

# Supporting Language Teaching Online

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## Abstract

This paper presents the work done in a project to support the teaching of New South Wales (NSW) Indigenous languages through online and mobile systems. The process has incorporated languages with a variety of resources available and involved community workshops to engage speakers and linguists in developing and sharing these resources with learners. This research looks at Human Computer Interaction (HCI) for developing interfaces for Indigenous language learning, by considering the knowledge sharing practises used in the communities, and we compare this work in Australia with similar findings on language reclamation with the Penan indigenous people Malaysia. The HCI studies have been conducted in workshops with linguists and community members interested in studying and teaching their language. The web services developed and used for various languages uses processes of tacit knowledge sharing in an online environment.

**Keywords:** under-resourced languages, indigenous knowledge sharing

## 1. Introduction

This work was conducted over many years with languages spoken in Sydney, but often with roots in other regions of New South Wales, Australia (NSW). These are languages spoken by a limited number of elders, and with language resources that may be a dictionary, some archival tapes held at Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), documents written by missionaries or recent tapes. Also the use that the community wishes to make of these resources may vary. Some wish to teach in schools, others in community. Most have a limited group of people interested or able to engage in the work.

To support the reclamation of these endangered language we have undergone a process of developing web and mobile tools for sharing and teaching language begins with consultations with the community members who have requested web support for their languages, and continues through workshops to train people how to use the system.

The software developed is stored as a simple unit on github, where the different options can be selected to suit community needs. Also a mobile app to utilise the data created for the web site has been used for one language. We are now working on the interface to the next generation app, which will include language comparison between dialects or related languages, and focuses on weekly wordlists or topics.

In this paper we compare our work to similar studies for language reclamation for the Malaysian Penan, a very different language under similar threat of extinction, and compare to their use of knowledge sharing resources. We have found some similarity in the development process for community consultation and designing learning tools so out of interest in the generalisation of this study we have referred to their work where relevant.

The research and development of the web service for language teaching does not depend on the language structure so much as language usage. Hence we believe this work has application to oral languages across the

globe, and provides an opportunity for Indigenous people to share their experience in learning and teaching under-resourced languages.

## 2. Background

We are working with both coastal and inland NSW languages where the structure and features of the language varies, although they are all of the Pama–Nyungan family. The similarity in the projects presented here is the learning focus, where community speakers or those trying to reclaim the spoken language are teaching in school or community groups and require support for language learning.

We are dealing with cultures that are under threat from encroaching western culture, where the elders wish to retain their languages, as a way to describing and understanding the country were they live, and the culture they still maintain.

The process of language reclamation has been two fold in Australia. Firstly to gain recognition of the importance of the maintenance of these language in school curriculum and in the community, and secondly to collect and understand the language resources that exist for each language and build on these to assist learners.

The focus of the teaching is on story telling and learning in context. The teaching uses the Accelerate Second Language Acquisition method (ASLA) developed by Stephen Neyooxet Greymorning, an Arapaho teacher from Montana. The Murrumbidgee Aboriginal Language and Culture Cooperative promoted this method for language teaching as it provides a context for the learning.

Hence the research focuses on the protocols and methods used in language sharing and teaching in the Australian Indigenous context. The specific features of the software include some language analysis to develop the simple parsing provided on the site. However this parsing focuses more on providing links between text, audio and image material and uses generic analysis of the language itself in terms of recognising common elisions and word forms.

### 3. Tacit knowledge sharing

The study of oral knowledge sharing begins with an understanding of the process of tacit knowledge sharing, and study of Indigenous cultures in the Pacific has strengthened our understanding of this process (Zaman et al., 2011). The storytelling process is used in many Aboriginal Australian communities as a way to carry on knowledge, so it is instructive to understand what works and what protocols are needed to carry out this teaching. In the telling or retelling of a story there are various rules that have relevance to providing stories in a permanent online repository:

**Authority to speak:** A significant feature of traditional storytelling is that only those with authority to speak are permitted to present a story. Authority comes from 'being there' in person or through a close relation, being part of the group involved in the story or having some kinship connection to the story (Povinelli 1993).

**Community narrative:** When a story is told at a community gathering such as a corroboree, many people will contribute the part they know, what they have experience in. First a theme of the story is established, then the many performers add their knowledge.

**Deferral to others:** When Aboriginal storytellers are speaking, they tend to include or invite other speakers into the story, either as a way of varying the story to keep the listener's attention, as a way of emphasising main points by getting corroboration, or to allow alternative view points to be expressed as a way to help the learner understand.

**Knowledge is given not requested:** While the teller of the story may start at any point in the narrative, it is their decision where to start. To elicit information a learner must give their present knowledge first as a statement of understanding, rather than a question, so the teller knows where to start and how to direct their story

In this work we use these criteria to evaluate the interactive tools that were developed. The analysis comes from data collecting, workshops, meetings and discussions. There was little opportunity for formalised study of the students or staff working with the system, however we were able to collect feedback from a variety of sources. Basing this on the traditional protocols provides grounding to the evaluation.

### 4. Grammar of knowledge sharing

In languages it is grammar that provides the cohesion of knowledge. To provide more than just a system for information sharing we developed a knowledge cohesion system that is respectful of the culture being shared.

The first aspect of the Aboriginal language that was instrumental in initiating the revitalisation process in NSW was the naming of place. This arises from the strong cultural tie to land and the fact that languages are used to name the land and create ties between people and land.

This is expressed by Aboriginal knowledge sharing practises in that stories are remembered and re-expressed as located in place. Also Langton (1997) notes that through the cyclic nature of the kinship system, a person's

mother's mother and father's father will be the same moiety, and hence will often relate in the same manner to the same country, which reinforces this link to place to the grandchild. Starting with this relationship mode we look at how to support cultural knowledge.

For thousands of years, Indigenous people have been sharing knowledge through oral means on how to live in and maintain both themselves and their physical and social environment. While some of this knowledge have been recorded in language, and some is available on the Internet, the online framework for this knowledge is highly unstructured. Research is being done on providing ontologies and frameworks that will provide online learning spaces for this knowledge, especially while retaining the oral format (Kutay and Ho, 2009).

The conception of an oral storytelling grammar is to support the sharing of Aboriginal knowledge online while respecting the cultural representation of knowledge. It is recognised that Aboriginal people have avoided colonisation in many aspects of their culture while living within the mainstream (e.g. Schwab, 1995), and wish to retain alternative means of living and knowing.

Online repositories of stories, supported by the cultural grammar, are becoming a learning tool for those within the culture, as well as those outside the culture to increase their understanding. It also enables Aboriginal trainers to access resources from the community to provide a broader range of cultural training.

The first aspect of the grammar is the protocols listed above which determine how stories are shared by community. The second aspect is the context: schools, community or University. The third aspect is the content, what resources are available in the language and what resources do we have that will help us to develop more material (such as living speakers). From this we have considered how the speakers and students can interact with the language on the web.

#### 4.1 Syntax

Aboriginal Australian story telling is a communal form of oral history designed to fit the community inheritance structure. While social status is granted to people based on their skills and experience, this authority is shared with others of equal skill in other areas, those with the same kinship and hence the same social and environmental responsibilities.

Aboriginal people use a group story telling process (performed as a corroboree) to select the stories that are valuable and hence worth repeating at ceremonies. This process also determines what is retained over time, and what is retained as knowledge of the environment.

This process is comparable to the social constructivist learning process (Berger and Luckmann, 1996). However the particular theme under which any story is presented may vary over time as priorities and events change.

Stories are placed in a story-path according to themes. These may be relating to morality e.g. how to uphold the law or the suffer penalties, and be presented with examples both from the Dreamtime and under the new

non-Aboriginal law. 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 can travel. The story will then describe in sequence the features, seasonal food etc. that can be found and the different aspects of the environment such as the star locations at that time.

Any story path may be related to an area in space, a path in time or a story on a theme (see Figure 2). These provide the framework within which the story is presented. Also this provides a context into which future telling of the story can be repeated and reinforced.

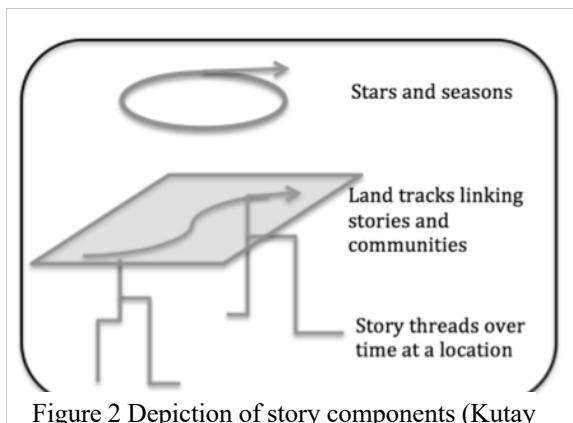


Figure 2 Depiction of story components (Kutay & Ho, 2009)

However it is important to note that this is only a framework. At any performance, only some stories will be told, and only some parts. These will be chosen for their significance to the community at that time, in that season and given recent social and political events.

It is this flexibility in the knowledge sharing that has both ensure the Aboriginal knowledge system has survived the huge upheaval of invasion, but also the highly variable climate of Australia.

In the online environment this approach to knowledge sharing focuses on the ability to incorporate new language words and stories from the community at all times, and we need to be able to support this community contribution.

## 5. Interface design model

Various studies have been run on the way Aboriginal people view the online environment, how they could use this for knowledge sharing, and the format in which the sharing might be done (Kutay 2011 & 2012). To provide interfaces for community use, we relate our work to existing knowledge sharing practises to reduce the cognitive load of the community members engaging with the system. Similar work has been done for language collection and sharing with the Penan (Zaman 2015), where the process of language classification for sorting words in the interface provided inside into the generational differences in language comprehension. We will discuss this later as it is an interesting aspect of cognitive load for users of mobile interfaces. While the Penan language is not of similar structure or provenance to Australian languages, the way that people live and

organise knowledge is similar, as well as the challenged in enabling engagement with information technology.

The model described here provides a conceptualisation or representation of searching, in this case for language information, from the perspective of Indigenous learning within the corroboree setting, where the re-enactment of the real environment assists the user in the construction of their knowledge. The model shown in Figure 1 is a process by which we can analyse the web systems we develop and ensure we cover the complete aspects of the system including the information gathering and learning process.

Pirolli and Card (1997) conceptualized searching for and making sense of information by using concepts borrowed from evolution, biology, and anthropology together with classical information processing theory called the information foraging food-theory (IFT). They describe searching strategies in terms of making correct decisions on where to search next, influenced by the presence or absence of "scent."

Starting with an ecological framework (Bishop 2007) which provides the levels of analysis of the user's environment, (shown as the left column in Figure 1), we mapped this to the key components of the knowledge grammar: the content, context and cohesion of knowledge within the site as pattern attributes (Kutay & Ho 2009).

These were then mapped to the functionality and interface analysis techniques, which cover learning semantics,

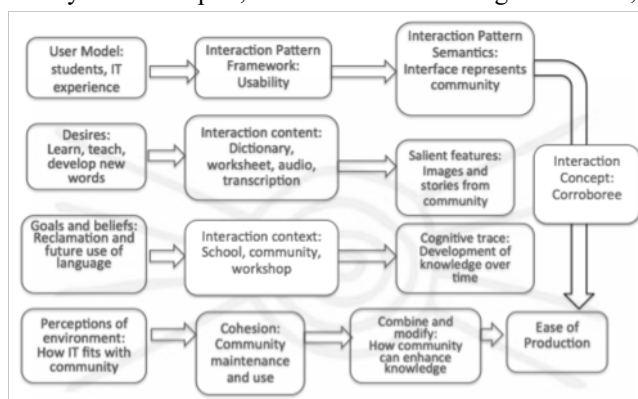


Figure 1: Shows the mapping from the ecological model for participation, to knowledge sharing to HCI aspects.

salient features and cognitive trace plus the final step of combining and modifying information on the site to form knowledge (Rogers, 2004). In particular the ease of production of this knowledge as a sharable resource was the focus of the analysis framework.

The framework provides a way to ensure that the learning system was consistent with the design criteria, the community processes and the learning needs. It was used to assist and evaluate the development of the software platform through workshops and discussion with linguists, teachers and community members.

### 5.1 Visual representation of oral knowledge

The aim of the visual design of knowledge learning web sites is to assist learning and enable engagement with the

oral components of the language through four aspects, adapted from Rogers & Scaife (1998).

As interfaces become more ubiquitous and pervasive new design paradigms are emerging (Rogers, 2004) as well as the possibility of creating affordances within these interfaces in a manner that may not relate to pre-existing real-world objects or interactions. This assists in reducing the cognitive load, an issue with online learning sites.

1. **Representations within real world**, or juxtapositions that can represent processes in real life narratives. This provides the narrative for the user to follow.
2. **Visual representations of temporal and spatial constraint** such as dialect, speaker, learning environment (worksheet, dictionary, etc), that provide constraints and affordances to assist the learning enquiry, and select the artefacts relevant for further enquiry, and the authority of different annotations available on these artefacts. This forms the resources for the activity.
3. **Artefacts found for further enquiry**, such as audio example, and the authority of different annotations available on these artefacts. This is based on the thematic structure of the activity.
4. **Graphical elements which provide affordances or constrain the inferences** that can be made about the relevance of the search artefacts and relevance to their focus audience, including the level of language used in the document. This provides a context for the user's search activity.

When working online with knowledge artefacts, there will be no 'elders' or over-arching knowledge holders online to tie the information together into knowledge to be understood. In effect an online system provides isolated media packets from which the user has to draw sense. The interface design framework we provide here has been developed around this need to design tools for the processes of information selection (thematic content), the interface format (context), and information linkage (cohesion) to create a knowledge repository.

Any support for the users' external cognition arises from the interaction between internal and external representations when performing tasks that reduce the user's cognitive effort through the use of external representations. The aim is to do this without reducing the information provided.

We used these properties and design dimensions to determine which kinds and combinations of graphical, audio and linkage representations would be effective for supporting different activities. The matrix of affordances provided the semantics of the interface pattern language (see Figure 1).

We will now look at similar models developed for interface design for Indigenous people. Then we provide an example of the use of the model in the development of language sites. These sites are developed to support both teachers who are searching for related material to present to students, and the students doing their own searches to collate knowledge.

## 6. Previous work on Indigenous interface design

A study by George et al. (2011) of urban Aboriginal people, used Hofstede's (1991) cultural model to analyse websites and provide a method of classifying salient features. They stated that cultural schema must be supported within a context before the culture can be conveyed. In our case the schema is the linkage of knowledge through story, the ability for community to contribute to develop the knowledge, and the levels of access to knowledge. This emphasis is on the multiple layers of knowledge representation within the culture (Pumpa & Wyeld 2006) is also reflected in work with the Penan in Malaysia (Zaman & Winschiers-Theophilus 2015)

Workshops run with the Penan found that the older community members have different schemas for language classification to the younger members, which will make the development of a suitable interface complex, or requiring adaptation. Similarly workshops run with Aboriginal language speakers has shown that there are many different design needs for the representation of language online.

Another project developing a website for sharing the alternate Arandic sign language used in Central Australia, in various contexts by people who also use spoken language (Green et al, 2011). This work required extensive community consultation on how the words are delineated and constructed, as well as how the signing should be authentically represented in an online environment.

The complex process of designing language repositories is repeated with every new project, as the communities deal with a variety of different environmental and social factors that provide a unique system of knowledge and understanding.

The next stage of the work is then to apply the methods developed and the patterns extracted to new situations and so establish the features of each specific site or module developed for culture sharing.

## 7. Implementation for Language Learning

The design concepts that we developed from the studies described above were divided into the three main systems in the language learning sites we developed. These language sites (Dalang, 2015) are based on a python system that provides easy access to the data to mobile apps and the ability to parse and analyse data uploaded to the site.

The language sites have three main context components. Firstly we provide a searchable dictionary, which is usually developed by a linguist and transferred to a database. Then archival material in the form of audio and (possibly) transcripts are uploaded and linked to the dictionary words where possible through time-aligned text. These audio files are often in the form of songs, which emphasise the imagery of the subject matter through sound (Magowan, 2001). Therefore much of the wealth of the material lies in the complete tape rather than

any segmentation into word or phrase examples. Thirdly teachers can edit and save wordlists and use these to develop worksheets (see Figure 3), which are exercises based on a topic or wordlist.

These worksheets are developed around wordlists, based on the ASLA. The basic process involves a wordlist that is used each week and the learning exercises are based around this list and designed in face-to-face teaching to include actions (eg the girl touched the tree is linked to a picture of this action).

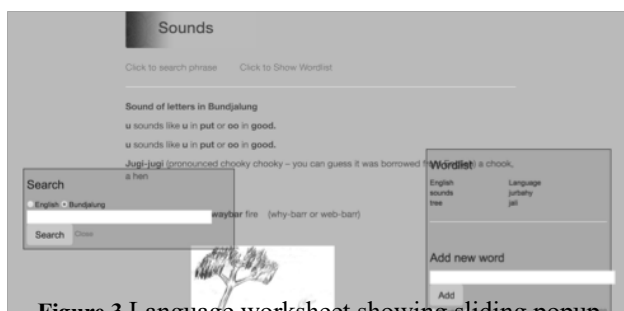


Figure 3 Language worksheet showing sliding popup support tools

Finally language cohesion is supplied by software that links all parts of the web site, including archival material, time-aligned text transcripts, further community contributed recordings, and text material.

The site has four functionalities to support the knowledge design proposed above;

**Firstly** the data structure is highly interactive, allowing community to add resources, which are then updated as part of the site information without requiring extensive tagging.

**Secondly** there are functions that enable example sentences to be linked to example recordings of their constituent words or phrase. Hence when linguist's transcripts include recordings that contain a searched phrase, these will be automatically linked the words in the example. In the dictionary learners can search for words, and will be provided with example sentences linked to the word.

**Thirdly** there are various JavaScript functions that provide support for users. Data hidden on the page can be accessed by JavaScript to verify the status and access of the user (e.g. whether teacher or learner) and then support can be tailored to their needs. These links are created interactively as the pages are loaded, since the resources on the site can change over time.

For instance if a sound file exists for a group of words (on the first search of a page) or a single word (on the second search) it is shown as a link for listening. Also resources are provided to searching for a word (student), or creating a word list (teacher). While working on a lesson, and learners have access to the wordlist to help them complete lessons.

**Fourthly** the site provides an application programming interface (api) for mobile users to access words and wordlists for weekly exercises, based on worksheets. This enables teachers to set up wordlists for users to practise on their mobile. A new mobile app being developed also

relies much more on swiping to move around between different views of words (e.g. full text, word list, examples, memory game, etc.) to enable the user to change context while retaining the wordlist as content.

Also another benefit of using python system is this language is designed for text manipulation and parsing. We have linked in the python natural language toolkit (NLTK) to parse example sentence provided by linguists to provide examples relevant to a word. Also we can parse answers entered to exercises by users to verify if they are related to the expected answer. This provides functionality on the site for teachers to set interactive questions with auto-answers, while retaining some options for flexibility in the answers. However it is acknowledged that Aboriginal language structure is highly fluid, using markers to distinguish parts of speech and so sentence comparison can be difficult.

The language system is provided open source as a web service, which can be used with different languages through changing the setup variables, and loading the data for a different language. However the language parser requires more work to assist with generalising between languages. At present we focus on the grammatical features that are common to provide some consistency in support, such as the type of elisions for combining words and the use of markers for parts of speech.

Given the limitations of parsing, we therefore refer first, where possible, to linguistic example sentences that are similar to the example given by a teacher or student in preference to parsing. When teachers enter a search word or phrase, we look for existing examples with those words, and then parse for further examples. We also search for pages within the site that may refer to that word.

## 7.1 Example of a site as use of the system

The site has been set up for some NSW languages and a separate interface used for each one to provide for material specific to that group, for instance in Sydney the issue around language and culture is that Aboriginal identity is often disputed. The population was decimated early after the English arrived through disease and hunting parties. Also the language has few archival materials and a limited wordlist. The site supports learning language by providing recent recordings, and place an emphasis on linking wiki-style pages on local history and genealogy.

Another language is the Bundjalung language of the northern coast of New South Wales and extending into the state of Queensland. This language comprises five dialects or sub-languages. By combining these on the one site we enable learners of a language that may lack a useful word to select from a neighbouring language.

The web service code is on github (Language, 2015) and is continually updated for the functionality of all sites supporting the differently resourced languages. In this way the functionality and resources can be shared across sites, while retaining the different cultural needs of the various language groups.

## 8. Verifying the interface design

Using the model developed above we consider now one workshop where the language site was discussed. For this workshop with teachers, we had the printed dictionary, which had been converted from a colour coded word document into a toolbox database to be used on the site. The dictionary includes example sentences after many words, which are also on the site as examples. For this language we had many audio archival tapes, as well as a language speaker. There was some transcription of tapes, but that was not in a searchable order.

The language centre involved in this project has a series of images on various topics that we included in the workshop and teachers could use these to make a collage on the table, depicting scenes and activities. As mentioned we are using the ASLAN process of learning and considering how to support this online.

The proposal was to provide weekly wordlists on mobile and the website on worksheets. The goal is to assist teachers to produce these and students to use and share them in their learning (Ease of production).

We looked at the semantics of the website, how we are to create meaning in the language when many students and teachers have limited vocabulary and grammar. By understanding how users interact with the site we can assist them in this meaning making.

The interaction patterns with teachers working from existing offline resources showed that they would search the dictionary for word, and seek their own dialect first. A second option was a list of neighbouring dialects but the order chosen for these differed for the different dialects. They would then ask others for a pronunciation, or seek an audio version. Then they would check a usage example, also in the dictionary. Finally they would give a changed example that related to their world.

One of the techniques in language teaching is to use archival examples and change one or two words to make a “new” sentence that may be more topical. So the man walked to the mountain may become the man walked to the shops, sometimes using a language word that describes new phenomena such as a shop.

The interaction content they used was the dictionary and each other. They also were keen to listen to the old tapes to hear ‘how the language is supposed to be pronounced’ but they did not see this as a resource to take apart or to make relevant to any particular topic. Hence the audio tapes do not provide a salient feature for specific language learning. We hope that with transcription this may change. We also had the images that are shared between many language groups at the centre and teachers produced ones they had made which we have included on the site. There was an emphasis on the need to have images to point to and make the language more active and visual.

The cognitive trace through the material was the theme or word they had chosen and were following up. The conversation may start with ‘what is that word’ and an attempt to say a half-remembered word, or it may be ‘what was a person talking about the other day’ or ‘how do we say this’. The last format came more when planning

a lesson, not so much out of community interest. Again the emphasis was to get the version for their specific dialect if possible.

Then the content was combined to provide example sentences with images and sound to provide exercises the students could do while they spoke and listened to each other. When reproducing online this was seen as the need to share graphics, link to audio to help practice and for community to upload new audio when needed.

Once the teachers had a list of words to describe a theme, they collected examples for that theme, through various techniques, including taking examples from the dictionary and slightly altering these to be more topical or to direct the example more towards the specific theme.



Figure 4 Linguistic Toolbox dictionary on the site, showing five dialects

### 8.1 Cognitive Load

The cognitive load for a learner was considered under the four aspects above. The learners and teachers (who are also learning) are focused on reconstructing the language as close as possible to how it was originally spoken. Hence to reduce this load we looked at:

1. Representations within real world, or juxtapositions that can represent processes in real life narratives.

The worksheet system is set up with editing tools, shared images and parsing support to assist the teacher creating the sheet and assist the learner who is following the learning material to link new words with sentences and audio. The links are done within the sheet where possible or in sliding popup windows that follow the user down the page.

We are also providing for male and female voices to be selected as preferred option. This arose from our observations of language learning that when students try to align the sound of their pronunciation with that of the speaker, this is harder to do across gender.

2. Visual representations of temporal and spatial constraint that provide constraints and affordances to assist the learning enquiry, and select the resultant artefacts.

The learner is provided with colour coded dialect options, and a map to show where the dialects are

located, as they will use nearby words if no local one available (see Figure 4).

3. Artefacts found for further enquiry, such as audio example, and the authority of different annotations available on these artefacts. This is based on the thematic structure of the activity.

Audio examples are chosen by the dialect option used by the teacher or learner. Also the gender of the speaker can be chosen, which is not used yet as we only have male speakers for most examples.

4. Graphical elements which provide affordances or constrain the kinds of inferences that can be made about the relevance of the search artefacts and relevance to their focus audience,

The dialects are shown in order of locality to the user. Also audio examples are sought as a word group and provided as a link to that group, before individual words, as the sound will change in context.

## 8.2 Evaluating protocols

The second part of the evaluation is to verify adherence to the design principles developed in the study of the protocols for tacit knowledge sharing. We list here the features developed for this:

**Authority of speaker:** We need permission to use any archival tapes from the eldest living relative/descendant, which required a long trip around northern NSW to collect. Then we provide these tapes and any community recordings as complete files on the site. However, we are also working with a team to develop a suitable transcription tool to allow segmentation to extract words and phrases for the dictionary interface, so we will need to retain some information on the speaker when segments of their recordings are used across the site.

**Community narrative:** The site can collect a continually updated series of recordings from community members. This will provide a student with a variety of audio forms, including different dialects and genders to support the different forms of speaking.

We use a map and colour coding to show the source of words as being different dialects as this is important for each community. Also the order of related words is chosen based on the communities expressed perception of what is the more related dialect.

**Deferral to others:** Where there are many version of a word, including audio versions, we allow various forms to be shown or linked as audio, and the community of language learners and teachers will verify or moderate these. This process is still being worked out so for the present new material is not made public except through the language centre recordings.

**Knowledge is given not requested:** We are encouraging teachers to develop their own thematic lessons and utilise the material as they wish. The language they know and understand is the material they will teach with best. While teachers can share sheets, we expect they will use their own where possible.

## 9. Conclusion

This paper presents a study on the cultural sharing of Aboriginal language online, developed in line with an analysis of the community knowledge sharing process. The focus is on improving computer support for oral learning as a way to provide teaching resources that can adapt to the learners' needs and the teacher's focus.

We have attempted to implement the traditional culture of Australian Aboriginal people into the teaching process wherever possible, not just through material, but also method. The work is also designed to be adaptable by teachers to suit the variety of Aboriginal cultures and histories in Australia.

However the important aspect of learning is the student's construction of their knowledge within the social context of the language community and the web can only really provide the information from which learners can do this. Hence we have emphasised the importance of the involvement of human teachers to create the teaching resources, and how the study is on how we can support their work.

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