease of access to participants for future in situ studies further motivated our interest in the Kenyan diaspora. As advocated in [9], we considered our primary researcher’s sentiments, understandings and familiarity with the participants as constituting the research we undertook. For example, interviews were conducted both in English and Kiswahili, following a norm amongst Kenyans to code-switch between the two languages. Code-switching allowed for colloquialisms, phrases, sayings, and commonly understood norms to be expressed by the participants and understood by the researcher, thereby allowing for nuanced user requirements to be collaboratively generated.

Recruitment was by snowball sampling, thus half our participants knew each other. This proved advantageous in that the stories that occurred in our data were enriched and clarified through multiple viewpoints.

Our primary research method was interviews, which were conducted at the residences or workplaces of the participants and lasted between one to three hours. In addition, pictures of traditional artifacts were taken in order to gain a richer understanding of how IK is transported and developed in places of migration.

Analysis of the data involved transcribing audio recordings of interviews while translating the Kiswahili parts into English. The data was then analysed through a P-P-P lens, where we interpreted how the social, physical and situated characteristics of IK were manifest in the reports participants. We identified the actions, interactions and workarounds employed by participants when attempting to sustain IK, sometimes during interaction with the people and places of their homeland. The identification of relevant elements in the data was motivated by asking how the development of IK related to people, place and practice.

We present our findings by first describing the motivations of our participants for sustaining IK in the diaspora, including an unexpected interest from the youth in IK. We then discuss the accommodations and workarounds made, with and without technology, to sustain IK through connections to people, place and practice. The gaps in what technology currently appears to offer, as we later discuss, present opportunities for improvements and new innovations.

Motivations: Identity, Values and Belonging

A key motivation for sustaining IK was the desire to construct a Kenyan identity amid the multiple other cultures that participants interacted with. There was a recurring concern that “Kenyans assimilate easily and forget their culture” [10]. Therefore, in order to sustain their Kenyan identities, including particular ethnic identities within the Kenyan nation, participants participated in activities such as attending Kenyan social events, maintaining active use of their national and/or ethnic languages, cooking Kenyan meals daily or occasionally, and keeping abreast with Kenyan news.

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There was a recurring perception that children were losing values due to living in new environments. Videos and documentaries about traditional communities were used to cultivate the learning of these lost values. We also observed that interactions and engagements around traditional activities provided a special site for the teaching of "traditional values". For instance, cooking of intricate traditional foods was coupled with storytelling where the cooking activities acted as prompts to pass on values that the teacher had learnt while cooking, and were reference points for the learner to understand a traditional value.

Another reported motivation for sustaining UK was to show belonging. The story below illustrates this:

"I remember when he first spoke to his future mother-in-law, his wife had called her mum in Kenya so that she could introduce her to the guy she planned to marry. He talked to the future mother-in-law on the phone in his limited Kikuyu language, blathering endlessly along the way but he persisted. Then the mother asked the daughter, 'Is that man a Kikuyu really? You have to teach him the language if he wants to talk to me.'"

Strangari

In this instance, the main question needed to show the mother-in-law that he was a "true Kikuyu". This could only be demonstrated by the degree to which he could speak the Kikuyu language fluently. This pushed him to learn the language from his fiancée, in order to achieve a sense of belonging and approval from his future mother-in-law. This sentiment recurred across the participants, with many of them stating, "I have to learn it" or "I have to teach him".

We found a strong desire by the younger participants (aged ≤30 years) and the children of older participants (expected indirectly), to learn about their ethnic background and to practise aspects of their culture. One of the drivers of these interests was a feeling of having "mixed out" on aspects of their ethnic or national background. This missing out was felt to be a result of having been physically or generationally separated from the place and people of their ethnic community.

Moreover, the knowledge sought by the youth was not only reserved to skill and language acquisition, but also about having an alternative reference point for everyday questions and activities. As summarised by Ann:

"I want to know the roots. Our roots, back at home. I don’t feel bad that I cannot speak my ethnic language. I don’t have sleepless nights about it. But when I am asked about my ethnic background, I can’t say anything, and that is why I feel as though I lack and I would love to know more about that. Growing up, we weren’t exposed to that... the things I do right now, would they be accepted? Would the elders give me a leso at my wedding?"

According to Ann, her ethnic community, the Taita, only gave a leso (a clothing item similar to a sarong) to women who the village elders or community members consider honourable.

There was also a preference for intuitive experiences. In the case of learning about "the roots", there was a preference for interactions involving music, artefacts and activities. According to Ann, while many technology applications she had come across for learning BC often relied heavily on storytelling, other media within her environment, like video conferencing and interactive public displays, could offer more memorable and engaging experiences.

Limits of current digital technologies

A multitude of social media applications and communication tools were used by participants to connect with the Kenyan and/or ethnic community. Common examples were Whatsapp, Viber, Skype, phone calls,
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forums, YouTube and email. These were used to facilitate various interactions, for example finding out what locally unavailable items could be replaced in a traditional recipe. Organising life events with other Kenyans, e.g. birthdays and weddings, keeping up with news via Kenyan YouTube channels and online newspapers, teaching children Kikuyu via Kenyan-produced animations on YouTube, e.g. TigaTiga tales, and crowd sourcing for information about a particular ethnic community or a particular practice.

While these technologies were found useful to an extent, the following findings indicate their limitations and opportunities for improvement, by describing various related workarounds and techniques for sustaining IK that go beyond what is readily possible with these technologies of connectivity.

Interactions with people holding IK

Following the P-P-P lens, the first technique of techniques to sustain IK are those that concerned connecting to people holding IK.

Physical encounters with people in the homeland

When searching for IK teachers were a desire to meet physically with elder members of the ethnic community who were perceived as legitimate sources of IK. The story below exemplifies this:

“We did a lot of Googling my husband and I, but we did not get much from there about our ethnic community. So we have been profiting that next time we go to Kenya we have to look for old men, old Kikuyu men to explain to us these processes because we realise we do not know them.” Mariamu

Such a meeting needed to be face-to-face given the importance of the people to be met, i.e. the elders of the village. Moreover, non-verbal interactions and feedback between the elders and the audience, constitute the learning that takes place in these physical encounters with knowledge bearers. Thus Mariamu preferred physical meetings with the elders given the wealth of learning it would offer and also an opportunity to sustain a relationship with the elders and her village.

‘Flying in experts’

The converse of visiting elders in the homeland, was to arrange for visits to the diaspora. Our study revealed instances where elders, religious leaders and ethnic community members from Kenya, were flown out to Australia in order that they could champion a traditional ceremony.

“I hadn’t paid attention to what the songs meant when I attended weddings in Kenya. At my wedding here, we had a lady from Kenya who taught us the traditional songs of my tribe. Her and my mum arranged it accordingly, as per our customs, and we performed this traditional ceremony of waving the bride out of the house.” Lucy

Here, knowledge experts were sought and brought in to guide the performance of a traditional ceremony.

Physical meetings among learners

Another technique of sustaining IK through its relation to people, was to create spaces and events for these in the Melbourne diaspora to meet with each other and to share their learning. Three participants were involved in launching and running a language school in Melbourne for children from the Kenyan community to learn Kikuyu. The school doubled up as a space of social interaction, where the children could meet, engage and practise their language.

Participants expressed pride in setting up a regular language school, as it was a visible means of passing “something down” to their children, and it gave them another reason to meet with each other. As noted by Shangazi, the school was also a physical avenue to the past as it brought connections to her childhood and reminded of the Kikuyu poems she used to sing.

Cultural apprenticeships

A related technique for sharing IK involves those in the Melbourne diaspora can be described as cultural apprenticeships. Here members arrange to meet physically for the sharing of specific knowledge. A frequent site for this kind of exchange was during learning of highly embodied practices, such as the preparation of traditional meals. The story below exemplifies this:

“One of my friends said that before she leaves Melbourne in two weeks she has to come over for me to show her how to cook chapattis. I told her I could explain it to her over the phone but she has refused. I have explained to her before how to do it over the phone, but she said every time she tried cooking them, they were hard. She insists on coming to do it with me.” Shangazi

Despite the availability and use of digital media to pass on knowledge, we observed a preference to ‘learn by doing’ in the presence of others.

Maintaining a connection to the places where IK is performed

The second category of techniques for sustaining IK are those that attempted to connect with the places of IK.

Visiting the homeland

Connections to Kenya and to participants’ ancestral homes were maintained primarily by regular trips to those physical places. The need for these trips went beyond visiting friends and relatives, and included the need to connect with the places of IK. The prevalence of this technique confirms the importance of sustaining IK and reminds us of the limits of technologies to fully substitute.

Being there through digital connectivity

However a range of digital technologies were used for a secondary kind of connection to place. This was reported in
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the use of, for example, phone calls, Skype calls, WhatsApp groups, diaspora forums and Facebook pages. While these technology-mediated always involved connections to people, and very often to places as well, it was clear in the testimony of participants that part of the value was in connection to the places of IK.

For example, in one reported case, to create a more immersive sense of 'being there', multiple channels of connection were used to transmit 'Baraka' watched a one-way live feed of a wedding celebration online. SMS messaging was used to communicate with her family members who she was watching live. Additionally, she performed actions in union with the wedding attendees, dancing with her family and enjoying the occasion when they did, and singing and dancing along to the traditional ceremonies being performed at the wedding.

Extending places of origin

We also observed how the connection to ancestral place was enhanced in the country of migration of the participants. We call this extending the place of origin, where the activities that would have been carried out in Kenya, are practiced as they would have been but in Australia. This is clearly also relevant to the notion of IK through practice. But here we refer to the way the place of the homeland is felt to extend to the periphery of the diaspora. As described by Senge:

"Australia feels more or less like Kenya, after some time you forget that you are not in Kenya. I have brought my Kenya here." Senge

By sustaining several IK practices in her life in Melbourne e.g. food, language, religious practices, community, radio, Senge was able merge her connection to Kenya with her current physical place. She augmented her indigenous practices in her place of residence. HCl provides some examples where the lived world of indigenous users has been virtually merged with their indigenous homelands. For example, Digital Sengelines [21] which is a game that allows the indigenous user to be immersed in a virtual world that closely resembles his/her ancestral land. By simulating place, Digital Sengelines provided a means through which users could invoke knowledge about their indigenous land, the fauna and flora, and the events that transpired on the land. Similarly, Senge cooked Kenyan meals daily, listened to Kenyan news and music, used artifacts from her country of origin and maintained the use of her traditional languages in order to recreate her home of origin into her new home.

Enacting the practice of IK

The third category of activities for sustaining IK are those concerned with the direct adoption of practices that embody and depend on IK.

Pre-learning indigenous practices

One technique occurred before participants left Kenya. Knowing that they were to migrate, they deliberately learned new aspects of IK that they would need in their new life. For example, Mariama decided to learn how to braid her children's hair before moving to Australia, where she anticipated that she would not have easy or immediate access to the practice.

"I am already learning how to braid my hair now so that it can be done on a girl, into an African hair style that I like. I need to do this for my daughters when they are younger, I learnt it in Kenya because I knew I was moving here. And here, the salons do not know what to do with your hair." Mariama

What is additionally interesting here is the bodily literacy. Mariama acquired in order to braid hair. However, Mariama stated that because she no longer did her daughter's hair, she had forgotten the indigenous skill. The bodily literacy of hair braiding could not be sustained without practice.

Re-enacting Traditional Ceremonies

Once out in the diaspora, a key technique in which IK is nurtured through focus on practices, is the re-enactment of traditional ceremonies. Participants used online searches to source detailed information about how to perform them. However, the internet was largely perceived as lacking in legitimacy sources. Consequently, information was sourced from peers, or notable books written about pre-colonial Kenya, the period before the western colonizers' subjugation of indigenous ways of knowing and living. These provided reference points from which traditional ceremonies were re-enacted into the life events of the participant, e.g. birth ceremonies and weddings. As illustrated below:

"When he was born, the men did the iguha (a traditional ceremony to celebrate the birth of a baby) for him. We got a goat, which is apparently supposed to be cooked by the men only. So my friends and I just sat here while the men were cooking and doing everything. I did not even know that is a traditional thing. Some people had been doing all these years without Kenya, and that is how they became aware of how things used to be done... So we re-enacted all that." Duda

As described by Shangari, the practice of IK, e.g. speaking the Kikuyu language, proved a sense of belonging to the ethnic community. Videos and pictures facilitated the sensing of evidence of belonging as they captured the practice of traditional ceremonies and life events.

DISCUSSION

In the previous section we have reported the motivations and techniques of eight Kenyan diasporans living in Melbourne for sustaining the IK of their homelands. The desire to know one's roots, and to know the real reason behind a traditional practice, performance, saying or ceremony, from a legitimate source, occurred in our data. This was true for all of our participants, and was reportedly strong in the young of their communities who are interested in interacting with the elderly, in order to learn about day-
to-day ways of living. This finding encourages us to take seriously the opportunities for new technologies of exchange between people of different exposure and experience of BK. This first requires attention to the kinds of activities of exchange currently sought and enacted within a cultural diaspora, this being the focus of the present study.

In the present study, then, we have sketched a people-place-practice view of BK, and demonstrated how it can be used as a lens to identify nine specific techniques for sustaining BK in the group of Kenyan diasporans. Most of these techniques involve at least some use of digital technologies of connectivity, though some do not. Collectively they are presented as evidence about the current gaps and opportunities for digital technologies to support the maintenance of BK in diaspora communities. As such, they provide directions for technology innovation, and speak to possible considerations when designing technologies that translate, formulate and support the P-P-P of BK. In this section, we will discuss some of the design considerations that are inspired by the appropriations and non-appropriations that were observed.

It is important to recall that while the appropriations have been framed here through the categories of people, place and practice, no distinct boundaries exist between the three; ie. practice cannot be separated from people, or people from place. Also, we are working under the premise, admittedly contentious, that while indigenous communities are distinctive, and their uniqueness carries with it unique ways of knowing and living, there are similarities that can be abstracted across indigenous knowledges. The people, place and practice lens is offered as a potential source of commonality that provides a reusable framework to inspire technology designs.

Based on the evidence of this small study, connected technologies were used largely to facilitate searching, and often a kind of crowd sourcing, for resources on BK, through platforms like Whastapp and Facebook. Principal targets for learning were family and friends in Australia, those in Kenya and other countries in the diaspora. Similarly to [29], we observed that “communication technologies are also information technologies”. Meaning that the technologies used for communication with other people e.g. Whastapp and Facebook, were seen as sources of BK, they facilitated communication with people who might be bearers of knowledge, or links to those who are. Phone calls were a popular means of communication when seeking BK from those in Kenya. YouTube proved a popular channel for keeping up with Kenyan news, music, dance, comedy, and learning Kikuyu. Video recording and live streams were used to record or participate in traditional ceremonies performed during life events like births and marriage. News collection sites were popular, in particular their webcasts had the audience of all major television channels. Radio stations, and entertainment blogs in Kenya. Technology also allowed for the live streaming of life events, such as weddings, where activities could be carried out with remotely located participants at the same time. Remote observers used props available to them to participate in the ceremony they were viewing via the live stream. Two-way communication was facilitated by phone messaging, which was preferred as it did not disrupt the activities in the observed place, and also supported a one-to-one intimacy. This viewing, augmented with two-way communication and synchronous participation of life activities, gave the remote participants feeling of “actually being there”.

Applying a P-P-P lens to these observations, revealed gaps where current technologies in use were not able to support the needs of the participants for BK. Perhaps one of the biggest gaps can be summarised through the continued desire and reliance on physical meetings where it might be thought that digital exchange could contribute. Physical meetings that supported techniques like apprenticeships and pre-learning, allowed learners to acquire knowledge found in taste, observation, feel and located interactions. Indigenous community members not only communicate knowledge verbally, but also highly utilise the non-verbal sounds, intonations, silences, changes in time and sound, mime, and body and gestural movements that constitute their languages [6, 20]. We observed that the cooking of intricate dishes and activities like hair dressing, involved knowledge in the form of feel of the food or hair, smell of the food, rhythm of hand movements when plucking hair, change of texture of the food while it is cooking etc. Additionally, Rushaka and Shangai attempted to use phone calls to give instructions on how to prepare traditional foods. However, our participants expressed difficulty in translating bodily literacy in a form that is afforded by phone calls and videos. By extension, we can infer that common knowledge sharing tools, e.g. YouTube and phone calls, unsatisfactorily translate the gamut of literacies indigenous communities use to share and nurture knowledge. These observations and the more general inference resonate with other research. As noted by [3], the instability of videos to capture the relationships with the place and artefacts, hidden or revealed in sound, movement or feeling hindered valuable expression of BK practices. This motivates a need to understand how audio-visual technology design can transport, engage and enrich interactions and artefacts, in everyday activities like cooking, and when the parties concerned are dispersed, i.e. between the diaspora and in situ. In another study[5], a traditional healer critiqued the use of video cameras when teaching about local herbs. The healer preferred to teach by walking with the student and participating in particular activities, tasks which he found cumbersome if done with a video camera.

The Flying in of experts, planned physical encounters and the creation of special meeting spaces also speaks to the need to enter the participants’ varied levels of experience and experience of BK. For example, Marram was involved in a
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KCI 2015, Crossings, Seoul, Korea

dowry ceremony for her niece. This involved her flying
from Melbourne to Adelaide three times to meet the
families of her niece's fiancé. Mariama had previously
understood the dowry ceremony to be about selling
the bride. However, by taking part in the ceremony and having
to physically meet the groom's family, she learnt otherwise.
Traditionally, the groom was not allowed to pay the full
price at once, and was required to do so bit by bit, every year,
to ensure the families of the couple met regularly, and
maintained a relationship throughout the marriage of their
children. Participation in the dowry ceremony further
prompted Mariama to travel to her home in rural Kenya, so
that she could understand the dowry ceremony from the
perspective of "the old men of the village". This presents an
interesting challenge as it pushes for a reconsideration of not
only the sanctity of life events, but the need for
participants to customise or build their own memories,
learnings and experiences of such events. IK life events,
while largely communal, are at the same time an assembly
of different roles, persons and positions, each with a need for
a personalised experience of the whole. The balance between
mediating IK practices for the whole and at the same time
for the one presents a significant consideration for IK
design.

CONCLUSION

Through a people-place-practice lens, we have identified
nine techniques to sustain IK used by a group of Kenyan
diasporas living in Melbourne. We contend that an
understanding of how existing technologies are appropriated,
or not appropriated, within these techniques can inform
the design of new technologies for IK exchange (as
discussed in [33]). By seeking to identify areas where
current arrangements and technologies do not suffice in
sustaining IK, our work invites the design of new
technologies that can fill these gaps. This represents a move
away from analysing the surface use or non-use of
technologies from a Euro-American perspective, to
understanding and designing for the less visible, but more
significant, influence of people, place and practice.
Moreover, examining the practice of IK among
transnationalists in the diaspora is a new space for technology
research and design. The indigenous transnational user
offers unique requirements, including the need to cater to
multiple connectedness, i.e. to places of origin and places of
migration, technologies that can be dissimilar to diverse
users e.g. in situ elders and urban diaspora, and yet fulfill the
same desire to cultivate IK, and technologies that can
transport, personalise and replicate people, place and
practice such that IK is cultivated in remote locations.

In conclusion, though focusing only on a small group of
Kenyan women, our study offers a window into
understanding the challenges faced by other globally
dispersed cultural groups who similarly desire to develop
IK in their places of migration. We hope that this paper will
motivate more research in the areas of IK and transnational
HCI, and that more nuanced technologies may be designed
to cultivate and share IK.

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Sessions with Grandma: Fostering Indigenous Knowledge through Video Mediated Communication

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ABSTRACT
Indigenous knowledge is nurtured through social, physical and situated interactions among community members. This paper reports on a study with Kenyan indigenous communities on the use of video-based telecommunication to nurture and enact indigenous knowledge. The paper explores how video-mediated communication technologies can be used and designed to support indigenous elders to share indigenous knowledge with diaspora youth. Four findings emerged: elders employ certain techniques in order to coordinate the expression of indigenous knowledge as a group, indigenous languages are used to refine the enactment of the sessions; a moving classroom is critical when sharing knowledge; and managing a video conferencing session is a burden to the elders. Discussion of the findings briefly highlights some possibilities for video mediated communication technologies to foster indigenous knowledge. These include supporting hands-free indoor and outdoor movement; enabling remote manipulation of video display and prioritising different affordances.

Author Keywords
Indigenous knowledge; Ethnic communities; video mediated communication.

ACM Classification Keywords
H.5.5 Miscellaneous.

INTRODUCTION
One of the growing interest in Human-Computer Interaction (HCI) is how technology can foster indigenous knowledge [1]. The motivation springs from the communities themselves. On the one hand, indigenous elders are concerned that their traditional knowledge will die when they die. They fear that due to various factors - including organisation, migration and the institutionalisation of western education - indigenous youth are not developing their indigenous ways of living and knowing [2]. On the other hand, diaspora youth fear that they have missed out on developing their indigenous identity, due to being physically or generationally separated from their indigenous community [3]. Diaspora youth wish to develop their indigenous skills and practices, nurture a hybrid identity of both their indigenous and migratory cultures and foster a belonging to their indigenous community [3, 4]

Our work is situated in this nexus, where diaspora youth are interested in learning and practising indigenous knowledge, and the elders are interested in fostering indigenous knowledge by sharing it with young people living in the diaspora.

However, there are unique challenges in supporting elders, who often live on their ancestral lands, to foster indigenous knowledge among diaspora youth. Indigenous elders commonly pass down indigenous knowledge through practical experiences, such as apprenticeship, camps and field journeys, on their ancestral lands [5]. Interacting with, or on the ancestral lands is therefore critical when nurturing indigenous knowledge. The first challenge concerns the diaspora youth given that they are not physically present on the ancestral lands, and are therefore likely to miss out on these situated interactions.

The second challenge concerns the design of technology. Commercial information and communication technologies fail to consider the ways of knowing and fostering knowledge that are upheld by indigenous elders. For example, technologies designed to mediate communication over distance are largely designed for individual person-to-person use. Indigenous communities on the other hand, are largely communal, and knowledge exchange occurs through highly social and physical interactions among groups of members (see [6]).

Indigenous communities view practice as knowledge, knowledge is developed through lived experiences, and shared via situated face-to-face interactions with people. Thus, to pass down indigenous knowledge to the youth, means to foster the practice of indigenous knowledge among the youth. Furthermore, apart from in written form,
indigenous knowledge is carried in movement, gesture, non-verbal sounds, silences, dances, changes in resonance and tone etc. [1]. The third challenge is to understand how the practices of these bodily and oral interactions can be mediated over distance.

To better understand these challenges we carried out a field study with two ethnic communities in Kenya. The goal of our research was to understand how indigenous knowledge can be nurtured when elders and youth are remotely located. To investigate this, we conducted eleven video mediated sessions between elders and diaspora youth. Elders lived in rural, largely mono-ethnic areas, while youth lived in urban cosmopolitan centres. In these sessions, we asked the elders to teach indigenous practices to the remotely located youth. We anticipate that findings from this study will further motivate the design of technologies that enhance indigenous knowledge.

Our next section explicates the background and motivation of our work.

BACKGROUND

**Fostering Indigenous Knowledge**

We define *indigenous knowledge* as knowledge retained and refined through time by an indigenous community, in order to ensure its continuity as that particular indigenous community. This knowledge constitutes the community’s unique language, socio-economic skills, spiritual beliefs, systems of government, health knowledge, socio-cultural and economic practices etc. [8, 9]. Indigenous knowledge is unique local knowledge, developed through members living in or indigenous to particular geographic areas [10].

The relationship to land is of key importance to indigenous community members. The community’s land is considered not merely a resource, but a sacred gift to be cared for and respected [11], a foundation of one’s indigenous identity [12, 13], and the lifeline of the indigenous community [11]. Ancestral lands are viewed as the origin or epicentre of the community, and provide a centrality to both those living on and off the land [12]. Being on the land, with the wider community, and using the existing tools and artifacts provide a rich environment for fostering indigenous knowledge.

Elders foster indigenous knowledge among the youth through various ways. For example, among the Ubahkhatuk, Canada the elders embarked on field journeys with the youth to teach them indigenous ways of fishing, dock hunting and camping [2]. The Amur of Nigeria enrolled young girls in ‘listening rooms’ for between 3 weeks to 7 years, where they are taught homemakering and child rearing skills by their aunts and experienced women elders. In these camps they are also beautified and ‘listened’ to improve their health and appearance ahead of marriage and child bearing [14]. Other ways of sharing knowledge include through demonstrating day to day activities [2], through evening teach-ins by the elder members of the family [13], and apprenticeship sessions with skilled community members [16].

**Challenges in Fostering Indigenous Knowledge**

However, indigenous communities face various challenges when trying to foster their knowledge. One key challenge is the impact of western education, which is institutionalised in schools. Formal education seems to separate the indigenous knowledge of the home and ancestral lands. The dichotomy is manifest through different languages (western vs indigenous) [17], different languages of communication and expression (colonial languages vs indigenous languages) [15], and a focus on different literacies (written literacy vs bodily and oral literacy) [7]. Wangari Mathai [15] summarises this tension clearly: “The language of my education was no longer the language of my culture”.

An unfortunate result of these competing knowledge structures is that indigenous knowledge is marginalised by the more widely institutionalised education systems. Often, even with contexts with indigenous communities, indigenous knowledge is not recognised, and thus not taught, in formal education institutions[18]. Indigenous youth that become less interested in nurturing their ways of seeing and knowing the world, given that they view western education as crucial for survival in an urbanising world. In turn, the elderly are discouraged in their ways of knowing and being, and more so in passing down indigenous knowledge to disinterested youth.

Nevertheless, recent socio-cultural movements such as decolonisation (e.g., among Kikuyu intellectuals [12]), pan-Africanism (e.g., among Ghanaian diasporas [19]), and transnationalism (e.g., among the Chamorro in North America [20]), have motivated an interest from the diaspora in cultivating their indigenous knowledge. Thus, amid urbanisation, migration, competing forms of education and other challenges, there is a renewed interest in keeping, practicing and fostering indigenous knowledge.

Given this interest from the youth, and considering the challenges faced by the elders, an opportunity for HCI research and design is to understand how to support elders with technologies that uphold an indigenous view of knowledge, that they may foster its practice among diaspora youth.

**Video mediated communication and Indigenous Knowledge**

Indigenous ways of knowing such as apprenticeship, camps and field journeys prioritise collaborative interactions and involve a close association with the land. The diaspora youth not physically present are therefore restricted in their ability to participate in such activities. This raises an opportunity for technology to mediate remote participation. While the challenge of supporting participation over distance is not new to HCI [21, 22], we posit that investigating indigenous contexts gives opportunity for technology to support unique interactions found in elder-
learner exchanges. For example, field journeys challenge technology to support remote participation for outdoor activities, and elder–learner engagements found in camps give opportunity to support situated interaction over extended periods of time.

Another design opportunity surfaced by indigenous communities is supporting group interaction. Largely, technologies designed to mediate communication are designed for individual person-to-person use. Indigenous communities on the other hand, are largely communal. We find interest in understanding how attending to indigenous ways of knowing, e.g. multi-person use, can broaden the design of technologies intended for knowledge exchange.

We thus sought to investigate how indigenous knowledge can be fostered over distance. We chose video mediated communication as our tool of investigation given its potential to augment, at least in part, the physical, mobile, social and situated interactions that foster indigenous knowledge.

There are however, few examples where video mediated communication has been used to foster indigenous knowledge among remotely located participants.

The Tamani Network [23] is a satellite based video conferencing system built by three Aboriginal communities from Central Australia. The Tamani network was created to revive Aboriginal communication patterns, and privilege the nurturing of indigenous culture. The Tamani network set the ancestral lands as the epicentre of the network, and thus information travelled from the Aboriginal settlements to urban centres in Australia such as Alice Springs, Darwin and Sydney. This flow of information contrasts with western models which view urban cities as the centre, and remote communities as the peripheries of information [23].

The Coolie-Outback project (http://coolie-outback.wordpress.com) used video conferencing to encourage collaboration, interactive learning and knowledge creation between the Bunyip Aboriginal Community of Australia and students in Australia, Alaska and South Korea. Sessions involve performances from the Aboriginal community, and an interactive question and answer session afterward.

These two examples demonstrate the role that video mediated communication can play in fostering indigenous knowledge. They also highlight considerations made when designing video mediated communication technologies (VMCT) for indigenous communities. For example, the Tamani Network highlighted the need to consider not only the technological affordances, e.g. ability to support face to face communication, but also the socio-cultural affordances of technology, e.g. supporting indigenous patterns of information flow.

In our study, we wish to investigate what other considerations and challenges emerge when nurturing indigenous knowledge between elders and diaspora youth, and how these may guide technology design. Our next section talks about our field research.

FIELD RESEARCH

Methodology

The goal of our study is to understand how in situ elders foster indigenous knowledge among diaspora youth. We use emerging video mediated communication technology, Skype, as our tool of investigation. Our aim however, was not to evaluate Skype, nor evaluate its use in an indigenous context. Instead, we were interested in using Skype to generate an understanding of how indigenous knowledge is fostered when elders and youth are remotely located.

To carry out our investigation, we carried out eleven video mediated sessions with two ethnic communities in Kenya. Each session was a video-based interaction between elders in ancestral lands and diaspora youth in urban settings. For each session, elders shared an indigenous practice or skill with the remotely located youth.

Methodological Orientation

To avoid conducting research that applies a foreign, often subjugating lens to the outcomes, we collaborated with local researchers in planning, executing and analysing our research studies. This helped us to mitigate the risk of “sugar thinking” our research and adopting a “development discourse” to our methodology. The “development discourse” is one where the researcher designs from an assumption that the indigenous community is in need of development, and would unquestionably benefit from western technologies [24]. “Sugar thinking” occurs when researchers adopt an authoritative orientation and fail to sufficiently accommodate the indigenous community’s perspective [25].

When working with indigenous communities, sugar thinking and the development discourse are undesirable because they tend to enforce a “comprehensive” mentality, whose motivation for technology design is “to compensate and overcome, rather than to innovate” [25]. This is problematic because technology appropriation is privileged over innovative solution building, further obscuring the design of systems that may spring from indigenous ways of knowing and being in the world. For example, while previous work has recommended design fixes as a solution for the proposed socio-economic realities of Kenyan urban slum dwellers and migrants [26, 27], a focus on appropriating current western technologies as a design solution, tends to obscure opportunities to design technologies in new forms and factors unique to the resources readily available to the users.

In contrast, we aim to achieve a “post-colonial discourse”, which recognises that design is an “intentional, motivated and power laden act.” [24]. Thus our methodological orientation regards members of indigenous communities as
active stakeholders in design, and the generation of user requirements as a negotiated, limited and situated process [24, 28].

Participants
The study consisted of 19 elders. There were 26 learners who participated remotely, but they were not the focus of this study.

We use the term elder to refer to the participants who facilitated and managed the sessions, and learner to refer to the diaspora youth. This contrasts with the terms teacher and student that are found in academic teaching structures. We instead use elder to reflect the norms of indigenous communities where values, skills and knowledge were taught by the elders of the family, village or community.

All participants were women. The elders lived in rural and peri-urban villages in Kenya, were between the ages of 30 and 65, and were from the Giriama and Kikuyu ethnic communities of Kenya. Learners either lived in the capital city, Nairobi, or a semi-urban town in Kenya called Kilifi. Learners were between the ages of 21 and 35, and from various ethnic communities.

Our choice to study ethnic communities in Kenya is motivated by the first author who is Kenyan and from an ethnic community in Kenya. This provided ease of access to research participants and local researchers. Further, we use the terms indigenous and ethnic interchangeably as they connote the same meaning to our participants. Africans typically consider all African ethnic communities indigenous [29].

The choice to investigate the connection between rural and urban centres is based on the understanding of the community’s lands as central to the community [3]. Largely, ethnic communities in Kenya view their homeland as the epicentre of their community and culture. These homesteads are mostly located in the rural or semi-rural parts of the country, and consist of high populations of the same ethnic community living in one geographical area. A connection to the homeland, and to those living on the land, is paramount when nurturing one’s indigenous identity and cultivating indigenous knowledge [3]. Thus, in our study, we observe how elders (who are located in the rural areas) foster indigenous knowledge among remote learners (who are located in the urban areas).

Recruitment
In our study, we worked with local researchers at both Ganze and Shambalwani. The local researchers handled the recruitment of elders. In Ganze, the elders were familiar to the local researcher, while in Shambalwani the elders were recommended to the local researcher by word of mouth.

Learners for Ganze were recruited by the first author via cold calls and snowballing.

Learners who took part in the sessions with elders from Shambalwani were recruited from AkiraChix (www.akirachix.com), an information technology training centre for young women. Flyers were placed at the centre asking the girls to take part in a session where they would engage in a live interactive video session with grandma and learn indigenous skills.

Language

Sites
We carried out our investigation on two sites. The first site was Ganze, a rural village in Coastal Kenya dominated by the Giriama community. Ganze is approximately 500km from Nairobi, the capital city of Kenya.

The second site was Shambalwani, a peri-urban village approximately 30km from Nairobi. The learners in site 2 were groups of young women between the ages of 18 and 30, from a technology hub in Nairobi, Kenya. Learners in site 2 differ from site 1 given that they took part as groups, as opposed to site 1 who took part individually.

At both sites, the remote learners were located in the capital city Nairobi or semi-urban town Kilifi.

The first author travelled to both Ganze and Shambalwani to conduct our research in situ.

Site 1: Ganze
We ran eight sessions in Ganze each consisting of an activity carried out by the Giriama community. The choice of activities to demonstrate was decided by the local researcher and the elders themselves.

In each session the elders enacted one indigenous practice

<table>
<thead>
<tr>
<th>Location of elders</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ganze</td>
<td></td>
<td>Shambalwani</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Locations of learners</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi</td>
<td></td>
<td>Nairobi</td>
</tr>
<tr>
<td>(60km from Ganze)</td>
<td></td>
<td>(60km from Shambalwani)</td>
</tr>
<tr>
<td>Kilifi town</td>
<td></td>
<td>Kilifi town</td>
</tr>
<tr>
<td>(50km from Ganze)</td>
<td></td>
<td>(50km from Shambalwani)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Languages</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giriama</td>
<td></td>
<td>English, Kikuyu</td>
</tr>
<tr>
<td>Kiswahili</td>
<td></td>
<td>KiSwahili</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Observation Sessions</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Activities</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Cooking and serving ugali</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii. Grinding maize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii. Making a roof tile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv. Making coconut oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v. Thrashing maize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vi. Splitting wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vii. Digging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>viii. Building a wall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ix. Cooking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x. Baskets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>xi. Digging</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Field study at Site 1 and Site 2
and explained the processes to the remote learner. All 8 practices/sessions are summarised in Table 1. Only one elder was tasked with conducting a session. However, as we will discuss later, there was considerable participation from other elders in teaching or directing the sessions. All sessions were conducted in Kiswahili, the national language of Kenya, which was spoken and understood by both urban and rural participants, the local researcher and the first author. The elders also switched to their ethnic tongue, Kikuyu, during the sessions.

Each session lasted between ten minutes and half an hour, and every session was video recorded. Elders were compensated in cash. These are traditional sarongs that the Girituma community uses as part of their everyday garb.

Site 2: Shambalaweni
This second study involved observing three sessions where the elders taught the remote learners everyday home skills. The elders in this study worked as a group, thus we observed multi-instructor sessions. Additionally, the learners participated in groups of between five and seven.

Elders participated from a peri-urban town of Limuru, a village called Shambalaweni. A peri-urban site was chosen for this study given that it has better internet connectivity than the rural site in study one.

The learners participated from a room at a user experience design firm in Nairobi. The room consisted of a large TV screen connected to a laptop. A table was setup in front of the screen with chairs for the learners to sit on. A video recorder was set up in the room to record the learners as they participated in the class. Figure 1 shows the setup of the study.

Sessions here were also conducted both indoors and outdoors. The elders were from the Kikuyu community, which is the largest tribe in Kenya. All sessions were conducted in Kiswahili, which was spoken and understood by all participants and researchers. Elders also regularly switched to the Kikuyu language, which was their ethnic tongue.

Technology
The elders used an iPad 2 (iOS 8.3), and Skype video conferencing software (Skype for iPad version 4.19). A mobile phone (Samsung S5) was also used as a backup when the internet failed and Skype was unavailable. Thus, when the internet dropped, the elders and learners communicated over a phone call (using speaker phone) instead of Skype.

Learners in the Ganze study (site 1) used their own laptops and Skype. Learners who took part in the Shambalaweni study (site 2) participated through a 40 inch television. The television was connected to a laptop with Skype installed.

Data Collection and Analysis
We collected data in the form of video, notes and audio clips. At site 1, we used a video camera and phone to record the elders’ activities. We also recorded sessions when the internet connectivity was poor. Such sessions, with limited connectivity were carried out via telephone call, thus only live audio communication between elders and learners. The elders’ end was still video recorded despite no live video communication between participants.

At site 2, elders were video recorded using a video camera. A video camera was also set up in the room (Figure 1a), to record the group of learners.

Additionally, we carried out brief post-study interviews with both elders and learners, to elicit their feedback about the sessions. We audio recorded these interviews using a phone.

Data analysis and synthesis involved three phases; a video annotation phase, a data analysis phase and a synthesis phase.

In the video analysis phase, we used NVivo software to review all the video and audio recordings. When analysing the videos, we made sure not to separate the text from the
actions captured in the video. Therefore, instead of solely transcribing the oral details of our videos, we focused on adding subtitles or annotations to the videos. That way, our analysis reflected the manner in which indigenous knowledge is expressed - not only verbally but also through non-verbal sounds, silences, clicks, grunts, and body and gestural movements [1], ensuring that we do not privilege verbal communication over bodily and gestural communication. Annotations consisted of descriptive accounts of our observations, insights and questions about the sessions we observed. Additionally, we included participants’ quotes in our annotations, which we translated into English. To note here, is that we did not translate all the audio content we recorded. At both sites, all participants were conversant with at least two languages. They switched between these languages depending on who they wished to address. We thus did not translate the parts that were in the edic languages of the elders (e.g. in Kionyo or Kigirama) as we understood these as not being intended for our ears. We instead noted this as a finding, and it later emerged as one of the key lessons from this study. We will discuss this later in this paper.

In the second phase, data analysis, we examined our data through a People-Place-Practice lens. The People-Place-Practice lens holds that indigenous knowledge is expressed, developed and stored, in and through people, place and socio-physical practices [3]. Therefore, in this phase we looked through our annotations and the raw video data, taking note of instances where participants interacted with each other, how they interacted with and navigated through the place of performance, and the physical and social movements and interactions that constituted the activities they were carrying out. We also observed how participants did, or did not, interact with and around the technologies we used for the study. We looked at how the participants viewed, managed, ignored or negotiated with the technologies. We made descriptions of these instances on a separate excel file, making sure to capture these for each video session we observed. The analysis phase further enriched the annotations that were generated in phase one, which was useful for a more nuanced synthesis of our study.

The final phase was synthesis. We collected our annotations, insights, observations and questions together, and sought to draw out the themes and issues that emerged. We then identified common themes across the data, often referring back to the video data for clarification. These themes and issues were then analysed via a review of existing work in HCI, providing a way to sieve out the themes that were still relevant. Additionally, we reviewed the emergent themes with the local researchers we had collaborated with in Sambalaweni and Ganza. This key step in our synthesis was done in order to build on our themes and encompass the insights from the participants’ viewpoint. Synthesis and analysis was conducted in Kiswahili. The first author transcribed and translated excerpts of the data to English when reviewing it with the second and third authors.

In the next sections we discuss the themes that emerged from our study.

**FINDINGS**

While our study involved both elders and learners, the focus of our work was to understand how elders foster indigenous knowledge when youth are remotely located. Our findings therefore focus on the elders’ end of the study.

**Coordinated performance among elders**

A key observation from our field research was that although the sessions were not extensively planned, they involved a carefully coordinated performance among the elders. Unlike the typical pattern of online classrooms, where a single instructor directs a class for the watching students, in our study there was an ongoing multiplicity of coordinated instructions from all of the elders involved. In the following analysis of this, we refer to an elder chosen to be the main performer of activities as the primary elder, and the others as secondary elders.

In Ganza, all elders and local researcher decided on what indigenous skill would be demonstrated for each session. Further, the most competent or most experienced elder was assigned as primary elder for each session. The primary elder’s main responsibility was to share one indigenous skill with the learners. What was interesting is that while only one primary elder was assigned to carry out a session, we observed that in all sessions secondary elders played key roles in conducting the session. Secondary elders switched between being observers of the session and being directors of the session. The sessions relied heavily on how the primary elder would conduct them, there was no formal lesson plan. The lesson was developed and corrected as it occurred. When secondary elders felt that an action or information had been left out by the primary elder, they instructed her accordingly, or corrected the mistake.

In Sambalaweni, the sessions differed from Ganza in that elders conducted all the sessions together. Thus, all the elders were primary elders. In the second session for example, the elders demonstrated the art of basket making to the remote learners. The three primary elders conducted three sessions in one, by demonstrating all the stages of basket making at once, and showing how each fit into the other. What is interesting in this was the manner in which demonstrations were carried out simultaneously and yet in a manner that was sequential. We observed Elder3 begin by demonstrating how to twist a rope. Then Elder1 showed the finished product in order to explain what the ropes would become. Elder2 displayed a basket with a hole. And a secondary elder demonstrated how to carry the basket. Elder2 then detailed how to weave a basket, demonstrating it practically by fixing the hole in the damaged basket, while Elder3 twisted more rope. Figure 2 demonstrates the simultaneous conversations. This style of presentation and demonstration
allowed the learners to see the end from the beginning, and the interrelationship of the end, the beginning and the process. We propose that this in turn accommodated the different levels of basketry proficiency, whether real or imagined, of the learners.

From both sites we observed that both primary and secondary elders played important roles in ensuring the indigenous activities were demonstrated correctly. There were no formal entry or exit cues between the elders. The common goal was to pass on ‘authentic’ indigenous knowledge to the remote learners. This prompted on-the-fly correcting and readjusting when secondary elders felt that crucial information or actions had been left out. The lack of a formal lesson plan allowed for storytelling to emerge through the activities performed and artefacts used.

For example, in Ganzé, one of the sessions was about cooking and serving a traditional meal known as agali. While the elder cooked the meal, she sat on a stool indigenous to the Giriama community. After the meal was prepared, the primary elder went on to explain how the stool is also used in traditional wedding ceremonies, and demonstrated how she sat on it during her marriage ceremony. She also demonstrated the actions performed while she and the groom sat on the stools; for example, as demonstrated in figure 3, how blessings were poured around them by their parents. Elders used the sessions to share stories held in artefacts they were using. The spontaneous yet coordinated sessions allowed varied knowledge to be shared with the remote learners.

**Use of a second language to refine the enactment of indigenous knowledge**

According to the sociologist, Erving Goffman [30], all human action is carried out as a performance; our roles in everyday life consist of acts and interactions which shift depending on our audience. The backstage is where performers prepare themselves, rehearse and correct each other. The secrets of their performance are discussed openly backstage – hidden from the audience.

This lens can be applied to how elders interacted amongst each other while conducting the sessions. What we observed in Ganzé is that secondary elders corrected, added to and reaffirmed the primary elder while she was still on the setting. That is, while still in full view of the audience. Thus, in order to achieve backstage openness with the elder and at the same time privacy from the audience, we noted that secondary elders switched to their ethnic language when communicating with the primary elder. Switching to a language not understood by the learners created a backstage where the elders could privately develop the session on the fly. By switching languages, elders created a space where they could sharpen their performance and thus demonstrate their competence to the learners. We also observed that the primary elder would switch languages when she sought the help of the secondary elders in supplementing the session.

In Ganzé, the elders’ ethnic language was not understood by any of the remote learners.

Alternatively, in some sessions in Shambalaweni (sessions (i) and (x) in Table 1), some of the learners were from the same ethnic community as the elders. Here, we noted the way in which learners also switched between the backstage and front stage. Thus, when the elders switched to Kikuyu, their ethnic language, the Kikuyu speaking learner would assist them in defining or translating a term to the non-Kikuyu speaking learners. Communicating in multiple languages enabled Kikuyu speaking learners to become remote co-facilitators of the sessions.

When sharing indigenous knowledge, language was used to sharpen the performance privately among the elders, and to engage learners as remote co-facilitators of the sessions. Through Goffman we identified that the elders undertook ‘impression management’ through manipulation of the ‘front and back stage regions’ of their performance. This lens was valuable in understanding why the elders switched languages during the sessions.
Sharing knowledge through a moving classroom

As mentioned earlier, learning in indigenous communities involves close association with land. Place plays a significant role in learning about and developing indigenous knowledge [13].

In our study, we observed that instead of performing all activities at one spot, elders preferred to carry out the sessions where the activities would normally occur. Thus, outdoor activities like basketry and maize threshing were performed outdoors, while indoor activities like grinding maize and cooking were performed indoors.

While place played a significant role in how activities were performed, what emerged from our observations is the significance of movement. Movement across places - whether indoors, outdoors, or between both - formed part of the indigenous activity. In making coconut oil in Ganze for example, the first task of husking and grinding a coconut was carried out in the open, the second task of cooking the oil was carried out indoors in the kitchen, and the last task of cooling and bottling the oil was carried out outdoors. It was necessary to move between the indoors and outdoors to perform the task of making coconut oil. In Shambalaweni, as the elders dug the garden, they shared knowledge on the crops, how to move while digging, harvest cycles and the importance of the foods they planted. Moving across the land formed part of the indigenous activity, and through these mobile and physical interactions, indigenous knowledge was shared. To capture all activities for the remote learners, the local researchers carried the iPad, following the elders as they moved (as shown in figure 1b).

However, not all aspects of the moving classroom could be adequately mediated. For example, the learner’s visibility of the session was impacted by movement. Elders would inadvertently move out of focus of the camera, as they assumed the iPad’s field of view was wide enough to display their entire work area. Noting this, we trained the elders briefly to check the iPad screen in order to see what the learners were seeing. However, given the mobility in the session, and thus a constantly varying distance between them and the screen, elders were not always able to clearly see the screen. Moreover, elders were more concerned with what they were demonstrating to the learners, than with what the learners could see.

We also found that the participants’ experience of the session was influenced by the changing physicality of the environment. For example, in the sessions where the elder demonstrated how to make coconut oil, the indoor kitchen used was dark and smoky while the outdoor area was bright and sunny. For the collocated participants, the change in lighting and feeling of the place contributed to learning about the different activities taking place. However, for the remotely located participants, darkness and smoke only served as impediments to their visibility of the session.

The burden of managing a video mediated session

In our study, we observed that despite the mobility of an iPad, elders found it troublesome to manage the device while carrying out the sessions. Thus, to accommodate the mobile, physical and interactive nature of the sessions without disrupting the performance of the elders, the task of managing the video mediated session had to be removed from the elders. We thus created an additional role, an iPad holder, whose task was to be an intelligent tripod. The iPad holder was tasked with moving, positioning and orienting the iPad so that the remote learners could see what the elders needed them to see, and the elder could see what they wanted the learners to see. The role was carried out by a secondary elder, the primary or local researcher, or a family member, thus allowing the elders to perform activities as they would naturally, that is, without having to manage a device.

Skype for iPad version 4.19 uses only the front facing camera for both video input and output. Thus, to ensure the elders and learners could see each other, the iPad holder had to hold the iPad with the front camera facing the elders, as shown in figure 1b and figure 3.

A number of interaction challenges emerged through the iPad holder’s role. The first was in anticipating how to hold or orient the device in order to continually capture the elders’ movements. There was regular communication between the iPad holder and the elder. This communication was however often disruptive; the elder would have to shift attention away from the learners and to the holder in order to direct him/her. The switch from remote learners to collocated iPad holder broke the flow of the session.

Another interaction challenge was that the iPad holder’s experience of the video mediated session was limited by his/her role. The iPad holder had to juggle between taking part in the session and managing the device. This left little room for the iPad holder to actively participate in the highly social and physical sessions. A trade-off emerged, better iPad management meant less participation in the ongoing sessions.

A related challenge and one that recurred often was in allowing the iPad holder to see what they were showing the remote learner. Given that the screen faced away from the holder, the iPad holder could not see what he/she broadcast to the learners. This meant that iPad holder had to ask the researchers and secondary elders to check the iPad screen and confirm what was being displayed to the learners.

Given these challenges, the iPad holder’s role was highly unpopular amongst the participants. Participants either handed over the role to someone else, or they completely forgot about holding the iPad and participated more in the in situ sessions. The iPad holder was forgotten because their role did not allow them to participate fully in the live sessions. Yet it was absolutely necessary because without
an intelligent tripod, there would be limited interaction and engagement between the remote learners and the elders.

**DISCUSSION**

In our work we chose to apply a post-colonial lens in the way we approach, analyse and translate our research. A post-colonial discourse recognizes that the technologies HCI investigates, designs or redesigns are laden with cultural encounters. Technology is not purely from the West; the design, generation and production of technologies from the West would not be possible without labour, raw materials and skills from former colonies [13]. During colonisation, colonies were robbed of their resources, power and legitimacy. Post-colonial HCI recognises that these colonial tropes continue to exist, and affect what technologies support or marginalise when they travel to new contexts [13]. At the same time however, former colonies, whether by merit (as sources of raw materials, labour and ideas), by buying power (as markets for finished products from the West), or interest, have the option to use, create and redesign technology (both local and western) to serve their cultural and situated contexts.

Thus, recognising these technocultural tensions, we were sure to do three things in our study: we applied an indigenous lens [1] when analysing and translating our data, thereby deliberately privileging the often subjugated ways of indigenous communities, secondly, we offered both insights and guidelines on how technology can further be designed, redesigned or extended to support indigenous elders. This allowed us to move from a compensation mentality, and towards an innovation mentality; and thirdly, we involved our first author, who is from an indigenous community in Kenya, as the primary author and researcher in the study. The first author informed the research with her knowledge and experience of being from an indigenous community, with her awareness of her own indigenous community’s need to nurture indigenous knowledge, and her experience researching participants in the diaspora, who like her desire to nurture indigenous knowledge.

Post-colonial computing also recognizes that new knowledge can emerge when cultures interact [13]. Thus, while western technologies may indeed advance certain indigenous ways of knowing and being, the encounter of western technologies and indigenous contexts allowed us to glean a better understanding of our indigenous users. In our work, as we used Skype and iPad to understand how indigenous knowledge can be fostered over distance, we acknowledged that this encounter illustrated the appreciation and difficulty the elders experienced when using current technologies to perform indigenous knowledge over distance.

**Opportunities for design**

Indigenous ways of knowing value highly social, physical and co-located learning methods when sharing knowledge. In our study, we sought to unpack how the sharing of indigenous knowledge plays out, when the elders and the youth are remotely located. We used video mediated communication technologies as our tool of investigation. Four findings emerged: elders employ certain techniques in order to coordinate the expression of indigenous knowledge as a group; indigenous languages are used to define the enactment of the sessions; a moving classroom is critical when sharing knowledge; and managing a video conferencing session is a burden to the elders.

Of note is that though the elders had not participated in Skype sessions before, the audio and video affordances made it easy for them to get used to the new experience of video conferencing. No elder expressed hesitation when participating in the live video sessions. Instead, in both Ghana and Shanakren, elders expressed interest in carrying out more sessions. Elders saw the video mediated sessions as an opportunity to connect with youth in urban centres and to display their rich culture widely. The interaction with the youth was the highlight of the sessions, for elders felt that their culture was being appreciated. Furthermore, enactment provided a way for elders to foster indigenous knowledge by sharing it with the youth and through concluding the sessions, revive some indigenous practices that they rarely performed.

Throughout the study, we noted that enactment was used a way for the elders to share indigenous skills with the remotely located learners. Among indigenous communities, collaboration enabled indigenous elders to teach indigenous skills by practice, and the youth to learn by doing. Thus, indigenous ways of sharing knowledge such as apprenticeship, camps and field journeys are common. In the sessions, we observed that though the elders and youth were remotely located, elders echoed indigenous ways of sharing knowledge during the video sessions. Enactment emerged as a way for the elders to echo the knowledge sharing methods used in apprenticeship. Consequently, practices such as teaching by demonstration, teaching in groups, using indigenous artefacts, associating with the lands, live interaction with the learners and storytelling were maintained during the video mediated sessions. Additionally, to ensure competence and correctness of the skills being shared, elders used their indigenous languages as a backchannel to correct their performance on the fly.

However, we observed that while the elders were comfortable with enacting indigenous knowledge over distance, managing the video sessions was a challenge. One of the challenges we observed is that elders were more interested in performing the activities and interacting with the learners, than in managing the display of the activities. We thus created the role of iPad holder to manage the sessions. Also, elders performed activities where and how they would normally occur. Mediating their highly social, physical and mobile interactions was a challenging task for the technologies we had. Finally, managing the display and recording of the sessions, required regular communication between the iPad holder and the secondary
elternersearchers, affecting their participation in the sessions.

These observations highlight some opportunities for design.

Supporting hands-free, mobile and face-to-face interaction for multiple users

The first design opportunity is mediating movement across place. From our study we observed that free movement was critical to the performance of the indigenous activities. Elders moved around between the indoors and outdoors when conducting the sessions. Despite use of mobile technologies this study, the challenges experienced by the elders and an iPad holder emphasized that mobile devices may not be best suited to mediate mobility across large spaces. One of the reasons for this is that mobile devices are designed to be carried around, while elders preferred not to handle devices while conducting the sessions. Similarly, research participants in [31] preferred that video conferencing technologies allowed them to move freely around their house.

A possible design opportunity for supporting indigenous elders is by allowing hands-free mobility in and between indoor and outdoor spaces. What is critical to consider here is that elders also enjoyed the face-to-face interaction with the remote learners. Thus, the solution should not only support hands-free capture of video as elders move between the indoors and outdoors, but at the same time maintain hands-free face-to-face interaction between the mobile and remote learners.

Enabling remote manipulation of video display

A second design opportunity is involving learners in managing the audio and video display of the sessions. While learners were not the focus of our study, we elicited some feedback from them about the sessions. One drawback they voiced was viewing the activities and environment of the elders. We observed that the learners’ experience of the sessions was affected when elders moved out of focus, when the indoor, the environment and the actions of the elders were partially displayed and when the iPad holder or the elders had to disrupt the session in order to manage the video display. Techniques such as orchestration (see [32]) have been proposed to cater to this challenge. Further research can explore direct manipulation of the video technology by the remote learners.

Prioritizing different affordances

Lastly, the structural, social and physical environments of the elders and learners differed significantly. Elders were mostly outdoors and highly mobile, while learners were indoors, with limited movement. Elders heavily relied on the mobility of the devices, whereas learners were more concerned with video and audio clarity. The moving classroom surfaced the need to accommodate the differing characteristics presented by outdoor, outdoor and moving spaces. To cater to these two contrasting environments, a possibility for technology design is to prioritize knowledge expression for the elders who are outdoors, and on the other hand prioritize knowledge practice for the learners who are indoors. Despite both ends supporting knowledge exchange, technologies for the elders and the learners may be different given that they would prioritize different affordances based on their context of use.

CONCLUSION

Indigenous knowledge is fostered through practice, with people and in close association with the lands of the indigenous community. In our study, we investigated how elders from indigenous communities in Kenya foster the practice of indigenous knowledge among youth who live off the lands. From this research, four themes emerged: contingent teaching sessions that involved multiple elders, use of a second language, moving classroom and the challenge of managing a video mediated session when teaching indigenous knowledge. These shed light on some possible directions technology design could take in supporting indigenous knowledge over distance. The next step for our work is to develop a prototype that attends to one or more of the design guidelines identified, and evaluate this with elders and diaspora youth.

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