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Book Title	Digitisation of Culture: Namibian And International Perspectives	
Series Title		
Chapter Title	A Digital Indigenous Knowledge Preservation Framework: The 7C Model—Repositioning IK Holders in the Digitization of IK	
Copyright Year	2018	
Copyright HolderName	Springer Nature Singapore Pte Ltd.	
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Abstract	Indigenous Knowledge (IK) preservation and management has been taken up as a serious endeavor by various governments who have realized the value of IK as well as the opportunities given by emerging technologies. Considering the various phases and activities of indigenous knowledge management which need to be supported through adequate designs and technologies, we propose an integrative framework: the 7C model. The aim is to guide design and implementation efforts as well as to identify and rectify any possible gaps in current implementation plans. The model comprises seven major phases within the indigenous knowledge digitization process, namely, codesign, conceptualization, collection, correction, curation, circulation, and creation of knowledge. We exemplify the application of the model with technologies currently developed under an indigenous knowledge holder's toolkit promoting the agency of digitalizing indigenous knowledge across the phases.

Keywords (separated by '-')	Indigenous knowledge framework - Cultural heritage preservation - Technology creation

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A Digital Indigenous Knowledge Preservation Framework: The 7C Model—Repositioning IK Holders in the Digitization of IK

Donovan Maasz, Heike Winschiers-Theophilus, Colin Stanley, Kasper Rodil and Uriaike Mbinge

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1 Introduction

Digitally preserving and maintaining Indigenous Knowledge (IK) has received much attention from various stakeholders over the last decade. Mainstream digitization efforts have invested in database and archiving constructs, gathering information from the IK holders, recording the information, and providing access to researchers, policymakers and to the public at large, but seldom to the IK holders themselves [1]. A major paradigm shift in responsibilities having moved from external expert curators to IK holders and carriers of cultural heritage demands the development of new technologies [2]. Worldwide-limited initiatives have explored alternative procedures including indigenous communities into a long-term cultural heritage digitization process. According to [3] whom surveyed the Intl. journal of intangible cultural heritage, few actors embrace the possibilities offered by ICT in

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D. S. Jat et al. (eds.), *Digitisation of Culture: Namibian and International Perspectives*, https://doi.org/10.1007/978-981-10-7697-8_3

preservation and very few engage with local indigenous communities in preservation processes. This leaves a question mark on how this collected material is "understood" and how its meaning is constructed and reconstructed by outsiders and how the indigenous communities are included and represented in the phases following data collection. Rodil and Rehm [3] argue for a partnership with inside actors in continuously evaluating captured, represented, and disseminated community-collected knowledge. Yet, researchers committed to the preservation of indigenous knowledge are not always seeing the need for holistic thinking.

The Namibia University of Science and Technology (NUST) has engaged indigenous communities throughout the design and implementation process, for some years the researchers have been actively codesigning technologies with Namibian indigenous communities (e.g., the OvaHimba and OvaHerero tribes). Specific technologies were developed to support IK holders in collecting, curating, and disseminating their own cultural heritage [4]. The toolset comprises a 3D graphics homestead creator application [5], a Media Collection Tool (MCT) [6], and the Community Crowdsourcing Platform (CCSP) with a Task Management Application (TMA) as a module [7]. While as part of a national IK digitalization project, a database is being designed among other technologies to support an organized IK management initiative at national level (see chapter Chamunorwa et al. in this book).

However, the collection, curation, and dissemination tools were developed in isolation on an ad hoc opportunistic project basis rather than following an integrated approach. Considering a national deployment, adaptation, and adoption of IK preservation tools, the conceptualization of a framework becomes necessary. A guiding framework for the implementation and usage of the applications will ensure continuous and sustainable development with a focus on long-term objectives and impact. The intention of the framework therefore is to directly identify the actionable areas we are working with and relay them into a structured mechanism for future development and improvement of tools. With a holistic view on actionable capacities, new areas in need of development are identified. With a national directive, spearheaded by the National Commission on Research Science and Technology, for the implementation of a countrywide IK management system sustained by research institutes, a framework paves the way for a wider governmental structure that will regulate the national repository. Most importantly, digitalization efforts within the scope of the framework will focus on the central position of the IK holder in the overall preservation process. The framework will be generic and validated in similar contexts.

In this article, we present mainstream concepts of indigenous knowledge and knowledge management processes. Furthermore, we describe our research context and methodology leading to the development of an adequate framework for the digitization of IK to govern the implementation and design of IK preservation technologies. We describe the IK holder's toolkit briefly to exemplify the integrative approach.

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2 A Theoretical Perspective

In this section, we look at the theoretical analysis of IK management, i.e., how does knowledge flow in the current implementation and the individual components thereof.

2.1 Indigenous Knowledge Management

Digital cultural heritage preservation has received much attention globally. More and more traditional practices are fading due to major rural–urban migration of indigenous youth, thereby interrupting traditional knowledge transfer and preservation mechanisms. The knowledge left with the community elders is slowly being lost as the elders are passing on.

When aiming to create a cohesive Indigenous Knowledge Management System (IKMS) with indigenous communities, there are numerous aspects that need to be considered in the overall system design and implementation. An IKMS has various mechanisms that contribute to the physiognomy of the system consisting of five phases, namely, knowledge generation, knowledge capture, knowledge curation, knowledge dissemination, and knowledge assessment (see Fig. 1).

First, we need to understand the concept of knowledge within this context. According to [8] knowledge refers to the Greek word episteme, roughly translated into knowledgeable, understanding, or to be familiar with. Terra and Angeloni [8]

Fig. 1 Indigenous knowledge management cycle

further emphasize that considering the interrelation between rationalism and empiricism leads to the more current understanding of knowledge. Accordingly, knowledge can be understood as information residing in one's mind and is derived from experience and reflection embedded in a set of individual and collective [8]. According to [9], IK in Africa is an embodiment of different modes of thought and epistemology. He defines IK as the traditional and local knowledge existing within and around specific conditions of women and men [9].

These definitions explicitly state the intrinsic nature of IK and differentiation that can be experienced from one IK holder to another as described by Bidwell and Winschiers-Theophilus [10]. Awori et al. [11] emphasize that IK is contextualized in the space between Practice, People, and Place. Considering IKs high-situated ness, tools designed with indigenous communities rarely are comparable to mainstream development.

The second component of the IKMS in the traditional sense will be the management aspect. Management systems consist of various subcomponents that form an integrated platform for collecting, curating, and disseminating the actual knowledge as described above. According to [12], a knowledge management system is an information management system with all the tools required to turn information into knowledge. Often based on organizational knowledge management theories, numerous attempts to create IK management systems exist around the globe. In most cases, those systems do not consider IK holders and communities as part of the knowledge 'organization' beyond the phase of knowledge capture. Thus, technologies developed do not provide for the indigenous community's inclusion in the digitization processes in an integrated manner. Besides, [13] who has developed a governance framework with the Penan communities to synthesize technology developments with community practices, we are unaware of similar models.

Considering the vast literature in organizational knowledge management, we briefly describe their principles as to understand which concepts could be transferable to an ongoing digital IK preservation process.

2.2 *Knowledge Conceptualization Framework*

Akbar and Tzokas [14] propose a knowledge conceptualization framework within a technological context. Based on various exploratory studies into the field, they discovered that projects studied showed similar patterns of interactions. We consider the framework relevant to our context. The derived framework is described in Fig. 2.

Stage 1: Knowledge Generation
It involves activities to experiment and create new knowledge, and results in the start of new thoughts. In our context following initial explorations of the local context as well as possibilities offered by technologies, all team members having

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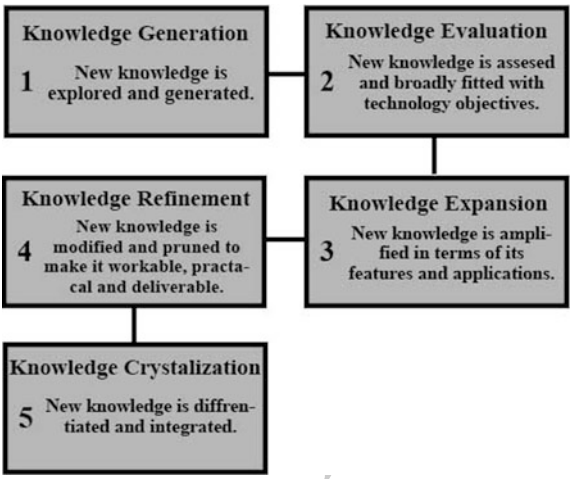

Fig. 2 Knowledge conceptualization adapted from [14]

gained new knowledge are now able to create new concepts and practices. At times following an indigenous approach to learning verbal communication and physical re-enactment (they physically demonstrate an activity) precedes, while at others conceptual understanding is required to produce new knowledge to technology design [14].

Stage 2: Knowledge Evaluation

It involves activities to evaluate new knowledge, that is, to evaluate whether it should be contemplated any further or not. The main objective of this process evolves around clarifying the goal of the knowledge being contextualized. This often results in a general discussion revolving around the daily usage of the technologies and the prospects as well as disadvantages thereof [14].

Stage 3: Knowledge Expansion

It involves activities that intensifies, or increases, new knowledge. This stage results in extending the scope of new knowledge, such as potential applications and addition of new features. This enables the IK holders to experiment and then revert back in the case where a gap was discovered [14].

Stage 4: Knowledge Refinement

This involves activities that modify, delete, or trim applications/features to make new knowledge implementable/deliverable. It results in improvement and refinement of new knowledge and its alignment with the preservation goals [14].

Stage 5: Knowledge Crystallization

This stage consists of activities that provide new knowledge in a standard format. Further, it involves two substages—differentiation and integration. In differentiation, new knowledge is partitioned in more detailed parts for specific work. In contrast, integration brings the detailed parts into a comprehensible whole. Together

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the differentiation and integration substages result in new knowledge getting crystallized into a concrete concept, which could be different objectives fed from various perspectives [14].

2.3 *Knowledge Creation Models*

In the general organizational structure, knowledge is categorized as tacit and explicit; however, IK has a profound conceptual and structural difference in comparison to the standard organizational knowledge. According to [15], knowledge travels in a spiral between different modes, namely, socialization, externalization, connecting, and embodying.

Figure 3 models the procedure of knowledge creation as a spiraling process. Noted that the knowledge creation is not a cycle but a spiral, thus the interaction between tacit and explicit knowledge is intensified through the process. The spiral becomes bigger in scale as it moves up the ontological stages. The process is defined as a dynamic process starting at the individual level and intensifying as it moves through groups of interactions.

Nonaka et al. [15] further denote that knowledge needs a context to be created. This contradicts the Cartesian view of knowledge that emphasizes the absolute and context-free nature of knowledge.

The knowledge creating process is conceptually context-specific in terms of who contributes and how they contribute. Knowledge needs a specific context to be created. According to [15], Ba as per Fig. 4 is roughly translated into "place" and this place provides the context for the creation of knowledge. This corresponds with our thinking of the creation of knowledge within the context of designing for the digitalization of IK [15].

Fig. 3 Socialization, externalization, combination, internalization (SECI) process adapted from [15]

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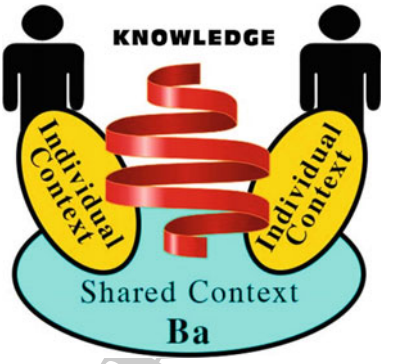

Fig. 4 Ba as shared context in motion adapted from [15]

3 Research Context

Since 2008, the IK research cluster of the Namibia University of Science and Technology has been codesigning technologies with indigenous communities across Namibia. Thus, this research is based on a decade of research and development activities.

3.1 Collaborating Community

Our most current research collaborations have been with the OvaHimba communities. They reside in the Kunene region in the northern part of Namibia. The Ovahimba up to today still lives a traditional life of semi-nomadic cattle herders. Their main method of survival is by exercising their acquired experience of the land, which they have gained through an active engagement with nature and its properties through time. Elders are custodians of their largely semi-nomadic kin, while they are also crucial holders and exercisers of IK. Our engagement and codesigning are with Uariaieke, our co-author, and the main elder of the Otjisa community. Otjisa is a homestead approximately 40 km outside the northern town of Opuwo. Uriaieke embraces the traditional lifestyle and does the occasional city visit to purchase additional food, make use of health and other services. The homestead is quite small in structural size and is in close proximity to other similar homesteads. Uariaike is supported by his family who are also executive stakeholders in the collaboration [12, 13].

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3.2 Methodology

Our research and development activities follow a community-based codesign approach which is based on philosophies of participatory design and action research. Endless joint activities with all research participants are pursued [16]. Following a design research approach, it addresses the intrinsic human needs that may not be easily generalized [17]. All interactions between researchers and the community are contextualized with numerous unfamiliar and uncontrollable variables promoting mutual learning. However, as part of the methodology, these circumstances are mitigated by continuous observation through both quantitative and qualitative measures to observe how the components play out [18]. Such circumstances are what conduces the mutual learning experience in the field of community-based codesign.

Our community-based codesign approach adopts fundamental principles of Afrocentricity and Ubuntu such as humanness, connectedness, and consciousness. We prevent creating a binary with mainstream research paradigms, but rather introduce a fresh perspective which enhances current research practices and foci [19].

3.3 Research Process

The framework presented below was developed over several steps. First, a systematic literature review was done, followed by a conceptualization based on our own empirical work. Then, the framework was refined with our research partners in Otjisa. The refinement process was initiated through a focused discussion with the community members from Otjisa. We then classified uses of the technologies they have within the scope of the phases in the framework. The explanation was started by verbally sketching the perfect technology usage scenario to the IK holder and his family and posing questions throughout the whole process. This ensured that they understand the process being presented and that they contributed meaningfully. Their inputs were integrated in the framework presented below.

4 The Digital IK Preservation Framework: 7C Model

Based on the systematic review of IK collection systems and frameworks discussed in Sects. 2 and 3 of this chapter, we have devised a framework called the 7C's. The building blocks of the 7C model are depicted below as codesign, conceptualization, collection, correction, curations, circulation, and creation.

Figure 5 shows a high-level abstraction of the functional stages involved in the digitization and preservation of IK. The following subsections elaborate the digital IK preservation framework layers in detail. The main goal of all our efforts is

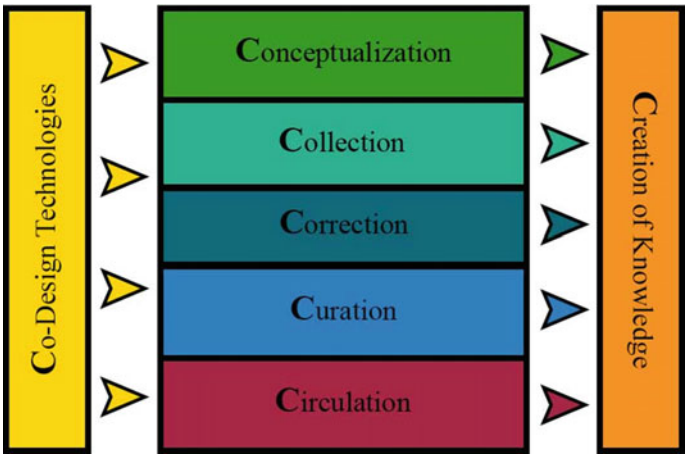

Fig. 5 Digital IK preservation framework (the 7C model)

positioning the IK holders as the main proprietors of the technologies, and digitization processes of their own IK, leading to new knowledge creation. As depicted in Fig. 5, codesign activities and creation of new knowledge are part of a continuous process of digitalizing IK.

4.1 Codesign Technologies

As mentioned, community-based codesign is the overarching methodology (with an underlying constructivist philosophy) that we follow in all our research and development endeavors. As part of the long-term engagement with communities throughout Namibia, the research cluster has refined the codesign process that has been tested and verified across various cultural tribes. The process amplifies the mutual learning environment between the researchers and the IK holders. The process also works at establishing the relationship between the researchers and the IK holders to prevent exploitation and other unfair practices as has been reported many at times in the literature, where benefit sharing was not discussed. The process outlined below works at empowering the IK holders to learn the necessary skills to design technologies that will ensure the digitalization of their cultural heritage in their own terms. Figure 6 depicts sequential activities involved in the codesign process.

Step 1: Introduction

This stage is simply intended for both parties to introduce each other and establish whether working together is an option. This stage is executed in isolation from any official recording material and a pure bonding session to ensure mutual respect.

Fig. 6 Codesign process

Step 2: Project Establishment

At this stage, researchers engage with the community in discussions around the project, reveal their research and personal agendas to ensure that both the researchers and the community are on the same level. Thus, both parties elaborate on their expectations regarding the project management and outcome.

Step 3: Commitment Agreement

Based on outdated ethics rules established at institutions not familiar with equal collaborations between researchers and communities, mechanisms such as consent are required. We use the request for recording and image taking as a discussion point about rules governing the two worlds and agreements among the collaborators. This step is only required in situations where it is the first encounter with a community or individual. Commitment agreements are continuously revised as the project progresses. We often find that models for commitment differ among partners. For example, that oral contracts are not respected in academia and that paper contracts are not respected in local communities.

Step 4: Joint Design Activities

Many different techniques are used to jointly produce design concepts, such as focus group discussions, card sorting, scenario creations, walks, and real-life tech evaluations. The sessions are led or initiated by members of the team being researchers or community members. The researchers record the activities and discussions for post-situ analysis and mostly translations.

Step 5: Technology Development

The technology development stage is done in isolation from the community as this stage evolves around purely technical process such as coding, testing, refining, etc. The developments of the technologies required by the communities are based on the codesigned ideas with the communities and with the researchers. This is done to ensure that when the application is deployed in the communities that the users will

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be familiar with the system to interact with the application interface as well as the functionalities that lie behind the interface. Often de facto co-creation is challenged by contextual factors such as the absence of grid power, etc.

Step 6: Technology Testing

This step is intended as an intense testing phase for the developed technology. The technology is deployed with the intended community and remains in their care for the duration of the probe. This step is vital for all types of usability testing as it provides the community with the opportunity to completely analyze the technology in their own environment isolated from the researcher's inputs.

Step 7: Technology Refinement

This step is a feedback stage that enables the community to iterate the difficulties they experienced during the probing stage. The designers can then along with the community redesign around these difficulties to improve the usability. Once this stage is completed, the technology should jump back into the probing stage to ensure that both the designers and the community agree upon the final version of the application.

Step 8: Technology Deployment

Once the probing and refinement stages have concluded, the technology is deployed with the community for their continuous use and exploitation of the technology. This allows the users to enhance their understanding not only of the developed technology but also other positive and negative social aspects of using the technology.

4.2 Conceptualization

Conceptualization in the context of digitizing IK means to understand the two epistemologies, namely one of the IK and one of the technologies to derive an appropriate mapping.

The conceptualization phase consists of a transcultural engagement approach where the focus shifts from cross-, inter-, and multicultural interactions. Thus, formulating an environment where the focus is no longer on the individual contributors, their interaction or roles, but on the smooth and elegant collaboration between stakeholders to co-develop technologies that will benefit all parties [20].

An example of this process would be the technology interface design process. This process is incorporated into a workshop, where the functionalities of the intended technology are broken down into meaningful sub-functionalities. These functionalities are then explained to the IK communities in a traditional sense. They are then tasked with selecting the appropriate depiction of the functionality that can be incorporated into the interface.

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4.3 Collection

Having agreed on a workable conceptualization of digitizing IK, the correct tools must be codesigned to enable the IK holder to collect IK. This phase in the framework refers to the codesign of actual technology to be integrated and used in everyday life of the IK holders to "Record" their knowledge through the functionalities provided in the technologies. Considering the semi-nomadic lifestyle of some indigenous communities, their day-to-day activities entail much movement and physical work. Therefore, technologies must be fit in the busy schedule and be lightweight. To date, we deployed two applications that enable the IK holders to collect their knowledge via the Media Collection Tool (MCT) and collate the collected media items on the crowdsourcing Task Management Application (TMA) (see details below).

4.4 Correction

This stage in the digital IK preservation framework attains to the ability of the IK holder to use the collection tool to review and correct possibly incorrect records before the curation process is initiated. Due to the physical nature of the activities pertained to IK communities, the assumption being made is that the IK holder will collect information throughout the day and at a later stage revisit the collected information. During the revisit process, he or she will be less active and have more cognitive freedom to process what was captured and identify what needs to be corrected.

The correction process is a seemingly majestic task as all collected data needs to be validated by a local knowledgeable person to ensure that all information being released portrays the culture of the specific communities with the best of intentions as to prevent a negative perspective from being formulated by external viewers.

The feasibility of this stage revolves around the implementation of the functionality in the IK holder toolkit that would enable the IK holder to "Edit" a recording (Video or Media) by "inserting" a new recording after or in the middle of a previous recording correcting the mistake or adding on to the discussion that was being recorded. This stage is not a very complex stage but is vital in the process of ensuring that the data collected is validated before any further processes especially dissemination to the outside world.

4.5 Curation

This stage revolves around taking the collected data and putting them together into a representation which could be meaningful to a specific audience. This stage is

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therefore subdivided into three possible scenarios namely database curation, Homestead Creator (HSC) curation, and technology curation. Database curation is deciding which elements of the data collected are necessary, which ones belong together, etc. In other words, it is grouping unstructured information in such a way that it forms a type of collective record on a certain topic such as medicine, building, gatherings, etc.

If we want to curate HSC material, it involves formulating a specific scenario out of the collected information and then putting a 3D plot and adding a narrative or scenarios. This enables a more intuitive view and explanation of the described scenario.

The same applies for the scenario where we need to develop a whole game, you look at the data at hand, then find an all-encompassing storyline to weave the collected information into, and then just build the game navigation accordingly.

Therefore, the curation phase is the stage where the collected knowledge is put into a contextual environment for the users to interact with and learn about the cultures.

4.6 Circulation

The main reason for the initial amplification of research into the preservation of IK relates to the rise in rural–urban migration. More and more community members are diverting from their traditional lifestyles to attend schools and universities. This therefore increases the danger of their culture fading away because the knowledge holders are passing on and they have no one around to continue the legacy that was built over centuries. Thus, the importance lies in reaching out to the youth and other audiences through different means and forms. This could be access to scientific databases, games, encyclopedias, etc. This will in turn ensure that that the knowledge transition is preserved for many generations to come.

This stage therefore entails the actual contextualization of curated information into the circulation tools for dissemination to the intended focus groups. Currently, the main tools for circulation of knowledge include some small-scale 3D games, Wikipedia, etc, with further enhancement plans for Augmented Reality (AR) and Virtual Reality (VR).

4.7 Knowledge Creation

Knowledge creation is in the general sense a continuous process. Be that while developing technologies, interacting with the communities, exploring new means, etc. Knowledge is a result of human experience and reflection based [8]; therefore, knowledge creation is not a single-sided process. In the spectrum of this research, knowledge is not only created inside the communities but when we as the

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researchers engage with the communities we formulate stories in the natural sense that we share with the world and this formulates knowledge. According to [13] knowledge in indigenous communities occurs via two main processes, namely, "interaction" and "action". Whereby interaction refers to the physical exchange of existing knowledge via communication channels such as verbal communication (sharing stories) and embodied action (showing or performing a deed). Action refers to the production of new knowledge during the embodied execution of existing and acquired knowledge in a certain context [13]. Thus, within a design context of IK tools, through interaction among researchers and community members and the action of design, new knowledge is cocreated.

5 The IK Holders Tool Kit

In this section, we present the set of tools that were codesigned with the IK holder covering the different phases of the framework.

5.1 Media Collection Tool

The media collection tool was developed as the main means of IK collection through capturing various media [6]. The media is then stored on the deployed device and collected by the researchers on agreed intervals to prevent data loss from occurring. The various media forms collected in the application are images, videos, drawings, text input, and audio. The IK holders use this application to mainly document daily traditional activities that they feel worthy to preserve (Fig. 7).

Function 1: Media Collection
This function combines all the media capturing features together such as videos, images, audio, and text. This caters for all possibilities of input, to maximize the efficiency of the application in the collection phase.

Function 2: Media Review and Edit
This is a very important functionality of the application that enables the IK holder to review and edit captured media. In the event of incomplete or incorrect media, the IK holder can then add or edit the existing file to complete what is missing or correct what was incorrect. Needless to say, still images can only be drawn upon, or completely replaced where needed. This functionality contributes to the correction phase in the framework.

Function 3: Media Grouping
This is also a very important functionality of the application as this allows the IK holder to group (categorize) media relating to certain activities or topics. This allows the IK holders to categorize their captured media into meaningful

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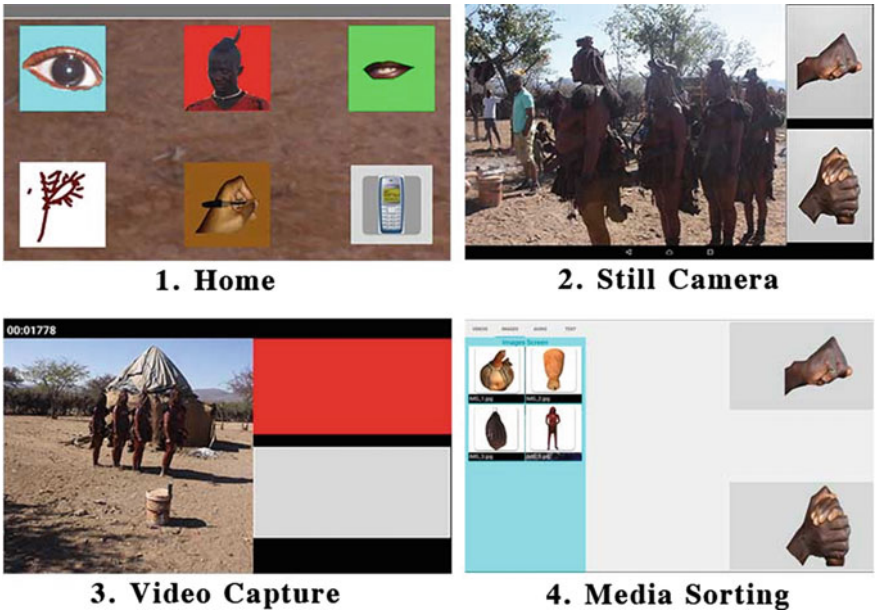

Fig. 7 MCT interface

classifications according to their own context. This feature contributes to the curation phase in the framework.

In summary, this technology at this junction supports the collection stage of the framework in the sense that it allows the IK communities to collect various media on their traditional activities such as building a hut. The collected data is then stored locally on the devices deployed with the IK holder, with a future addition of pushing viable information directly into an institutional database where it can be verified and pushed into the national repository.

5.2 Task Management Application

The task management application is an in-development prototype that was code-signed with the IK holders to allow them to indirectly communicate with the global crowd [7]. It will enable the knowledge holders to implicitly direct the request of 3D model designs to a global audience. These designs alternatively will then be integrated into our dissemination tools such as the Homestead creator discussed in a later section of this chapter. The following functions are supported:

Function 1: Formulate Task Request

Of all the media collected through the before-mentioned media collection tool, the IK holder must combine the related media items. The process starts with the IK

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holder selecting the preferred photos of the traditional object to be modeled to 3D. After the selecting the preferred photos among the set of all captured images, the IK holder selects the audios that we recorded about those photos and the process continues in a similar manner until all related media items are assigned to the selected photos. The intention is that all media placed into a specific collection will be related to a single request. This exercise is part of a curation process.

Function 2: Process Request

This functionality revolves around the ability of the IK holder to submit a collection of media to the crowd that will enable the global community to take part in the design process of the request. The collated media items are sent as a task to the community crowdsourcing website for the translators to translate the media items such as audios from the rural communities' language to English for the graphic designers to understand. The process does not involve much except for the IK holders to review the task request content and to provide consent to upload the requests into the cloud. This is part of the dissemination process though formulates as a request.

Function 3: Evaluate Requests

The review process is also a simple process that involves the IK holders evaluating the 3D design submission. If the delivered 3D models need to be refined the IK holders, then provide details on where to improve on the 3D model or they reformulate the task request. Upon approval, the crowdsourcing platform administration is alerted as to take the necessary arrangements for the designs to be incorporated into the dissemination tools. This is part of the correction phase.

In summary, the TMA is also a type of support mechanism for the MCT as mentioned in the framework section of this chapter. The TMA mainly allows the IK holder the opportunity to group-related media files together to represent a specific object/person. This representation is then sent to the crowdsourcing platform to design a graphical representation of the object/person that will then be incorporated into one of the currents or soon to be curation tools [21].

5.3 Homestead Creator

The HSC, a 3D graphics application, enables indigenous community members to depict their lifestyles and traditions by interaction and manipulation of a virtual 3D world [5]. The purpose of the HSC is to support the elders to digitally curate and disseminate IK to youths about their traditions and culture in and around their homesteads. Yet, over the years, it has become an interface, which makes space for dialog between researchers, technology developers, and indigenous elders about their conceptualizations of their own experienced lifeworlds when transferred into bits and bytes. Which in turn allows the researchers and technology developers to be more critic toward the systems they develop, when they expose their own conceptualizations of the data they "think they understand" ~~(Fig. 8)~~.

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Fig. 8 Homestead Creator interface

The HSC is still in exploration phase due to some implications that the implementation process presents us, in the sense of importing newly created 3D objects and then redeploying. But in the current state as explained above the HSC tends to lean toward supporting the collection and curation stages more than it does the circulation stage.

5.4 Wikipedia

Wikipedia, the renowned online encyclopedia, allows in principle everybody to upload content, which would include IK holders. However, the current structure is based on written information with a very specific codification. Yet, indigenous communities have often not developed written accounts of their past and current practices as they relied on oral transmission thus making their form of information incompatible with current Wikipedia structures [22]. Several initiatives in Namibia attempting to create a Wikipedia editor community, be it of the English or the indigenous languages, have failed so far. While [23] established a persuasive approach to uploading indigenous content, it did not manifest in a continuous activity. The use of Wikipedia could be part of the curation, correction, and circulation phase.

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6 Conclusion

Numerous efforts around the globe attempting to digitalize IK have shown to be a complex endeavor. And although often at time organizational knowledge management concepts have informed the development of specifically national IK management systems, the IK holder was not considered equivalent with an expert but rather an informant. Thus, technologies developed support collection from IK holders, yet processes of curation and dissemination remained inaccessible to the IK holder. In this light, we have developed a framework which suggests a continuous codesign collaboration of the tools catering for all the phases of heritage preservation thereby repositioning the IK holder. Not only will the IK holder work with the tools but has created them within his or her own context. The 7C framework has integrated codesign activities, with cultural heritage preservation phases as well as knowledge management processes based on our empirical data as well as existing theories and best practices. We have exemplified the 7C model with current technologies under development with the Ovahimba communities ensuring an integrative approach.

Acknowledgements We would like to thank the Namibian Commission for Research Science and Technology (NCRST) for their financial support over the years. More closely, we would like to thank the participants from the Otjisa village for their unwavering commitment to the project and all the contributions they have made.

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