ARCHIVES AND MANUSCRIPTS
2019, VOL. 47, NO. 1, 72–93
https://doi.org/10.1080/01576895.2018.1551143

Routledge
Taylor & Francis Group

ARTICLE

Locating knowledge

Cat Kutay

Faculty of Engineering and Information Technology, University of Technology Sydney, Sydney, Australia

ABSTRACT

This paper arose from a discussion of the richness of languages used to describe different landscapes of Australia and how the landscape provides the affordances for the language created from this land. More importantly, each language embodies its place and associated world view. This paper looks at how information technology (IT) is supporting knowledge-sharing through approaches used in Indigenous community IT practice and projects to enhance multimedia repositories of knowledge. The origin of any archive is important, in terms of access and control of the use of this material, but also it is important in teaching, to provide the context and connectedness when presenting the material. A collection of knowledge resources can be used to recreate online flexible learning environments around engineering on country and traditional knowledge practices. IT can provide an interactive interface for people wishing to learn the material, through games or worksheet-style activities. Various case studies and their analysis illustrate the way IT can be used to share this knowledge in a legitimate manner across landscapes and cultures. In particular the aim is to understand how authentic this approach can be in view of concerns over appropriation or co-option of Aboriginal knowledge.

KEYWORDS

Indigenous knowledge; IT for knowledge-sharing; Aboriginal language reclamation

Introduction

Aboriginal knowledge comes from the land, in the literal and a poetic sense. The language has developed to describe the land, how to manage it, how to walk it, how to live with it. Given the great variety of vegetation and landscape in Australia, we have developed in this country a great variety of language to express the different 'affordances' of the landscape and the embodied intentional relation with the land and the life on it.[1]

Poetically the language is a storage of knowledge about the land, the history and the details of the landscape. The reclamation of languages in Australia was initiated with naming the country, re-saying the Aboriginal names for significant land features. Collecting the language in relation to country in this way is to know that place.[2] This paper discusses how information technology (IT) and its various formats can be constructed to fit the needs of Aboriginal knowledge-sharing, using and creating significant archives of knowledge, in language and in multimedia.

CONTACT Cat Kutay cat.kutay@uts.edu.au Faculty of Engineering and Information Technology, University of Technology Sydney, Sydney 2007, Australia

The location of language is important when using archival material to assist in language reclamation, in terms of access and control of this material, but also it is important in the teaching, to provide the context and motivation for learning. This work is partly derived from studies of language and place,[3] and how the landscape provides for the creation of a unique language used in that place. But more importantly how this in turn creates a people who are the embodiment of that place in their culture and world view.

The paper is a series of evolving experiences in IT development with communities and the paper is directed at understanding and improving this design work. In developing knowledge management tools and how to design technology to support sharing this knowledge, this paper compares the work with traditional knowledge-sharing processes. In particular, design work with Aboriginal people involves sharing the knowledge of the technology but also the culture that is embedded in the technology.[4] As designers, either we ask people to enter the culture that created the technology, that is assimilate, or we engage people in design to change that technology to suit the culture. Then we are embedding the Indigenous Australian cultural knowledge in that IT, so that the knowledge becomes part of the artefact, and so Aboriginal people will then consider they have some ownership of the product, similar to the rights recognised in copyright and IP laws.

Any role of IT is severely limited by the need to retain Aboriginal control of the knowledge in an authentic manner. However, providing another context online where people can collaborate and share knowledge around and within language and place, is a significant process for our future understanding. This paper considers the location of that knowledge into the IT format and the validity of doing so.

The various case studies derive from the experience of the author who is an engineer and IT developer who has worked in appropriate technology design and training while living in Indigenous communities around Australia and the Pacific since the mid-1980s.

To create repositories of knowledge, and their interfaces, be they interactive as in games or simply searchable material, the protocols for engagement with Aboriginal communities are extended by the consideration of the specific knowledge-sharing protocols involved.[5] We need to understand how these protocols translate into suitable actions and sustainable relationships across cultures. In development of IT applications with Aboriginal peoples as traders in knowledge we apply the sentiment of the Pitjantjatjara people: ‘Ngapartji Ngapartji: We give, you give’.

Knowledge located

How we can recreate Aboriginal knowledge-sharing techniques and protocols online is a vital part of developing IT for Aboriginal communities. The author has been involved in many projects with communities in technology training and design. The described approach is not only for community to participate in the design and use of their own IT resources, but for students, for example, in university Indigenous Summer Schools, to encounter technology that is relevant to community development and so lead to a growth in Aboriginal developers.

First case study – fire burning

An early adaption of IT in community was by Victor Steffensen, a filmmaker working on his country in Cape York. Working with his elders he travelled their county, sometimes conducting burn-offs when the elders said there was a need. Victor GPS-located and recorded these burn-offs. Soon after a hot fire went through the area but missed the areas that had been burned by the Elders (Figure 1).[6] Steffensen presents this as Aboriginal adaption of complex technology,[7] an intuitive appreciation of its use. However, it is also a lesson in who is listened to, the man with the locating device, rather than just the man with his stories.

This was a way that Aboriginal knowledge of fire maintenance could be proved through European science. However, it should not take such a process for the knowledge to be heard, as the stories themselves have an embedded location device.

Many Aboriginal people have expanded this process of filming stories on country to educate both their own people and non-Aboriginal people. This process aims to convey the cultural knowledge while not located on the country of which it is an expression, by retaining some link to the landscape. However, these videos may be used in many different contexts, losing some of their significance. Concerns have been raised about the authenticity of this sharing process, which will be discussed throughout this paper. As Christie points out during a project of collecting botanical knowledge:

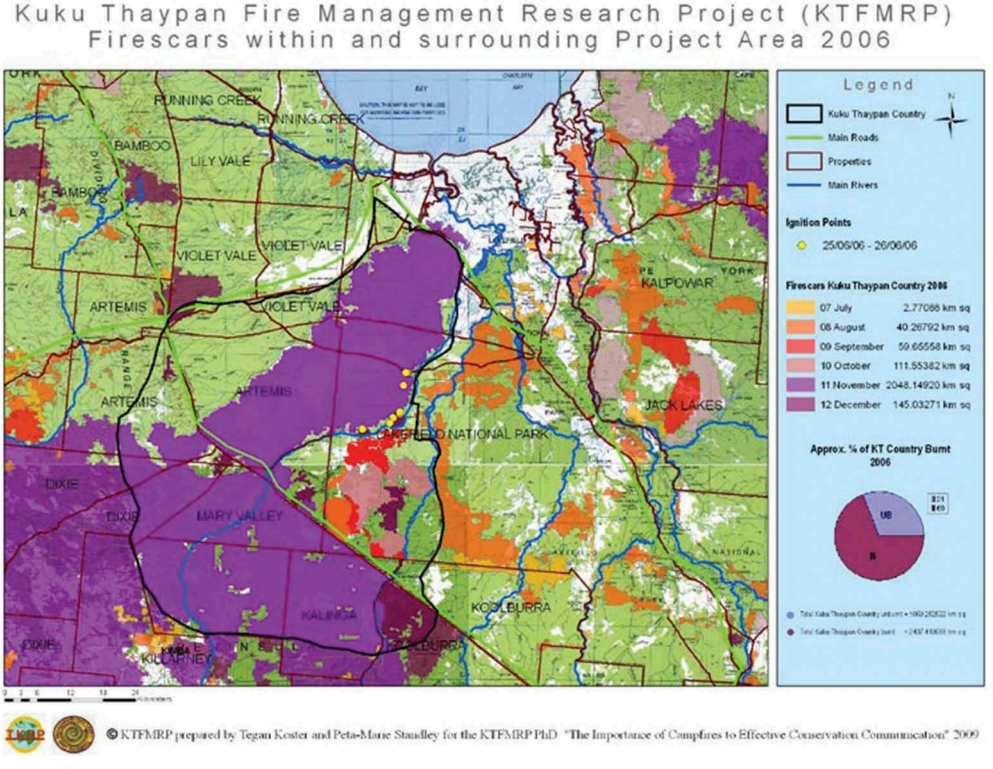

Figure 1. Traditional Knowledge Project data on cold fire burning (reproduced with permission from Standley et al.).

> The very features which provide its main significance in an Aboriginal knowledge tradition (where this particular plant happens to be for these particular people at this particular point in their lives, who is telling the story, why they are telling it here and now, and how the story fits into the wider networks of kinship, art, music, ceremonials and philosophy) are lost in the process of abstraction which records how any plant of this particular species in any location might be of use to any person at any time.[8]

Using video as a medium to convey knowledge has been questioned, even though this retains much of the location context. In particular, the representation of traditional place-based and holistic knowledge systems in new interfaces requires an analysis of shared meaning of the community sharing their knowledge, and the dominant culture viewing it. The use of video media and the highly personal stories of and on country provide new ways to look at knowledge-sharing,[9] while acknowledging the effect of the location-based nature of all knowledge:

> … [T]he fact that our vision of the world is a vision from somewhere, that it is inextricably based in an embodied and therefore partial perspective, … . makes us personally responsible for it. The only possible route to objectivity on this view is through collective knowledge of the specific locations of our respective visions.[10]

Verran discusses the way location is treated in different knowledge traditions when Aboriginal fire burning is explained to non-Aboriginal scientists.[11] One major difference is the non-Aboriginal scientists' attempt to generalise to the level of habitat while the Aboriginal experts will focus on the role and experience of the different participant groups, which combine to make a successful performance of fire burning. What this means is that the plants and animals in an Aboriginal world view are unique in terms of their unique location in a complex environment. For Aboriginal people the knowledge of such skills is in the land, and the people who belong to that land.

> In Aboriginal knowledge traditions it is most important that particular knowledge authorities participate in specific roles in the planning and execution of the firing. Expressions of knowledge are not valid unless this condition is met.[12]

This knowledge is stored in the repository called the Dreamtime, in which the knowledge is conveyed as a continuous period from the past to the future, expressing the timeless and changing aspects of the people's knowledge of country and society. Much of this does not translate into knowledge for Western scientists:

> Things seemed to be the wrong way around, and too mixed up for the scientists. In their understandings of knowledge, the land is quite independent of and separate from human acts. Humans as knowers might tell of the land in this way or that, but the land can only speak in a metaphorical sense. It was clear to all that our instructor was not speaking metaphorically. Where were the generalizations about habitat that the scientists saw as necessary to justify a firing?[13]

In fact:

> Aborigines report their episodes of burning, they completely fail to attend to the place as a whole. They emphasise and recognise only the diverse involvements of the groups who have variable interests at stake in a collective episode like a firing.[14]

However, when Aboriginal people extract knowledge and material from the land to create something, such as fire sticks, then the knowledge is in the human craftsman and

the artefacts are embodiments of that skill. Verran noted that then the material loses its uniqueness and becomes part of a generic 'stick to create fire'.

> [T]he scientist asks the names of the two bushes from which the fire making sticks were plucked. It is quite clear to him that the plants are very different – they belong to different biological families. He is genuinely shocked when the old man insists that they are really the same. While the old man accepts that the plants might look different, he insists that what is important is that logically they are 'the same one'.[15]

What we aim in this paper is to look at how to extract the generic patterns without losing the significance of the knowledge to the location or people. Also, how to teach this complexity of knowledge to non-Aboriginal people who are coming in as children to the culture and experiencing these concepts for the first time.

Overall approach to IT – storytelling in corroboree

We are trying to achieve through IT the ability to make effective worlds in place where knowledge can be constructed by a learner out of the available multimedia artefacts. However, a video, audio, image or text story in itself is not knowledge, it is information that may or may not engage the listener, but when there are various sources used (as in a journal paper) or when various speakers contribute to the story, the combined whole is not only more engaging for those contributing and listening, this is also a method of providing a coherent and complete knowledge of the theme of the story. If immersive in place, can this provide an effective and authentic online location for sharing Aboriginal knowledge?[16]

A significant difference between the knowledge-sharing processes of IT collaboration and an Aboriginal ceremony is in the organisation. In a corroboree the elders first gather to establish the issues that need to be discussed, the theme of the ceremony. This is when those who are expert will present their knowledge of what should be shared and what should be performed (for example, what is relevant for this season).

> When a ceremony is to be performed, there are long, complex, and often fraught, negotiations necessary to develop agreement on everything from where and who, to which images, which sacred names, which ancestral song lines, and which ritual acts are best for this time, these people, and this place. … Its work is not simply to represent an ancestral reality, but to produce it here and now. Effective Yolngu knowledge work does not produce effective representations of an external world; rather it produces effective worlds in place as performance.[17]

When they perform the corroboree in front of the community, those who have authority to speak will be teaching this knowledge, so need to provide a complete and accurate story from the material. Stories are placed in a story-path sequence and the theme may relate to morality, for example how to uphold the law otherwise suffer penalties, with examples both from the Dreamtime and as experienced under non-Aboriginal law.[18] In this case the story path may be located in one point in space and form a path in time.

Alternatively, stories may relate to preservation of the land, and the processes used by ancestors which may relate to a path across the land that people will use to travel between communities. The story will then describe in sequence the features,

seasonal food, waterholes that can be found and the different aspects of the environment.[19] The story is then remembered and repeated as people walk the country, with features in the landscape acting as memory triggers, as described in Cicero's oratory method of loci:

> [Simonides] inferred that persons desiring to train this faculty [of memory] must select places and form mental images of the things they wish to remember and store those images in the places, so that the order of the places will preserve the order of the things, and the images of the things will denote the things themselves, and we shall employ the places and images respectively as a wax writing-tablet and the letters written on it.[20]

Christie and Verran explain that media as representation often does not match the methods or format of knowledge-sharing as understood or performed by Aboriginal people. For instance:

> How conversations produce symptoms was quite lost on the doctor who didn't understand the ways in which collective Aboriginal performances produce new possible worlds. We must therefore be careful how we perform in a collective agreement making episode.[21]

Much of the storytelling where the knowledge is shared in performance is lost when removed from the place of ceremony. However, not all ceremonies are conducted in place, a version of the effective world is created in the corroboree, and a suitable place is chosen for that. For digital collections a compromise is often reached with the technology available, and the media of the Internet has been adapted as a messaging tool by many communities. The site developed by Steffensen described above, 'The Living Knowledge Place', was an early use of the Internet for sharing Indigenous stories and this is used in schools as a resource for cultural learning.[22]

In any online version of knowledge-sharing the aim is to emulate this way of both enhancing and verifying the content. The issue is how to link material in a way that is relevant to those seeking to learn. To do this we need to work with the community in a way that ensures the methods match the knowledge being shared. Rather than creating an archive, we are trying to bring the archive into the performance space. In particular we want an integrated whole between Western and Aboriginal knowledge presented. So, we start with Aboriginal engineering.

Knowledge to be shared – Indigenous engineering knowledge

The Aboriginal people of Australia have always been engineers and philosophers, just using different approaches to Europeans. Also, Aboriginal people have always been innovative, with David Unaipon inventing the sheep-shearing comb that converted the curved motion of the shears into a straight motion (Figure 2).[23] However, acknowledgement of inventions or prior knowledge has been sparse. Often traditional engineering knowledge was denigrated by the early Europeans as it flew in the face of the perception of Aboriginal people as an inferior race.[24]

The case studies in this paper come from technology for teaching Aboriginal knowledge into the university and school curricula. This paper looks at the various processes for enhancing both the experience of students of the Aboriginal technology, and an engagement with learning in general. For the creativity of our students, both Aboriginal

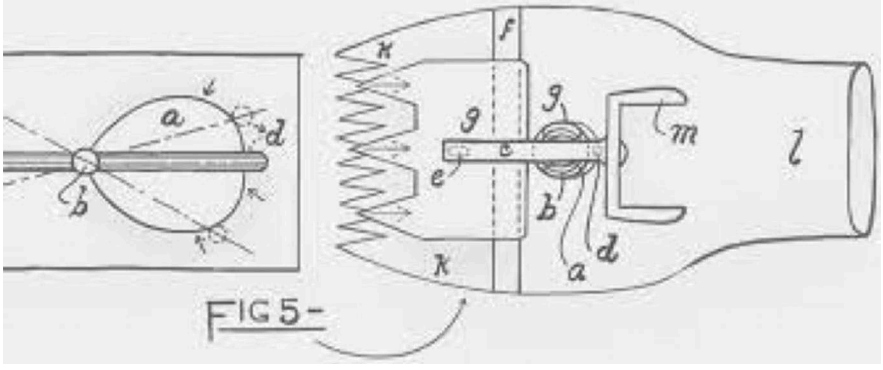

Figure 2. Sketch of an 'Improved Mechanical Motion Device' (wool shearing handpiece) invented by David Unaipon, 3 September 1909, reproduced from Adelaidia under Creative Commons Attribution-NonCommercial 3.0 License (CC-BY-NC).

and non-Aboriginal, will be only enhanced by a deep understanding of other knowledge systems, in two-way learning.

There are both educational aspects to be shared from Aboriginal knowledge, and practical aspects to consider in this sharing. And both of these issues can only be learnt from Aboriginal people. This knowledge has not been shared for many generations outside the immediate family or community, so it is still being formed in a way to be shared in the specific present conditions. In particular we consider the significance of this type of understanding for new approaches to technology and development as suitable for the Anthropocene, the epoch where human activity dominates the geology and climate of our world.

This approach to teaching engineers at university in an authentic manner, to provide a new perspective on technology and development, expanding the understanding and creativity of our students, requires Aboriginal storytellers who can share their knowledge, often off country. It requires a way of presenting the knowledge from the land now embodied in the speaker and their stories.

Landscape

In using IT for knowledge-sharing we lose the location. While this can be emulated in games with extracts from Google Earth as a 3D model of location, or through videos, the enduring connection to land is weakened. But what is gained is the respect for the crafting of the Aboriginal authors to create the pattern of the knowledge in a generic form.

While the history of Aboriginal settlement in Australia is now believed to be over 80,000 years, Tobler et al. established that Aboriginal people lived in specific regions of Australia for at least the last 40–49,000 years (Figure 3).[25] After settling in an area, Aboriginal people did not move around the continent in large numbers, most people stayed in a specific region, developing the languages we know and a strong understanding of their country. This strong tie to the land is significant in the history of forced removal and the denial of languages in schools.

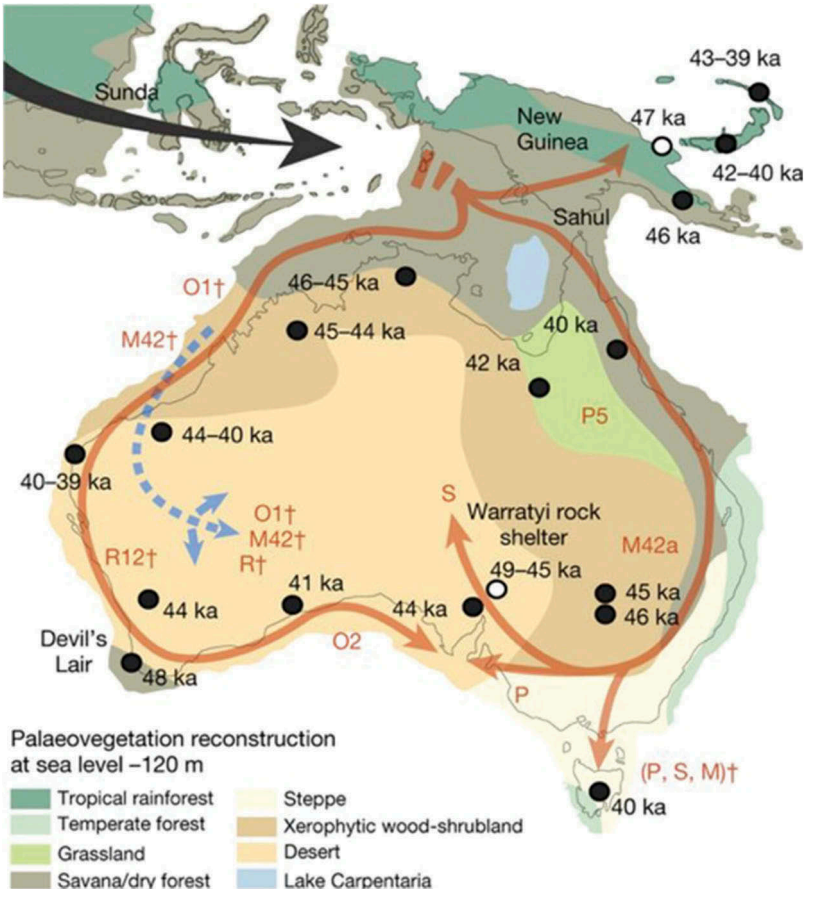

Figure 3. Genetic distribution of Aboriginal Populations reproduced from Tobler et al.

The Ngurrara country was painted by the people of the Great Sandy Desert to depict their knowledge of country and this formed their claim to the land, which they were subsequently granted under Australian law, a law that was not originally able to understand this collective ownership.[26]

Much Aboriginal art is a representation of country and can be used to map back to country. For instance, Morphy relates the story of the painting by Narritjin Maymuru of the journey of the Guwak bird,[27] the possum and the emu to Djarrakpi. The painter had not been to his country in 30 years, but when he returned to the country he could understand what he saw from the images he remembered in his drawing.

This art is another use of Western technology: canvas and paint, mixed with the aerial view that Aboriginal people have of their country. It is these stories that have lived on and provided the means to retain these images and share the landscape through time. To tell the tale of each area of land, you need the language to 'talk up' that land. To express its features, its perils and its food.

The map of Australian vegetation and land types has some similar boundaries to the language maps of Australia, for instance the desert language groups are very different to the coastal. 'Ethnophysiography is the investigation of categories of landscape features,

especially those denoted by common words.'[28] These categories derive from the perception and conceptualisation of the landscape by a culture. The Aboriginal languages express connectivity between human and habitat, rather than independence. Also, aspects of the landscape such as the significance of water for life, will create different forms of language. Mark, Turk and Stea note that similar terms will apply to river systems and a range of permanent or seasonal waterholes in many parts of Australia.[29]

There are other factors in this relation between land and people. Research done in the United States on the Hopi and Apache languages shows different types of languages when living on the same land.[30] The Apache, a newly arrived group 5–10,000 years ago, will describe landscape features with words that translate to terms like 'deep ravine' or 'high mountain'. They note that:

> Distinctions are made in Navajo [an Apache language] among colors of landforms, landforms that are large or small, concave (e.g. canyons) or convex (e.g. mountains). Distinction is also made between certain substances that can be wet or dry.[31]

However

> A single Navajo word may be used for what would require several words in English, [a particular word] for example, refers to any long, sloping depression in the ground, whether a large valley with steep sides through which water may flow, or a mere wash.[32]

The names for such features in the longer settled Hopi community are a name without other meaning, a spiritual word with unique reference to that place.[33] This is similar to many Aboriginal Australian words of place, which have no known link to other words, they just exist as names. The significance of place names is indicated in the importance of place naming, a process that started in the early stages of the language revitalisation in urban Australia and has continued throughout.

We use this idea when we are providing games and editable exercises for speakers to share, based around stories to engage and interact in the language. The most engaging language games relate back to 3D models of country, using stories of being on country and invoke the health effects of the affirmation of identity for speakers. But such tools might not be easy to share across different languages with their different language usage.

Based on work by Turk, Mark and Stea regarding the field of ethnophysiography we consider the naming of not just the significant features,[34] but also the way the country in its entirety is named and spoken about.

Language describes the 'affordances' of a country that the Aboriginal language holders have inhabited for time immemorial. For instance, in country with hills and gullies the land is described in terms of the difficulty to move around, the 'up' and 'down' of the land (Figure 4).[35] They are all places where if you go down, you will have to go up, or vice versa, which is different to areas where walking is flat. This is similar to the English word undulating.

In country where water is scarce, a river of water and its river bed have separate existences. An example is also used by the English speakers around the Fitzroy river. In English the topological features such as gully and a watercourse will have distinct names. The Fitzroy River is however a largely dry river in large sections, yet the river bed retains the name 'river' (Figure 5).[36] However, when water flows in the river, it is

Figure 4. Gullies and hills by Gypsy Denise with Attribution-ShareAlike 4.0 International (CC BY-SA 4.0) from Wikimedia Commons.

Figure 5. River that does not flow – Wundu (reproduced with permission from Mark, Turk and Stea).

described by the locals as 'the river flowed today', an event rather than a topological feature distinct from the dry bed.[37]

Hence the study of language not only describes the values and priorities of the people, but also the significant features of the land and the entire flora and fauna environment.

Culture

To understand the location, we need to know the language, and that brings with it an understanding of the people and culture of that language and place. Early IT work in Sydney communities focused on providing projects for communities to engage in IT through meaningful applications, the first being language reclamation.

This work linked with linguistic tools for the analysis of Interlinear text (for example, Toolbox and EOPAS) and computational linguistics which enhanced language collection and analysis as in the Natural Language Toolkit.[38] These help learners gain insight into the language through archival and recent material linked online.

Second case study – language online

Online language reclamation sites for Aboriginal languages are a growing resource for language reclamation that combines existing knowledge material:[39]

- dictionaries extracted from their word format or toolbox files;
- archival recordings from linguists, some with transcription;
- recent audio recordings of speakers; and
- word sheets provide by teachers and tutors.

These sites have the functionality to analyse and combine resources so that words in the dictionary can be heard by linking to an archival segment that has been transcribed, sample from community members or an example sentence. Worksheets written in the system provide similar support with any audio auto-linked to the words contained, also word lists can be created by the user online. One main feature is a pop-up look up window to help teachers to search for a word, which can be added to a wordlist for that worksheet.

The worksheets are an attempt to generalise the teaching method developed at Muurrbay Aboriginal Language and Culture Co-operative, where the students interact with images or objects in an immersive lesson. This concept has been extended to games where the interaction can be in a virtual world. We are extending the language system so uploaded resources can include material related to location. Re-embedding examples into Google Maps or providing animations and images gives the language a visual and audio aspect to assist learning, and we provide tools to assist people to create their own story online by using drag and drop technologies.

The language sites provide an application programming interface for gaming environments to access information about a word in the specific language of the chosen site, the same information that is available through the dictionary. This allows the creation of games through linking to the site that will be auto-updated with further resources when the community contributes to the online resource.

We are interested here in how this work touches on a contentious issue of language sharing. The archival resources used are obtained from Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) in most cases. This means the access to these resources would have been established prior to the Internet existing, so making them available online is not a possibility considered in the original 'permission to use' descriptions. Similarly, the speakers have usually passed on, and the authority to use can be vague. There have been concerns that sacred material might be shared from these archives, or that people might be offended hearing the voice of dear, departed kin. Even when permission has been obtained, we have been informed we still need permission from the descendants of the linguist who had passed on.

This process is being worked out with language centres and the traditional owners of country. However, there is another overriding issue, that when one family obtains knowledge, the concern over this knowledge being co-opted and misused, as well as the possibility of financial gain from the way this knowledge is shared, has often become a reason to claim 'ownership' over languages, rather than just claiming the output of research and the language reclamation processes set up by any group.

The issue for this work is over how the language is shared, not over who owns the language per se. Whoever claims ownership must be involved in any decision to share, as well as effort made to include others who may be interested. However, this work will often require risk-taking and proactive methods, rather than fearful and reticent ones, based on an understanding of the aspirations of the community. While we cannot rush the community, who are developing a control of their material, prior to sharing, we should not be daunted by the emotional aspects of this work but accept that is part of the reclamation.

One example was given by Stan Grant Senior, who recollects how when he started teaching Wiradjuri he spoke to the Wiradjuri Council of Elders, saying he wanted to only teach Aboriginal children, but the Elders said he had to teach all students at school. He explained he was afraid that the non-Aboriginal children would pick up a new language quicker. In fact, the Aboriginal children were more adept at the languages, partly as they were familiar within their experience of language structure in Aboriginal English, but also as the culture embodied in the language was familiar and expressed the ideas they wished to discuss in any language.[40]

Third case study – language immersion through games on country

Teaching requires context, so another tool is games or virtual reality systems where the user encounters the language in context. For example, the Digital Songlines world (Figure 6), which provides a way of peeling back time to see the landscape as it was before colonisation.[41] Within this world Leavy has presented many exhibitions of the life and technology of Aboriginal people, including the fish traps of Wolli Creek in inner western Sydney. This involves collecting knowledge and artefacts from the region being represented and recreating these in the digital world.

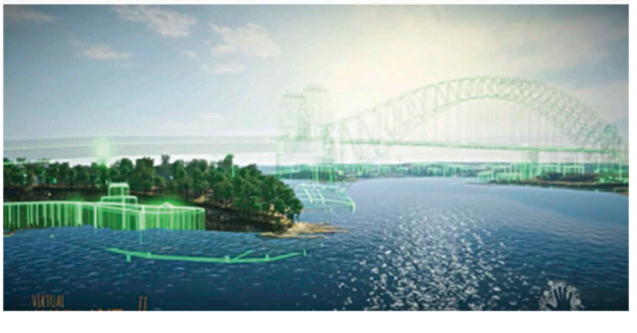

Figure 6. Digital Songlines World (reproduced with permission from Leavy).

Digital Songlines was developed to combine the narrative format with the knowledge artefacts in a database of information. The aim was to emulate Australian Aboriginal cultural understanding. It uses the Unity game engine to provide an immersive environment in a narratological landscape. This was considered the format most similar to that proposed by Indigenous contributors of knowledge.

Another work to recreate the world of Aboriginal people at the University of Western Sydney was developed by Trescak, who studied 3D worlds for his PhD in Spain. He has developed tools to help recreate ancient civilisations around the world. His world is used as a teaching environment to immerse in the cultural practice of the Dharug people around Paramatta River (Figure 7).[42]

While it is preferable to link knowledge with country, often this is not possible, as when people shared a corroboree about a large region or past time. How much does the knowledge which comes from the country now reside in those who have the right to tell this story? If the knowledge now resides in the people, as in the skill of making boomerang or collecting medicine, can we recreate this by bringing many people together? Such knowledge is now not a truth from the land as embodied in community ceremonies, but the understanding or skill of an individual. Individuals then look for ways to validate and verify the stories as they retell them, through community collaboration. We look at the protocols of knowledge validation in the following section.

Knowledge-sharing

The first application of IT for knowledge-sharing was as a repository, but this loses much of the context of the stories, and in effect their significance in a spiritual sense. However, if the theme of the story is not the landscape, but the moral or relationship aspects, there is scope for 'de-located' knowledge. Some successful sites were that of the Stolen Generations Foundation with testimonials of those taken away from their culture,[43] and AIATSIS, which provided an interface to various resources on Aboriginal studies. These sites provided access to community knowledge for many people via an interface to existing repositories or a way for people to upload and share their related stories to develop a learning platform.

There has been distrust of online knowledge-sharing, which has prevented material being available even with password protection, instead requiring a face-to-face and

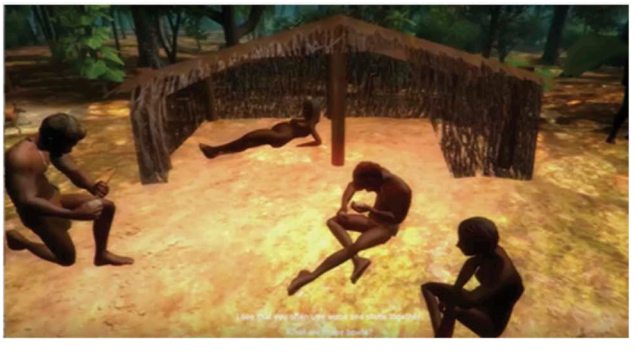

Figure 7. Dharug people in 3D world 'Generations of Knowledge', University of Western Sydney (reproduced from Trescak).

relationship transfer of knowledge, which is more appropriate. However, communities are realising the advantage of getting stories and knowledge available more publicly, to be shared at a suitable depth and in a context chosen by the people sharing.

Fourth case study – Indigital app

One project looking at how to control this work, the Indigital mobile application by Jade,[44] provides a virtual experience triggered by scanning unique point clouds generated as a pattern of points extracted from an artefact or image. These point clouds can be generated from a section of an artwork or made as a barcode-style system to attach to the artefact. When the app scans the original work, it triggers a video to play on the screen, so this is a form of augmented reality where the artwork now includes the information from the related video. The video can be about the artist, the country depicted in the images or anything that provides context to the artwork, which may be used to keep knowledge in context.

To manage Aboriginal knowledge online, retaining the aspects of its authenticity that would come from being located on country, we need to understand what the knowledge-sharing protocols are and how they work, but also why they existed. In particular if we wish to make a valid interface to engage with existing knowledge, we want to emulate the Aboriginal methods for doing this.

Knowledge-sharing protocols

The protocols of knowledge-sharing arise from the relationship between the researcher and the community. These procedures reduce incorrect information being inserted into stories. In the open format of mainstream knowledge-sharing, we have experienced false information shared many times, and in the Aboriginal domain, information that should be private (for example, during mourning) being shared publicly. Also, information that 'belongs' to one person is frequently shared by another claiming authority which they do not have.

We wish to understand the nature of traditional culture and how these processes are still incorporated in today's values. To do this we need to consider why processes may differ from Western methods. What is the culture aiming to preserve and create in the civilisation, and the peoples' understanding of the effective world?

Aboriginal cultures are based on observational methods which often use intuition to gather an understanding of the world. So how did this knowledge-gathering process maintain integrity? What prevented stories being changed every time someone had a vision or an experience? What ensured that the great variety of stories was worked into a coherent whole? When we consider what is the right way to do design participatory workshops, it is helpful to understand or gain knowledge about why this is the right way and why are there different protocols.

When and by whom can knowledge be shared

In many Aboriginal languages there are fourth- or fifth-person pronouns, so if I talk about what we did (you and I), that is a different authority to talking about what we did (myself and someone else) or they did (which I did not take part in). It is a way of expressing authority over the knowledge given. So, when this knowledge comes over the Internet, whose is it and what is the relation to the source?

Who owns the knowledge

Aboriginal culture is based on relationships. In order to talk to someone, you have to establish how you relate to them first. When you have a place in the knowledge network, the stories that relate to this position can then be shared with you, other stories cannot be shared. This is a form of 'need to know' and ensures that information is not misinterpreted. By linking knowledge into stories in the Internet, or immersing the learner in effective worlds, we aim to reduce the opportunity for misunderstanding or misrepresentation. Mikael Jade is working on a Blockchain application to retain information with an artefact so as to link the context of the knowledge with stories when they are provided on the Internet.

What will be told to you

Any design activity requires knowledge to be passed on to researchers (or developers). Experience in developing systems shows that researchers are told information based on what they can understand (as perceived by the stakeholders). However, sometimes they are told information simply because they provide an opportunity for its preservation, by passing information on to someone outside the community with no responsibility and links to the community. Some Elders in the communities have shared with researchers to allow knowledge to survive until their people are ready again to use it.

In general, such sharing knowledge openly for all time is not suitable, yet this is the intent of the Internet, and material can be shared by others across new and less suitable contexts. This concern is not only about intellectual property but also about a suitable process of sharing that preserves the integrity of the knowledge.

How will knowledge come

The understanding of matters relating to another culture comes through experience, through listening. This takes time. Asking a question is demanding knowledge that you may not be ready for. Answering another person's question is risking error.

The lack of questioning in the knowledge-sharing process can be understood in that traditional society could not afford people to make errors often, as food could be missed when throwing a spear or lives lost when navigating a new area. There is great shame attached to such actions. Trust comes when these points are respected by researchers. We consider here some of the ways to handle these knowledge transactions.

Engagement in holistic knowledge-sharing

When developers are setting up IT systems to provide for knowledge-sharing, we may already have an archive, or we may still need to encourage people to contribute to this. Either way the negotiation has to be well planned and handled with understanding of cross-cultural issues, both the protocols of knowledge-sharing as described, and the two-way learning processes required to engage Aboriginal people in the creation of the product, to ensure they feel ownership. The process of creation of your product and the relationship you develop with your users is as important as the final product.

To use the example of the man making fire sticks mentioned in Verran,[45] it was shown that this process of a human acting on objects in the environment removed the objects from their unique relation with the environment and made them generic parts or a pattern of the created artefact.

This can be compared to the fish traps of Baiame's Nhunnhu in Brewarrina, Ngemba country.[46] These are dry-stone walls built in the river from local stone. They trapped fish during floods and were designed to both withstand high flow and be opened or closed to the flood waters to corral fish. They were built and subsequently maintained as a group project, involving all the communities who came there to meet and feed on the fish while they discussed the land management. They were also human artefacts and hence made from generic rocks that formed the traps. However, the whole structure now has significance beyond the artisans, perhaps as it was a community project rather than an individual one. The traps have been embedded in the stories of the landscape as the traps built by Baiame, having their place in the spiritual significance of the area.

Hence, we wish to emulate the holistic and communal process in our IT design projects. These are started by sharing images with community workshops, where designers discuss the offline process already existing or a prototype interface, or images of the language objects or artefacts being used in the project.[47] Approaching knowledge that is holistic, from a framework that seeks to break down knowledge into component parts, means that we start with the whole picture in order to find common ground to talk. In dealing across cultures this provides access to other people's world view while grounding it in something that is known to both parties. In particular an understanding of visualisation methods in describing the environment is important.[48]

We consider how we provide an interface to the data repository, in a way that is more immersive and less representational. A study by George et al. of urban Aboriginal people used Hofstede's cultural model to analyse websites and provide a method of classifying salient features.[49] Similarly, Hofstede's model can be used to develop human interactions in games that emulate the culture of the Aboriginal characters represented.[50] George et al. state that cultural schema must be supported within a context before the culture can be conveyed.[51] In our case the schema is the linkage of knowledge through story, the ability for community to contribute together to develop the knowledge, and the levels of access to knowledge.

An Aboriginal story covers many levels to engage audiences with different skills. The level of the physical landscape and its features are part of the story to engage children; then the moral tales and human relations are for their growth; the practical details are comprehended better when people are familiar with the landscape; and the spiritual knowledge is unclear to those without prior understanding.[52] This understanding of the levels of engagement with oral knowledge links this research with the issues that arise in tacit knowledge-sharing, which is important in sharing technical knowledge.[53] The emphasis in interface design is on the multiple layers of knowledge representation within the culture.[54] It is the spiritual aspect that ties the knowledge into an immersive narrative and is the hardest to convey across cultures, and also this is most easily lost when the performance is removed from place.

Fifth case study – Indigenous graduate attributes at university

Knowledge-sharing with Indigenous people is a two-way process where both parties benefit from new knowledge. At universities around Australia we are trying to embed Indigenous knowledge in the curriculum in a way that enhances the initial subject content but also provides a forum where Indigenous students will feel valued and included. This teaching involves not only considering the content of the subjects, but also the manner of teaching, where immersive and experiential methods such as games

are more suitable for knowledge-sharing.[55] The narrative style used in Pascoe's book is what makes the message generated so powerful and memorable.[56] It forms a rewriting of the story Australians have been told since childhood about Aboriginal history and hence is able to overwrite these myths.

Traditional Yolngu epistemologies, metaphysics and ontologies have been useful in cross-cultural and intercultural education in the Northern Territory,[57] providing innovative ways of creating new knowledge-sharing in this context. Knowledge-sharing in urban and semi-urban Australia at university level is based on the knowledge of that country and its people and is only just beginning to be shared.

Content

We are using Indigenous knowledge that links directly to the content being taught, for example data protection, data analysis, teamwork, knowledge-sharing, and narrative teaching. This provides for authentic knowledge-sharing from a different perspective and enables students to reflect and reconsider their understanding of fundamental values. For example, the Dreamtime stories retain their relevance today, and have been used in research to tackle some of the issues of modern communities.[58]

Context

The method in which the material is presented to students is important. Techniques of storytelling are used to provide narrative teaching but also a form of immersion in the experiences of Aboriginal people that inform the knowledge or explain the difference in values. For instance, the importance of relationships in the society ensures that less emphasis is placed on individual needs, so this kinship system provides a good introduction to teamwork and the aspects important in making a team function well.

Consciousness

To enable knowledge to be understood, the entire environment of the learning, including some aspect of the level of spiritual immersion, is needed in the learning environment.[59] This comes with experience on country with local knowledge holders, or ongoing immersion in language and culture. Aboriginal spiritualism is the way of understanding the value system and perspective of holistic and sustainable approaches to knowledge, which concerns itself with the relationships between all things.

Anthropocene

There is a particular imperative in this work as mentioned earlier. In training our students in Indigenous knowledge, including the spiritual approach of holistic and relational knowledge, we are introducing them to a flexible knowledge system that has managed to survive a harsh invasion. We see this as an introduction to how to live in the Anthropocene and to build a new sustainable society for humankind.

As an example of this flexible knowledge system, there is the dandelion story of Ngarrindjeri of Hindmarsh that Diane Bell refers to in discussions with Annie Rankine.[60] It is part of a Seven Sisters story Annie's father had told her. Women were told not to swim when the dandelions were in bloom and the Seven Sisters star constellation was not yet moved away. When the flowers died, and the constellation

moved, they were again allowed to go into the water. Dandelions are an introduced species, but they flower at the same time as the flower they replaced,[61] so they served the purpose of the warning of the chilly water, or relating to the timing of fish migration, and are an example of the adaptability of Ngarrindjeri myth.[62]

Future work

The retelling of Indigenous knowledge through IT should respect 'Indigenist research [which] is research by Indigenous Australians whose primary informants are Indigenous Australians and whose goals are to serve and inform the Indigenous struggle for equality'.[63] Part of this process is linking non-Aboriginal people with experts in a language, an environmental region or engineering topic.

We are refining a mobile and online repository of community contacts. The app links to the community elders who can advise on resources on different themes, and with support for lecturers to integrate this into the content, material, or process of their lectures, not as a side issue. In particular we hope to link academics with local community members to invite as guest lecturers and blend the content into the subject through two-way discussions.

Bringing users to the design process for developing any useful technology is an important part of current human–computer interaction research, but it has been argued that the historical dispossession of land, forced removal and the institutionalisation of Aboriginal people in Australia has reduced their engagement, or their willingness to engage, in the process of design and development.[64] To counter this, we build on experience in appropriate technology in the designing of hardware appropriate for the culture,[65] environment and activities of people in rural and remote Aboriginal communities.

In many instances, the technical knowledge of Aboriginal people is well adapted to a specific technical need, however they may not have the required resources or training to engage with a specific application they need. For instance, Aboriginal people have made innovative use of Twitter (for example, the IndigenousX Twitter hashtag) and Facebook, but rarely are they trained to develop such platforms in their own design. Hence the ongoing work of linking skilled designers with the community needing a design in a two-way participatory collaboration.

Pumpa and Wyeld explain the link between knowledge and place in Aboriginal epistemology as follows: 'In Aboriginal knowledge, the landscape is both the visualization of knowledge and the narratives of knowledge.'[66] IT projects are being run with rangers and community members to collect knowledge and retain this in place or to reclaim and share knowledge in urban environments.[67] This process can lead to enterprise development from the artefacts collected, or employment for those involved in the project. This work will help people promote the skills they develop in contributing to design and data collection.[68]

In this way IT can support both 'activities within Aboriginal communities [that] provide new and innovative ways in which people can access knowledge and information at the local community level',[69] but also to extend this knowledge to Aboriginal people off country and those around them who can learn knowledge adapted to new people and place.

Conclusion

Concern over the emulation of traditional knowledge-sharing in the Internet age requires greater understanding of the purpose and methods used in these traditions. We cannot reproduce a process that is obscured through ignorance and neglect. While there is much hesitation and self-criticism amongst people working this area, we can most importantly appreciate the depth of knowledge required to maintain an oral tradition and to value its use into the future for all peoples.

While not co-opting or appropriating these techniques, through greater understanding we can respectfully integrate them into our processes. This also will improve the ability of people to learn such a complex system of knowledge through emulation of the original storytelling teaching methods.

To understanding the significance of the land to the knowledge assists us in understanding when and how this knowledge can be moved from the land and into an individual's knowledge or storytelling. By being equipped with this approach and being better informed, we can support and value the growing knowledge-sharing process by Aboriginal people in Australia.

Notes

1. Andrew Turk, 'Space, Place, Phenomenology and Jukurrpa', 2013, available at <*https://pdfs.semanticscholar.org/ee85/eee00157e7489a30b000677a62f2ddf4e894.pdf*>, accessed 9 November 2018.
2. David Mark and Andrew Turk, 'Landscape Categories in Yindjibarndi: Ontology, Environment, and Language', in W Kuhn M F Worboys and S Timpf (eds), Spatial Information Theory, Foundations of Geographic Information Science, COSIT 2003, Lecture Notes in Computer Science, vol. 2825, Springer, Berlin, Heidelberg, 2003, pp. 28-45.
3. David Mark and Andrew Turk, 'Landscape Categories in Yindjibarndi'.
4. Emmanuel Mesthene, 'The Role of Technology in Society', in Kristin Shrader-Frechette and Laura Westra (eds), *Technology and Values*, Rowman & Littlefield, 1969, pp. 71–85.
5. Lyndon Ormond-Parker and Robyn Sloggett, 'Local Archives and Community Collecting in the Digital Age', *Archival Science*, vol. 12, no. 2, 2008, pp. 191–212.
6. P Standley, N Bidwell, T George Senior, V Steffensen and J Gothe, 'Connecting Communities and the Environment through Media: Doing, Saying and Seeing Along Traditional Knowledge Revival Pathways in, *3CMedia*, 5 October 2009; Turk.
7. Victor Steffensen, Presentation at the University of Technology Sydney, 2017.
8. Michael Christie, 'Aboriginal Knowledge Traditions in Digital Environments', *Australian Journal of Indigenous Education*, vol. 35, 2005, p. 2.
9. Nicola Bidwell, Peta-Marie Standley, Tommy George Senior and Victor Steffensen 'The Landscape's Apprentice: Lessons for Place-Centred Design from Grounding Documentary' in Johann van der Schijff and Gary Marsden (eds), *Proceedings of the 7th ACM conference on Designing interactive systems*, ACM, New York, 2008 pp. 88–98, doi: 10.1145/1394445.1394455.
10. Lucy Suchman, 'Located Accountabilities in Technology Production', *Scandinavian Journal of Information Systems*, vol. 14, no. 2, 2002. p. 96.
11. Helen Verran, 'Knowledge Systems of Aboriginal Australians: Questions and Answers Arising in a Databasing Project', 2007, doi: 10.1007/978-94-007-7747-7_8690. Later published in Helaine Selin (ed.), *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*, 2nd ed., Springer, Dordrecht and London, 2008. pp. 2444-2452.

12. ibid., p. 5.
13. Helen Verran, 'A Postcolonial Moment in Science Studies: Alternative Firing Regimes of Environmental Scientists and Aboriginal Landowners', *Social Studies of Science*, vol. 32, nos. 5–6, 2002, p. 739, doi:10.1177/030631270203200506
14. Verran, 'Knowledge Systems', p. 8.
15. ibid., p. 7.
16. Malcolm Pumpa and Theodor Wyeld, 'Database and Narratological Representation of Australian Aboriginal Knowledge as Information Visualisation using a Game Engine', in Ebad Banissi, Remo Aslak Burkhard, Anna Ursyn, Jian J Zhang, Mark Bannatyne, Carsten Maple, Andrew J Cowell, Gui Yun Tian and Ming Hou (eds), *Tenth International Conference on Information Visualization (IV'06), London, United Kingdom, 5–7 July 2006*, IEEE Computer Society, Los Alamitos, CA, doi:10.1109/IV.2006.39
17. Michael Christie and Helen Verran, 'The Touch Pad Body: A Generative Transcultural Digital Device Interrupting Received Ideas and Practices in Aboriginal Health', *Societies*, vol. 4, no. 2, 2014, p. 219.
18. Marcia Langton, 'Grandmothers' Law, Company Business and Succession in Changing Aboriginal Land Tenure Systems', in Galarrwuy Yunipingu (ed.), *Our Land is Our Life*, University of Queensland Press, St Lucia, Queensland, 1997, pp. 84–117.
19. Cat Kutay, 'Teaching an Australian Aboriginal Knowledge Sharing Process', in Collette Faucher (ed.), *Advances in Culturally-Aware Intelligent Systems and in Cross-Cultural Psychological Studies*, Springer, Cham, Switzerland, 2017, pp. 63–96.
20. Cicero, *On the Orator: Books 1–2*, translated by EW Sutton, H Rackham, Loeb Classical Library 348, Harvard University Press, Cambridge, MA, 1942.
21. Christie and Verran, p. 4.
22. Victor Steffensen, 'The Living Knowledge Place', available at <*http://livingknowledgeplace.com.au/*>, accessed 11 June 2018.
23. Philip Jones, 'Unaipon, David (1872–1967)', *Australian Dictionary of Biography*, National Centre of Biography, Australian National University, available at <*http://adb.anu.edu.au/biography/unaipon-david-8898/text15631*>, published first in hardcopy 1990, accessed 10 November 2018; Philip Jones, 'David Unaipon', Adelaidia, available at <*http://adelaidia.sa.gov.au/people/david-unaipon*>, accessed 19 November 2018, published first in hardcopy in John Healey (ed.), *S.A.'s Greats: The Men and Women of the North Terrace Plaques*, Historical Society of South Australia Inc., Adelaide, 2001. Figure 2 appears to be derived from David Unaipon, provisional specification for an Improved mechanical motion device, 3 September 1909, no. 15, 624/09, Department of Patents, Commonwealth of Australia, available at School of Science, Engineering and Mathematics, Flinders University, 'Aboriginal Knowledge and Perspectives into Science and Technology', <*https://csem.flinders.edu.au/thegoodstuff/IndigiSTEM/docs/engineering/Patent15624-09.pdf*>, accessed 19 November 2018.
24. Bruce Pascoe, *The Dark Emu*, Magabala Books, Broome, 2014.
25. Ray Tobler et al., 'Aboriginal Mitogenomes Reveal 50,000 Years of Regionalism in Australia', *Nature*, vol. 544, 13 April 2017, p. 183, published online 8 March 2017, available at <*http://www.nature.com/nature/journal/vaop/ncurrent/full/nature21416.html*>, accessed 10 November 2018.
26. Larissa Behrendt, 'Ngurrara: The Great Sandy Desert Canvas, Aboriginal Art Directory, available at <*https://www.aboriginalartdirectory.com/news/feature/ngurrara-the-great-sandy-desert-canvas.php*>, accessed 10 November 2018.
27. Howard Morphy, *Ancestral Connections: Art and an Aboriginal System of Knowledge*, University of Chicago Press, Chicago, 1991.
28. David Mark, Andrew Turk and David Stea, 'Progress on Yindjibarndi Ethnophysiography', in Stephan Winter, Matt Duckham, Lars Kulik and Ben Kuipers (eds), Spatial Information Theory, 8th International Conference, COSIT 2007, Lecture Notes in Computer Science, vol. 4736, Springer, Berlin, Heidelberg, 2007, p. 2.
29. ibid., pp. 1–19.

30. Andrew Turk and David Stea, 'David Mark's Contribution to Ethnophysiography Research', *International Journal of Geographical Information Science*, vol. 28, no. 6, 2014, pp. 1246–63, doi:10.1080/13,658,816.2013.874560
31. ibid., pp. 9–10.
32. ibid., p. 9.
33. Andrew Turk, personal communication with the author, Perth, 2017.
34. Andrew Turk, David Mark and David Stea, 'Ethnophysiography', in David Mark, Andrew Turk, Niclas Burenhult and David Stea (eds), *Landscape in Language: Transdisciplinary Perspectives*, Benjamins, Amsterdam, 2011, pp. 25–46.
35. Photo by Gypsy Denise available at <*https://commons.wikimedia.org/wiki/File:Millstream_National_Park,_Pilbara,_Western_Australia.jpg*>, accessed 19 November 2018.
36. Mark, Turk and Stea, 'Progress on Yindjibarndi Ethnophysiography'; Mark and Turk, 'Landscape Categories in Yindjibarndi'.
37. Turk, Mark and Stea, 'Ethnophysiography', 2011.
38. Field Linguists Toolbox, SIL, available at <*https://software.sil.org/toolbox/*>, accessed 15 June 2018; EOPAS, available at <*http://www.eopas.org/*>, accessed 12 June 2018; NLTK, available at <*https://www.nltk.org/*>, accessed 2 June 2011.
39. SALC, available at <*http://salc.cities.org.au/*>, accessed 20 June 2018; Bundjalung, available at <*http://bundjalung.dalang.com.au*>, accessed 20 June 2018; Yugambeh, available at <*http://yugambeh.dalang.com.au/*>, accessed 20 August 2018; Dharug, available at <*http://dharug.dalang.com.au*>, accessed 20 August 2018.
40. Stan Grant Senior, television presentation on development of Wiradjuri classes in schools on country, 2016; also discussion at Sydney University in 2006.
41. Brett Leavy, Virtual Songlines, available at <*https://www.youtube.com/watch?v=MwM8t6vs-_c*>, accessed 2 June 2018.
42. Tomas Trescak, 'Generations of Knowledge', University of Western Sydney, available at <*https://www.youtube.com/watch?v=YwYfh-OW0mo&feature=youtu.be*>, accessed 10 June 2018.
43. Stolen Generations Foundation, available at <*http://www.stolengenerationstestimonies.com/about-us.html*>, accessed 11 August 2018.
44. Mikaela Jade, Indigital, available at <*https://www.indigital.net.au/*>, accessed 15 October 2017.
45. Verran, 'Knowledge Systems'.
46. Cat Kutay and S Beetson, 'Brewarrina Fish Traps, on the Barwon–Darling Catchment, NSW', *Engineering Heritage Australia Magazine*, vol. 2, no. 8, May 2018, p. 10.
47. Tarak Zaman and Heike Winschiers-Theophilus. '"Penan's Oroo" Short Message Signs (PO-SMS): Co-design of a Digital Jungle Sign Language Application', in J Abascal, S Barbosa, M Fetter, T Gross, P Palanque and M Winckler (eds), *Human-Computer Interaction – INTERACT 2015*, Lecture Notes in Computer Science, vol. 9297, Springer, Cham, 2015, pp. 489–504, doi:10.1007/978–3-319-22668-2_38; Tom Goldfinch, Lesley Jolley, Juliana Prpic and Elyssebeth Leigh, 'Australian Engineering Educators' Perceptions of Indigenous Cultures and Challenges of Minority Inclusion', paper presented at 44th SEFI Conference, 12–15 September 2016, Tampere, Finland.
48. Andrew Turk, 'A Visualization in Environmental Management: Beyond the Buzz Word', *Landscape and Urban Planning*, vol. 21, no. 4, 1992, pp. 253–55.
49. Reith George, Keith Nesbitt, Michael Donovan and John Maynard, 'Evaluating Indigenous Design Features Using Cultural Dimensions', in Haifeng Shen and Ross T. Smith (eds) Proceedings of the Thirteenth Australasian User Interface Conference (AUIC 2012), Melbourne, Australia, Australian Computer Society, Inc. Darlinghurst, Australia, pp. 49-58, available at <*http://crpit.com/confpapers/CRPITV126George.pdf*>, accessed 10 November 2018; Geert Hofstede, *Cultures and Organisations: Software of the Mind*, McGraw-Hill, London, 1991.
50. Cat Kutay, Samuel Mascarenhas, Ana Paiva and Rui Prada, 'Intercultural-Role Plays for e-Learning Using Emotive Agents', in Joaquim Filipe and Ana Fred (eds), *ICAART 2013 – Proceedings of the 5th International Conference on Agents and Artificial Intelligence, Volume 2, Barcelona, Spain, 15–18 February, 2013*, SciTePress, Setúbal, Portugal, pp.

395–400, available at <https://dblp.org/rec/bib/conf/icaart/KutayMPP13>, accessed 12 December 2018.
51. George et al.
52. Karl-Eric Sveiby and Tex Skuthorpe, *Treading Lightly*, 2006, Allen & Unwin, Crows Nest.
53. Kutay 'Teaching an Australian Aboriginal Knowledge sharing process'.
54. Pumpa and Wyeld.
55. Cat Kutay and K Mundine, 'Training for Inclusion', in Lyndon Ormond-Parker, Aaron Corn, Cressida Fforde, Kazuko Obata and Sandy O'Sullivan (eds), *Symposium, Information Technology in Indigenous Communities*, AIATSIS Research Publications, Canberra, 2013, pp. 75–88.
56. Pascoe.
57. M Christie, 'Galtha: The Application of Aboriginal Philosophy to School Learning', *New Horizons in Education*, vol. 103, 2000, pp. 3–19.
58. Gawaian Bodkin-Andrews, Frances Bodkin, Gavin Andrews and Ross Evans, 'Aboriginal Identity, World Views, Research and the Story of the Burra'gorang', in Cheryl Kickett-Tucker, Dawn Bessarab, Juli Coffin and Michael Wright (eds), *Mia Mia Aboriginal Community Development: Fostering Cultural Security*, Cambridge University Press, Cambridge, 2015, pp. 19–36.
59. Sveiby and Skuthorpe.
60. Diane Bell, *Daughters of the Dreaming*, McPhee Gribble and George Allen & Unwin, Melbourne and Sydney, 1983, pp. 30–1.
61. ibid., pp. 574–75.
62. Margaret Simons, *The Meeting of the Waters: The Hindmarsh Island Affair*, Hodder Headline, Sydney, 2003.
63. Lester-Irabinna Rigney, 'A First Perspective of Indigenous Australian Participation in Science: Framing Indigenous Research Towards Indigenous Australian Intellectual Sovereignty', *Kaurna Higher Education Journal*, vol. 7, August 2001, pp. 1–13.
64. P Radoll, 'Aboriginal Peoples, Education and Information and Communication Technologies in Australia', in Nicola Bidwell and Heike Winschiers-Theophilus (eds), *At the Intersection of Indigenous and Traditional Knowledge and Technology Design*, Informing Science Press, Santa Rosa, CA, 2015.
65. Cat Kutay and G Ho (eds), *Appropriate Technology for Remote Communities: A Selection of Papers Illustrating the Effort Carried out by the Remote Area Developments Group*, Murdoch University, Perth, 1992.
66. Pumpa and Wyeld.
67. Alessandro Soro, Margot Brereton, Jennyfer Taylor, Anita Lee Hong and Paul Roe, 'Cross-Cultural Dialogical Probes', in Proceedings of the First African Conference on Human Computer Interaction, ACM, New York, 2016, pp. 114–25.
68. Susan Beetson, Sojen Pradhan and Cat Kutay, 'Community driven model to enhance skills development from a Ngemba perspective', presented at Indigenizing Entrepreneurship Conference, Ottawa, Canada, June, 2017.
69. Ormond Parker and Sloggett.

Disclosure statement

No potential conflict of interests was reported by the author.