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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



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

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

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

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

56 In this article, we present mainstream concepts of indigenous knowledge and
57 knowledge management processes. Furthermore, we describe our research context
58 and methodology leading to the development of an adequate framework for the
59 digitization of IK to govern the implementation and design of IK preservation
60 technologies. We describe the IK holder’s toolkit briefly to exemplify the inte-
61 grative approach.

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



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

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

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

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

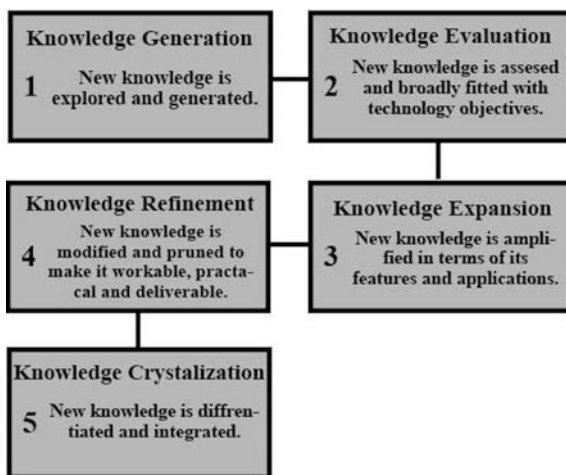
111 2.2 Knowledge Conceptualization Framework

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

117 Stage 1: Knowledge Generation

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

Fig. 2 Knowledge conceptualization adapted from [14]



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

126 **Stage 2: Knowledge Evaluation**

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

132 **Stage 3: Knowledge Expansion**

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

137 **Stage 4: Knowledge Refinement**

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

141 **Stage 5: Knowledge Crystallization**

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

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

149 2.3 Knowledge Creation Models

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

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

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

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

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

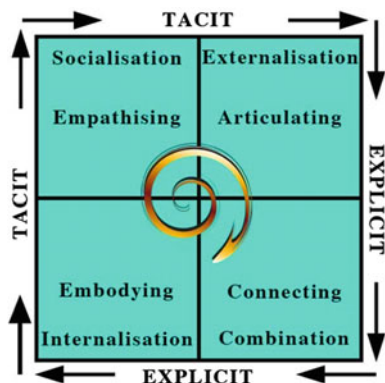
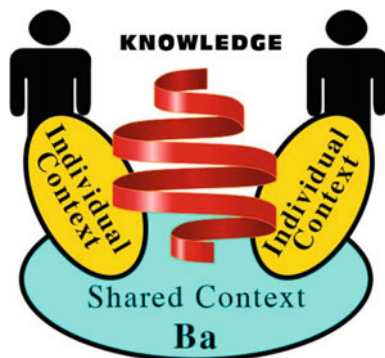


Fig. 4 Ba as shared context in motion adapted from [15]



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. **Uariaieke** 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. Uariaieke is supported by his family who are also executive stakeholders in the collaboration [12, 13].

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

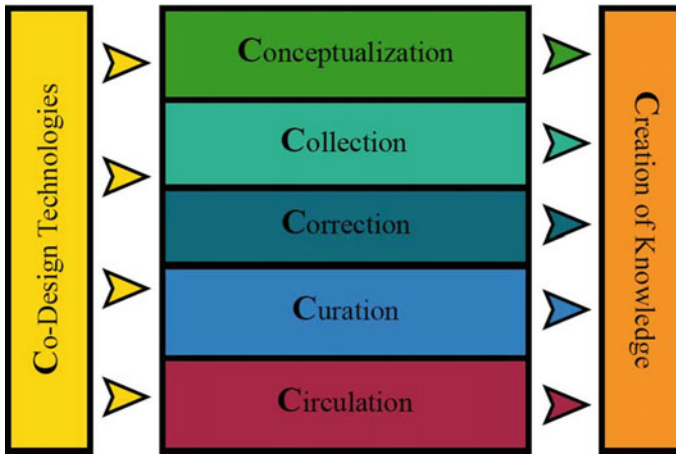


Fig. 5 Digital IK preservation framework (the 7C model)

225 positioning the IK holders as the main proprietors of the technologies, and digiti-
 226 zation processes of their own IK, leading to new knowledge creation. As depicted
 227 in Fig. 5, codesign activities and creation of new knowledge are part of a contin-
 228 uous process of digitalizing IK.

229 4.1 Codesign Technologies

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

243 Step 1: Introduction

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

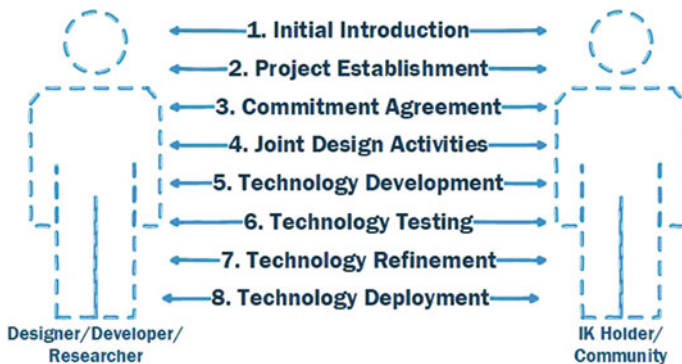


Fig. 6 Codesign process

Step 2: Project Establishment

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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.

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Step 3: Commitment Agreement

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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.

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Step 4: Joint Design Activities

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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.

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Step 5: Technology Development

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

278 **Step 6: Technology Testing**

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

284 **Step 7: Technology Refinement**

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

291 **Step 8: Technology Deployment**

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

297 **4.2 Conceptualization**

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

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

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

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

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

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

394 5 The IK Holders Tool Kit

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

397 5.1 *Media Collection Tool*

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

404 **Function 1: Media Collection**

405 This function combines all the media capturing features together such as videos,
406 images, audio, and text. This caters for all possibilities of input, to maximize the
407 efficiency of the application in the collection phase.

408 **Function 2: Media Review and Edit**

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

415 **Function 3: Media Grouping**

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

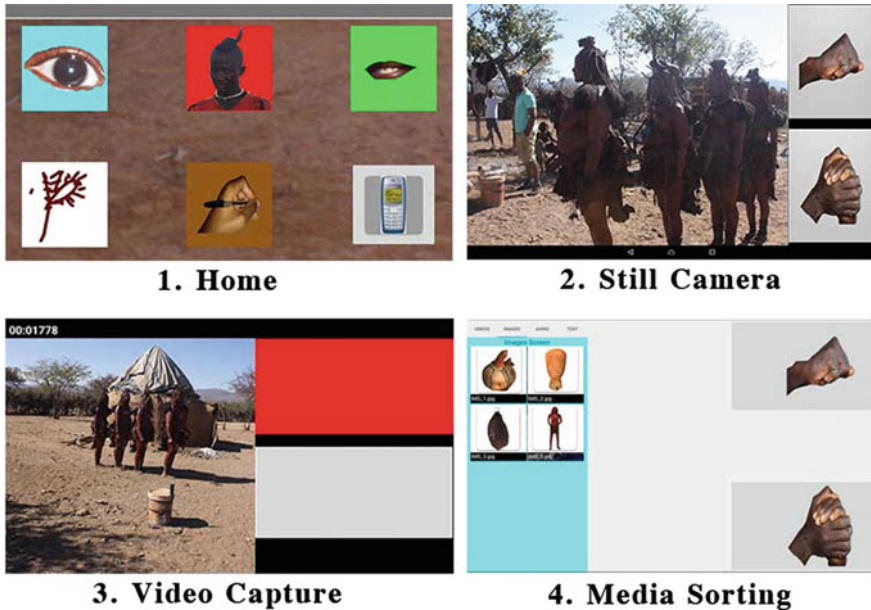


Fig. 7 MCT interface

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

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

427 5.2 Task Management Application

428 The task management application is an in-development prototype that was code-
 429 signed with the IK holders to allow them to indirectly communicate with the global
 430 crowd [7]. It will enable the knowledge holders to implicitly direct the request of
 431 3D model designs to a global audience. These designs alternatively will then be
 432 integrated into our dissemination tools such as the Homestead creator discussed in a
 433 later section of this chapter. The following functions are supported:

434 Function 1: Formulate Task Request

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

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

443 **Function 2: Process Request**

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

453 **Function 3: Evaluate Requests**

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

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

466 **5.3 Homestead Creator**

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



Fig. 8 Homestead Creator interface

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

482 **5.4** *Wikipedia*

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

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.

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