

Angkety map

Digital resource report



.....

'Angkety map' is from the Anmatyerr language, meaning 'many stories'. You can pronounce it by saying 'ang' as in sung, 'ke' as in keep and 'ty' is a similar sound to 'ch' in church.



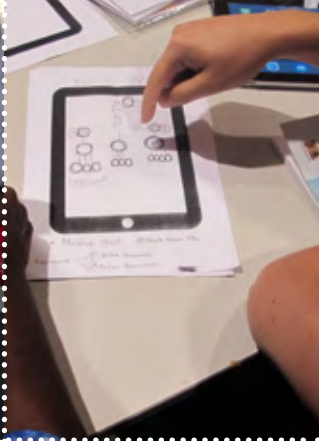
Image credit:

Tjunkaya Tapaya, Kungkarangkalpa Attila (2014)
840 x 1700 mm
Image courtesy of Ernabella Arts
© Tjunkaya Tapaya/Licensed by Viscopy, 2014

First Languages Australia would like to advise readers that this report may contain images or names of people who have since passed away.

Contents

Introduction	1
Strengths and weaknesses of digital	2
Points to consider	3
Contexts for use	6
Contextual information about resource use	10
Increasing awareness	11
Customising resources and managing rights	13
Challenges of change	20
Community	21
Relationships amongst resources	24
Access issues	25
Resource development appropriate to people's skills and interests	26
Challenges of obsolescence	27
Build once, use often	29
Resource gaps and growth opportunities	31
Commercialisation	36
Assessing effectiveness	39
Appendix I: Online reference	40
Appendix II: Consultations	40
Appendix III: Bibliography	40



Introduction

This report aims to provide an overview of the current directions, review recent approaches, identify major issues and propose strategies to mitigate the risks in using digital resources for Indigenous language work.

It has been written with the input of language speakers, language learners, community language workers, representatives of Language Centres and academics.

From the responses of people who have contributed to this report it is apparent that the term 'digital resources' is used by different people to refer to different technologies. In consideration of this, throughout the report the term 'digital resources' is intended to include such technologies as:

- Computer programs and applications for language documentation, recording, annotation, archiving
- Mobile/tablet apps (wordlists, dictionaries, music games, learning games, learning environments)
- Interactive whiteboard resources
- Multimedia CD-ROMs or DVDs
- Websites and web applications (e.g. YouTube, dictionary sites, online learning sites, etc.)
- Interactive dictionaries, word or sound lists, phrase books, flash cards
- eBooks
- Computer games
- Radio programs and audio podcasts

Strengths and weaknesses of digital

Digital resources can be highly beneficial for language programs, but they are also known to have significant weaknesses. These weaknesses should be considered when designing a program in order to maximise its effectiveness. Some can be mitigated by attention to design factors in developing resources, other weaknesses can be compensated for in a project’s planning, or by providing supplementary systems. Each digital resource project will have a different combination of strengths and weaknesses, depending on that project’s technology selection and the demographic of the users. Some of the more common include:

	Weaknesses	Strengths
Non-digital	<ul style="list-style-type: none"> high cost of duplication (e.g. printing) after publishing, content typically can’t be updated without reproduction 	<ul style="list-style-type: none"> not reliant on ongoing maintenance not reliant on external infrastructure (power, internet) easily adaptable by photocopying degrades gracefully—a poster may still be readable after being torn or getting wet
Digital	<ul style="list-style-type: none"> requires ongoing maintenance or redevelopment to maintain compatibility with changing or new operating systems (depending to varying degrees on the hardware and software used) users may have resistance to using ‘technology’, particularly storage of media outside a community may rely on internet access or other infrastructure that could be unavailable for the users (cost/network access/location reasons) degrades drastically—all content and functionality of a resource may be lost if a device is dropped or gets wet, or a server fails high cost of professional programming services 	<ul style="list-style-type: none"> content can be replaced in resources; one framework can be shared between many language groups centralised distribution allows control of language content from a central point, especially important in early phases of resource development and use content is adaptable during and after publication; digital resources can be ‘living resources’ with material available for people to use while continuing to be worked on once made, resources have low cost of duplication potential for access across distance, by users at multiple sites at any one time resources can hold many types of media (audio+video+text) and provide learners with interactive experiences, allowing language knowledge holders, many of whom are elderly, to rest

A recurring theme throughout the consultations was that the most effective language projects tend to include some components of digital and non-digital resources. This approach can balance the weaknesses of one format with the strengths of another. For example, the drastic degradation of a digital resource can be balanced by the graceful degradation of a related printed publication. Some production processes that are intended to produce a non-digital output (such as printing a poster) can also output digital assets (such as a digital copy as an image file or PDF) without too much extra effort.

Points to consider

The following points can be used as a guide when planning a digital-resource development project, or when selecting an appropriate existing resource to use in a language program. Each point is explored in more detail in the following sections.

Contexts for use

- Has the project planned to include user-centric design processes: identification of users and user needs; consideration of accessibility and flexibility of use; and user-centric data structures?
- Has the project planned to conduct usability tests evaluating intended contexts of use and check for responses to unexpected use?

Contextual information about resource use

- Does the project intend to publish information that clearly describes how, and for whom, a resource was designed to be used, and what existing knowledge is needed for the most effective use?

Increasing awareness

- Does the project include activities to raise awareness about the resource, awareness of how resources used in the project were implemented, and awareness of project outcomes/evaluation findings?
- Does the project intend to facilitate wide discussion within the language community, in particular cross-discipline knowledge exchange?

Customising resources and managing rights

- Is the project intending to make its resources available under appropriate software licences to allow people to adapt the resource to their own situations (in conjunction with providing access to the resource and implementation documentation)?
- Does the project clearly communicate the licence conditions of its software and content, to increase people's awareness of what they can legally and ethically do with the resource?
- Does the resource provide for personalisation of content: allowing people to filter content and save content states; allowing customisation of settings; or enabling people to add their own content?

Challenges of change

- Does the project include activities that encourage people's safe experimentation with, and exposure to new technologies or resources?
- Have processes been considered to identify and attempt to address people's concerns with the introduction of new technologies?

Community

- Does the project encourage intergenerational collaboration and knowledge transfer?
- Does the project intend to encourage and facilitate multi-user interaction and resource use in a multi-user environment?
- Is the project planning to create new communities of support, or maintain and encourage the use of existing communities?



Relationships amongst resources

- Will the resource allow content to be imported/exported/shared according to standard data formats?
- Will the resources work with high quality content for maximum potential future use?

Access issues

- If the resource is intended for reuse or commercialisation, will it provide clear and publicly available information about costs for use and support?
- Will the resource be made available in a way that reduces the need for personal relationships as a method of distribution, such as listing on app stores, software sites, etc., along with publication of appropriate training and support material?
- For resources with sensitive content, has the security of the content been considered; including access permissions for users and technical security arrangements?

Resource development appropriate to people's skills and interests

- Is the resource being planned or chosen likely to make the most of people's existing skills?
- Will the project provide opportunities for community members to develop new skills?

Challenges of obsolescence

- Will the resource be able to export content (ideally in common data formats) so that material can be reused?
- Does the project plan include strategic planning for budget, personnel capacity, and activities to maintain a resource's security, stability and compatibility with changing technologies?
- Have plans for future updates in response to evolving needs of the user base been considered?

Build once, use often

- Will the project publish their technology as open-source for other groups to access?
- Will the resource be able to be used (technically and under appropriate licence conditions) by more than one group?
- Does the project include dimensions of collaboration between groups to identify commonly desired features and contexts of use?
- Has the project planned to include documentation and promotion activities for wider awareness of a resource's reusability?
- For software projects, has a project used existing frameworks rather than beginning from scratch?

Resource gaps and growth opportunities

- Has the project explored the potential of games for engagement, cultural experience, and learning?
- Will the project adapt existing (in-person) games to digital, open-source platforms?
- Is the project planning to encourage community members to engage with metadata creation?
- Will the resource collect metadata based upon a standard, with more detail added arising from the unique attributes of a project?
- Does the project plan to explore creative expressions of language?

Commercialisation

- Has the potential for commercialising the resource been explored through research into potential markets and user groups?
- Have business plans and marketing strategies been considered, and is there capacity within the group to carry them out?

Assessing effectiveness

- Is evaluation planned beyond basic reporting for funding compliance, and is there scope within the project budget and timeframe to do something with the findings?
- Does the project plan include sharing and discussing evaluation findings within the community?
- Does the target audience play a key role in the evaluation, ensuring that material is evaluated from a community/users perspective?



Contexts for use

Digital resources are usually described in terms of their feature sets—the things the resource does, particularly in relation to what other resources don't do. This information is typically used to differentiate one resource from another. While this is useful in identifying whether a resource fits within specific functional needs, looking at the ways a resource is used can give more of an idea about its potential effectiveness. The context in which a resource is used, and the way that it fits within the context, are worth taking into account when identifying the long-term success of a resource.

Consideration of the contexts of use during production of a resource ensures that the resource is made to suit actual user needs rather than imagined or idealised situations. Identifying user groups and their needs, conducting usability tests, prototyping concepts and having meetings with users during planning and development stages ensures that the resources will be useful, useable, learnable and likeable.

User-centered design, user needs and user testing

User-centered design is a design process that seeks to base production upon the needs of the resource's intended users. The process investigates an idea for a resource, with the intention of improving its usability. User-centric design involves working with users, by observing them using a resource and discussing their experiences. Resource prototypes and mockups can be used during resource development stages.

Involving users in the planning stages of design, development and testing contributes to the making of a quality resource. Through these experiences dedicated user groups can form, and these people can hold a strong sense of ownership of the resource.

A good understanding of user needs is crucial for building useful resources. Some needs can be identified by asking people questions. Unarticulated needs can be gleaned by observing users performing related tasks. Concentrating development on specific user needs ensures that the resources that are made will be appropriate. For many language groups, development of digital resources has been based on a desire to 'have our own app' (and a generation ago, to 'have our own website'). While this may be high kudos and good for a language group's status, the resource should be genuinely useful, not just a show-piece. Identifying the users' needs will ensure that high quality, useful resources are made.

Involvement in design, development and testing stages can have a significant influence on people's digital literacy, and contribute to their awareness of digital-resource production processes and of issues related to using digital resources. Raising people's awareness increases the quality of their resource and contributes to people having high, yet realistic, expectations of resources.

User testing of a resource is vital for checking that a resource adapts well and doesn't fail in response to unanticipated or 'incorrect' demands. Failures can lead to users abandoning a resource. For example, a data entry resource may have a limit on the number of characters allowed per entry. If entering more characters than are allowed causes the resource to crash, or to not save the data without offering meaningful information about the cause of the failure, this could lead a user to abandon the resource. Resources that exit a process gracefully, say by presenting information about the failure, support the user in knowing



what went wrong and how it might be avoided in future. This experience is likely to cause a user to modify their behaviour to fit within the parameters of the resource, or in some cases (especially during user testing), requesting adaptation of the resource to suit their needs.

Usability

Usability is a quality related to a person's experience when using a resource. Highly usable resources benefit people by enabling them to easily and happily fulfil their language goals. Unusable systems hinder the success of language activities, are detrimental to people's long-term goals and can set in place adverse long-term biases. Usability describes a set of factors including: ease of comprehension of what the resource can do, the efficiency of the resource in being used for particular language tasks, and the enjoyability of using the resource.

Proposals for resource developments that include usability design stages in their activity schedules show that contexts of use are being considered. Different types of resources may vary in their project planning, though typically a project plan will detail stages such as identification of an audience, user or learner and their traits; identification of users' needs and environment; investigation of existing resources that address needs; and the relationship of the resource to existing resources or resource gaps.

Projects that are not developing new resources, but are implementing existing tools, also benefit from incorporating usability design activities. The suitability and effectiveness of a resource can be tested before implementation by investigating the fit of a resource with users' needs.

Learnability

The learnability of a resource relates to the amount of effort a user must make in comprehending a resource in order to competently achieve their goals. Comprehension of a resource is very much based upon the user's personal experience and general competency with digital resources.

Designing a resource to be wholly intuitive is a major goal of interactive design. However, some people consider this to be an unrealistic ideal, particularly in cross-cultural contexts

of use. A more achievable aim is to design a system that requires a minimum amount of guidance or instruction, especially in repeat use. Common design patterns and standard methods of interaction can be used to make a resource that is more like others, in the hope that a user has had experience of that form, reducing the amount of instruction required.

For particular demographics within the language community, there is resistance to using digital resources. This may be due to a hesitation around learning new ways of working. Where people haven't had a broad exposure to other digital resources, the learnability of a resource becomes more about how, once shown, someone can repeat a task with low incidence of error.

Recognising that some resources are used sporadically, learnability may include the extent to which a resource must be relearnt for intermittent users. Learnability may also be impacted by the availability of clear, accessible guidance and support. There are a variety of ways in which this can be provided, for example in the form of training, documentation, FAQs, online forums, or through the availability of people who understand the resource well—either within the community, or externally.

Likeability/attitude

Likeable resources are those that satisfy people's attitudes. Satisfaction is a driver of continued and enhanced resource use, and can be a significant factor in people genuinely promoting language resources and broader aspects of language revival and maintenance. Likeable resources increase people's engagement, naturally drive a high recurrence of use, inspire people to spread the good word about the resource, and encourage people to participate further in language revival and maintenance activities. Appearance, functionality, cost, and the quality of content contribute to a resource's likeability.

Visual design and interface design have a high impact on the success of a resource. Design is the integration of human, cultural, aesthetic and experiential aspects of a project—defining the space in which a resource is used. Design can have a big impact on the uptake of a resource; how it looks and feels sets the tone for people's value expectations.

The quality of content within a resource has a great effect on its suitability for a particular purpose, leading to satisfaction where the content matches the user's needs. Content quality may relate to resolution attributes of the content's format, linguistic or cultural errors in content, the depth of content proficiency, even the degree to which the content represents Indigenous knowledge.

Likeability may be derived from the innate playfulness of a resource. Digital language resources tend to be aligned with specific work tasks or learning activities; few resources or implementations of resources fully explore the power of fun and play for learning. Game-based resources provide engaging ways for people to embrace language and connect with language revival and maintenance. These types of interactions are highly attractive to young generations, and validate Indigenous language and culture in the context of media they consume.

Kisima Ingitchuna, Never Alone

Video games and other digital media are often perceived as distancing youth and young adults from their elders, their culture and their language. Digital games are largely alien to most elders, creating a concern that the more time youth spend playing these games, the less time they are connecting with their history, culture and values.

Confronted by the problem of maintaining indigenous cultural knowledge, the Cook Inlet Tribal Council, a tribal nonprofit organisation serving Alaska Native and American Indian people, worked with experienced game developers at E-Line Media to see if video games could be part of the solution.

The group was keen to explore the potential of video games to connect young Alaska Native people with their elders and their own culture, and to inspire gamers from around the world to experience Iñupiat culture and stories. By designing the game to reach a global market of players, the council hopes the project will be a path to self-sustainability.

The group values subsistence hunting and fishing, and a deep connection with nature, as a way of life. Based on a traditional Iñupiat story 'Kunuksaayuka' (phonetically Koonook-sah-yooka), the project team developed a gameplay, *Kisima Ingitchuna, Never Alone*,

which is deeply rooted in the values and themes of this indigenous culture. The game promotes interdependence, as manifested in the cooperation between a girl and a fox. Minnie Gray, the Iñupiaq elder whose father was first recorded telling the story, was involved to ensure that the key themes, plot and messages of the story were accurately reflected in the game design.

Another of *Never Alone*'s theme is resilience, the capability to survive in one of the most difficult environments without giving up. The last major theme is about intergenerational exchange, or the passing on of wisdom from one generation to the next.

'*Never Alone*,' says Dyani Wood of PlayStationLifeStyle.net, 'is one of those games I want everyone I know to be able to play ... If this is an indication of more to come, I can't wait to participate in other cultures and stories from around the world in an interactive art form.'

The positive reception of the game by a global audience has inspired the group to form a commercial partnership and invite others to work with them on developing more titles in this new genre of 'World Games'.

<http://www.neveralonegame.com/game/>



Contextual information about resource use

As the range of available digital language resources grows, the provision of adequate and clear contextual information has been noted as an area of language resource development that needs improvement. The more information that is provided about the intent of a particular resource, the easier it is to identify the resource's suitability for its users. Identifying suitability at an early stage increases the likelihood of a person's success in achieving their language work goals.



Contextual information can describe how a resource is intended to be used, and for whom it is designed. This information can cover: whether a resource is suitable for use in a group-learning environment, as a resource in an immersive-learning environment, or for individual self-directed use. The contextual information can describe who the resource is intended for: linguists, language workers, language learners, language teachers, interpreters, archivists, etc.; and describe requisite skill-levels and skill-sets for using the resource. For example, a resource could nominate that it is designed for someone with advanced knowledge of linguistic terminology; another resource may nominate as being suitable for someone with beginner levels of proficiency in video camera use.

Contexts of use can build on feature descriptions, by indicating how features are most effectively used. Making this information easily and separately identifiable from descriptions of a resource's features is desirable.

An example of descriptive information about the intended users and uses of a language learning resource is shown at <http://www.textfugu.com>. This site describes that the resource is made for self-learners rather than class-based learners, and that it is written in conversational language focussing on simplicity in explanation rather than deep linguistic analysis of the content.

Increasing awareness

Increasing people's awareness of available digital resources makes for a more informed, more effective sector. Having a high degree of awareness of existing resources helps people to make good choices in selecting resources to use for their particular situations. It also helps to avoid waste or duplication of effort associated with re-development of functionality which already exists in other resources.

Awareness comes from personal experience, personal research, recommendations by colleagues, teachers or Language Centres. Awareness can be fostered through websites, newsletters, social media or other publications that share resources and provide reviews or comparisons of existing resources.

Awareness leads to people having high and realistic expectations of what they can achieve when planning or selecting resources. People's decision-making is limited to what they know. High levels of awareness can stimulate the imagination and lead to the creation of new types of resources. With awareness of what resources have been developed and are being used, people can build upon others' experience, learning from what they have done.

Coordination of activities with similar aims, and sharing expertise amongst creators and users, increases community awareness and consequently, the diversity and quality of resources available. Collaboration and information sharing between language communities encourages people to develop resources for a broader range of language proficiencies than arises from groups working in isolation. With the knowledge that a group is working on a wordlist resource that can be shared by others, another group may consciously develop a resource for a higher level of proficiency. Sharing contextual information about resource production will assist language workers to move from the level of thinking 'I need to look for funding to make an app', to being able to identify a range of funding sources for resource development based on specific needs.

One of the most effective ways to increase people's self-confidence and awareness is through participation in resource development. Specific activities for people to be gradually exposed to aspects of the production can be included in a project plan. This gives the participants a chance to experience, learn, and develop an understanding of what can otherwise be very abstract concepts (such as the effects of public publishing of video online, and ways to limit exposure).

Awareness of the advantages and disadvantages associated with digital resources allows people to plan for issues and benefits during development or selection of a resource for use in a language activity. Without awareness and planning to mitigate issues, language activities using a resource may not succeed due to: hardware failure, lack of fit with user requirements, obsolescence or lack of access. Appreciating the benefits that digital resources have over non-digital resources enables resources to be designed, developed and used in ways that maximise the potential of digital.

Iltyem-iltyem

Anwern mpwarem iltyem-iltyemel arelh mapel kwer maparl akaltyerreyek. Website-wern anwern arrernem. If inang website altywer-ilem, ina can arerl iltyem-iltyem nthakenh apek. Anwerneh akaltyantheke iltyem-iltyemek angerrepat mapel, anwernek imperl-alhek. Anengkerrant alkenty ina irrkwek angerrepat mapel ant hand-em over-ilerlapetyart, passing on anwernek. Lyet anwern want-em-irrem akwerek pass em on-irretyek. We want to website-warn arrernerl anwernekenh angkety so they can iltyem-iltyem yanhek akaltyerreri.

All of us women are doing the handsign project so that the children can learn. We are putting the signs on a website. If they open the site then they'll be able to see how handsigns are done. The old people taught us handsign language, they handed it down to us. They held that knowledge from the Dreaming and they handed it over and passed it on to us. Now we want to pass it on to our children. We want to put our language on the web so that the children can learn sign language. Janie Long Pwerreri, Hanson River, 29 June 2011

A group of Anmatyerr and Warlpiri speaker/signers from Ti Tree, 200km north of Alice Springs, and Ngaatjatjarra speaker/signer Elizabeth Ellis from Tjukurla in the Western Desert region, worked on the pilot phase of the project in partnership with linguists and IT designers. The pilot involved raising community awareness of the consequences of internet publishing, the

development and testing of a prototype website, and ongoing review and consultation over the use of recorded material.

In the early stages of the project, a Tumblr blog was set up for participants to go through the processes of uploading video and discussing the implications of publishing videos online. While many of the participants had made films before, with experience on both sides of a video camera, online publishing was new to them.

It was important during this investigative stage not to get caught up in the mechanics of using a particular technology or elaborate design activities, which can be a great temptation when setting up a bespoke website. To keep things simple the free online blog service Tumblr, with preset content types and styles, was selected for its ease of use.

After participating in the video publishing experiments, some communities decided to record and publish their sign material online, while others have only recorded at this stage. For these communities, highlights of each signer's recordings have been produced on DVD.

The opportunity to try a new process enabled these people to make an informed decision about the availability of their content.

<http://www.iltyemiltyem.com>



Customising resources and managing rights

Customisation of resources allows people and groups to apply a resource to their specific situations, and to suit an individual's needs. This is extremely beneficial for language work.

The functionality and form of digital resources tend to be fixed in their adaptability to tasks beyond an original specification. In comparison, the form of non-digital resources tend to be highly adaptable to individual tasks, able to be written upon, cut, rearranged, added to, and reduced. Limitations for adapting a resource range from the rights involved (cultural knowledge rights, copyright on media and software), the licence conditions under which material is released, the degree of specialist knowledge required, the cost of updating, to the degree to which the original resource's design accommodated variations of use.

Cultural knowledge rights

The majority of language resources are fundamentally grounded in cultural knowledge. Resources may contain stories and knowledge of land and ecosystems; they may be designed to consider cultural values; and operate from particular ways of learning, playing and working.

Rights to cultural knowledge and cultural heritage are often owned by a community or language group, or held according to trans-generational concepts of ownership. Cultural heritage is living, thus Indigenous cultural and intellectual property (ICIP) rights may also include items that are yet to be created.

Australian law provides protection for some forms of ICIP relevant to language resource production (such as copyright to artwork and documentation of stories), however many rights are not covered by current Australian laws. To respect and empower language communities, it is important that resource projects include early-stage processes to identify and negotiate ICIP rights that are relevant for the community, and develop protocols for dealing with ICIP.

ICIP protocols for a resource project may include access restrictions; moderation of content in relation to the death of a community member; respect for inclusion or exclusion of particular content; prior and informed consent of people involved in a project; involvement in significant stages of a production; and acknowledgement and attribution rights.

Custodians of knowledge may want to set boundaries to the use of cultural resources. These may be about access of particular types of content for particular groups of people; they may be about appropriate locations for storage and archiving of content. In designing a resource there must be ways of enacting these boundaries appropriately, and in some cases, modify access to content in response to changes in ICIP rights.

For more information about ICIP rights in relation to Australian law, refer to <http://www.aitb.com.au/information-sheets/entry/indigenous-cultural-and-intellectual-property-icip>

Copyright and content licences

A person's legal ability to adapt a resource to suit their own situation is limited by copyright. For example, a teacher may be legally restricted from photocopying a published dictionary and making flash cards from the copied pages. To allow people to legally adapt resources, licences can be granted from the creator to the user.

Hearsay and the complexity of copyright law are barriers for many people's understanding of how they can modify resources. In addition, copyright law does not always fit well with the access and usage expectations of Indigenous people in regard to cultural knowledge. To address these concerns, a range of licence frameworks have been developed, including Creative Commons, Traditional Knowledge Licences, and software licences such as MIT, Apache, GPL.

Creative Commons (CC) licences, written to conform to international legal treaties, are intended to be effective worldwide, and are legal tools for licensing content. They feature a 'human readable' version of the licence, as well as the legal code, as a handy reference for creators, educators, and community members who aren't lawyers. A resource can be released under one of six main CC licences, allowing a resource to be copied, modified and/or redistributed, for commercial or non-commercial use.

<http://creativecommons.org/licenses/>

Traditional Knowledge (TK) licences and labels can be used separately or in combination with CC licences, to add conditions of use, and information, regarding how material should be respectfully and ethically treated according to community expectations and obligations. TK licences cover uses such as: labeling material as being open to all users, restricted to women only, for men only, requiring attribution, for community or commercial use. These licences are not legally binding, however they are informative and useful for developing rights awareness for a resource's users. *<http://www.localcontexts.org>*

For software products, software licences are available. They fit within the broad groups of proprietary and open-source licences. The distinguishing feature is usually the terms under which a user may modify and distribute the software.

Proprietary software licences grant the use of a resource under an agreement, with certain rights (such as ownership) remaining with the publisher. Proprietary licences tend to limit the number of installations allowed, or other terms of distribution. Proprietary licences typically restrict a resource from being changed from the form in which it is published. The specifications of the design are typically not made available for others to duplicate the resource.

Open-source software licences allow people to access a resource's design and components. Resources published under an open-source licence enable people to copy, change, and adapt them to their own purposes. Adapting the functionality of open-source resources tends to require specialist programming knowledge. Language groups may already have relationships with programmers through their existing networks, such as project partnerships with education institutions. If not, these relationships can be developed and shared within language networks through increased awareness and communication of digital production processes.

Some language resources have been made available under open-source licences, allowing people to adapt them to their own situation. For example:

- EOPAS *<http://www.eopas.org>*
- FieldDB *https://www.lingsync.org/slides/offline_databases.html*
- LingSync *<http://www.lingsync.org>*
- Ogoki app *<http://www.ogokilearning.com/native-language-app-code/>*
- Field Guide to Fauna *<http://museumvictoria.com.au/discoverycentre/mv-field-guide-app/>*
- Jila *<http://www.thoughtworks.com/insights/blog/preserving-culture-digital-age>*

For developers who are committed to proprietary products, having an exit strategy in place can provide a means for the language community to continue to access their resources in the event that the developer ceases business. For example, a company may have a plan to release their resource code as open-source software in the event that the company closes or the product is retired from sale. This would give the users of that product the opportunity to maintain their resources.

When selecting a resource, users should read the fine print on the proprietary product's licences and terms of condition. The users should ensure that the conditions don't prohibit them from accessing the content in any way during or after their use of the resource. If in doubt, users should seek the advice of a rights lawyer.



Personalising content

Digital resources lend themselves well to personalisation of content, function, and setting. They present great opportunities for searching and filtering content, and storing results for later reference.

Personalisation may come through a user's ability to select particular content for a specific activity. For example, a teacher may select a set of bird words from an animal wordlist to use in a language lesson. Through personalisation, this teacher's learning activity would be made more focused, avoiding potentially losing students' attention while negotiating a more comprehensive list of words during a class.

Personalisation may be in the configuration of an audio recording/playback tool that allows a project team to share song audio and associated metadata with an archivist at maximum quality, and share the tune with their friends at lower quality. The archivist would be able to store the high-fidelity recording and data, while the friends could more widely share the lower quality recording across limited bandwidth networks.

Personalisation at a community level might be through the addition of a community group's own language content to a resource. Some resources may allow users to edit or add content over time, enriching the cultural and community knowledge stored in the resource.

The Ma! platform

Ma! Iwaidja is a smartphone app developed with ILS funds by the Minjilang community from Croker Island in northwestern Arnhem Land, in partnership with the ANU. This app contains a 1,500-entry Iwaidja-English dictionary, a 400-entry phrase book, a word conjugator (all with audio files), and an information section about the language and other endangered languages in the area. The aim of app is to allow interaction with the language by Iwaidja speakers, community workers and researchers; they can record new words or phrases with their own translations, which are added to each user's collection.

The platform has grown in response to users' needs. As a result of the need to be able to share information with other users, the Language Team developed the Ma! Iwaidja Dictionary. It is published as an online database to which the app can sync, and an administration interface where the Language Team can approve, edit and publish contributions uploaded by the community.

The most thorough piloting of the platform has been carried out on Croker Island, Northern Territory, in 'pods' consisting of at least one knowledgeable adult Iwaidja speaker and one or more young people who are mobile-device competent. The feedback from this process has suggested a number of useful improvements to the platform, including social sharing of content, socialising the content by profiling author profiles, and moving away from a formal dictionary style to more community-oriented evocative usage of terms.

Since being published initially for the Iwaidja language, the Ma! framework has been adopted by other groups within and outside Australia. Interpret (produced for the Northern Territory Aboriginal Interpreter Service), *Ma! Gamilaraay*, and a 26,000 word *Somali English Dictionary* are all available now on Apple's App Store and

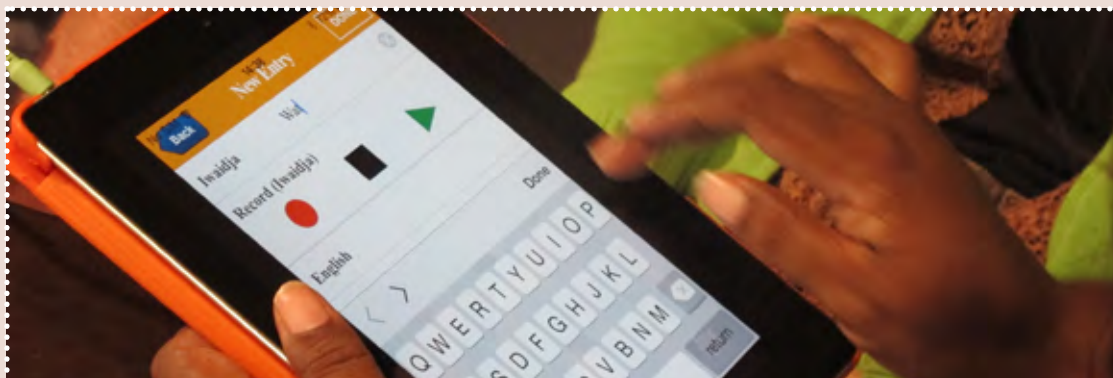
Google's Play Store. Pilots have been carried out for Mokpe (a Cameroonian language), Bena Bena (a language of the PNG highlands), and Marrithiyel (NT), and projects are underway for Yorta Yorta, for the NPY Women's Council, and for the Mawng-speaking community at Waruwu (NT).

The software has gained a relatively high profile amongst the language documentation community worldwide with the creators being invited to workshops and conferences around Australia, as well as Brazil, Cameroon and several European countries. It has also had significant media exposure, including national exposure mainly via the ABC (TV, radio, and web), and international exposure via CNN.

Although it was developed as proprietary software, interest from the language community in using the software has prompted the release of core components of the project code under an open-source licence (<http://www.github.com/polleninteractive/ma>). This enables other language teams to freely download the code and adapt the software to their own needs. Further code components are planned to be released as funds become available.

Copyright over the content in the various apps has been a matter for each group using the platform to work out to suit their own needs. In the case of Iwaidja, all content published on the apps is subject to a Creative Commons Non-Commercial licence. This licence allows people to add content to their own collections, and share content between app users. For a resource that has social sharing of content in its development plan, having an appropriate content licence is an important part of the preparation for future features.

<http://www.themaproject.org>



Flexible resources

An important approach to usability design is to plan for people using a resource according to their individual needs. Universal design principles enable resources to be designed for particular purposes, while accommodating a wide range of people's divergent needs, to the greatest extent possible. Digital resources are well suited to be designed to adapt to different environments, users and uses. Content published in a digital resource can be presented in device-independent ways. Visual elements can dynamically resize to adapt to different screen sizes. Font sizes and colour can be personalised to suit people's specific visual needs. Media can be presented with alternate forms that may be more perceptible to an individual. For example, a video can be published with a separate transcript for users in noisy or noise-sensitive environments, or for people with hearing impairment to read. Equitable use through the adaptation of design elements is a well-developed trend. Accessibility standards, guidelines, tips and techniques are available from organisations such as the Web Accessibility Initiative (<http://www.w3.org/WAI/gettingstarted/Overview.html>), against which resources can be checked and validated. Resources that plan to conform to accessibility standards in their planning are well grounded in being adaptable for individual users.

Flexible use is a design principle that accommodates a wide range of individual preferences, abilities and intentions. Designing a resource for flexible use enables people to adapt a resource to a task that may not have been imagined in the initial specification. For example, an audio recording resource offering only one format and no export options would be limited in its flexibility, whereas a resource that offers a choice of recording formats and export options would be highly flexible. The more flexible design is more likely to have a longer lifespan as it can be used in changing situations.

To be usable, a resource design must convey meaning to the range of options, settings and functions that come with a high degree of flexibility, and make it clear to a person how they might use the configurations to best suit their needs. For some resources, it may be beneficial to conceal or reveal a particular functionality depending on a level of experience that is selected or demonstrated by a user.

Flexibility at a conceptual-design level is a major design consideration. Research projects in recent years have investigated the design of resources that are highly adaptable, and use culturally matched structures, particularly for data storage. Data storage is typically designed according to conventional database design principles that separate data from context. Projects such as Charles Darwin University's Traditional Knowledge Revival Pathways (TKRP) have investigated the design of data structures that are explicitly designed according to a community group's knowledge structures. The TKRP project's database maintains the relationship between knowledge and context, and accommodates data retrieval methods that align with an entity's place within a knowledge system.

Projects that are designed by user-centric processes of comprehending knowledge structures are more politically and ethically appropriate than those that are based on other knowledge structures. While there are strong reasons to support the customisation of knowledge and data structures in digital resources, there are also benefits to standardisation, including potentially easier maintainability and interoperability with other resources. Projects may need to weigh up the advantages of customisation and standardisation in regards to a variety of design decisions.

Living Archive of Aboriginal Languages

The Living Archive project began with a commitment to develop a digital archive to support and enhance Australian Aboriginal knowledge practices.

The archive contains digitised material in Indigenous languages from the Northern Territory, with an initial focus on sourcing material from NT schools that had a Bilingual Education Program. These schools had Literature Production Centres, which produced books in local languages. Teacher-linguists and Literate Production Supervisors recorded a wide array of stories: versions of old-time children's stories; pre- and post-contact histories; books about the environment, hunting, bush medicines, ghost stories, creation stories, stories of memorable events, life stories, conception stories, and cautionary tales. There were readers, curriculum documents, bilingual magazines and newspapers. Stories came from schoolchildren, community members, and community elders.

While some of the books are still available in the communities, books from some sources had dispersed and were retrieved from small private and large public collections from around Australia. The copyright holders (e.g. the Northern Territory Department of Education) gave permission to digitise the books, and each named contributor was also sought (or family members of those who had passed away) to give permission for the books to be made public on the open-access website.

The archive now contains hundreds of books in over twenty-five languages from communities across the Northern Territory. A highly visual interface allows users to access the books through a map where they can click on either a language or a place, and cover images of the books are presented for selection. Standard search and browse options are also available, searching both metadata and full text. Most of the books are illustrated, and many have English translations. In consideration of the preservation and presentation needs of the archive, multiple versions and formats of each item are created

in the digitisation process. Books are published in the archive as PDFs, accompanied by Unicode text-only versions, while high-resolution preservation image scans are available on application. Some have been published as talking books, combining the original printed page with newly recorded readings.

The provision of the material in different formats opens up potential uses for the resources. Publishing the components of image and text makes the archive a great source of content for creating resources in the future, in collaboration with the story owners. It provides flexibility for people to adapt the material to their own use, such as updating text, adding new images, creating new ways to engage with the content. A Creative Commons licence allows non-commercial use of the materials with appropriate attribution.

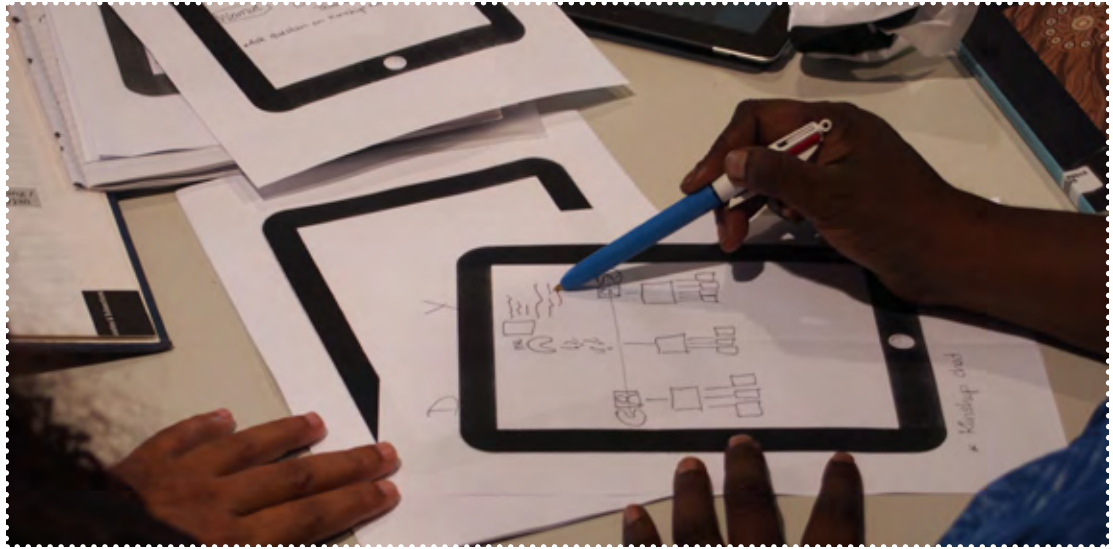
The process of reformatting reflects the activity and excitement that surrounded the original preparation of the books—the recording, the transcribing, the illustrating, the checking, the making, printing, collating, and distributing. It is this activity, and the ability for the material in the archive to be added to, edited, updated, which keeps it alive.

The archive balances the competing needs for material to be held as representation of knowledge, and for the archive to be performative, flexible and usable in multiple ways.

The second stage of the project involves engagement of users with the materials in the archive. A 'search and rescue' effort invites people to add more materials to the collection; there are efforts to engage communities in customising and enhancing their own collections; schools are invited to incorporate materials from the archive in the curriculum; and academics from around Australia and globally are encouraged to draw on the resources. The archive is still being modified to allow such engagement, in consultation with stakeholders.

<http://www.cdu.edu.au/laal>





Customising user interfaces

The ability to customise the user interface of a resource to reflect the cultural identity and language of the user community can have an important influence on the likability and usability of the resource. Incorporation of community-specific images, logos, colours and language content can help users to identify with the resource.

Digital resources that are designed for multiple groups to share can reinforce each group's sense of ownership by being provided by the publisher/developer as a 'white-label' product. Each group can then personalise the resource, branding it as their own. White-label resources are currently commercially available for a range of print and digital marketing resources, websites, email distribution channels, etc.

Use of traditional or local languages in the user interface can help to create an experience in which use of these languages is valued and encouraged from the outset, as well as reinforcing certain words or phrases in language. However, it is important to bear in mind that not all users of the resource will necessarily be fluent or literate in these languages. Consideration needs to be given to providing translations or the ability to switch between several user interface languages. Work may also be required to ensure that suitable fonts, customised keyboard apps, etc. are available to support non-standard characters in some orthographies.

Sense of ownership

A major contributor to the ongoing use of a resource is the users' feeling of resource ownership. A sense of ownership grows through: active participation in the development of a resource; use of a resource during a significant positive training experience; or by identifying with a language group that is particularly associated with a resource.

The differing rights of content owners and resource owners can lead to major problems in resource development. People who add their own data to a licensed product are too often at the mercy of the licensor to retrieve or access their content at a later date. Device obsolescence and media failure can be catastrophic for people's access to content; the licensing conditions around resource use can be just as damaging.

Challenges of change

While some people are keen to use new technologies in the service of their language outcomes, others are more reticent, wary of the unfamiliar or the unknown.

An individual's hesitation and resistance may be due to: having had a bad experience with technology, lack of time or budget to investigate options, lack of training in using new technology, cynicism of the marketing buzz around new technologies, unfamiliarity with the benefits of new technology, or being unaware of strategies to deal with weaknesses of digital technologies. Some people may also have genuine concerns that adoption of new types of technology may be a form of cultural assimilation, may expose members of the community to undesired external influences, or may distract young people from cultural priorities they see as being more important.

Where concerns are based on prejudices, they can be very difficult to overcome. Opportunities to experience new technologies within guided, supported contexts can be effective for some people. This could be in the form of a breakout space at a cultural event, with a range of digital resources available for people to look at and be guided in using. Structured activities to respond to specific concerns may be required to soothe the feelings of those who are particularly reticent.

If there are deep-seated concerns about the impact of new technologies on the community, the project may need to provide a space for these concerns to be heard and discussed. Examples of how similar resources have been used in other communities, and the positive and/or negative effects experienced, may provide useful input.

Community-wide resistance to digital resources can be due to an accumulation of individual biases, or be a communally agreed position regarding concerns about issues such as the protection of knowledge. Online resources may be perceived as providing open-door access to their content, against the wishes of the community, which wants to limit the access to specific people or groups. Content permissions are known to be an issue in one community, where resistance to digital resources is a smokescreen, covering people's avoidance of negotiating content rights.

Within a community language group, it isn't necessary for all members to be active supporters of the technology. It is enough that people's uncertainties are ameliorated, and that they have a choice about whether and how they engage with the resource.

Community

The effectiveness of a resource depends greatly upon the activity and satisfaction of its community of makers and users.

A benefit of digital resources is the ability of a community of users to participate in shared activities across disparate places and times. This leads to opportunities for people to participate in language learning activities that aren't dependent on sites of language knowledge (locations where speakers and teachers are concentrated) and at times that suit their personal circumstances. Digital resources can be effective at reducing the burden of key individual knowledge holders, due to their ability to challenge users, give feedback, and be user or presenter controlled.

Being able to collaborate on activities at times/places that suit individuals within a group can benefit language groups that are spread across vast regions of country. Across different sites, groups can collaborate on common tasks in real-time or by saving data and working on tasks at their own pace. Schools in the Northern Territory are using digital resources that can create and share data, enabling different groups across vast distances to make content for a shared language, then share and review each other's material.

Communities are strengthened through the making, adapting and positive promotion of their resources.

Online communities

Online communities exist for conversing in and learning language, for language research activities, and as support networks between language workers.

Online social networks present good opportunities, especially within sparse language groups (and where people have internet access), for online speaker communities to promote and use language. These sites have great potential for language revitalisation by encouraging language use and technique sharing. Despite some claims in mainstream media, using social media alone will not save endangered languages. However these sites can play an important role in language activities, especially around encouraging people to use language more frequently and naturally in conversational and social learning modes.

While social media sites such as Facebook and Twitter innately support the publishing of Indigenous language content, the site menus, labels and instructions are typically in English. Some sites include translation systems for their interface; Facebook's method is based on crowd-sourced translations, publicly moderated through a voting system. Unfortunately, no new translations have been added to the Facebook translations since 2012. Different approaches are being taken by some digital resources to fill this gap.

IndigenousTweets is facilitating translation of social media platforms, and software such as Mozilla FireFox, into Indigenous languages. Their approach is for the translation to occur on specific users' computers rather than as part of the websites' systems. This enables their communities to benefit from using social media sites in language without waiting for the official translation systems to be updated.

Adapting social media sites to use language for their interface emphasises the usefulness of the language for both content and instruction, and can be of great symbolic value.

Wiradjuri Mob

'Language is an important part of our page as it is extremely important in our lives.'

In 2013, Mark Saddler started 'Wiradjuri Mob', a Facebook page for people to engage with Wiradjuri culture. He decided to use Facebook rather than set up a website or blog as he finds that it is a good way to connect with people without needing any technical input. This allows him to put more time into coming up with stories and taking photos of country to target what people want to see and learn.

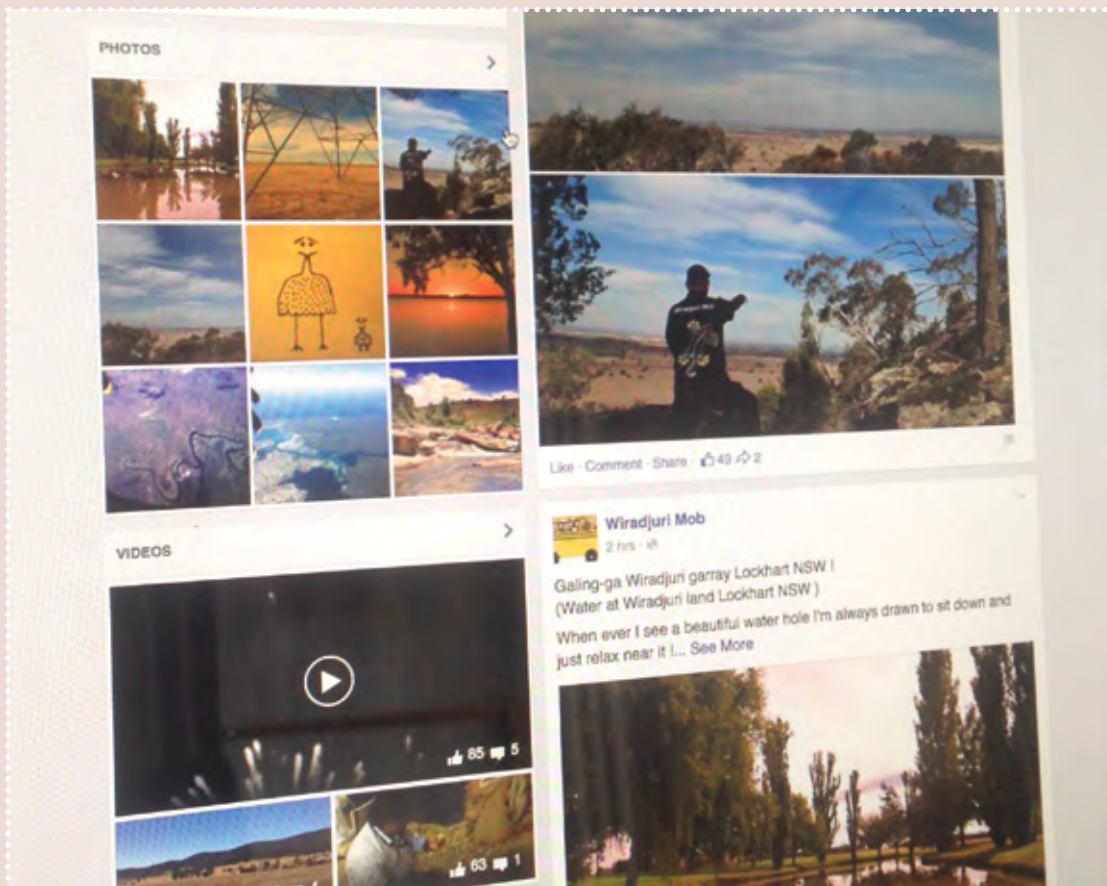
Mark posts about land, culture and language, encouraging visitors to the page to connect with language and country by freely asking questions and sharing knowledge.

Other people are able to contribute to the page, with many sharing photos, asking questions about culture and their own

identity, and promoting other resources. The page has been used by people who want to re-connect with Wiradjuri family members past and present.

The response to the page has been great, with over 7,000 likes, and 50,000 people from 40 countries viewing the content. The page regularly has high levels of engagement, with a third of the audience interacting by commenting, liking stories, and sharing. Mark is hopeful that community participation will increase and that the page will inspire others to start similar pages, leading to more connections between groups.

<http://www.facebook.com/WiradjuriMob>



Communities of support

Communities of support form around collaboration and information sharing activities, and in turn provide network structures for further knowledge sharing.

Networking opportunities abound: national and international Indigenous language, media and archiving conferences; email lists and Facebook groups; informal get-togethers. In recent years, the organisation of community-oriented workshops and conferences has increased networking opportunities for non-academic language workers around training and information sharing related to digital resources. Though well supported and appreciated, these in-person activities are still few and far between, as are the extension of in-person activities into ongoing, online networks of support.

Where communities of support are based upon specific areas of knowledge, their accessibility tends to depend on people's depth of knowledge in a particular field, their literacy, location, financial capacity and for some groups, their internet connectivity. For newcomers, lack of familiarity with existing participants can be a barrier to participation.

Where financial capacity is a barrier, mechanisms such as the provision of travelling scholarships may assist in participation at in-person events. Encouraging greater attendance at events is a strong foundation for more active online communities of support to evolve. The connections made from in-person contact can form a solid basis for ongoing online interactions.

Raising people's awareness of technologies and existing networks of support, through demonstrations of digital resources and methods in language communities, can provide the foundation of knowledge for people to participate in ongoing interactions. Awareness-raising may be in the form of information sessions or training pertaining to issues of concern for language communities, such as the maintenance and archival of digital materials. Such activities can create an awareness of other people having shared experiences, and provide the connections for people to network to find solutions to common needs.

For communities of support to flourish, the motivation to participate must be strong, especially for online communities and groups where the members are dispersed. People's social identity, self-confidence and the cohesion of a group are factors in the degree of interaction within the group. Maintaining a feeling that a community is active and responsive can be achieved by the participation of an individual in a leadership or coordinating role. Regular posting of discussion topics, questions, news and updates can inspire people from the broader community to respond, and bring vitality to a community.

Inter-generational production

Digital-resource production processes can be a great framework for bringing together elders who speak language to work with young people; sharing knowledge within a space that values each person's particular skills and abilities.

Access to digital resources allows young people to control new forms of cultural production, and engage with language and cultural knowledge. In some cases, empowering old people to engage with computer technology that they otherwise don't see value in using.

When language speakers bring language knowledge to a project, and tech-focused youth work on production, projects can become vibrant vehicles for collaboration. Project environments foster cultural production and social learning. Collaborative projects strengthen the relationships among the participants and develop language and technology literacies.

Relationships amongst resources

Language work activities can be complex; there is not always a direct mapping of resources to purposes. Much language work requires a combination of resources, or for resources to be used in multiple ways. The relationship amongst resources is an important consideration in the success of a language activity. Ideally, resources can be 'connected' through content sharing, or by integration in a progression of activities. If the available resources are disparate and unconnected, people's ability to conduct their desired activities may be hindered.

Connections between resources may be through direct relationships such as the import/export of language content and sharing of metadata, or through perceptual relationships between language content.

Especially in language learning scenarios, people build up knowledge incrementally, by using different resources over a span of time. Clear perceptual relationships between content used in different resources encourages people to bring new insights and coherency to their current understanding, challenge their perspectives, and validate the resource's authenticity. Perceptual relationships may come from resources that build on content in other resources, add complexity to a person's existing understanding, or provide opportunities for people to incorporate personal experience.

Digital resources have great potential for supporting direct relationships by using standard formats for storing, importing, exporting and sharing content.

Digital resources that can import, export or share content contribute to efficient workflows. Content sharing enables content to be input in one resource and exported for use in another. This is especially important for resources that contain significant amounts of content. On a mechanical level, sharing content can save much duplication of effort when working with large sets of content, for example, when making sets of flashcards using words from an existing wordlist. Reducing duplication of effort gives more time for attention to language activities other than content entry.

Ideally, content sharing would offer options to export high-quality formats of content for preservation, as well as lower quality versions for sharing on limited bandwidth networks or devices with low processing power.

Resources that don't enable content to be shared are at a great risk of catastrophic content loss if the resource fails. This risk could be extremely detrimental to learning or revival programs. Many language programs in Australia are working to document the knowledge of the last speakers of the language. If this material is captured and stored using technology that doesn't have the capacity to export the data, technology failure or obsolescence would lead to irretrievable loss of the content. Resources that do export data, but in proprietary formats, are in a similar high-risk category due to the reliance on the long-term viability of the resource's publisher for ongoing access to the systems that hold the content.

With digital environments evolving and changing rapidly, continuity of access to content is threatened. The ability to export data from one resource, and import it to another for further use or storage, is critical for the survival of that content. Without this safeguard, options for long-term use and recovery are greatly restricted.

Access issues

There are significant issues around people's access to existing language resources. While some projects have been designed with shared content or reusable frameworks in mind, too often there are hindrances to other groups using the resources due to poor communication, lack of understanding between groups, and underlying personal politics.

Example: A language group requested access to a locally produced digital resource that was designed to be used by many groups. The resource was provided and an offer made and accepted for a supporting training session, with no indication that there would be a cost associated with the support. After the session, the resource producer sent an invoice for a few thousand dollars, which was a significant amount for the language group to raise.

The issues in this scenario indicate lack of awareness on various levels. The community group evidently had no awareness of the needs of the resource producer to recoup their costs; the producer had a lack of awareness of the community's financial capacity, and it suggests that there was generally poor communication between the groups about the relationship. Situations such as these can be avoided by a producer clearly communicating the costs associated with using resources at the start (such as any ongoing or once-off licence and support fees), resource users communicating their financial capacity when requesting development or support services, and adequate contractual relationships when entering into development or support relationships.

Example: A member of a language group, looking at resources to use for their language work, vetoed the inclusion of a particular resource due to a history of working with that resource's developer. On an earlier project where they had been working together, the developer had allegedly paid project funds to members of his family who had not been involved in the project. The new resource was only available for others to use by collaborating with the developer—there was no means of accessing the resource independently of a close working relationship. This experience with the developer's poor financial accountability and other concerns over the potential mismanagement that may be involved in a collaboration gave cause to avoid choosing to use a new resource made by that developer.

Had the resource in this scenario been made available in a way that didn't require close collaboration with the developer, the group could have accessed a resource that would have suited their functional needs very well.

Resources can be published via distribution channels that are independent of the developer, increasing their accessibility. Depending on the resource's licence conditions, app stores, software distribution websites and resource collection sites are available for developers to distribute their resources. Third-party distribution services avoid conflicting personalities from being an impediment to resource access.

Resource development appropriate to people's skills and interests

When considering technologies and formats for digital resource production, making the most of people's experience leads to the creation of strong digital resources. Where someone has experience in video production, using services such as YouTube is a natural fit of experience with technology; where a person has community radio broadcasting experience, creating a series of audio podcasts is likely to lead to the development of a quality resource.



Using technologies that have a direct connection with people's experience gives resources strong natural champions, and helps to create the feelings of ownership that lead to resource longevity. These resources are likely to be richer, due to the depth of prior knowledge and by not requiring great amounts of technological upskilling. More time in a project's development can be devoted to aspects of content rather than upskilling in completely novel technical aspects of production.

Challenges of obsolescence

Technology obsolescence and physical failure of the storage media are among the greatest risks in making digital language resources. The short upgrade cycles of current computer, mobile and tablet technologies put resources developed for particular systems at risk of being unusable in very short timeframes; while the physical properties of digital storage media are fragile.

Making digital resources typically involves the creation of a resource designed to run on a particular combination of hardware and operating system, and in some cases, underlying software frameworks or libraries. When manufacturers release updates to hardware and operating system software, digital language resources often need to be updated to maintain compatibility. Without continually updating the digital resource, major hardware and software changes result in resources no longer being supported, and the language content being lost. Failure to update resources to current versions of underlying code bases can also result in security issues, lack of support and inability to use new features that become available.

This has been seen most alarmingly in the production of language CD-ROMs. A significant investment of time and funding went into the production of language CD-ROMs nationally, which are now no longer accessible. This obsolescence occurred through a devastating mix of CD-ROM programs not being supported by current operating systems, the increasing number of computers being made now without CD drives, and the prevalence of tablets and mobile devices as primary digital tools for language work. Where projects did archive production material in forms that are accessible to provide content for other projects, the effect of this obsolescence was reduced. Projects that didn't archive material have suffered a much more serious loss.

The legacy of CD-ROM obsolescence has made many language workers wary of working with new digital resources. They are cautious about committing time and effort towards creating content for a new suite of technologies that, in an even shorter timeframe, won't work.

While no-one has solved the broad problems of preserving digital information, content can be kept accessible over time by refreshing, migration and replication. Refreshing involves moving the content from one storage medium to another, to avoid the decay of the first medium. This may be done by copying a digital resource from one hard drive to another. Migration is the act of changing the form of the content from one system to another to avoid obsolescence. An example of this would be regularly opening and saving a text document through versions of some word processing software over a number of years. This activity seeks to limit loss of content and format. Often, contemporary versions of software don't fully support formats available in previous versions, so there may still be some loss of formatting in this process. Replication seeks to limit the risks of decay, destruction or loss, by backing up copies of a resource onto numerous devices.

To reduce the risk of losing language content through obsolescence, resources can be continually updated, or content can be separated and stored in ways that can be reused. Language content developed during the production of resources can be archived in ways that have longer lifespans. This may be a consequence of archiving content in paper-based formats, or by adding digital language content to an archival organisation's collection, so

the material can be included in their planned archival management activities. This is quite common practice within the language community for projects that have separate content production and publishing activities, especially where academics are involved in the projects. However, where people can record and publish content 'in-resource' the ability to export content for archiving or repurposing must be explicitly designed as part of the resource for this material to be easily included in archival collections. Content in resources without export capabilities is effectively 'locked in', lost for future use.

Other strategies that can help to reduce risks of early obsolescence include avoidance of proprietary formats for storage of data; use of standards-based approaches that provide the greatest likelihood of compatibility with other systems; and thoughtful selection of technologies with a consciousness of the directions in which technology is developing and with a view to minimising platform-dependence.

Content loss may also come from physical failure of the storage media. Storage media can be extremely volatile. CD-ROMs, promoted by manufacturers as having longer than hundred-year lifetimes, are commonly failing within two years (<http://www.rense.com/general52/themythofthe100year.htm>). Hard disk drives have varying failure rates, some lasting less than five years (<http://blog.backblaze.com/2014/01/21/what-hard-drive-should-i-buy/>). Video tapes are known to be unreadable within five to ten years. Note that storage media failure is not limited to digital technologies. Some photographic and film media is renowned for spontaneously combusting or disintegrating.

Digital resources' short lifespans are particularly apparent in comparison with the relative longevity of paper-based resources (when protected from insects, rodents and moisture). Forgotten hand-written documents dating back hundreds of years are still being found in archives and collections around the country. In contrast with digital media, paper's ability to sit quietly on a shelf, without significant deterioration, awaiting discovery in hundreds of years, is striking.

All digital resources, and collections of digital resources, should have adequate backup strategies in place to protect against accidental loss, decay or damage. In some cases, the strategy may involve widespread sharing of multiple copies of the resource. Lodging copies of items with language resource archives may also provide a 'safety net' against loss of local versions. Digital resources that exist on only one computer or server are at particular risk of being lost. These installations must have strong backup strategies including redundant and offsite backups to minimise risks of data loss.

Maintenance costs for minor updates to sustain security, stability and compatibility for some years may be estimated and included in project plans. Costs to adapt resources to changes in hardware are much harder to estimate, and are more likely to require complete redesigns to make the most of the new technologies.

For many projects, the best approach for longevity is to include schedules for short-term resource updates, and plan for long-term resource redesigns based on content archived from the production process or from within the resource. By doing so, the great benefits of rich interactivity and multi-modal content (combining multiple forms of media) are underpinned by data-export abilities enabling content to be repurposed for future uses.

Build once, use often

A cost effective way to increase the widespread adoption of language resources among language groups is for resources to support adaption for use with any language. Rather than many language groups developing, say, their own resource to publish a wordlist and companion audio, a single resource could be developed into which any group could place their own language content. This could reduce duplication of expenditure on technical development and build up a wider support base of users than would be achieved if each group duplicated their efforts. (People using the same platform or coding language—e.g. HTML—will be in a good position to advise each other through shared, personal experience.)

Duplication of the production of similar language resources reduces the proportion of funding being allocated towards language content production and resource implementation. A survey of available resources shows that duplication of digital language resources is occurring, particularly with mobile/tablet-based resources in the ‘publishing’ end of the spectrum, such as wordlist apps.

To reduce the occurrence of resource duplication, the ability for resources to be reused can be encouraged by supporting projects that allow people to input their own language content into a shared resource. Rather than funding a dozen groups to develop their own technology for a simple wordlist app, a single instance of the technology could be made, and designed in such a way that other groups could add their own content.

A principle of reusing resources shouldn’t preclude groups from developing resources that are similar to those currently available, if their needs can be shown to not be satisfied by the current options.



Making resources available for others to use is a concept intrinsic to much open-source software development: the software is built once, and people can either reuse the tool as it is, substituting their own content, or adapt the tool to their needs. Language projects may



look to existing open-source code to avoid reinventing the wheel, and may also consider sharing their own outputs as open-source resources for others to build on in turn.

To be effective, the shared resource should be well documented, be made available under licence conditions that allow it to be reused, and be built using best-practice, standards-based code. Building resources with standards-compliant code can cost more than making resources with 'hero' code—code that doesn't conform to common design standards. Although the development cost and extra stages of producing adequate documentation may be slightly higher than the development cost of a single non-shared instance, the cost benefits of avoiding building duplicates are greater. Building well-documented, standards-compliant resources also means that these resources will be easier to maintain and less vulnerable to early obsolescence.

Another consideration in promoting reuse is modular design. Separation of the core logic of the resource from language-specific elements and from platform-specific requirements can make it easier to transfer the resource to new languages or platforms. This is particularly relevant to tablet and mobile apps, which ideally will be able to run across multiple operating systems.

Bearing in mind the potential for cost savings of using existing resources, the opportunity for groups making their foray into digital resource production to work on small, low-budget projects is, nonetheless, a great way to get started with production experience. In reusing an existing resource, people can still benefit from exposure to the production process through planning, adaption and implementation stages.

Getting the word out about the availability of reusable resources is critical to reducing the incidence of language groups requesting funding to make duplicate resources. Promotion can happen through good news stories in print and digital media, presentation at language conferences and events, and by word-of-mouth. Project plans that include promotion and marketing strategies are good indicators that efforts will be made to spread word that the resources are able to be used by other groups.

Resource gaps and growth opportunities

Using apps downloaded from the Apple App Store or Google Play Store for Android, people can now create and self-publish digital storybooks for distribution. Community language workers can create and upload video content to online video platforms for students to refer to in classes. Communities can run workshops in collaboration with design/development partners to self-publish digital dictionaries and wordlists using existing software templates.

For many language groups, the first steps into making and using digital resources have been modelled on paper-based resources: wordlists, books, flashcards. For the most part, resources that have been developed to meet these needs have been easily imagined (their design has been closely modelled on existing resources); they have been built on relatively simple methods of interaction, keeping costs down and helping with familiarity and usability; and people have made the most of existing tools and technologies such as YouTube rather than building resources from scratch.

As people gain experience in working with these technologies, demand is created for more effective and engaging methods of interaction, learning and communication. New types of resources are required for opportunities that grow out of the development of new technologies.

The topics below have been identified as growth opportunities for resource development due to gaps in existing resources for known language tasks, or to the availability of new technologies that could be beneficial for language work.

Game-based learning

Games can inspire people to deeply engage with language. Some language groups have created simple word games and limited interactive materials, particularly to attract young learners. Other groups are exploring sophisticated game resources for language learning and cultural expression.

The Bunuba, Nyikina and Kukatja CD-ROMs published by the Kimberley Language Resource Centre were early examples of digital resources using games for language learning. Very popular with young learners, this series featured a collection of word games to be used for spelling, word recognition and typing instruction.

The Aboriginal Languages Network, a team of teachers and language workers in Port Augusta, South Australia, have developed a collection of interactive material for revitalisation of threatened languages spoken in northern South Australia. Animations, songs, memory games, word games, and drag-and-drop games have been created, along with supporting teacher resources. <http://www.apps.sa.edu.au/ablang.htm>

Of the simple word game materials that are currently available, the majority have been made using Adobe's Flash platform, proprietary software which is facing obsolescence by no longer being supported on many devices. Whether the resources that are currently available will be adapted to new formats—ideally open-source technologies for other groups to use—remains to be seen.

The power of play for language learning underpins *NEOMAD*, an interactive comic and film series created by thirty young people, as part of a long-term, inter-generational cultural arts project. *NEOMAD* is a lively cultural expression of life in a Western Australian community.

Although it is not primarily a language resource, it sets a high standard for engagement, richness of content and detail in supporting documentation upon which other resources could be modelled. <http://yijalayala.bighart.org/neomad/love-punks/>

Game-based learning is being explored by the Inuit group Pinnguaq, who have developed a mobile app that uses music to teach language. Most notably, Pinnguaq are also in the prototype stages of developing *Qalupalik*, a computer game based on Inuit culture and mythology. As a resource that is intended to be accessible and competitive in the mainstream game market, this is a very powerful approach for learning about culture and language. <http://www.pinnguaq.com/index.php/en/services/singuistics-menu>



Natural Language Processing (Text to speech and speech recognition)

Natural Language Processing (NLP) refers to the use of technologies to recognise and process spoken and written texts. NLP technologies include automated translation tools; speech recognition, text-to-speech and speech comparison tools; grammar checkers and spell checkers.

Machine involvement is particularly relevant for language research. NLP tools are used by linguists for analysing language, such as automating investigations into language structures. NLP has the potential for increasing research efficiency by speeding up annotation activities in Indigenous language documentation programs. Experiments with European languages, incorporating machine-suggestions of annotations indicate considerable promise for more efficient workflows.

NLP technologies are more commonly available for languages with large collections of content, which provide data for the system's interpretive algorithms; and languages with large populations of speakers or learners. Indigenous languages are rather poorly supported in access to NLP technologies, with some notable exceptions. The following two projects indicate positive directions for people to access automation tools for Indigenous language literacy, taking different approaches in attempting to overcome scale and cost barriers.

With a goal of producing tools that work for any language, the Idibon company has an acute awareness of the access issues for Indigenous language groups to NLP tools. They test and launch products for languages with large populations, then apply them to

languages with smaller populations with minimal retooling. Idibon's tools were recently implemented on a Navajo website to separate constructive from non-constructive comments. <http://idibon.com/nlp-for-all/>

The AVENUE project at the Carnegie Mellon University develops new machine translation methods for languages for which only scarce resources are available. In spite of the lack of standardised corpora and orthography, AVENUE has developed systems for two Andean languages, Mapudungun and Quechua. Over many years enough content was collected to develop a suite of simple language tools that were then built upon to create more sophisticated processing tools. <http://www.cs.cmu.edu/~alavie/>
[http://www.cs.cmu.edu/~aria/Papers/FontAranovich_CILLA2_mapuche_quechua\(2\).pdf](http://www.cs.cmu.edu/~aria/Papers/FontAranovich_CILLA2_mapuche_quechua(2).pdf)

Text-to-speech (TTS) is a technology that converts written words into speech. TTS has been used internationally for many years within the visually impaired community to provide accessible alternatives to written texts. The benefits of combining visual and audio modes of content are well known for people who have difficulty reading, and are particularly useful for people with dyslexia. TTS has enormous benefits for language revival and maintenance activities. Hearing the pronunciation of a written word can be very helpful for people's comprehension, and builds better speech and literacy skills. While TTS technology is commercially available for major global languages, accessing TTS technology for other languages may require the development of relationships between TTS researchers and language communities.

Speech recognition software can be beneficial for proficient speakers by converting spoken word into text, say for transcribing a storytelling or documentation project. This could be of significant benefit to projects that aim to digitise large quantities of language materials.

Speech comparison—the analysis of a learner's speech in relation to a recorded word or sentence—is particularly helpful for learning correct pronunciation. Some language resources have a facility for learners to practise words and self-assess a comparison of recordings of their speech with 'authentic' recordings. Automation of comparison, with graphical representations, is a core feature of a number of resources for learning international languages. Opportunities for licensing international resources' automation technologies are being explored by local groups, however there is room for more to be done to benefit local language learners.



Collaborative transcription

Currently, the resources that language workers most commonly use for transcribing recorded media are designed for an individual user working on a desktop computer. This often leads to language content being recorded collaboratively, then annotated in isolation from the sources. Using collaborative annotation tools could lead to greater participation of non-academic language workers throughout the documentation process, greater sharing of the annotation workload, and make for easy proofing of language content.

While there are a few online tools for collaborative transcription, these are currently limited to particular data sources and major global languages, and there is little awareness of ways to adapt the tool to Australian Indigenous languages. One of these tools is built using open-source code, so there is some potential for extending this resource and raising awareness of it to suit the needs of Australian language workers.

Metadata

Metadata is data about data. It enables collections of content to be easily contextualised and understood, and is important for the future accessibility of language content. Metadata for language documentation and description has grown from initially having a 'cataloguing' focus on resource discovery, to now being a more comprehensive documentation of the language content and process, enabling deeper understanding in the future. There are several types of resource-level metadata, including catalogue information (about the speakers, the recording activity's time and place, etc.), descriptive (content description and relationship to other content), structural (language patterns, etc.), technical (formats) and administrative (access protocols, etc.). Metadata can include transcriptions, annotations and other commentary and analysis.

One of the defining traits of metadata documentation is the variety of metadata standards, and the shifting of standards over time. While there is no meta-standard for the range of metadata standards, general principles shared across many individual standards can be abstracted. Labels of one metadata standard can generally be mapped against labels of another with a high degree of similarity. Increasingly, diversity of metadata content is seen less as a problem for interoperability between archival systems, and more of a benefit for the richness of metadata detail that is collected.

Best practice metadata collection recommends that data be recorded as a basic part of the process of collection, not afterwards. This approach is most likely to lead to active involvement of language speakers in the documentation of metadata, reducing the risk of errors being introduced due to knowledge gaps between information providers and eventual users of the materials.

Without good, 'thick' metadata, created by the relevant knowledge bearers to accompany content, we face a future of wading in digital quicksand. Lack of metadata can lead to content being less usable over time as it becomes more difficult to interpret when language competencies change.

Metadata can be documented through systems including free text, structured text, spreadsheets, databases or metadata managers. A great opportunity exists for digital resources that can record content, to collect contextual information about the language content, and expose this information in ways that extend existing metadata standards.

Quality documentation

Providing suitable documentation is a key to the commercialisation and widespread

adoption of resources. As more digital language resources are produced, particularly with national and international markets in mind, the quality of the supporting documentation will be critical for their success. Access to information about how to setup, work (or play) with, and evaluate a resource is required for it to be usable by someone who was not involved in its development.

Given the complexity of some resources, adequate instruction and documentation is important for people to reference both during initial instruction and in later use. Documentation may be in different forms depending on the needs of the user group and attributes of the resource—in some instances, video documentation may be appropriate, in others a paper information sheet may be more suitable. Documentation may include technical, administrative, cultural information about the resource; for teaching resources, activity plans proposing ways that resources can be embedded within classroom activities are beneficial. Different sets of documentation may also be needed for users as opposed to resource administrators or technical support people.



Usage data, analytics and updates

Current technologies offer unprecedented opportunities for language content to be published and updated in response to users' feedback. Digital resources are ideally suited to combining the creative, artistic and cultural expressions of language with data analysis and manipulation tools. Websites and mobile apps can include technologies to (unobtrusively or explicitly) collect data about usage patterns and resource performance. This data can be used to review usage behaviours and guide updates to a resource's content or design. The process of review can be at a very high level; such as updating an app with new genres of content based on data about what users have been searching for; or at a level of miniscule detail such as changing the design of interface buttons based on user feedback.

Resources can publish content and be a method for collecting meta-information about a user's language knowledge. The dynamic nature of many digital resources enables additional content to be added to the resource after publication, or for content updates to be pushed out to users with associated commentary.

Commercialisation

New technologies bring opportunities for new methods of commercialisation, and enable people to reach new markets for their resources. While it may be unrealistic to expect returns from app sales to be able to solely support a language program, they may provide supplemental income to a project. If these directions are to be explored, it is important for projects to ensure there is capacity within the group to undertake the financial and accounting requirements of selling resources, and that the group consider developing appropriate business plans, marketing plans and retail strategies.

New distribution channels

Mobile or tablet resources can be distributed in an ad-hoc fashion directly between the developer and the users, or via a device manufacturer's app store. App stores are collections of resources across many genres; each app store is particular to a device manufacturer's system. To distribute an app via an app store requires registration and payment of a small fee. A developer account registration fee for Apple's store costs USD\$99 per year. Submission to Google's store requires payment to Google of a once-only registration fee of USD\$25. Distribution through an app store puts a resource within reach of a global group of users at an unprecedented low cost.

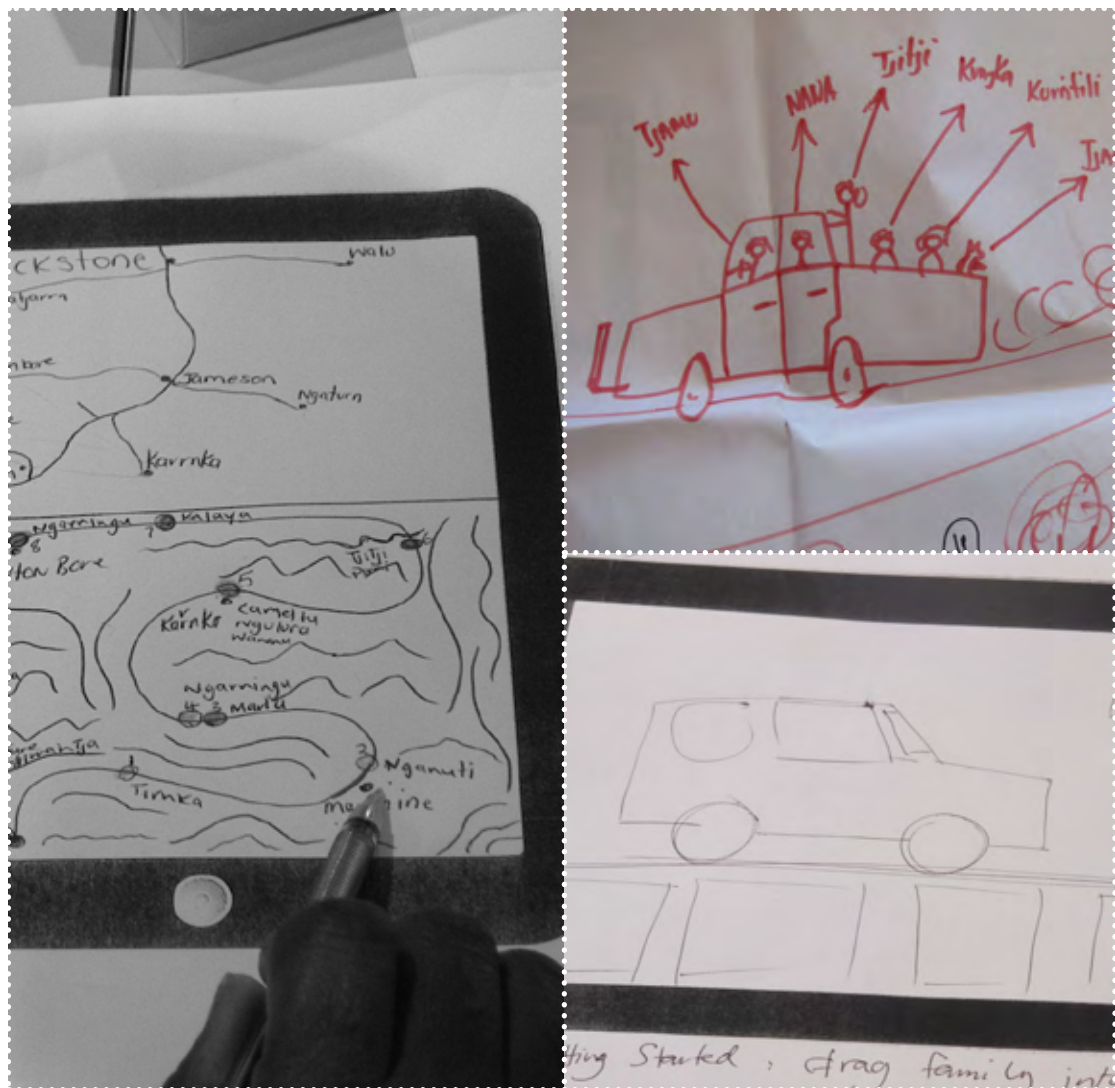
The app stores are primarily distribution services rather than promotion channels. Rather than browsing through app stores looking for resources to suit their situations, users tend to look for specific apps that have been suggested by others. This can be attributed to the sheer number of apps within these stores, and factors such as time pressures and technical confidence. Although searches on either Apple's or Google's stores currently return few results for (relatively) specific terms such as 'indigenous language', the significant number of apps displayed for broad terms such as 'language' hinders people from searching and browsing without a specific app in mind. People's feelings of not having adequate time or the technical nous to evaluate apps prior to use also contributes to the mode of app store use. As with printed publications, it is necessary to promote or market a resource in order to reach and maintain the visibility required for successful commercial outcomes.

Access to new markets

The availability of resources via new distribution channels opens up new national and global markets for language content, and particularly for resource technologies. People moving to regions for work can access language-learning resources prior to their relocation. Language resources may also be useful in supporting cultural competence or cultural awareness training. Location-based delivery of language content can enrich the cultural experience of tourists through an area. There are great opportunities to commercialise the sharing of resource templates among language groups internationally and supporting client groups to implement shared resources.

Promotion

Promotion is the key to connecting with new users. Strategies such as word-of-mouth marketing; paid advertising; soliciting positive media stories; and display or presentation at conferences are effective ways to promote any resource. A beneficial attribute of some digital resources is an ability to be used in trial or demonstration mode, giving people a better idea of the resource's usefulness for a particular situation. Digital resources can be designed to include 'share' features—useful for spreading the word within a user's



networks of friends and colleagues. In recent years, some resources have been particularly successful in attracting positive news stories. *Ma! Iwaidja* reached over forty news stories in the national press; *Ringbalin River Stories* made international headlines and was selected as a finalist in an international competition of interactive resources. The presence of these resources in the media, and the associated stories about language revival and maintenance, contribute to an increasing awareness of the resources among potential customers.

Financial capacity

Strategies to raise the financial capacity and encourage the inclusion of people within the language sector would help realise the potential for the increasing commercialisation of digital language resources. While organisations such as NAB have been working with people on financial literacy through a federal National Financial Literacy Strategy, these programs are focused on personal finances. Increasing people's knowledge of business needs is required. This may be achieved by supporting the development of new financial literacy programs (or encouraging participation in existing programs where they are available); creation of programs to increase marketing and promotion skills within the sector; and the development of specific programs to support Indigenous entrepreneurship.

Miromaa

Miromaa was developed by the Arwarbukarl Cultural Resource Association (ACRA), now known as Miromaa Aboriginal Language and Technology Centre, as a way to manage their growing collection of language content. Beginning with an 1892 publication of Awabakal language traditions and culture titled *An Australian Language*, members of the community documented all the language content they could access. Initially the words were typed into an Excel spreadsheet.

Inspired by the lack of community-developed database technologies and finding the steep learning curve of existing linguistic database tools daunting, the group made their own database product using their existing IT skills. The group named their product Miromaa, which loosely translates to 'saved' in the Awabakal language.

The group used the database for some months before presenting it at a state language meeting resource showcase. They were surprised to see that it was the only digital resource shown. Following the meeting, there was much interest from other language groups who were keen to access this technology. In response, the database was redeveloped extensively to enable

other language content to be input and it was made available for other groups to use.

Early on, Microsoft assisted with travel and training costs for support activities as part of their social responsibility program. The Language Centre began to run training workshops and provide in-person and online support for other groups that were using the database.

In 2009, Miromaa was shown for the first time outside Australia at a language conference in North America. A group of Pueblo tribes from New Mexico were among the first international users. They began using it and the relationship between these communities grew. Six years on, staff from the Language Centre are proud to support language groups globally, including groups in Australia, the Torres Strait Islands, and North, Central and South America.

As of 2015, approximately 900 licences to use the product have been provided to language groups globally for people to document their language and the knowledge held within.

<http://www.miromaa.org.au/miromaa.html>



Assessing effectiveness

Across the spectrum of digital resources, there is very little empirical evidence demonstrating their effectiveness for language learning. Digital resources are anecdotally considered to increase engagement and make for more enriching multi-modal media experiences. However, few projects adequately evaluate their activities beyond compliance with goals described in funding applications; or if they do, few promote their findings within the language community in ways that could benefit other projects.

Collecting and analysing information about a project's implementation, activities and outcomes identifies a resource's strengths and weaknesses. The information can be used to improve a resource; to guide the development of a follow-up resource; to find out if a project is really making a difference; and if shared within the language community, to inform design decisions for other resources; and potentially to contribute to a broader knowledge about what approaches are effective in language maintenance and revival.

Evaluation at different stages of a resource's design and implementation can cover: assessments of user needs, process or implementation evaluation, evaluation of outcomes, and evaluation of impact. Within the broad outlines of evaluation design, particular methods of measuring goals and objectives, collecting and analysing data, and sharing findings, will differ from one project to another. Some resources are designed to be present information only once, others may be designed to be used repeatedly. Consequently, evaluation of these resources will require different considerations and techniques. Designing methods of evaluation to suit each project should be identified in a project's planning stages, and reviewed during evaluation to ensure that unforeseen occurrences are included.

Evaluation of digital language resource will be aided by clear identification of the goals that prompted the development of the resource. These may relate to the quality and usefulness of the project outputs, but also to the outcomes that are intended in relation to the language, for example more positive attitudes towards the language; increased knowledge of the language or of cultural information; increased fluency in understanding or speaking the language; or increased usage of traditional language instead of English in certain contexts. It may also be useful to identify the groups to which these goals relate—children or young people may be a focus for outcomes in many language maintenance programs.

While evaluation toolkits are available for other sectors, few guides are readily available for community language teams to evaluate their programs and resource projects. Provision of guides and toolkits, including some means for evaluation outcomes to be published, would increase the quality of evaluation by making the evaluation process less daunting for project teams. Quality feedback is important for a quality evaluation. Where evaluation does occur, it is too often hastily done at the conclusion of a project, with reporting compliance as the sole objective. Rather than relying on evaluation only at the conclusion of a project, evaluation actions during a project can lead to more authentic responses and higher quality conclusions. As a participatory process, evaluation should include representatives of all people involved in a project, to include those most likely to be affected by the findings.

Evaluation activities can be in many forms, from having in-person conversations and using website/app analytics to gather data, through to publishing evaluation reports as video posts or writing blog posts about the progress of a project.

Appendix I: Online reference



This document is published online at:
<http://firstlanguages.org.au/projects/digital.html>

Appendix II: Consultations

We acknowledge the contributions of Language Centres, representatives of project teams and individuals working with languages across Australia in compiling this report.

Workshop activities have been conducted at four language conferences—Melbourne, Alice Springs, Cairns and Broome—to discuss and test the report's recommendations.

The report includes feedback from 54 respondents to an online survey.

Photo credits

piii Photos courtesy

Living Archive of Aboriginal Languages, Charles Darwin University

Getting in Touch workshop, Research Unit for Indigenous Language, School of Languages and Linguistics, University of Melbourne

NT Language Support Program—Central Australia, Batchelor Institute of Indigenous Tertiary Education

The Ma! Project

italklibrary

p4, 12 Photos Margaret Carew

p5, 10 Photos Ben Foley

p7 Photo italklibrary

p9, 32 Photos Upper One Games

p15 Photo Bruce Birch

p16, 19, 26, 29, 30, 37 Photos Getting in Touch workshop

p18, 33, 35 Photos Living Archive of Aboriginal Languages

p22 Photos Mark Saddler

p38 Photo Daryn McKenny

Appendix III: Bibliography

Articles online

Baldrige, Jason; Palmer, Alexis, 'How well does active learning actually work? Time-based evaluation of cost-reduction strategies for language documentation', <http://dl.acm.org/citation.cfm?id=1699510.1699549>

Begay, Winoka Rose, 'Mobile apps and Indigenous language learning: new developments in the field of Indigenous language revitalization', 2013, <http://hdl.handle.net/10150/293746>, University of Arizona

Besser, Howard, 'Digital longevity', 1999, <http://besser.tsoa.nyu.edu/howard/Papers/sfs-longevity.html>

Burnham, Denis; Estival, Dominique; Fazio, Steven; Viethen, Jette; Cox, Felicity; Dale, Robert; Cassidy, Steve; Epps, Julien; Togneri, Roberto; Wagner, Michael; Kinoshita, Yuko; Göcke, Roland; Arciuli, Joanne; Onslow, Marc; Lewis, Trent; Butcher, Andy; Hajek, John, 'Building an audio-visual corpus of Australian English: large corpus collection with an economical portable and replicable Black Box', <https://austalk.edu.au/sites/default/files/IS11-AusTalk.pdf>

Campbell, Matthew; Christie, Michael, 'Indigenous community engagement', 2008, http://www.cdu.edu.au/centres/spill/pdf/ICE@CDU_FINAL.pdf, Charles Darwin University, Darwin, Australia

- Capiluppi, Andrea; Stol, Klaas-Jan; Boldyreff, Cornelia, 'Software reuse in Open Source: a case study', *International Journal of Open Source Software and Processes*, vol. 3, no. 3, 2011, <http://www.igi-global.com/article/software-reuse-open-source/68148>
- Christie, Michael, 'Digital tools and the management of Australian Desert Aboriginal knowledge', http://www.cdu.edu.au/centres/ik/pdf/DIGITAL_TOOLS_24102005.pdf, Charles Darwin University, Darwin, Australia
- Christie, Michael, 'Words, ontologies and Aboriginal databases', <http://www.cdu.edu.au/centres/ik/pdf/WordsOntologiesAbDB.pdf>, Charles Darwin University, Darwin, Australia
- Clarke, Roger, 'Beyond the Dublin Core: rich meta-data and convenience-of-use are compatible after all', <http://www.rogerclarke.com/II/DublinCore.html>
- Connelly, Sherilyn, 'Navajo translation of *Star Wars*', http://www.toplessrobot.com/2013/11/the_five_coolest_things_about_the_navajo_translati.php
- Godbold, Natalya, 'User-centred design vs. "good" database design principles: a case study, creating knowledge repositories for indigenous Australians', <http://hdl.handle.net/10453/8975>, University of Technology, Sydney, Australia
- Hobson, John, 'What is the best technology to support teaching language?', 2013, http://www.indigoz.com.au/language/technology.html#What_is_the_best_technology_to_support
- Hobson, John; Lowe, Kevin; Poetsch, Susan; Walsh, Michael (eds), 'Re-awakening languages. Theory and practice in the revitalisation of Australia's Indigenous languages', 2010, <http://prijipati.library.usyd.edu.au/bitstream/2123/6929/1/RAL-prelims.pdf>, Sydney University Press, Sydney, Australia
- Jackson, Julian, 'Digital longevity: the lifespan of digital files', <http://www.dpconline.org/events/previous-events/306-digital-longevity>
- Jirage, Reshma, 'Benefits of being bilingual', 2013, <http://www.buzzle.com/articles/benefits-of-being-bilingual.html>
- Johnson, Becky, 'Can the digital age save the Cherokee language? The halls of Facebook, Google and texting', <http://www.smokymountainnews.com/news/item/9653-can-the-digital-age-save-the-choerokee-language?-the-halls-of-facebook-google-and-texting>
- Kral, Inge, 'Generational change, learning and remote Australian Indigenous youth', *CAEPR Working Paper No. 68*, 2010, <http://ssrn.com/abstract=2244636>
- Kral, Inge, 'Plugged in: remote Australian Indigenous youth and digital culture', *CAEPR Working Paper No. 69*, 2010, <http://ssrn.com/abstract=2244615>
- Merino, Miguel Bernal, 'On the translation of video games', http://www.jostrans.org/issue06/art_bernal.php
- Nathan, David; Austin, Peter K., 'Reconceiving metadata: language documentation through thick and thin', http://www.hrelp.org/events/workshops/eldp2008_6/resources/nathan-austin.pdf
- Ni, Kuei-Jung; Tsikun, Marina Igorevna, 'Using licensing contracts to protect holders of traditional knowledge related to genetic resources: a reflection on ICBG Projects', 2011, <http://ssrn.com/abstract=1930941>
- Paul, Margaret, 'New technologies to revive Indigenous languages', <http://www.abc.net.au/news/2012-11-05/new-technologies-to-revive-indigenous-languages/4353136>
- Scannell, Kevin, 'Indigenoustweets', <http://indigenoustweets.blogspot.com.au/2012/10/facebook-in-your-language.html>
- Scannell, Kevin, 'Translating Facebook into endangered languages', <http://borel.slu.edu/pub/fel12.pdf>
- Somers, Harold, 'Faking it: synthetic text-to-speech synthesis for under-resourced languages—Experimental design', <http://aclweb.org/anthology/U/U05/U05-1012.pdf>
- Thieberger, Nick, 'Australian humanities research infrastructure funding', 2011, <http://www.paradisec.org.au/blog/2011/03/australian-humanities-research-infrastructure-funding/>
- Tolisano, Silvia Rosenthal, 'Evaluating apps with transformative use of the iPad in mind', <http://langwitches.org/blog/2012/05/27/evaluating-apps-with-transformative-use-of-the-ipad-in-mind/>

van Weeren, Trevor; Cathcart, Juli; Guyula, Yingiya; Gumbula, Ian; Gumbula, Mercy; Rami, Gwen; Greatorex, John; Christie, Michael, 'An evaluation of the ANZ-TCU Financial Literacy Project', 2008, http://www.cdu.edu.au/centres/yaci/pdf/ANZ_TCU_FL_Nov08.pdf

Vargas, John E.; Cruz, Juan A.; Castro, Richard A., 'Let's speak Quechua: the implementation of a Text-to-Speech System for the Incas' language', http://www.academia.edu/2177189/Lets_Speak_Quechua_The_Implementation_of_a_Text-to-Speech_System_for_the_Incas_Language

Walker, Harry, 'Evaluating the effectiveness of apps for mobile devices', *Journal of Special Education Technology*, http://ttools2.com/technology/evaluating_apps.pdf

Books

Austin, Peter K., 'Going, going, gone? The ideologies and politics of Gamilaraay-Yuwaalaraay endangerment and revitalization' in Austin, P.K.; Sallabank, J. (eds), *Endangered languages: beliefs and ideologies in language documentation and revitalization*, Oxford University Press, Melbourne, Australia, 2014

Gee, James Paul, *Good Video Games and Good Learning*, Peter Lang Publishing, Inc., New York, USA, 2007, 2008

Met, Mimi, 'Teaching content through a second language', pp. 159–182, in Genesee, F. (ed.), *Educating Second Language Children: The Whole Child, the Whole Curriculum, the Whole Community*, Cambridge University Press, New York, USA, 1994

Ormond-Parker, Lyndon; Corn, Aaron; Obata, Kazuko; O'Sullivan, Sandy (eds), *Information technology and indigenous communities*, AIATSIS Research Publications, Canberra, Australia, 2013

Shackel, Brian; Richardson, Simon (eds), *Human Factors for Informatics Usability*, Cambridge University Press, New York, USA, 1991

Conference papers, reports, newsletters

Austin, Peter K., 'What is metadata and what is it good for?' *Metadata in Language Documentation and Description* session, Annual Meeting of the Linguistic Society of America, Pittsburgh, USA, 6–9 January 2011

Demosthenous, Catherine; Robertson, Boni; Cabraal, Anuja; Singh, Supriya, 'Cultural identity and financial literacy: Australian Aboriginal experiences of money and money management', *Financial Literacy, Banking and Identity Conference*, October 2006, Storey Hall, RMIT University, Melbourne

Eira, Christina; Couzens, Vicki, 'Meeting point: setting up a typology of revival languages in Victoria', *Report G2008/7366*, Victorian Aboriginal Corporation for Languages/AIATSIS, 2010

Furneaux, Craig W.; Brown, Kerry A, 'Indigenous entrepreneurship: an analysis of capital constraints Indigenous entrepreneurship', in Murray, Gillin, L. (ed.), *4th AGSE International Entrepreneurship Research Exchange*, 2007, <http://eprints.qut.edu.au/12947/>

Hunter, Jane; Koopman, Bevan; Sledge, Jane, 'Software tools for Indigenous knowledge management', Paper presented at *Museums and the Web 2003*, Charlotte, North Carolina, USA, 2003, http://www.itee.uq.edu.au/eresearch/papers/2003/IKM_software.pdf

Lampe, Cliff; Wash, Rick; Velasquez, Alcides; Ozkaya, Elif, 'Motivations to participate in online communities', CHI '10 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 10–15 April 2010, Atlanta, Georgia, USA, <http://dl.acm.org/citation.cfm?id=1753616>

Lenker, Ashley; Rhodes, Nancy, 'Foreign language immersion programs: features and trends over thirty-five years', *ACIE Newsletter The Bridge*, February 2007, <http://www.carla.umn.edu/immersion/acie/vol10/BridgeFeb07.pdf>

Mundy, Paul; Compton, J. Lin, 'Indigenous communication and Indigenous knowledge', *Development Communication Report 74*, 1991/3. Clearinghouse on Development Communication, Arlington, Virginia, USA.

Palmer, Alexis; Moon, Taesun; Baldrige, Jason, 'Evaluating automation strategies in language documentation', Proceedings of the NAACL HLT Workshop on Active Learning for Natural Language Processing, pp. 36–44, Boulder, Colorado, June 2009

Journals, online and printed

Boyle, Alicia; Wallace, Ruth, 'Indigenous people and e-nabling technologies: an analysis of recent experiences in northern and central Australia', *Kulumun. Indigenous Online Journal*, vol. 1, pp. 1-14, 2011, The Wollotuka Institute, University of Newcastle, Australia

Clarkson, Jodie, 'Building successful organisations via culturally grounded governance', in Behrendt, L.; Glanville, J.; Laing, N. (eds), *Ngija: Talk the Law*, vol. 1, 2007

Clément, Richard; Dörnyei, Zoltán; Noels, Kimberly A., 'Motivation, self-confidence and group cohesion in the foreign language', *Language Learning*, vol. 44, no. 3, September 1994, pp. 417–448

Hermes, Mary; King, Kendall A., 'Ojibwe language revitalization, multimedia technology, and family language learning', *Language, Learning & Technology*, vol. 17, no.1, February 2013, University of Hawai'i

Huggins, Jackie; Mackinlay, Elizabeth (eds), *The Australian Journal of Indigenous Education*, vol. 36, <http://www.indigoz.com.au/hobson/HobsonAJIEReview.pdf>, University of Queensland

Levy, Mike, 'Technologies in use for Second Language Learning', *The Modern Language Journal Special Issue: Focus Issue: Toward an Ecological CALL: Update to Garrett (1991)*, vol. 93, supplement s1, pp. 769–782, December 2009, <http://onlinelibrary.wiley.com/doi/10.1111/j.1540-4781.2009.00972.x/abstract>

McLoughlin, Catherine; Oliver, Ron, 'Designing learning environments for cultural inclusivity: a case study of Indigenous online learning at tertiary level', *Australian Journal of Educational Technology*, vol. 16, no. 1, pp. 58–72, 2000, <http://ascilite.org.au/ajet/ajet16/mcloughlin.html>

Standley, Peta-Marie; Bidwell, Nicola J.; George Senior, Tommy; Steffensen, Victor; Gothe, Jacqueline, 'Connecting communities and the environment through media: doing, saying and seeing along traditional knowledge revival pathways', *Journal of Community, Citizen's and Third Sector Media and Communication*, issue 5, October 2009

Thouësny, Sylvie; Bradley, Linda (eds), 'Second language teaching and learning with technology: views of emergent researchers', research-publishing.net, 2011

Webster, Jane; Ho, Hayes, 'Audience engagement in multimedia presentations', *ACM SIGMIS Database Newsletter*, vol. 28, issue 2, Spring 1997, pp. 63–77, ACM New York, New York, USA

Websites

'Access college: universal design', <http://www.washington.edu/doit/programs/accesscollege/faculty-room/universal-design>

'Introduction to natural language processing', http://www.mind.ilstu.edu/curriculum/protothinker/natural_language_processing.php

'Introduction to usability', <http://www.nngroup.com/articles/usability-101-introduction-to-usability/>

'Libraries dig deep and reawaken lost Indigenous languages', <http://blog.sl.nsw.gov.au/media/index.cfm/2013/8/26/libraries-dig-deep-and-reawaken-lost-indigenous-languages>

'Multiple benefits of text to speech applications', <http://www.lc2.ca/item/85-multiple-benefits-of-text-to-speech-applications>

'Notes on User Centered Design Process (UCD)', <http://www.w3.org/WAI/redesign/ucd>

'Planning digital resources', http://www.ndlrn.edu.au/developing_digital_resources/creating_digital_resources/planning.html

'Teaching and learning languages: a guide. Evaluating language programs', http://www.tllg.unisa.edu.au/lib_guide/gllt_ch7.pdf

'Teaching and learning languages: a guide. Resourcing and materials', http://www.tllg.unisa.edu.au/lib_guide/gllt_ch4.pdf

'What is learnability', <http://www.igi-global.com/dictionary/learnability/16765>



First Languages Australia works to ensure that the wishes of Aboriginal and Torres Strait Islander community members are included in key decision-making processes that impact on the current and future management of their languages. This work supports the survival of Australia's traditional languages into the future.

The organisation facilitates discussions between communities, the government and key non-government partners whose work affects, or could affect, Australia's Indigenous languages.

By supporting communication within the language network, First Languages Australia works to help colleagues share their experiences, resources and expertise and to encourage sustainable partnerships that support the broad spectrum of language endeavours.