

DIGITAL ACCESS FOR LANGUAGE AND CULTURE IN FIRST NATIONS COMMUNITIES

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Acknowledgements

This research was supported by the Social Sciences and Humanities Research Council of Canada, through the Knowledge Synthesis program, Grant No. #421-2015-2076. We are grateful to members of the Heiltsuk Nation, in Bella Bella and beyond, for their gracious welcome and invitation to work in respectful partnership in their traditional territories. In Bella Bella, we in particular wish to thank Janice Gladish, Rory Housty, Rex Slett and the staff of the Heiltsuk Cultural Education Centre and the Bella Bella Community School for their contributions and support of this work. In addition, we are grateful to Heiltsuk Hereditary Chief and lifelong educator Chester Lawson for his insights and wisdom as this project took shape. At UBC, we are very grateful first and foremost to Pamela Brown at UBC's Museum of Anthropology for her generous guidance and profound counsel, to Anne Kruijt and Aidan Pine for their careful reading and valuable editorial input, and to Emma Novotny, Senior Graphic Designer in the Faculty of Arts, for kindly developing the layout for this report and assisting with its digital preparation.

KEY MESSAGES

Documentation of community-initiated, community-grounded, and community-directed work to protect and revitalize Indigenous languages is not present in the published literature, nor is it readily available outside of individual communities. The tenor, perspective and value of such work is distinct enough that it needs to be included in the process of determining national directions for future strategic research priorities. To develop such policies without the inclusion of locally-grounded knowledge and experience would be inadequate and problematic.

Why is evidence of the vibrant history of communities stewarding their language and culture unavailable outside of communities? In large part because it had to be hidden. The resilience of Canada's Indigenous languages is despite—not because of—government policy. On account of repressive government legislation regarding the practice of Indigenous cultural traditions and the ban on speaking Indigenous languages in Indian residential schools, the continued use and development of Indigenous languages and cultures was a necessarily subversive activity for most of the nation's history. Although federally prohibited, cultural activities continued underground, hidden from government scrutiny.

The story of resilience of Indigenous languages and cultural health in Indigenous communities is a story of local endurance and perseverance against enormous opposition. The complex and dynamic ways in which individual Indigenous people, community organizations and nations have chosen to engage with others, including academic researchers and institutions, other nations, and Indigenous organizations and governments are important aspects of the 'technoscape'.

Understanding and evaluating success in language revitalisation is community-dependent and locally contingent. Necessarily, it must take stock of different language learning strategies as well as embodied, place-based knowledge transmission and sharing that exists within Indigenous communities. Imposing external metrics of success to measure language learning, generally derived from assessments intended for colonial languages, is at best inappropriate and potentially damaging.

Externally-generated best practices models are rarely effective for localized implementations and often work to position Indigenous organizations for failure and disappointment. Rather, community-based support networks and localized knowledge-sharing are more appropriate ways to develop criteria and tools for the evaluation of language programs, and have the benefit of strengthening the support for effective language methods and tools at the community level.

The 2015 SSHRC *Statement of Principles on Aboriginal Research* is welcome but needs to go further to reimagine Indigenous communities as principal and primary applicants on grant applications, who draw on university partners as needed. Funding grassroots, community-initiated, community-grounded, and community-directed research will likely be less bureaucratic and have higher impact. At the same time, federal and provincial funding agencies must acknowledge that much fundamental work is not research, but is necessary to enable Indigenous communities and community leaders to participate in research in a meaningful way.

Externally inspired research projects can exert complex pressures on Indigenous communities, diverting community energy and resources away from core tasks and requirements to address outside agendas and expectations. Direct provincial and federal investment in the research infrastructure and human capacity in Indigenous communities is therefore imperative and urgent.

EXECUTIVE SUMMARY

CONTEXT

In Canada, the documentation and revitalization of Indigenous languages and cultural knowledge are now increasingly cited as priorities in support of well-being in Indigenous communities [1]. Although undermined for generations by colonial institutions and processes, elders and youth in Indigenous communities actively use and appropriate emerging technologies to strengthen their traditions and language in ways that challenge conventional representations of the ‘digital divide’. Whereas cutting edge technological efforts in the 1970s included specially modified typewriters and custom-made fonts to represent Indigenous writing systems, contemporary Indigenous communities draw upon digital tools—online, text, Internet radio and mobile devices—to nurture the continued development of their languages and cultures.

FINDINGS

Historically, media technologies in English (and other colonial languages) informed how settler cultures imagined Indigenous peoples—whether through print, photography or film. The design of the Internet, initially envisioned to serve specific military functions, unexpectedly developed into a widely available, free and relatively open space, available to anyone with access to a computer and a level of comfort in one of its principal languages.

Yet, just as Indigenous writers, photographers and filmmakers have carved out powerful Indigenous spaces in earlier media, so too Indigenous communities around the world are working to develop unique networked, digital tools that support their work. While digital technologies certainly can and do mediate Indigenous experiences, in this report we are more interested in the ways that Indigenous experiences and traditional knowledges also mediate the suite of digital technologies that we now commonly refer to as cyberspace.

We now live and work in such ‘digitized’ spaces, with portable devices, databases and materials present in all aspects of our lives, that the very word ‘digital’ is becoming less relevant. While the term ‘Digital Humanities’ still has traction in universities, we foresee a time in the not-so-distant future when the ‘Digital’ aspect of humanities scholarship will be implicit, and students

will instead refer to an era of ‘Analogue Humanities’ before access to computing power was so widespread.

The availability of free, sometimes open source, versatile and mobile technologies has created high expectations among young people in terms of what digital tools can do, how they function and what they should look like. Many mobile (in all senses) users now rely exclusively on devices, such as smartphones and tablets, with operating systems that are app-driven. This “appification” has fragmented digital functionality, assigning specific tasks to specific software, and it is not clear what the long term intellectual, practical or legal consequences of this splintering will be.

With the consistent encoding, representation, and handling of text expressed in most of the world’s writing systems—known as Unicode—now in place for many Indigenous languages, some analysts see the next step to effective language mobilization being computational tools such as automated translation, optical character recognition, semantic interpretation and speech recognition. These developments are very much in their infancy. Even for well-supported Indigenous languages such as Hawaiian (‘Ōlelo Hawai’i), most widely used translation software can still only effectively manage individual words or short phrases. Users expect to realise all of their work through off-the-shelf systems, yet assumptions baked into many of these tools limit their functionality for different languages and across various operating systems. Basic research is critical to identify opportunities to increase the flexibility of such systems as they cross epistemological and ontological boundaries.

While emerging technologies provide opportunities for crowd-sourcing information and funding, they can also amplify the risks that communities already face. Collaborative technologies are being used by linguists and community language learners to collect and synthesise knowledge about language programs. Crowd-funding websites can provide a digital platform for people to campaign, raise awareness and gather resources for language programs, with filmmakers, artists, poets and teachers launching effective online campaigns to realise specific projects around language revitalisation.

Despite the sharp uptake of digital tools to support endangered language learning, there is little in the way of systematic and rigorous evaluation on the results of their use. In order for such technologies to have lasting and positive impacts on language revitalisation, all stakeholders—communities, policy makers and academics—need to know which tools are proving to be most effective, where, why and how. For that, longitudinal case studies need to be commissioned that assess the success and review the impact of emerging technologies using criteria that are community-developed and locally appropriate.

Unworkable standards and a dogmatic insistence on ‘best practices’ in digital technologies and language documentation, set by scholars and funding agencies, can have a disempowering effect on individuals and communities. Even well-funded academic research programs, archives and library systems are not always able to adhere to the standards that they themselves promote and advocate. No surprise, then, that community-based language mobilization projects that utilize emerging technologies—often without sustainable funding and outside of academic research ‘standards’—risk being silenced in a culture that promotes unrealistic technical ideals. The First Nations in BC Knowledge Network, a hub for First Nations in the province to share ideas and tools on many aspects of governance and community development, encourages the creative term ‘inspired practices’ [2].

Digital technologies do not, cannot and will not save languages. Speakers keep languages alive. A digital dictionary on its own won’t revitalize an endangered language, but speakers might use it to do work that will. At the same time, technology can be as symbolically powerful as it is practically useful, and often carries considerable political weight. In the English-dominant world of cyberspace, Indigenous communities are engaging with and disrupting technologies to create their own online presences. By generating their own digital visibility and legibility, Indigenous communities become ‘present’ online, and thereby exert increasing control over the terms of their own representation rather than be continually misrepresented by others [3].

Although rarely addressed in the scholarly literature, there are significant trauma-based barriers to language mobilization within Indigenous communities. As a result of the legacy of the Indian Residential school system, many Indigenous language learners and teachers still carry feelings of distress and shame in relation to their language, and can have deeply emotional responses to learning, hearing and sharing their language. Such conversations are rooted in complex historical, social and emotional contexts that go far beyond simply building and implementing a curriculum, let alone an emerging digital tool or technical platform. These complicated and interconnected factors need to be better recognised and understood by technologists, educators and academics involved in language revitalisation.

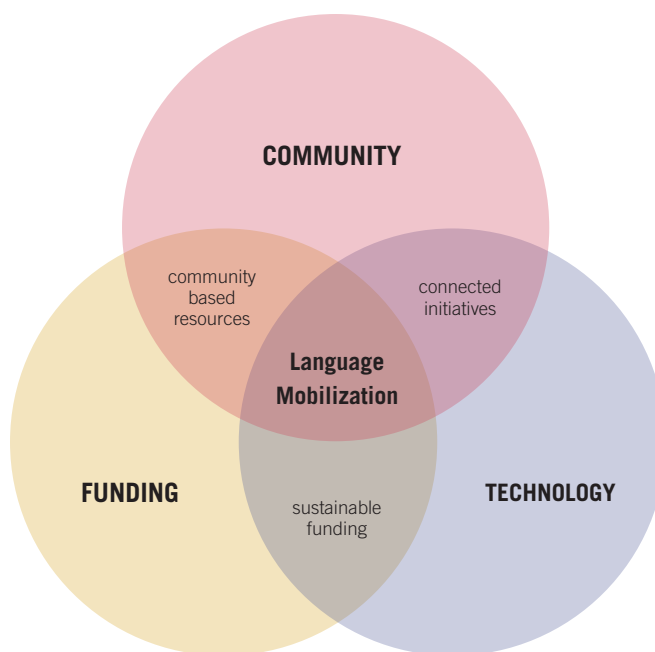
IMPLICATIONS

Implications from our report can be organised around three intersecting themes: **community**, **funding** and **technology**.

The following eight implications emerge from this report:

1. **Community-based language work needs significantly more resourcing.**

2. There is an urgent need for **sustainable funding models** to support long-term technology investment and language planning.
3. **Connected initiatives** that ground work within a community’s specific revitalisation environment are essential.
4. **Not all work is research.** An overemphasis on funding mechanisms for academic research can divert energy and resources from community needs in order to fulfill research agendas and strategic objectives forwarded by post-secondary institutions. Additional investment in strengthening communities is necessary for the experts and knowledgeable people within Indigenous communities to participate in research—even collaborative research—in ways that don’t negatively impact other important community initiatives and needs.



5. The growing availability of open source and payment-free technology platforms offers an opportunity to **build digital tools that better support Indigenous content.**
6. **Unicode is central** to achieving a baseline agreement about digital language encoding. Customised, proprietary character sets and unique encodings pose barriers to digital language use and wider mobilization for Indigenous languages.
7. **Support networks should be fostered** to share expertise and experience within, across and between communities. Technology platforms can incorporate channels of communication to support sustainability and community knowledge-sharing.

8. **Community-grounded evaluation and impact assessments are needed.** Given the great variety of ways in which emerging technologies are already being used by Indigenous communities and the fast rate of technological change and innovation, there is a surprising scarcity of published material reporting on their impact. Going forward, evaluative criteria must be grounded in local understandings of impact and success that are rooted in the experiences and aspirations of Indigenous communities.

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Social Sciences and Humanities
Research Council of Canada

Conseil de recherches en
sciences humaines du Canada

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DEPARTMENT OF
ANTHROPOLOGY



The Institute for
Critical Indigenous Studies
Faculty of Arts, UBC



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CONTEXT

THE ISSUE

The vitality and expression of language within communities is a key aspect of the technoscape. Within Canada, the concept of Indigenous communities is complex and dynamic, reflecting intricate relationships between family, geographic and political groups [*]. The legacy of suppression of Indigenous languages and knowledge is embedded within policy and legislation intended to break family and community cohesion. Technology has had a role in work undertaken by individuals and communities to maintain and restore these relationships.

In ways that challenge conventional representations of the 'digital divide' as a split between the "technology haves and have-nots" [4], Elders and youth in Indigenous communities are actively using and appropriating emerging technologies to strengthen their traditions and languages. While technological efforts in the 1970s included specially modified typewriters and custom-made fonts to represent Indigenous writing systems, communities are now making use of digital tools—online, text, Internet radio and mobile devices—to nurture the continued development of Indigenous languages and cultures.

Significantly undermined by colonial institutions and processes, Indigenous cultures have suffered systemic harm and marginalization. In Canada, the documentation and revitalization of Indigenous languages and cultural knowledge are increasingly cited as priorities in support of well-being in Indigenous communities [1].

Yet such interventions are not without risks and consequences, both for individuals, community organizations and the Indigenous knowledge systems that are being mobilized. There is little agreement about what form an ideal presentation and dissemination platform for Indigenous cultural heritage organizations should take, how it might work, be maintained and migrated over time. At the same time, Indigenous experiences with—and expectations of—technology can productively challenge normative Western understandings. While many research councils and libraries view the move towards open access publishing to be of scientific and public benefit, Indigenous cultural and linguistic knowledge is often location-specific and community-internal,

and not to be shared through an open portal [5]. Indigenous understandings of the responsibilities that accompany traditional knowledge offer rich insights into the different ways that intellectual property and ownership can function [6].

HEILTSUK FIRST NATION LANGUAGE AND CULTURE INITIATIVES

The Heiltsuk Nation in Bella Bella, BC, offer a compelling example of how Indigenous communities have long made use of emergent technologies to support language mobilization.

Heiltsuk use of technology builds upon all of the front line work Heiltsuk have done to save and re-invigorate their language in the face of oppressive forces, from refusing to be silent and speaking Heiltsuk to grandchildren; to taking advantage of (analogue) recording devices to record these voices; to bringing a linguist into the community and supporting him to stay for over a decade; to collaboratively participating in creating dictionaries and grammatical instructions; recording autobiographies in Heiltsuk as a special project initiated by the Band Council; creating bilingual texts of transcripts and translations of audio recordings; to modifying first typewriters and then computer fonts; and creating digital dictionaries with sound added. This is the story of all that Heiltsuk have initiated themselves—the wealth of voices and documents that they wish to make available to, first of all, the Heiltsuk nation, to foster language learning, pride, and Heiltsuk world views.

The Heiltsuk Nation initiated extensive language research and documentation starting in 1973. Through its Heiltsuk Language Studies program, the Heiltsuk Cultural Education Centre has a mandate to continue the documentation and revitalization of the Heiltsuk language and has created and compiled extensive resources in the following focus areas:

- **Developing** a practical orthography (alphabet) for writing down the Heiltsuk language; recording and analyzing words in order to produce comprehensive word lists, bilingual dictionaries, and taxonomies; analyzing and identifying the basic structure of the Heiltsuk language; recording an extensive body of oral traditions, narratives, and discourses, and transcribing and translating these into English;

* Of the many terms that are currently in use, we chose the term 'Indigenous' for this report, with the exceptions of names of specific Nations, communities and organizations, such as the First Nations Technology Summit, First Nations Confederacy of Cultural Education Centre and the Union of BC Indian Chiefs, or specific titles such as The Indian Act. Name changes from 'Aboriginal' to 'Indigenous' at Canadian post-secondary institutions (including at UBC) and in other Canadian contexts, such as at CBC News, reflect this wider discussion. For an exploration of these terms and their historical origins, see [UBC Indigenous Foundations](#).

- **Assisting** and promoting the understanding and interpretation of Heiltsuk culture through linguistic analysis of information recorded or transmitted in Heiltsuk;
- **Promoting** and assisting in the development of Heiltsuk language instruction programs;
- **Maximizing** use of available and emerging technologies to promote the preservation of and access to Heiltsuk language materials.

In 1978, the Bella Bella Community School instituted Heiltsuk Language Instruction as a formal part of school curriculum, and has focused its attention on curriculum development, Heiltsuk Language teacher certification and the pursuit of effective language teaching strategies since then.

Through a Memorandum of Understanding signed in 2016, the Heiltsuk Cultural Education Centre, Bella Bella Community School and the First Nations and Endangered Languages Program at the University of British Columbia are partnering in an effort to collaboratively create new opportunities for speaking, writing and reading the **Hítzaqv** (Heiltsuk) language by expanding existing community language revitalization and cultural documentation in a digital environment.

This collaborative mobilization of existing language recordings and archival and cultural resources has resulted in the release of a cross-platform **Hítzaqv** Unicode keyboard and a beta version of a fully searchable online **Hítzaqv** Digital Dictionary. Next steps include releasing the dictionary through Waldayu Mobile, a free, open source language revitalization tool that visualizes lexical terms for community revitalization goals [15].

THE DIGITAL DIVIDE (AGAIN)

Some of the earliest research in the emerging space around Indigenous uses of technologies explored how the Internet could bring ‘economic development’ to remote and rural areas. This early literature is often hopeful and speculative around the potential benefits and implications of Internet access in Indigenous spaces [7]. Similarly, conversations from the late 1990s and early 2000s presuppose that universal Internet connectivity was both imminent and inevitable, and that the rollout of all future technology would be predicated on stable, high-speed broadband across the global North.

Almost two decades later, many remote communities in Canada, the United States and beyond are still waiting for the promised infrastructure backbone that will make high speed, affordable and stable broadband connectivity possible. While a presumed lack of proficiency in English was previously stated as a barrier to Internet use for Indigenous peoples in Canada [7], in the

interim (rather paradoxically), the conversation has shifted to explore how a more multi-vocal and multilingual Internet can be tasked to support the revitalisation of endangered and Indigenous languages that relies less on English.

INDIGENIZING COLONIAL THINKING

This report demonstrates that Indigenous communities have always engaged with and made use of appropriate technologies to further community aims.

Twenty years since the birth of the term ‘digital divide’, an emphasis on simply providing and ensuring ‘access’ has drawn criticism for the emptiness of its rhetoric and its enduringly paternalistic tone [8]. The underlying assumption that it is in the hands (and at the grace) of richer societies to initiate technological development ‘on the other side of the divide’ fails to critically address the deeper, systemic social injustices that are embedded in technological developments. Moreover, the trickle-down model (from top to bottom, rather than anything more horizontal, let alone bottom to top) remains an inappropriate and unfortunate metaphor to describe how community development actually works.

Embedded at the core of such technologized ideologies lies an entrenched belief that Indigenous people always have been and always will be late to catch on to technological developments. For the greater part, “government agencies have taken on the servicing of Indigenous needs rather than encouraging communities to participate themselves”, write Michael and Dunn [9], with remarkable restraint.

Indigenous communities have long been engaged in the process of ensuring that technology platforms reflect and respond to their traditional ways, cultures and languages. This fact is not well known by the wider public or government agencies. In large part this ignorance is the legacy of legislation that made Indigenous language and cultural practices illegal. However, some recent examples are better known, such as the work of language revitalisation proponents in Hawai‘i, who were quick to recognise the potential of ICTs to support, develop and further strengthen the Hawaiian language. The 1993 deployment of ‘**Leokī**’ is widely cited as the first electronic bulletin board system that was delivered entirely in an Indigenous language [10]. Since early advancements and uses of ICTs, Hawaiian has moved rapidly into cyberspace through negotiations and partnerships with Microsoft and Apple. The Hawaiian language is now offered as an option on most major operating systems, helping to normalise and in some ways equalize the language and increase its uptake, usability and functionality in everyday life [11].

Heartening examples aside, such work is almost by definition never-ending and requires constant resourcing and vigilance to ensure that hard won gains are not quickly eroded. The path is long and the journey inevitably uphill, rooted in historical and institutional efforts to permanently eradicate Indigenous languages from everyday use. The irony of the new funding landscape has not escaped Indigenous scholars and activists who have spent years resisting punitive and racist government legislation designed to extinguish their languages and cultures, but who are now being courted by those very same agencies who—in the spirit of reconciliation—have pivoted to fund and support that which they earlier set out to destroy.

To that end, when the Social Sciences and Humanities Research Council of Canada (SSHRC) poses the question: “How are First Nations, Inuit and Métis cultural heritage organizations responding to the opportunities and challenges of emerging technologies?”, our response may be invert and rather ask: “How are emerging technologies responding to the opportunities and needs of First Nations, Inuit and Métis cultural heritage organizations?”

Addressing the needs of policymakers within (and beyond) government for reliable data, this report aims to deepen the institutional understanding of the history of Canadian-Indigenous relations and expand the possibilities for new conversations that prioritize voices of Indigenous community members as creators, synthesizers and mobilizers of emerging technologies. The experience of Indigenous and community-based scholars is not well reflected in the existing academic literature. Our environmental scan and knowledge synthesis establish that Indigenous cultural heritage organizations have sophisticated, complex and multi-modal technical needs that no single ‘out-of-the-box’ solution has yet been able to address. Overall, Indigenous scholars and organizations are creators and innovators (and not just recipients or clients) of new technologies, particularly in the domain of cultural and linguistic heritage.

IMPLICATIONS

Our considered position is that Indigenous cultural insights can help to inform national policies around access to, and engagement with, emerging digital technologies. This section outlines some of the implications emerging from our environmental scan and some productive directions moving forward. Implications from this report can be organised around **community, funding and technology**, with obvious intersections. In many of the most successful technology-based language initiatives, funding, technology and community concerns are well aligned, working in common cause, with information and resources flowing freely.

These implications speak to many diverse audiences, including, but not limited to:

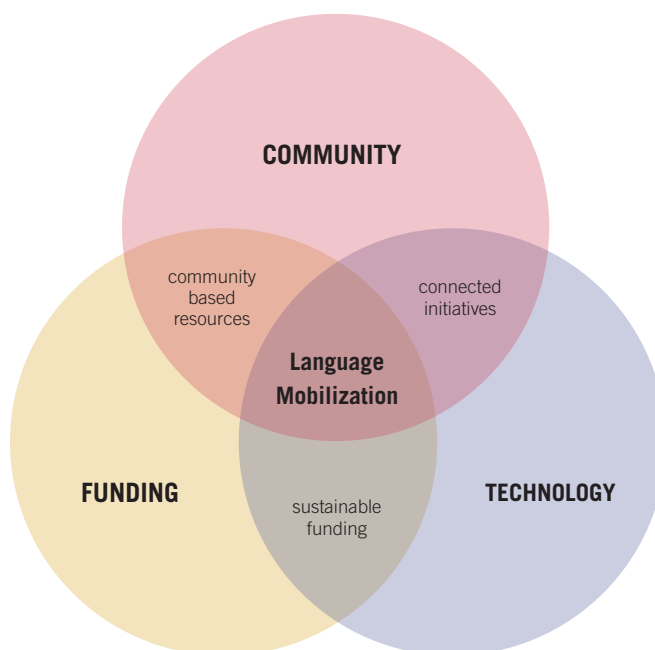
- *Community organisations* (e.g., cultural, political and educational)
- *Community groups* (e.g., families, teachers, cultural practitioners)
- *Government* (e.g., federal, provincial, funding bodies)
- *Academics* (e.g., universities, faculty, staff, research NGOs)

These interested groups are implicated by the outcomes of this report in the following ways:

1. **Community-based language work needs significantly more resourcing.** Previous funding, largely focused on novelty, has resourced a series of pilot language projects in communities without the means for continuity, even when proven to be very effective. Sustained, multi-year funded support is required for community-based language revitalisation and planning that is not necessarily tied to research or academic partnerships.
2. **Sustainable funding models for continued technical infrastructure, development and support at the community level are essential.** Most funding bodies reward novelty and innovation over pre-existing projects that have a proven track record and community involvement. Communities cannot plan without secure funding for existing platforms and digital commitments. Short-term funding breeds self-contained, disconnected, poorly articulated and often rushed, time-bound projects that are hard to maintain and migrate forwards. It is imperative that future funding models address this gap and target support for successful, ongoing, community-led projects.
3. **Connected initiatives that ground work within a community's specific revitalisation environment are needed.** Technologies do not save languages, speakers do. Rather than discrete, independent technology installations, communities need

integrated tools that engage with, reflect and nurture the lived experience of language learners and teachers.

4. **Not all work is research.** An overemphasis on academic funding mechanisms can divert energy and resources from community needs in order to fulfill research requirements and strategic objectives within universities and colleges. While academic-driven projects can generate datasets that are useful to communities, they do not always do so, and often prioritise 'research' over applied, practical work and advocacy. In order to truly serve community needs through research, university-based academics and bodies that fund research must address the research interests and needs of communities and be open to engaged community-directed research agendas that benefit the communities themselves.



5. **Platforms that better support Indigenous content must be explored and resourced.** The last decade has seen an increase in language mobilizing technologies that are either very cheap or entirely free, considerably reducing the bar to entry. Users are multi-modal, utilizing a wide array of technologies, which they combine to achieve broader tasks. Communities may no longer need to spend a great deal of money on specific customized software and the capital costs of hardware continue to come down (but remain non-trivial). One consequence of the plurality of platforms is that little structured and experience-based guidance exists to support community members to choose from a growing 'buffet' of technologies that do not necessarily interact or communicate well with one another. Herein lies an opportunity to develop platforms that better support Indigenous

content. Further research that addresses knowledge security concerns to inform supportive policy and the development of appropriate applications is needed.

6. **Unicode is central in achieving a core baseline agreement about digital language encoding.** Customised and proprietary character sets and unique encodings pose barriers to digital language use and wider mobilization. Mobilization and roll out can only begin once Unicode standardized encoding has been agreed on. It is likely that governing bodies such as the Unicode Consortium will need to continue to engage with localization requests and that community organizations will have to agree to adopt certain character sets and representations.
7. **Support networks should be fostered to share expertise and experience within, across and between communities.** Inspiring and creative work is being undertaken in individual communities across Canada, but there are few structured spaces for sharing what people are learning, asking for advice or seeking guidance. Technology platforms can build in channels of communication to support sustainability and community knowledge-sharing. In addition, structured knowledge-sharing provides an effective way to develop tools and criteria for evaluation that strengthen the support for effective language learning and mobilization at the community level. Support networks can be developed through existing networks, such as the Confederacy of Cultural Education Centres, the First Nations Schools Association, and the informal network of communities that participated in Indigitization projects.
8. **Community-grounded evaluation and impact assessments are needed.** Despite the great variety of ways in which emerging technologies are being used by Indigenous communities and the fast rate of technological change and innovation, there is a surprising scarcity of published material reporting on the impact of such technologies. At this point, it would be valuable to explore what has worked in the past. It should be noted that ‘inactivity’ does not necessarily imply ineffectiveness. Some good methods and technologies are defunct simply through lack of financial support or human resources. Independent studies are needed to review and evaluate the success of strategies such as dictionary apps and online learning modules, to offer just two examples. Researchers and communities conducting such evaluative work should be mindful to consider a number of criteria for how impact might be measured, including speaker proficiency, political impact and symbolic value. At present, publications on Indigenous uses of technology for language mobilization are mostly sensational press reports that speak either of languages being ‘saved’ by technology or rather predict doom, gloom and ‘extinction’. More nuance and community-grounded, systematic review is needed.

APPROACH

Technology-assisted language mobilization is a rapidly evolving field moving faster than most peer-reviewed journals can keep up with. Through collating knowledge and experiences over the last decade, including some very recent developments, we have looked beyond academic publications to more instant and sometimes ephemeral forms of information, as well as case studies and findings from community-based projects. To that end, we drew upon:

- Published research findings in the somewhat limited scholarly literature;
- ‘Grey literature’: information produced and circulating outside of conventional academic distribution channels [12]; such as projects within Indigenous communities;
- Critical assessments and evaluations of a range of recent technical interventions.

In our search, we have considered the emerging ‘technoscape’ both within and beyond Canada and have reflected on community-level, specific tools as well as larger organisations that host, support or promote multiple platforms and initiatives. By reviewing examples of relevant and recent technologically-oriented projects in the area of language mobilisation, we hope to have identified trends and ‘successes’ alongside gaps in knowledge and attention.

Our methodology was necessarily flexible. We located published literature through database searches, reviewing recent publications and searching through promising citations. ‘Grey literature’ and examples of technological interventions were more difficult to locate systematically, to which end we cast our net wider, using online resources, personal networks and email fora—such as the excellent and active Indigenous Languages and Technology (ILAT) discussion list—to learn of projects that have so far escaped the attention of academic journals and scholarly publications.

Our approach was by no means comprehensive. We have not attempted to document every project, technology or initiative. Instead, we have aimed for this report to be illustrative, representative, and generative. We document promising processes and approaches, successes and challenges, that may have traction beyond a special location, community or time.

The emergent nature of the field entails that an inherent paradox is built into this document. As soon as this report is released it will cease to be current. It offers a glimpse into the ‘technoscape’ of language revitalization in 2016, and all that we can hope—just like many of the publications that we have benefitted

from reading—is that this document will serve as a historical snapshot of the lay of the land at this time.

How can such diverse information best be organized, collated and shared? We first thought to structure our findings according to the specific technology or platform being used, whether that was a mobile App, an interactive website or an audio feed. Yet we quickly revised our thinking as it became apparent that such an approach embodied the very technological determinism that we reject.

It is not a particular technology that determines the outcome or success of an initiative, but a broader web of social, cultural and often political factors that help to create (or constrain) a supportive environment for language revitalisation. To that end, we organize our findings thematically, rather than by specific technologies, cutting across regions, applications and communities. We believe that this better represents the flexibility and innovation of technology appropriation for culture and language mobilization in communities.

RESULTS

THE PACE OF CHANGE: SPEED & OBSOLESCENCE

Emerging technologies provide new opportunities and offer great possibilities. However, the pace of development also poses a challenge for communities, such as the Heiltsuk, who continue to be early adopters of emerging tools for language and culture work. A survey of literature over the last 15 years demonstrates a series of rapidly changing uses, perceptions and expectations of the Internet.

In 1965, co-founder of Intel Gordon Moore, observed that the number of transistors per square inch on integrated circuits had doubled every year since the integrated circuit was invented. Now commonly referred to as ‘Moore’s Law’, it has become a truism to state that overall processing power for computers doubles every two years.

At the turn of the millennium, as Internet availability and capability increased, the Internet was largely discussed as a tool for delivering information and economic opportunity [7]. Rural and remote communities in Canada expressed frustration at the comparatively sluggish pace of infrastructure development, which had failed to keep up with technological change. Yet to this day, communities struggle with connectivity problems; and impatience with centrally organised infrastructure projects has fuelled community-driven efforts to establish broadband and mobile networks. K-Net, for example, is a First Nations-owned ICT service provider that has established a cellular service, broadband connectivity and online applications envisioned by and for rural and remote First Nations communities in Ontario [13].

Since 2001, the Internet is increasingly being conceptualized as a medium through which different and diverse tools function. The recent explosion of digital applications, prompted by the growing pervasiveness of mobile devices, is now shaping the future of the Web. This “appification” has fragmented digital functionality, assigning specific tasks to specific software, and it is not clear what the long term consequences of this splintering will be.

Media technology is fast becoming asynchronous and individualised. In-flight entertainment systems on long-haul aircraft offer a lens through which we may observe this development. Films and television shows were first shown on one fixed screen requiring that all passengers would watch together. In the 1990s, advances in technology coupled with the demand for

more personalized in-flight entertainment systems prompted airlines to install individual screens, through which a sequence of films could be broadcast synchronously. In the early 2000s, airline entertainment systems were upgraded to allow passengers to choose content from a wide selection, consume it when they liked, and pause programming as needed. The most recent trend in in-flight entertainment has individualised the experience even further, allowing (in some cases even forcing) passengers to access the system through their own digital devices, removing the costly requirement for screens in the back of each seat and pushing the service to passengers who use their computers, tablets and phones.

Such shifts offer an insight into the direction of individualized, customized digital experiences. We can now say with confidence that no two users of the Internet use its services and consume content in the same way.

FREE, ACCESSIBLE AND OMNI-PRESENT MOBILE TECHNOLOGIES

The availability of free, sometimes open source, versatile and mobile technologies has created high expectations among young people in terms of what digital tools can do, how they function and what they should look like. Many mobile (in all senses) users now rely exclusively on devices, such as smartphones and tablets, with operating systems that are app-driven. Users expect to realise all of their work through off-the-shelf systems, yet assumptions baked into many of these tools limit their functionality for different languages and across various operating systems. Basic research is critical to identify opportunities to increase the flexibility of such systems as they cross epistemological and ontological boundaries.

The development of cloud computing, which provides shared, Internet-based processing and storage power on demand, presents a major reconceptualization of how hardware, firmware and software technologies should be considered. Instead of relying on and committing to one expensive software tool locally housed within their device, users can now access, utilize and save their licensed software in ‘The Cloud’, sometimes for free, other times for a fee. With this shift to multiple digital tools stored externally in third party data centres, the issue of ownership and compatibility—already complex for Indigenous users—becomes even more intricate. Once located in the cloud, it is difficult to exercise control over a software platform, opening users up to unexpected vulnerabilities, changes and updates, as well as new challenges in terms of backup and offline access.

Younger digital users have increasingly high expectations of what technology can do for them and how adaptive it is. Over

the last decade, we have witnessed a growth of immersive and interactive technologies that support such expectations. Yet, with the technological landscape moving so quickly, there is very little incentive to commit to tools that do not serve a user group's immediate needs. At the same time, although expectations for new technologies remain high, very few have the capacity to deliver everything that a user wants. An understanding of the range of available technologies and how these can be effectively combined to realize specific tasks is increasingly necessary to keep up with the needs of users. This process needs to be carefully explored to understand how choices are being made and what compromises, if any, are made along the way.

Harnessed through the use of free software, emerging technology is being used to support access to learning of Indigenous languages, such as UBC faculty member Candice K. Galla's project to teach [Hawaiian Hula lessons](#) over Skype [14].

[Waldayu](#), and its mobile counterpart Waldayu Mobile, are the first dictionary app suite for endangered languages to combine a language agnostic design, customizable approximate search, cross-platform deployability (Web/Android/iOS), and open-source code. Waldayu, meaning "word-tool" in Kwak'wala, allows language communities with pre-existing lexical data and materials to quickly create web and mobile apps that display their data in an engaging way. Additionally, Waldayu can be used on- or off-line, making it especially useful for remote communities. Waldayu has been implemented and is in beta testing for over six languages from five different language families, including Tsimshianic, Wakashan, Salishan, Sino-Tibetan and Iroquoian [15].

[FirstVoices](#) is a suite of online and mobile app-based language archiving and learning tools developed for and available to Indigenous communities in Canada and administered by the First Peoples' Cultural Council. Tools include a chat app with an orthography keyboard input system and language learning games. Language communities receive training and technical support to develop and manage their own language and culture archives and resources. The FirstVoices Keyboards app gives its users access to more than 100 Indigenous languages—spoken in Canada, New Zealand, Australia and the US—through specialized keyboards that can be used within email, social media, word processing and other apps on mobile phones. FirstVoices Chat was developed in response to Indigenous youth who want to communicate via social media in their own languages. This mobile app supports people who wish to compose and send text messages in the unique characters of their own Indigenous languages [16].

[The Resource Network for Linguistic Diversity](#) is an international non-profit organisation founded in 2004 to advance the sustainability of the world's Indigenous endangered languages, and to support Indigenous peoples participation in all aspects of language documentation and revitalisation through [training](#), resource sharing, networking, and advocacy. The network hosts interactive online lists of Indigenous language projects, blogs, [relevant links](#), and teaching resources to support language documentation and revitalisation projects [17].

[Haida-speaking Alaskan communities](#) are engaging with multiple digital platforms, including creating language-based YouTube videos to support Indigenous language learning [18].

The multimodal [ACORNS project](#) supports the language revitalization efforts of the tribes of Northern California and Southern Oregon. The ACORNS project provides free software to support teachers and learners of any language in building digital classes for language practice outside of the classroom [19].

[The Mi'gmaq Language group](#) developed an interactive language learning website, blog, talking dictionary, interactive Mig'maq wiki, Facebook, Instagram, tumblr and Twitter accounts to help language learners understand and speak the Mi'gmaq language in whichever platform or combination of platforms they feel best serves them. The talking dictionary project, for example has over 3,900 entries recorded by three different Migmaq-Mi'kmaq speakers, to assist with variations of pronunciation. These are then used in accompanying phrases to give learners the opportunity to distinguish individual words when they are spoken in a phrase [20].

THE EVALUATION GAP

Despite the sharp uptake of digital tools to support endangered language learning, there is little in the way of systematic and rigorous evaluation on the results of their use. In order for such technologies to have lasting and positive impacts on language revitalisation, all stakeholders—communities, policy makers and academics—need to know which tools are proving to be most effective, where, why and how. For that, community-grounded, longitudinal case studies need to be commissioned that assess the success and review the impact of emerging technologies using criteria that are community-developed and locally appropriate.

In researching and preparing this report, examples of technological interventions for language mobilisation were easy to find. Gauging their success and impact in supporting language preservation and use, however, has proved to be much more difficult. Few initiatives explicitly document and evaluate their impact on language use, and there is very little published research in this area. We therefore highlight the assessment and impact of revitalisation technologies as a key knowledge gap to be addressed in future work.

We are not the first to highlight the lack of reporting on the evaluation, impact and success of revitalisation initiatives. While we found a general lack of evaluation programs in global as well as local contexts, previous research has highlighted that Canada in particular could do more to develop appropriate criteria to understand the impact of revitalization programs. Wetzel [21] observed that most research studies focus on the status of Indigenous languages, with little attention paid to revitalisation efforts and their impact. Little progress has been made in the intervening decade; Pulla's [22] SSHRC Knowledge Synthesis Report on mobile learning technologies found almost no research to report on. Calling for more research in order to understand the impact of newer projects across the country, Pulla concluded that "Canada lags behind other countries in innovating, implementing and reporting on mobile learning for Indigenous people" (p. iv).

More recently, Iokepa-Guerrero [23] noted that despite a range of programs designed to support Indigenous language learning, most programs do not document language use outcomes: "There is a wide variety of programs to teach traditional Indigenous languages [...]. However, most such programs have not explicitly documented language use impacts" (p. 227). Greater knowledge in this area would help to identify successful strategies that could translate to other locations; with McIvor [24] concluding that a great deal more could be learned about the "efficacy of Indigenous language revitalization strategies" from existing projects and programs. Comparative evaluations based on locally-relevant criteria to assess the functionality, technical architecture and deployment of different software platforms and products have proven beneficial to communities when considering which resource management package to select, and would likely also be of use in reviewing and selecting technologies that support language and culture.

The emergent nature of much of the technology is certainly one reason behind the apparent lack of evaluation. Since many language revitalization strategies are still relatively new, "few longitudinal studies are available to assess the impact on language vitality" [25] (p.967). The public media also has a role to play. Articles and reports usually focus on technology rather than on the use, community or relationships that underwrite a language context, and thus perpetuate a form of technological determinism that is unnuanced and unhelpful. While we welcome the

pivot away from sensationalist reports along the lines of "last speaker dies, language now extinct" to stories that are more positive and focus on Indigenous resurgence and vitality, mobile phone apps and online dictionaries do not save languages any more than linguists do. Long form, investigative journalism has an important role to play, but even science reporters have an appetite for catchy headlines. The new online platform for increasing public engagement with anthropology, SAPIENS, recently published an article entitled '[Can an iPhone App Help Save an Endangered Language?](#)' [26] while the independent news and views web platform, The Conversation, led with an editorial entitled '[Taking Indigenous languages online: can they be seen, heard and saved?](#)' as we were finalizing this report [27].

Understanding which stakeholders are actively involved in a specific project and making sense of how a collaboration progressed is not always easy. Relationships and dynamics within and between communities and outside partners are complex, and technology projects often have an impact on these relationships and establish new power dynamics. Projects operating within a community informatics framework are more likely to be driven by community needs and agency. Projects that involve corporate bodies are often influenced by market forces. We would be well advised to be sceptical of headlines such as "community team up with tech company to save language" as there is often a back-story. Any account of a specific project, whether by academics the media or the community themselves, will be written from a certain subject position and agenda. The subjectivity of such representations is unavoidable, and simply needs to be acknowledged.

RESISTING TECHNOLOGICAL DETERMINISM & SELECTIVE USE OF TECHNOLOGY

Digital technologies do not, cannot and will not save languages. Speakers keep languages alive. A digital dictionary on its own won't revitalize an endangered language, but speakers might use it to do work that will. At the same time, technology can be as symbolically powerful as it is practically useful, and often carries considerable political weight. In the English-dominant world of cyberspace, Indigenous communities are engaging with and disrupting technologies to create their own online presences. By generating their own digital visibility and legibility, Indigenous communities become 'present' online, and thereby exert increasing control over the terms of their own representation rather than be continually misrepresented by others [3].

Some communities have chosen to resist engaging with certain technologies in order to retain control of their cultural knowledge

and adhere to specific cultural sensitivities and protocols. What may therefore appear to outsiders as the ‘non-presence’ of an Indigenous community online is very often deliberate, intentional and thought out: a form of mindful resistance to a hegemonic representation rather than any kind of technological inexperience.

An example can be seen in how different communities have responded to BC-based FirstVoices. Initiated by the First Peoples’ Cultural Council, FirstVoices is a suite of web-based tools designed to support Indigenous peoples in language documentation, archiving, teaching and revitalisation. FirstVoices supports individual language communities to manage a space on their site to share language phrases, recordings and teaching tools. The FirstVoices team have also developed and released an app for language learning and a keyboard and messaging app for texting and communicating in Indigenous languages [16]. While many Indigenous communities in British Columbia have a presence on the FirstVoices website, others have chosen for their language not to be included on the site at this time. To note that even a system built with the needs of Canadian Indigenous peoples in mind may not meet the requirements of all communities is not intended as a criticism of the work undertaken by FirstVoices. Reasons are varied, but may include policies around access to and ownership of information, specific structural design features that are not appropriate to certain languages and communities, or because communities are developing their own culture-specific digital tools. In addition, many technologies do not allow for much selectivity or value-driven adaptation by those trying to use them in different or unanticipated ways [28].

INDIGENIZING CYBERSPACE

Historically, media technologies in English (or other colonial languages) informed how settler cultures imagined Indigenous peoples—whether in print, photography or film. The Internet, initially envisioned to serve military functions, unexpectedly developed into a widely available, free and relatively open space, available to anyone with access to a computer and a level of comfort in one of its principal languages. Yet, just as Indigenous writers, photographers and filmmakers have always carved out powerful Indigenous spaces in earlier media, so too Indigenous communities around the world are working to develop unique tools to reclaim cyberspace.

Within many English-dominated new media technologies, much ‘free and open-software’ actually asserts ownership and requires full access to all materials created by users or hosted through its architecture. Since the early 1960’s, Indigenous new media artists, and programmers have been working to reclaim or ‘Indig-

enize’ technological spaces by generating their own sovereign spaces, on their own terms; what Mohawk artist, Skawennati Tricia Fragnito, and Swampy Cree artist, Jason Lewis refer to as [“Aboriginal Territories in Cyberspace”](#) [29].

In [isi-pīkiskwēwin-ayapihkēsīsak \(Speaking the Language of Spiders\)](#), Cree/Metis artist Ahasiw Maskegon-Iskwewhe created an interactive, interconnected web portal showcasing various Indigenous artists with a focus on Indigenous culture and worldview as expressed by Indigenous languages [30]. In his [artist statement](#) on the website, Maskegon-Iskwewhe outlines how “the underlying thematic context of the screenplay is based on an examination of the differences in worldview and the construction of reality that occur between cultures structured by First Nations languages and those constructed by English language” [31]. The site was designed in 1996, the same year that the last Indian Residential school closed.

Mohawk artist, writer and independent curator Skawennati Tricia Fragnito’s [‘Cyber Powwow’](#) is a powerful and popular project that created an “Aboriginally-determined corner of cyberspace”. Part virtual gallery and part virtual chat rooms, ‘Cyber PowWow’ was designed by emerging and established Indigenous writers and artists. Also launched in 1996, Skawennati’s goal was to “overcome stereotypes about Aboriginal people; to help shape the World Wide Web; and to generate critical discourse—both in person and online—about First Nations art, technology, and community.” [32]

As Unicode standards have extended and become more inclusive, and greater localization has enabled people around the world to use computers in any language, mainstream platforms such as Twitter have witnessed increased Indigenous presence in Indigenous languages. An example is the Twitter feed of Rory Housty, Heiltsuk community member from Bella Bella and staff member at the Heiltsuk College. Housty regularly tweets in Heiltsuk, often (but not always) with an English translation or audio/video file attached [33]. In a digital space that is so dominated by colonial languages, Housty’s creation of an online presence for the language of his community serves both a pedagogical and political function. His Twitter feed is followed by many Heiltsuk community members, whose employment has taken them away from traditional territories, and provides them with a freely accessible and searchable archive of useful phrases. At the same time, by not translating all of his tweets into English, Housty is helping to create a distinct Indigenous online presence in Heiltsuk.

[Never Alone](#), also known as *Kisima Injitchujana* ("I am not alone"), is a puzzle-platformer video game and a landmark in game development. Built in collaboration with the Iñupiat Nation in Alaska, and made with contributions from around 40 Alaska elders, storytellers, and community members, *Never Alone* was produced by Upper One Games, the first Indigenous-owned commercial game company in the United States. Following an Iñupiaq girl named Nuna and her companion, an Arctic fox, the player completes puzzles in a story based on an Iñupiaq story told across eight chapters [34]. By developing a contemporary digital tool to present, represent and engage people with Indigenous knowledge and culture, the designers made clear that: "we are not a museum piece, the Iñupiat people are a living people and living culture" [35].

TECHNOLOGY DIDN'T START WITH THE DIGITAL

We now live and work in such 'digitized' spaces, with portable devices, databases and materials present in all aspects of our lives, that the very word 'digital' is becoming less relevant. While the term 'Digital Humanities' still has traction in universities, we foresee a time in the not-so-distant future when the 'Digital' aspect of humanities scholarship will be implicit, and students will instead refer to an era of 'Analogue Humanities' before access to computing power was so widespread.

Our contemporary digital lives are the cumulative sum of the technologies of the past, and this layering shows no signs of slowing down. In language description, conservation and revitalization, our current reliance on screen and keyboard derives from our earlier use of pen and paper, wax cylinders, reel-to-reel and other audio recording technologies, early video tape and even specially modified typewriters with customized keys that could accurately represent Indigenous orthographies. In the 1960s and 70s, for example, the Bell and Howell Language Master, used by communities in BC, including Bella Bella, recorded on cards holding a magnetic tape with two 3 second audio tracks—one for the language student and one for the teacher—allowing a comparison between student and teacher pronunciation [36].

In the North American context in particular, with such a rich and deep history of language documentation and recording, we must be mindful to represent digital technologies for what they are: simply the most recent tools being harnessed to represent Indigenous languages, cultures and worldviews. It is perhaps paradoxical to note that the depth and richness of cultural and linguistic documentation in North America makes the deploy-

ment of emerging digital technologies more complex, even if the promise of what can be achieved is all the more exciting. Any new technology, in the context of such a rich history of documentation, has to address the legacy of colonial collections and engage with a complex and problematic archival record.

THE DOGMA OF BEST PRACTICE

Unworkable standards and a dogmatic insistence on 'best practices' in digital technologies and language documentation set by scholars and funding agencies can have a disempowering effect on individuals and communities. Even well-funded academic research programs, archives and library systems are not always able to adhere to the standards that they themselves promote and advocate. No surprise, then, that community-based language mobilization projects that utilize emerging technologies—often without sustainable funding and outside of academic research 'standards'—risk being silenced in a culture that promotes unrealistic technical ideals. The First Nations in BC Knowledge Network, a hub for First Nations in the province to share ideas and tools on many aspects of governance and community development, encourages the creative term 'inspired practices' [2].

Terms such as 'evolving practice' and 'inspired practice' in language mobilization move the conversation beyond the 'best practice' of implementing a specific technological tool or platform to include a consideration of the complex social, cultural and historical contexts in which the work is being conducted.

Although rarely addressed in the scholarly literature, there are significant trauma-based barriers to language mobilization within Indigenous communities. As a result of the legacy of the system of Indian Residential Schools, many Indigenous language learners and teachers still carry feelings of distress and shame in relation to their language, and can have a deeply emotional response to learning, hearing and sharing their language. Inter-generational trauma and distress can lead to tensions and conflict over how or what to teach, particularly around the utility of writing systems versus the importance of oral transmission.

Such conversations are rooted in understandings that go far beyond simply building and implementing a curriculum, let alone an emerging digital tool or technical platform. These complicated and interconnected factors need to be better recognised by technologists, educators and academics involved in language revitalisation; and the power of language to work as a force for healing and well-being needs greater acknowledgement.

FURTHER RESEARCH

Computation, Crowdsourcing and Crowd-funding offer promising emerging directions for future research.

Unicode standards are now in place for many Indigenous languages and some analysts see the next step to effective language mobilization being computational tools such as automated translation, optical character recognition, semantic interpretation and speech recognition. Yet these developments are very much in their infancy. Even in well-established Indigenous languages such as Hawaiian ('Ōlelo Hawai'i), most translation software can still only effectively manage individual words or short phrases [11].

Collaborative technologies provide a means and a space for collecting and synthesising knowledge. Ryan Henke, a doctoral candidate at the University of Hawai'i, used Google Sheets to solicit input on and then compile [a list of Master-Apprentice programs](#). The list is "intended to help serve as a first stop for linguists or language community members looking for answers to questions such as: Has the Master-Apprentice program been used for my language? For languages related to my language? For languages near my community?" [37]. By sharing the document on list-serves, Henke has helped to crowdsource and synthesize information that would otherwise be difficult to locate.

Emerging technologies are also being leveraged to fund language revitalisation initiatives. Crowd-funding websites such as [Kickstarter](#) provide a digital platform for people to campaign and raise resources for language programs, with filmmakers, artists, poets and language teachers launching effective online campaigns to realise specific projects around language revitalization.

The answers to the questions raised in this report are not primarily technological, but rather social, cultural, political and economic. Specifically, future research will need to address the following issues:

- **Sensitive, user-based, community-grounded evaluation and impact studies** must be commissioned to evaluate the effect of emerging technologies on projects that seek to revitalize Indigenous and endangered languages. These studies must be designed collaboratively with communities so that their methodologies and criteria are rooted in a recognition of cultural norms and community goals.

- **Further research is urgently needed on the state of digital media asset management in Indigenous communities** in order to better understand the barriers to effective mobilization and deployment of digital media for language revitalization and cultural work. Once again, this process should be comparative and community-driven, encouraging knowledge-sharing across and between Indigenous communities.
- Since evaluation and assessment have a bitter colonial legacy for many Indigenous communities, it is essential to **co-design methods and assessment tools that strengthen the work being undertaken in community rather than compromise it**. It is easy to forget that learning to read and write activates a different set of neural pathways than learning to hear, understand and speak a language. Multiple longitudinal studies can help to identify areas where the development and deployment of digital platforms has brought or is bringing tangible benefit to community-based language revitalisation programs. Specific areas to explore include applied language learning programs as well as language use in natural cultural contexts, initiatives that have been designed to increase literacy and confidence, and programs that increase incentives through engaging technologies that help to generate prestige through digital access and ease of use in digital environments. Such impact studies should be publicly available in a central repository for easy access.

KNOWLEDGE MOBILIZATION

The process of knowledge mobilization—moving available knowledge from more formal scholarship into active use—is integral in both the development of this report and in its dissemination. Practical recommendations are being communicated directly to policy makers through the public document—online and in print—as well as with information professionals, research-

ers and cultural heritage practitioners through existing collaborations, emerging partnerships, pre-scheduled capacity-building program meetings, online platforms, social media, peer-reviewed open-access publications and presentations at professional conferences. The table below outlines main features of our knowledge mobilization program.

Target Users & Stakeholder Group	Rationale & Dissemination Method & Mechanism
Knowledge end-users in Government & Administration	<p>The Public Policy Report synthesizes our findings around our focal research questions in a clear and succinct way.</p> <p>Recommendations focus on policy makers (Ministry of Education, Indigenous and Northern Affairs Canada, Provincial agencies) and research councils and funding agencies.</p>
Information Professionals, Scholars & Researchers in Universities & Colleges	<p>Invited presentations at various international conferences, symposia and workshops, including:</p> <p><i>Translating Across Time and Space</i>: The American Philosophical Society’s symposium on endangered languages and cultural revitalization, October 2016 in Philadelphia, PA.</p> <p><i>Vital Voices: Linking Language & Wellbeing</i>: The 5th International Conference on Language Documentation and Conservation (ICLDC), March 2017, the University of Hawai’i at Mānoa.</p> <p>Two co-authored publications in peer-reviewed, open access journals, such as:</p> <ul style="list-style-type: none"> • Canadian Journal Of Native Studies • Language Documentation and Conservation (LD&C) • Journal for the Association for Information Science and Technology (JASIS&T) <p>Additional mobilization through:</p> <p>Nathan and K. Lawson’s 2014 SSHRC Insight Grant ‘Sustaining Information Practices’, and meetings of the Association of Tribal Archives, Libraries, and Museums (October 2016); American Anthropological Association conference (November 2016); British Columbia Library Association Conference (May 2017); the Native American and Indigenous Studies Association (hosted by UBC in 2017); the UBC Indigitization Toolkit for the Digitization of First Nations Knowledge; the MOA Reciprocal Research Network; and the Confederacy of Cultural Education Centres.</p>
All Target Users & Stakeholders	<p>UBC web domain <heiltsuk.arts.ubc.ca> will host the full report, and an annotated bibliography of research literature and other relevant links.</p>

CONCLUSION

The Heiltsuk language, as with other Indigenous languages, is an integral component in Heiltsuk traditional and contemporary knowledge systems. Heiltsuk knowledge creation, development, dissemination and intergenerational sharing is developed in—and carried through—varied modes of documentation and expression. These include spoken language, song, oral performance, ceremony, visual arts, architecture, fishing and wood-working technologies. Heiltsuk knowledge exists in an intercultural and international context, and Heiltsuk people have a long, uninterrupted history of artistic innovation and cultural creation, sharing with and learning from other Nations across the central coast. Similarly, Heiltsuk people and organizations have always adopted and adapted writing and media recording technologies.

Better resourcing language instructors in Indigenous communities and schools will promote stronger learning outcomes, language retention and trust. Learning goals set by the community are more attainable, more credible and have a higher chance of fulfillment.

The intellectual property and ownership implications of cloud-based storage and mobile language-learning apps are underexplored and central to ensuring that our shared digital future is a space of respectful co-existence.

Community-based language mobilization needs significantly more longer term, stable, and sustaining funding. Simply put, Indigenous communities need more funding, dispersed in a better way, in order to plan strategically over the long term. Communities must not be positioned as competitors with universities for funding resources and visibility, but rather have dedicated funding streams that will enable more equitable partnership.

Research agendas, funding needs, as well as success criteria, must be designed, determined and implemented by Indigenous communities themselves. Indigenous communities have long identified the language-related questions that they want research to answer, and should be directly resourced to further develop and investigate these.

For Indigenous communities to continue to participate and co-create our shared digital future, ongoing investment in the common digital backbone is essential. Infrastructure and capital costs are rarely one-off, and technology investments must be long-term and equitable, not just for communities themselves, but also for the organisations that support them.

The story of resilience of Indigenous languages and cultural health in Indigenous communities is a story of local endurance and perseverance against enormous opposition. Indigenous scholars and organizations are creators and innovators (and not just recipients or clients) of new technologies, particularly in the domain of cultural and linguistic heritage. Direct provincial and federal investment in the research infrastructure and human capacity in Indigenous communities is therefore imperative and urgent.

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- [37] Henke, R. (2016). *List of Master-Apprentice Approach (MAA) programs*. Retrieved from https://docs.google.com/spreadsheets/d/1rLfTi3gLmrHfLNrZ8KMeLkdORtESrh-7Q1oddIHG1F4c/edit?usp=drive_web&usp=embed_face-book

APPENDIX A

ANNOTATED RESOURCES

Adams, M., Carpenter, J., Housty, J., Neasloss, D., Paquet, P., Walkus, J., & Darimont, C. T. (2014). Towards increased engagement between academic and indigenous community partners in ecological research. *Ecology and Society*, 19(3): 5.

The authors present their reflections on the process of an academic-community engagement project within three Indigenous territories in coastal British Columbia, Canada. Their research looked at the way in which traditional ecological knowledge and Indigenous community engagement plays a key role in conservation and resource management, as well as policymaking.

Anderson, J. (2005). The Making of Indigenous Knowledge in Intellectual Property Law in Australia. *International Journal of Cultural Property*, 12(3): 345-371.

Explores the ways in which Indigenous knowledge has been made into a category of intellectual property law and how this category helps to address the unauthorized use of Indigenous knowledge.

Banks, M. A. (2006). Towards a continuum of scholarship: The eventual collapse of the distinction between grey and non-grey literature. *Publishing Research Quarterly*, 22(1): 4-11.

Proposes an integration of 'grey literature' into scholarly databases. Explores how the growth of open source online options for information access collapse the distinction between grey and academic research.

Beaton, B., & Carpenter, P. (2015). Creating appropriate participatory action research with remote First Nations. *Antistasis*, 5(2): 50-61.

Speaks to the importance of respecting First Nations cultural practices and territories for research purposes. Specifically focuses on the acknowledgement of the unceded traditional territories of the Wolastoqey Nation, and the process of working to create meaningful working relationships with this community. Explores how First Nations communities are establishing their own organizations, protocols, and digital management systems to ensure

their digital networks and knowledge are being protected and used to serve their own communities' needs.

Belanger, Y. D. (2001). Northern Disconnect: Information Communications Technology needs assessment for Aboriginal communities in Manitoba. *Native Studies Review*, 14(2): 43-69.

Explores the potential benefits of the Internet as a tool to access information and connectivity at the turn of the 21st Century, including its role in education and e-commerce. Speculates about the challenges and feelings of mistrust that many Indigenous communities have with unfulfilled government promises of Internet infrastructure.

Bell, J., Christen, K. & Turin, M. (2013). After the Return. *Museum Anthropology Review*, 7(1-2): 1-21.

Looks at the often-contested issues of repatriation among scholars, local communities, and collecting institutions. Examines how the digital age has shifted the discussion away from legal assumptions to one of digital return and community stewardship.

Brown, J. S. (2000). Growing up: Digital: How the web changes work, education, and the ways people learn. *Change: The Magazine of Higher Learning*, 32(2): 11-20.

Explores the history of the Internet, and the ways in which it continues to act as a transformative medium. Speaks to the ways in which the Internet can foster the growth of community knowledge-sharing.

Chappell, C. (2015). How do you say, "I love you" in !Xóõ? *College & Research Libraries News*, 76(10): 552-556.

Reviews and lists endangered language resources, including projects, organisations, YouTube channels, lectures, MOOCs, language policies, digital repositories, as well as relevant scholarly journals.

Christen, K. (2008). Archival challenges and digital solutions in Aboriginal Australia. *SAA Archaeological Recorder*, 8(2): 21-24.

Explores issues surrounding the digital archiving of Indigenous cultural materials. Discusses museums and other institutions working to actively collaborate with Indigenous communities to practise best archival collection process and protocol. Connected to the community-based, digital archiving system, Murkutu, built from Warumungu protocols and knowledge systems.

Coronel-Molina, S. M., & McCarty, T. L. (eds.) (2016). *Indigenous Language Revitalization in the Americas*. New York: Routledge.

Explores the history and state of language revitalization across the Americas. Addressing both “bottom-up” and “top-down” approaches to revitalisation, the book is organized geographically and addresses the themes of: policy and politics; processes of language shift and revitalization; the home-school-community interface; local and global perspectives; linguistic human rights; revitalization programs and impacts; new domains for Indigenous languages.

Crow, T., & Parsons, D. (2015). A Mobile Game World for Māori Language Learning. In T. H. Brown & H. J. van der Merwe (Eds.), *The Mobile Learning Voyage - From Small Ripples to Massive Open Waters*. Cham: Springer International Publishing: 84-96.

Describes the process and development of a mobile-assisted language-learning tool to support the Maori language that takes the form of a virtual game world. Explores the research methodologies used in the making of the game and the process of testing aspects of the virtual reality game with teachers, students, and academic design partners.

Dietrich, C., & Bell, J. (2011). Representing culture via agile collaboration. In G. Styliaras, D. Koukopoulos, & F. Lazarinis (Eds.), *Handbook of Research on Technologies and Cultural Heritage: Applications and Environments*. Hershey, PA: Information Science Reference.

Explores some issues involved in the development of digital tools and software, specifically designed to support communities' cultural knowledge management. Speaks to the importance of this digital software reflecting and acknowledging community specific desires as well as paying close attention to community protocol and cultural sensitivities. Looks at ways to group various smaller digital applications that support cultural knowledge management for a wider variety of users' needs.

Dyson, L. E., Grant, S., & Hendriks, M. (2016). *Indigenous People and Mobile Technologies*. New York: Routledge.

Explores how mobile technology and new media tools are being embraced and generated by Indigenous peoples across the globe. Looks at how the rise of mobile technology accessibility in remote locations,

and the growth of available open source mobile tools, are contributing to the revitalization of Indigenous culture and language within communities. Examines how some Indigenous communities are establishing their own Indigenous mobile networks to support community-based needs, as well as offering modes for social change.

Eisenlohr, P. (2004). Language Revitalization and New Technologies: Cultures of Electronic Mediation and the Refiguring of Communities. *Annual Review of Anthropology*, 33: 21-45.

Reviews the growing number of language activists and linguists utilizing digital technologies to support the revitalization of endangered languages. Explores the potential that linguistic ideologies have to inform and shape the development of digital tools used to support endangered languages. Speaks to some of the issues involved when digitally documenting endangered languages, such as the creation of electronic cultural objects, and the protocol surrounding those.

Federation for the Humanities and Social Sciences. (2015). *Strategic Direction 2016-2020*. Ottawa: Federation for the Humanities and Social Sciences. Retrieved from <http://www.ideas-idees.ca/sites/default/files/strategic-directions-2016-2020-oct-5.pdf>

Explores the aim, vision and strategic directions in place to better improve the Federation of the Humanities and Social Sciences over the next five years. Looks at an environmental scan conducted on the Federation's human and financial resources. Explores the results of this scan, which focuses on the Federation working on a new commitment to advance reconciliation with Aboriginal peoples throughout their work.

First Nations Schools Association. (2009). *Curriculum and Resources for First Nations Language Programs in BC First Nations Schools*. Retrieved from http://www.fnesc.ca/wordpress/wp-content/uploads/2015/05/PUB-LANG-FNSA_Resource_Directory_2009.pdf

Sets out a list of linguistic resources, language specific resources, adaptable resources, language revitalization resources, language teaching journals, further education, funding, and organization resources for the support and improvement of community-based, First Nations educational materials.

First Peoples' Cultural Council. (2013). *A Guide to Language Policy and Planning for B.C. First Nations Communities*. Brentwood Bay, BC: FPCC. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.681.1759&rep=rep1&type=pdf>

Supporting First Nations communities, governments, schools and language projects across British Columbia to approach language policy and practices with a view to long term First Nations language revitalization.

First Peoples' Cultural Council. (2015). *Report on the status of B.C. First Nations Languages 2014*. Retrieved from <http://www.fpcc.ca/files/PDF/Language/FPCC-LanguageReport-141016-WEB.pdf>

In this second edition of the Report on the Status of B.C. First Nations Languages, the First Peoples Cultural Council provides updated information on the status of B.C.'s 34 First Nations languages. This report also forms part of *Our Living Languages: First Peoples' Voices in British Columbia*, which is an exhibition in partnership with the Royal British Columbia Museum that opened in June 2014 and celebrates the diversity of the B.C.'s Indigenous languages. This report explores the current state of B.C.'s languages and celebrates the communities and projects that are working to make sure these languages continue to be vital.

First Peoples' Cultural Council. (2016). *2015/16 Year in Review* (Annual Report). Brentwood Bay, BC: FPCC.

A report on recent activities by the FPCC, including recently funded projects in B.C. and a summary of progress on the FirstVoices project.

Galla, C. K. (2009). Indigenous language revitalization and technology from traditional to contemporary domains. In J. Reyhner & L. Lockard (Eds.), *Indigenous Language Revitalization: Encouragement, Guidance & Lessons Learned*. Flagstaff, AZ: Northern Arizona University: 167-182.

Describes the critical areas in which technology plays a key role in language and culture revitalization. Looks at Indigenous, community-based projects working to preserve, maintain and revitalize their languages with the support of technology.

Galla, C. K. (2010). *Multimedia technology and Indigenous language revitalization: Practical educational tools and applications used within Native communities* (Ph.D.). The University of Arizona, United States.

Reports on findings from a research study looking at the types of multimedia technology Indigenous communities, families, teachers, and language learners found useful to support language revitalization, documentation, education, preservation and maintenance. Provides a general overview of the types of digital technologies being used by communities for the revitalization of their languages. Looks at where, when, why, and how digital users are carrying out these technologies in their communities, homes and schools.

Galla, C. K. (2016). Indigenous language revitalization, promotion, and education: function of digital technology. *Computer Assisted Language Learning*: 1-18.

Explores some of the possible effects technology can have on Indigenous language learning and teaching, and how Indigenous language learners, teachers, speakers, and technology users feel they are best understanding, utilizing, communicating and applying language mobilizing technology.

Gaertner, D. (2016). *Bibliography for FNIS 401f: Indigenous New Media*. Retrieved from <https://novelliances.com/2016/08/12/bibliography-for-fnis-401f-indigenous-new-media/>.

Bibliography of essays, notes, and reflections on Indigenous politics, arts, and new media from an allied perspective. Explores issues and works of Indigenous futurism, cyberspace, visual sovereignty, reconciliation and justice.

Goodwin-Jones, R. (2013). Emerging technologies: The technological imperative in teaching and learning less commonly taught languages. *Language Learning & Technology*, 17(1): 7-19.

Reports on some of the ways in which technology is being used to support endangered languages or 'Less commonly taught language' (LCTL) learning and instruction. Explores various LCTL programs such as the 'STARTALK program', which provides funding for intensive summer courses in various lesser taught languages for high school students, and has proven to have been a successful effort in promoting new language options at the high school level. Looks at various post secondary institutions across America that now offer LCTL courses in the form of face-to-face instruction, self-instructed language courses, as well as mentored language courses. Advocates for

the further development of mobile language learning apps, and encourages LCTL instructors to incorporate digital tools into their teaching, as they argue these technological skills are becoming essential for learning, documenting and revitalizing less commonly taught languages.

Hallett, D., Chandler, M. J., & Lalonde, C. E. (2007). Aboriginal language knowledge and youth suicide. *Cognitive Development*, 22(3): 392-399.

Explores how Indigenous language-use in community settings correlates with youth suicide rates among six other cultural continuity factors as previously identified in past research. Reports that youth suicide rates dropped to zero in those communities in which at least half the band members reported a conversational knowledge of their own "Native" languages.

Health Canada. (2013). *National Aboriginal Youth Suicide Prevention Strategy (NAYSPS): program framework*. Retrieved from <http://www.hc-sc.gc.ca/fniah-spnia/pubs/promotion/suicide/strat-prev-youth-jeunes-eng.php>

Explores Health Canada's updated statistical findings on First Nations, and Inuit suicide rates, using geozones methodology. Speaks to suicide prevention through coordinated initiatives carried out on diverse social levels. Looks at the program planning of a National Aboriginal Youth Suicide Prevention Strategy (NAYSPS) for First Nations living on reserve and Inuit living in Inuit communities. Notes the importance of community-based programs for suicide prevention.

Hermes, M. (2012). Indigenous Language Revitalization and Documentation in the United States: Collaboration Despite Colonialism. *Language and Linguistics Compass*, 6(3): 131-142.

Explores various Indigenous language revitalization and documentation efforts in the United States, as well as globally. Brings attention to community-based and empowerment models of language documentation and revitalization projects in collaboration with academics of various disciplines, cultures, languages and ideologies. Looks at Indigenous languages as key to a sustainable future, as opposed to artefacts.

Hermes, M., Bang, M., & Marin, A. (2012). Designing Indigenous language revitalization. *Harvard Educational Review*, 82(3): 381-402.

Speaks to the lack of attention endangered Indigenous languages have received from the American research community. Looks at the negative impact dominant models of education have had for endangered Indigenous languages. Speaks to the need to take education beyond culturally relevant curriculums and explores an Ojibwe language revitalization effort aimed at helping to illustrate the context of community-based language projects. Explores various interactive multimedia tools and ways in which to help inform digital technologies that better support community language efforts.

Hermes, M., & King, K. A. (2013). Ojibwe language revitalization, multimedia technology, and family language learning. *Language Learning & Technology*, 17(1): 125.

Explores the ways that emerging digital technology can support efforts to teach and revitalize endangered Indigenous languages such as Ojibwe. Looks at research designed to illustrate ways in which urban Ojibwe language participants utilized specific computer-based language learning technology with their families. Explores how particular multimedia tools might inspire creative communication for Ojibwe language use at home.

Huaman, E. S., & Stokes, P. (2011). Indigenous language revitalization and new media: Postsecondary students as innovators. *Global Media Journal*, 11(18): 1-15.

Explores the importance of Indigenous languages for human diversity and the detrimental effects of language loss for Indigenous peoples. Looks at the vital role post-secondary Indigenous students have towards language revitalization efforts and examines a sample project in which Indigenous postsecondary students founded a new media language revitalization project.

Hudson, H. E. (2015). *Connecting Alaskans: Telecommunications in Alaska from Telegraph to Broadband*. Fairbanks, AK: University of Alaska Press.

Explores the unique history of Alaskan communications, radio, television, phone, and Internet services, and how historically the communication needs of the military presence superseded the needs of communities.

Hughes, L. M. (2004). *Digitizing Collections: Strategic Issues for the Information Manager*. London: Facet Publishing.

Speaks to the emerging developments in digital technology, and the challenges this creates for choosing the right method of digitizing resources for information organizations. Explores various options for digitizing software as well as the importance of planning a strategy to assess the costs and benefits of a collaborative digitization project. Presents detailed, step-by-step information of the entire digitization process, outlining the different techniques available.

Hurley, Mary C. & Wherrett, J. (1999, rev. 2000). *The Report of the Royal Commission on Aboriginal Peoples*. Ottawa: Library of the Parliament of Canada, PRB 99-24E.

The Royal Commission on Aboriginal Peoples (RCAP) issued its final report in November 1996. This report made 440 recommendations and called for large changes to the relationship between Aboriginal and non-Aboriginal people and governments in Canada. The revision to this report (2000) further recognized Aboriginal peoples in Canada as self governing Nations, with a unique and special role. The second edition to this report continued on with a 20-year plan for the recommendations and called for new legislation, additional resources, and a redistribution of land. It also brought more urgent attention to socio-economic conditions affecting Aboriginal peoples in Canada. In response to this report Aboriginal communities and organizations pressed for actual action on these recommendations.

Ignace, M. (2005). *Background document for the taskforce on aboriginal languages and cultures*. Gatineau, QC: Aboriginal Affairs Branch, Department of Canadian Heritage.

Looks at the Ministry of Canadian Heritage's announcement to commit \$172.5 million over 11 years to create a non-profit corporation for the preservation, revitalization and promotion of Aboriginal languages and cultures in Aboriginal communities of Canada. Reports on the Canadian Heritage's appointed Task Force recommendations to that council. Looks at research findings based on a review and analysis of existing reports and published data of Indigenous languages in Canada.

Indigenous and Northern Affairs Canada. (2008, November 14). *First Nations* [fact sheet; resource list]. Retrieved from <https://www.aadnc-aandc.gc.ca/eng/1100100013791/1100100013795>

Indigenous and Northern Affairs Canada looks at First Nations people in relation to their Status and/or Non-Status. According to their 2006 statistics, more than one million people in Canada identify themselves as

Aboriginal, or 4% of the population. Fifty-three per cent are registered Indians, 30% are Métis, 11% are Non-status Indians and 4% are Inuit. Reports that over half (54%) of Aboriginal people live in urban areas.

Indigenous Languages and Technology Discussion List, moderated by Phillip Cash <http://www.u.arizona.edu/~cashcash/ILAT.html>

The Indigenous Languages and Technology (ILAT) discussion list is an open forum for community language specialists, linguists, scholars, and students to discuss issues relating to the uses of technology in language revitalization efforts.

Jones, M. C. (Ed.). (2015). *Endangered languages and new technologies*. Cambridge & New York: Cambridge University Press.

Explores how new technologies such as visual archiving of text-based resources, digital mapping, and social media have potential to play a vital role in language documentation and revitalization. The author also considers the possible challenges these new technologies can have for endangered language revitalization.

Landzelius, K. (Ed.). (2006). *Native on the Net: Indigenous and diasporic peoples in the virtual age*. London & New York: Routledge.

Landzelius and contributions from other anthropologists and ethnographers explore how global technologies have impacted the lives of Indigenous and diasporic peoples. They examine the different ways in which these peoples are using the Internet for communication and community. Using case studies from across the globe, the book addresses themes such as the relationship between place and identity, notions of community, and the meaning of 'Indigenous'.

Lawson, K. (2004). *Precious Fragments: First Nations materials in archives, libraries and museums* (Masters). University of British Columbia, Vancouver, BC.

Explores the need to better connect living Indigenous knowledge from communities to that of fragmented Indigenous knowledge held in archives, museums and libraries through bridging the gap between Western knowledge systems and Indigenous Knowledge systems.

Lawson, K. & Carpenter, J. (1989). *Bibliography of the Heiltsuk Culture, History and Environment*. Waglisla: Heiltsuk Cultural Education Centre.

Lists works pertaining to Heiltsuk culture, including explorers, fur traders, missionaries, and government publications and documents, along with historical publications, anthropological, archaeological, and ethnological materials, linguistic works, geographical and natural history reports, as well as locally produced documents such as alphabets, teaching materials, and writing systems.

Lynch, C. (2002). Digital collections, digital libraries & the digitization of cultural heritage information. *Microform & imaging review*, 31(4): 131-145.

Speaks to the growing desire of Internet users to have access to broadband services, while addressing the lack of availability of broadband communication technologies. Looks at education, research, and cultural heritage as important factors informing the demand for more digital content. Explores communities' need to have good digital rights protections in place. Addresses the lack of availability of broadband communication technologies.

Maffi, L. (Ed.). (2001). *On biocultural diversity: Linking language, knowledge, and the environment*. Washington, DC: Smithsonian Institution Press.

Explores efforts to prevent the predicted decline of linguistic diversity through the recognition of linguistic, cultural, and biological diversity, referred to as 'biocultural diversity'. Looks at the threat of losing traditional ecologies that many endangered language communities face. Focuses on ways to conduct language research for field linguists that would apply a practical approach to support biocultural diversity within language communities.

McCarty, T. L. (2007). Bilingual education by and for American Indians, Alaska Natives and Native Hawaiians. In J. Cummins & N. H. Hornberger (eds), *Encyclopedia of Language and Education* (2nd ed., Vol. 5, p. 239-252). New York: Springer.

Looks at ways in which Native American bilingual education programs can help to revitalize endangered Indigenous languages while at the same time promoting children's English language learning and school achievement.

Mclvor, O. (2009). Strategies for Indigenous language revitalization and maintenance. In *Encyclopedia of language and literacy development*. London, ON: Canadian Language and Literary Research Network: 1-12.

Looks at ways in which Indigenous languages in Canada have been affected by 500 years of colonialism, genocide, and forced English-only residential schools. Explores how over the past 100 years alone, at least 10 Indigenous languages have become completely extinct. Speaks to various Indigenous language revitalization and reclamation projects that have happened in the past 50 years. Explores the importance of ensuring the survival of Indigenous languages. Looks at community-based revitalization projects and the methods communities are finding useful in their efforts.

Montler, T. (2005). The Klallam language program. *UNESCO register for good practices in language preservation*. UNESCO.

Describes the development of the Klallam Language Program. Identified by UNESCO as exemplifying collaboration among community, linguist and authorities in the implementation of a public school language program.

Nathan, D. (2013) Access and accessibility at ELAR, a social networking archive for endangered languages documentation. In M. Turin et. al. (eds.) *Oral Literature in the Digital Age: Archiving Orality and Connecting with Communities*. Cambridge: Open Book Publishers: 21-40.

Focuses on the use of new media, digital technologies and ethical, community-based protocols to help support endangered language revitalization, as well as exploring descriptive linguistic approaches.

NSERC. (2015). *Tri-Agency Open Access Policy*. Retrieved from http://www.nserc-crsng.gc.ca/NSERC-CRSNG/policies-politiques/OpenAccess-LibreAcces_eng.asp

Explores the Natural Science and Engineering Research Council of Canada, (NSERC), the Canadian Institutes of Health Research (CIHR) and the Social Sciences and Humanities Research Council of Canada (SSHRC), collaborative policy project aimed to provide open access to research publications.

Obonyo, V., Troy, D., Baldwin, D., & Clarke, J. (2011). Digital Smartpen Technology and Revitalization of the Myaamia Language. *Journal on Computing and Cultural Heritage*, 4(4): 12:1-12:11.

Reports on the results of a usability test applying computer-based emerging technologies, digital smartpen technologies as well as interactive audio books, to support language revitalization efforts from the Miami Tribe in Oklahoma. Explores the desire to further develop additional technological tools to support Miami 'Home learning kits'. Looks at ways to adapt smartpen sound files to support other community language revitalization efforts.

O'Donnell, S., Milliken, M., Chong, C., & Walmark, B. (2010). *Information and Communication Technologies (ICT) and Remote and Rural First Nations Communities: An Overview*. Presented at the Canadian Communication Association Annual Conference, Montréal, Quebec.

Explores the value of information and communication technologies (ICT) being used to establish and maintain connections within and between remote, rural and urban First Nations communities across Canada. Reviews the history, policies, and partnerships between ICT and First Nations communities. Explores First Nations community access to and utilization of broadband networks.

O'Donnell, S., Beaton, B., McMahon, R., Hudson, H. E., Williams, D., & Whiteduck, T. (2016). *Digital Technology Adoption in Remote and Northern Indigenous Communities*. Presented at the Canadian Sociological Association 2016 Annual Conference, University of Calgary, Alberta.

Discusses the legacy of the Report of the Royal Commission on Aboriginal Peoples (RCAP), and how 20 years after its release, very few of its 440 recommendations have been implemented. Explores how Indigenous-settler conflicts over land and treaties have escalated, socioeconomic disparities persist, and the number of missing and murdered Indigenous women has increased.

Penfield, S., Cash, P., Galla, C. K., Williams, T., & ShadowWalker, D. (2006). *Technology-enhanced language revitalization*. Tucson, AZ: University of Arizona.

An in-depth exploration of the 'Technology-enhanced language revitalization' training manual and the issues that surround endangered Indigenous language revitalization. Explores endangered Indigenous language statistics, role of endangered language advocates, and how digital tools can help to support endangered language revitalization projects. Explores computer basics, the multi-media language lessons, and emerging language learning software.

Priest, L., & SIL International. (2007). *Unicode on the Front Lines: Endangered Languages and Unicode*. Presented at the 31st Internationalization & Unicode Conference, San Jose.

Explores the non-profit, faith-based organization, SIL international, which works with language communities across the globe to help support capacity for sustainable language documentation, development and revitalization. Explores what endangered language documentation is, reasons for language 'death', and the ways in which SIL are working to support endangered language revitalization. Looks at the role the Unicode font contributes to language revitalization efforts. Speaks to the proposal of specific characters for the Unicode font that would help support a greater number of endangered languages.

Prime Minister of Canada Justin Trudeau Website (15 December 2015). *Final Report of the Truth and Reconciliation Commission of Canada*. Retrieved from <http://pm.gc.ca/eng/news/2015/12/15/final-report-truth-and-reconciliation-commission-canada#sthash.4RIGfADO.dpuf>

Addresses the implementation of the Indian Residential Schools Settlement Agreement, which involved individual and collective elements to address the legacy of the Indian Residential Schools, such as the Truth and Reconciliation Commission of Canada (TRC). The official mandate of the TRC is found in schedule "N" of the settlement agreement.

Pulla, S. (2015). *Mobile Learning and Indigenous Education in Canada: A Synthesis of New Ways of Learning* (SSHRC Knowledge Synthesis Grant Final Report). Royal Roads University.

Explores the potential of mobile learning and mobile learning technologies to support the needs of Indigenous learners in Canada. Looks at existing research and knowledge gaps relating to mobile learning technology and its uses for urban, rural, and remote Indigenous communities in Canada. Looks at emerging mobile technologies as a means to support culturally relevant community-based learning materials. Explores the development of virtual high school learning opportunities to provide First Nations students equal access to education opportunities from their home communities.

Rath, J. (2005). *Making the Heiltsuk Alphabet Computer-Friendly*. Bella Bella, BC: Heiltsuk Cultural Centre.

A report by linguist John Rath for the Heiltsuk Cultural Education Centre that details the challenges in using the Heiltsuk alphabet on computers. Rath assesses the advantages and drawbacks of the Heiltsuk Duolos font and suggests ways forward in making the Heiltsuk language more accessible in a digital environment.

Reading, C. (2015). Structural Determinants of Aboriginal Peoples' Health. In Greenwood, M., De Leeuw, S., Lindsay, N. M., & Reading, C. (eds.), *Determinants of Indigenous Peoples' Health*. Toronto: Canadian Scholars' Press: 3-15.

First Nations, Inuit, and Metis writers explore various topics to better understand health inequality within Indigenous communities across Canada. Explores the multiple health determinants such as social factors, geography, economic, and biological issues that would have an impact on Indigenous people's health status within Canada.

Shaw, P. A. (2004). Negotiating against loss: Responsibility, reciprocity, and respect in endangered language research. In Osamu Sakiyama, Fubito Endo, Honoré Watanabe and Fumiko Sasama (eds.) *Lectures on Endangered Languages 4: From Kyoto Conference 2001*. Kyoto: Endangered Languages of the Pacific Rim, 181-194.

Explores the necessity, on the part of linguists and the academic institutions within which they function, to recognize a major shift in responsibilities in the conduct of linguistic research on endangered languages. The traditional role of the Linguist as 'Expert' and the Native Speaker as 'Consultant' must be re-evaluated, and redefined to create a more balanced, collaborative, and empowering model which recognizes the vital importance of community-centered self-determination and control over their language, their heritage, and their linguistic future.

Siekmann, S., & Hishinlai' "Kathy R. Sikorski." (2013). Reinventing Technology: Computers as Tools for Constructing the Local Voice in Materials in Materials Development. In P. E. Marlow & S. Siekmann, *Communities of practice: An Alaskan native model for language teaching and learning*. University of Arizona Press.

Reports on data collected during a second language curriculum and materials development course that focused on the uses of technology in developing culturally appropriate materials. Discusses whether computer technology is appropriate for Yugtun language-learning by elementary students in Alaska.

Sinclair, B., & Pelletier, D. (2012). *We have to hear their voices: A research project on Aboriginal languages and art practices*. Ottawa: Canada Council for the Arts.

Outlines a range of concepts within Aboriginal worldviews that may be unknown to non-Aboriginal language speakers. It includes: background information and findings on demographics and trends on Aboriginal languages in Canada; voices of the Elders, the wisdom keepers, who continue to pass on their knowledge of languages and the arts – both traditional and contemporary; voices of the interview/talking circle and survey participants; a summary of opportunities for further exploration.

Smith, C., & Ward, G. (Eds.). (2000). *Indigenous cultures in an interconnected world*. Vancouver: UBC Press.

Focuses on the ways in which digital technology can be used to support Indigenous language revitalization and cultural reclamation. Explores the role globalization has had on Indigenous culture and language. Speaks to the ways digital communication tools support Indigenous community's language learning efforts, and addresses the negative impact these digital tools can have on Indigenous traditional knowledge in the form of cultural appropriation.

Social Sciences and Humanities Research Council. (2016). *Leveraging Knowledge for 21st Century Teaching and Learning: Insights and opportunities for knowledge mobilization and future research* (Imagining Canada's Future). Ottawa: SSHRC.

Explores some of the emerging tools used for teaching and learning that help meet the needs of an evolving, technology-mediated labour market. Draws on knowledge synthesis studies, workshops, forums and roundtable discussions to illustrate some of the initiative's key findings that call for better ways to support learning and teaching across multiple disciplines. Calls for more research on experiential learning to help develop a more supportive educational policy.

Tablan, V., Ursu, C., Bontcheva, K., Cunningham, H., Maynard, D., Hamza, O., McEnery, A. M., Baker, P. & Leisher, M. (2002). A unicode-based environment for creation and use of language resources. *Proceedings of LREC 2002*: 66-71.

Explores the project 'GATE', which is a Unicode-aware and development effort, capable of processing all human languages. Explores GATE's challenges and limitations with the Unicode font in supporting

all of the world's languages. Describes GATE's efforts to update and improve the Unicode font to better support all Indigenous languages.

Tobias, T. N. (2000). *Chief Kerry's Moose: A guidebook to land use and occupancy mapping, research design and data collection*. Vancouver, BC: Union of BC Indian Chiefs & Ecotrust Canada.

Part one in a series of publications intended for First Nation researchers and decision makers, illustrating best practices in land use and occupancy research and mapping.

Truth and Reconciliation Commission of Canada (2015). *Truth and Reconciliation Commission of Canada: Calls to Action*. Winnipeg: TRC.

Outlines the 94 "calls to action" for the Canadian government to "redress the legacy of residential schools and advance the process of Canadian reconciliation".

Truth and Reconciliation Commission of Canada (2015). *Truth and Reconciliation Commission of Canada: Final Report*. Winnipeg: TRC. Retrieved from <http://www.trc.ca/websites/trcinstitution/index.php?p=890>

Final report of the Truth and Reconciliation Commission, investigating the residential school system and its legacy in Canada.

Turin, M. (2007). *Linguistic Diversity and the Preservation of Endangered Languages: A Case Study from Nepal*. Kathmandu, Nepal: International Centre for Integrated Mountain Development.

A large number of Nepal's over 100 mother tongues are in danger of being reduced to markers of identity within our lifetime if nothing is done to reverse the trend. Results of recent international research point to a link between biological and linguistic diversity, and can be used to illustrate how revitalizing minority languages also helps to support historically marginalized communities in their work to improve their socioeconomic status and political standing.

Turin, M., Wheeler, C. & Wilkinson E. (2013). *Oral Literature in the Digital Age: Archiving Orality and Connecting with Communities*. Cambridge: Open Book Publishers.

This volume explores the political repercussions of studying marginalised languages; the role of online

tools in ensuring responsible access to sensitive cultural materials; and ways of ensuring that when digital documents are created, they are not fossilized as a consequence of being archived. Fieldwork reports by linguists and anthropologists in three continents provide concrete examples of overcoming barriers—ethical, practical and conceptual—in digital documentation projects.

UN General Assembly (2007). *United Nations Declaration on the Rights of Indigenous Peoples A/RES/61/295*. Retrieved from http://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

Explores the United Nations declaration on the rights of Indigenous Peoples based on recommendations made from the Human Rights Council from 29 June 2006. Affirms that Indigenous peoples are equal to all other peoples, while at the same time recognizing the right of all peoples to be different, and to be respected.

Villa, D. J. (2002). Integrating technology into minority language preservation and teaching efforts: An inside job. *Language Learning and Technology*, 6(2): 92-101.

Looks at the increased use of digitizing technologies and its implications for the documentation of heritage languages. Explores specific communities' cultural boundaries with regards to access of authentic language use. Describes a pilot project that presents the use of technology in a culturally appropriate manner for the training of 'in-group' community members for revitalization of the Navajo language.

Vincze, V., Nagy, Á., Horváth, C., Szilágyi, N., Kozmács, I., Bogár, E., & Fenyvesi, A. (2015). FinUgRevita: Developing Language Technology Tools for Udmurt and Mansi. *Septentrio Conference Series*: 108-118.

Explores how digital language use on social media platforms and other digital communication technologies has increased the amount of visibility and possibility for minority languages. Specifically looks at ways to provide computational language support tools for endangered Finno-Ugric languages in Russia.

Walton, P. D., Bowden, M. E., Kurtz, S. L., & Angus, M. (2001). Evaluation of a rime-based reading program with Shuswap and Heiltsuk First Nations prereaders. *Reading and Writing*, 14(3-4): 229-264.

Examines 'rime-based' reading strategies for B.C First Nations pre-reading learners. Looks at research conducted within a Shuswap kindergarten class, as well as in a Heiltsuk grade one class. Focuses on results that clearly illustrate phonological awareness can be enhanced by adding rime-based strategies to early readers.

Warner, N., Luna, Q., Butler, L., & van, V. H. (2009). Revitalization in a scattered language community: problems and methods from the perspective of Mutsun language revitalization. *International Journal of the Sociology of Language*, 198: 135-148.

Addresses the challenges faced in revitalizing endangered languages when the language speakers are living outside the community. Explores the issues involved in minority languages that have no living speakers. Looks at some specific teaching methods, materials and emerging technologies used for 'dormant-language' revitalization work.

Warschauer, M. (1998). Technology and Indigenous Language Revitalization: Analyzing the Experience of Hawai'i [1]. *Canadian Modern Language Review*, 55(1): 139.

Reports on ethnographic research findings of Hawaiian educators who are using emerging digital technologies to support language revitalization programs. Looks at the development of online bulletin boards that operate entirely in endangered Indigenous languages. Addresses the role of the Internet in supporting, as well as obstructing, linguistic diversity. Explores the creation and accessibility of Hawaiian digital content. Calls on the need to further develop digital learning tools that reflect Hawaiian culture and worldviews.

Weintraub, I. (2000). *The role of grey literature in the sciences*. Access: Brooklyn College Library: 10.

Explores the history of grey literature and its value towards academic and scientific research. Speaks to the challenges involved in accessing grey literature, specifically the issues surrounding the bibliographic control of this type of literature. Scans current library literature, and provides a compilation of annotated citations to journal articles from 1981-2002 that address the issue of access and acquisition to grey literature within science and technology.

Wetzel, C. (2006). Neshnabemwen Renaissance: Local and National Potawatomi Language Revitalization Efforts. *American Indian Quarterly*, 30(1/2): 61-86.

Reports on findings of a Potawatomi language survey. Explores the current state of the Potawatomi language within six Potawatomi tribes. Looks at community interest in revitalizing the language. Addresses historic Potawatomi language recordings, and the issues such as inconsistent orthographies, and failings to grasp Potawatomi worldviews. Speaks to the emphasis of technology-assisted learning at the day-care level within tribal administration complex, as well as adult classes and online learning seminars.

Whaley, L. (2003). The future of native languages. *Futures*, 35(9): 961-973.

Examines the challenges involved in predicting the future of endangered languages. Addresses previous efforts to predict endangered language vitality. Explores various language revitalization projects connected to information technology, globalization and environmental issues.

Yong, D. L., & Hoffman, E. S. (2014). Teacher Technology Narratives: Native Hawaiian Views on Education and Change. *The Qualitative Report*, 19(8): 1.

Explores the experiences that eight 'native Hawaiian' teachers had within the Hawaiian language immersion program, called Papahana Kaiapuni, through the Hawaiian public school system. Addresses how the Hawaiian language teachers feel emerging technologies have supported and changed the Hawaiian Language Immersion program.

Zaman, T., Yeo, A. W., & Kulathuramaiyer, N. (2013). Augmenting Indigenous knowledge management with information and communication technology. *International Journal of Services Technology & Management*, 19(1-3): 137-148.

Explores research surrounding Indigenous Knowledge management systems as compared to technology supported management systems. Focuses on a project designed to support the preservation and documentation of Traditional Botanical Knowledge in the community of Long Lamai, Sarawak.

APPENDIX B

LANGUAGE MOBILIZATION PROJECTS AND INITIATIVES REVIEWED FOR KNOWLEDGE SYNTHESIS REPORT

Listed below are projects and initiatives that we reviewed in the course of preparing this knowledge synthesis report. While the projects are varied in their approach, context, funding and geography, all use technology to widen public access to—and understanding of—endangered language revitalization work. A brief disclaimer: this brief appendix is neither comprehensive nor representative. We simply wish to recognize some of the creative and innovative work taking place in communities and organisations around the world.

The 7000 Languages project

Location: Worldwide

Language: Various

Originally created in 2009 under The Heritage and Endangered Languages Preservation Program (H.E.L.P.P.), it was expanded 4 years later to become The 7000 Languages Project. This non-profit project aims to make endangered and minority language learning technology available to language teams working with lesser-known and under-resourced languages.

<http://www.transparent.com/about/7000-languages.html>

ACORNS: [A][C]quisition [O]f [R]estored [N]ative [S]peech

Location: Based in USA

Language: Created to support any language.

Named in honour of the acorn sacred to the tribes of California and Oregon, the ACORNS project supports the language revitalization efforts of Native American tribes. The project provides free software to support teachers and learners of any language in building digital language classes for language practice outside of the classroom. The software includes a desktop/laptop version as well as an app for mobile devices. Language lesson features include voice recognition, allowing the learner to speak their answer to pre-set questions.

<http://cs.sou.edu/~harveyd/acorns/index.php>

Canada 150 Typeface

Location: Canada

Language: Indigenous languages in Canada

In celebration of its 150th birthday, the Canadian government released a typeface designed to support Canada's two official languages—English and French—as well as Aboriginal language

orthographies. Designed by Raymond Larabie, the font includes all Latin characters and accents, as well as common Cyrillic characters and syllabic and diacritical elements that are part of Indigenous languages. The typeface may be obtained by any individual or group through an application process.

<http://canada.pch.gc.ca/eng/1469545358960>

Crow Apsaalooké Language App

Location: Montana, USA

Language: Crow Apsaalooké

Launched in 2015, the Crow Apsaalooké language app was developed by the Crow Nation and [Thornton Media, Inc.](#), a Native-owned media company that specialises in endangered Indigenous languages. The app includes over 600 words and phrases, songs, culture notes and a searchable database. The app is available on [Apple](#) and [Android](#) and has accumulated around 3,000 downloads to date.

<https://itunes.apple.com/ca/app/crow-apsaalooke/id956337368?mt=8>

Cyber PowWow

Location: Worldwide

Language: Various

Mohawk artist, writer and independent curator Skawennati Tricia Fragnito's 'Cyber Powwow' was created in an "Aboriginally-determined corner of cyberspace". Part virtual gallery and part virtual chat rooms, 'Cyber Powwow' was created by emerging and established Indigenous writers and artists. Launched in 1996, Skawennati's goal was to "overcome stereotypes about Aboriginal people; to help shape the World Wide Web; and to generate critical discourse—both in person and online—about First Nations art, technology, and community".

<http://cyberpowwow.net/>

Emotiki emoji keyboard

Location: New Zealand

Language: Maori

Emotiki is a free app that provides an emoji keyboard of 150 characters that are familiar to or have been made famous by Maori culture. Developed by Te Puia in Rotorua, the Emotiki app is free and all-inclusive, and aims to raise awareness of Maori culture and concepts across New Zealand and the world.

<http://www.emotiki.com/>

Feed me! Hawaiian

Location: Hawai'i, USA

Language: Hawaiian

An app for young children that teaches 11 subjects including maths and science with Hawaiian vocabulary through games and play. Part of a series of apps developed by PencilBot Preschool and Kamehameha Publishing.

<http://www.kamehamehapublishing.org/feedme/>

FinUgRevita Project

Location: Russia

Language: Udmurt and Mansi

The FinUgRevita Project aims to develop and provide computational language tools for endangered Indigenous Finno-Ugric languages in Russia. Researchers working at the University of Szeged and University of Helsinki have been working on developing tools, such as online dictionaries, morphological analysers and corpus building, to help speakers to use their language in digital, text-based spaces.

<http://www.ieas-szeged.hu/finugrevita/>

First Nations Unicode Font

Location: B.C., Canada

Language: *hənqəmihəm*

The First Nations Unicode Font, developed by the University of British Columbia's First Nations and Endangered Languages Program under the auspices of a Teaching and Learning Enhancement Fund (TLEF), is available free of charge to anyone with the goal of promoting documentation of and literacy in First Nations languages. Available for both Windows and Macintosh operating systems, the font, documentation and keyboard layout (current version FNuni_v2.3) support users to view and type characters used in First Nations languages.

<http://fnel.arts.ubc.ca/resources/font/>

First Voices

Location: Canada

Language: Various

FirstVoices, is a suite of online and mobile app-based language archiving and learning tools available to Indigenous communities in Canada. Tools include a chat app with orthography keyboard and language learning games. Language communities receive training and technical support to develop and manage their own language and culture archives and resources. FirstVoices is administered by the First Peoples' Cultural Council.

The FirstVoices Keyboards free app gives its users access to more than 100 Indigenous languages—spoken in Canada, New Zealand, Australia and the US—through specialized keyboards that can be used within email, social media, word processing and other apps on mobile phones. FirstVoices Chat was developed in response to First Nations youth who want to communicate via social media in their own languages. This ground-breaking mobile app allows people to compose and send text messages in the unique characters of their own Indigenous languages of Canada, Australia, New Zealand and the United States.

www.firstvoices.com

“Granny’s House” - Tsuut’ina Gunaha Institute

Location: Canada

Language: Tsuut’ina

“Granny’s house” is a fully interactive Tsuut’ina Language animation, created by the [Tsuut’ina Gunaha Institute](#) and the [Tsuut’ina Nation](#) in collaboration with [StandingRock Innovations](#).

The project is aimed to support the revitalization of the Tsuut’ina Gunaha, and with the theory that natural language transmission occurs during childhood years, it is heavily focused on the children and youth of the Tsuut’ina Nation.

<https://www.youtube.com/watch?v=sBfiTmtofZA>

Indigenous Tweets and Blogs

Location: Worldwide

Language: Various

Indigenous Tweets and blogs is a data based mapping website and blog created by Kevin Scannell, a professor of Computer Science at Saint Louis University. The main goal of [IndigenousTweets.com](#) is to help build online language communities through Twitter. The site aims to make it easier for speakers of Indigenous and minority languages to find each other via Twitter through searching by language. Indigenous Tweets currently supports over 100 Indigenous languages.

<http://indigenoustweets.com/>

isi-pikiskwêwin-ayapihkêsîsak (Speaking the Language of Spiders)

Location: Canada

Languages: Various

Developed in 1996 by the Cree/Metis artist, Ahasiw Maskegon-Iskwew, this First Nations contemporary art web piece is entitled *isi-pikiskwêwin-ayapihkêsîsak* (Speaking the Language of Spiders). It was created as an interactive, interconnected web portal showcasing various Indigenous artists with a focus on Indigenous culture and worldview as expressed by Indigenous languages.

<http://www.spiderlanguage.net/domains.html>

Klallam language (nəxʷsʰəyəmúçən)

Location: Canada/USA

Language: Klallam

Indigenous generated, interactive language program and social media portals, using the official writing system for the Klallam language based off the American Phonetic Alphabet. Offers Facebook and Twitter word of the day, audio clips of stories told by Klallam elders, learning resources, as well as a written Klallam dictionary and grammar guide.

<http://www.cas.unt.edu/~montler/Klallam/ktted.htm>

Leokī: Hawai’i Bulletin Board

Location: Hawai’i

Language: Hawaiian

In 1993 the Hale Kuamo’o created **Leokī**, a digital Bulletin Board System written entirely in Hawaiian. The digital **Leokī** Hawaiian bulletin board system features private email, both to other **Leokī** users, discussion groups, news, file transfers, chat

rooms, searchable curriculum and dictionary databases, as well as an online version of "Na Maka o Kana", the Hawaiian language newspaper published by the Hale Kuamo'o. **Leokī** has over 600 users, and was used in every Hawaiian language immersion school, Punana Leo preschool, the University of Hawai'i at Hilo and Manoa, Maui and Kaua'i Community Colleges, and several Hawaiian language support and curriculum offices. **Leokī** was retired in 2012.

<http://www.olelo.hawaii.edu/enehana/leoki.php>

Liicugtukut Alutiic

Language: Alutiic language

Location: Alaska, USA

The Liicugtukut Alutiic program created a website to help revitalize the Kodiak Alutiic language by offering community members access to digital resource lists, an online dictionary, curriculum with specific lesson plans, songs, traditional gatherings, cultural values, first words, and language news.

<http://www.alutiiclanguage.org/>

Marma Language Revitalisation: educational materials

Location: Chittagong Hill Tracts, Bangladesh

Language: Marma

Chelsea BA Graphic Design Communication graduate, and Mead Scholarship winner, Irina Wang, developed an educational materials project, designed to support children in the Chittagong Hill Tracts area to better learn their native language, Marma.

The project aims to produce language-learning tools such as typefaces and dictionaries to help revitalize and document the endangered Marma language. The Marma language revitalization project began as a collaboration with [Endangered Alphabets](#) founder Tim Brooks, Marma language project [Our Golden Hour](#), and Chittagong Hill Tracts native [Maung Nyeu](#).

<http://irinawang.com/marma>

Mi'gmaq Language group

Location: Canada

Language: Mi'gmaq

Created in 2015 by the [Lisutguj Education Directorate](#), The Mi'gmaq Language group developed an interactive language learning website, blog, talking dictionary, interactive Mi'gmaq wiki, Facebook, Instagram, tumblr and Twitter account aimed to support language learners understand and speak the Mi'gmaq language in whichever platform or combination of platforms they feel best serves them. The [talking dictionary project](#), for example has over 3900 entries recorded by three different Mi'gmaq-Mi'kmaq speakers, to help with variations in pronunciation, which are then used in accompanying phrases to give learners the opportunity to distinguish individual words when they are spoken in a phrase.

<http://www.learn.migmaq.org/units/1.1.html>

Miromaa Language Technology Program

Location: New South-Wales, Australia

Language: Awakabal and other Indigenous languages

The Miromaa Language Technology Program was developed by the Miromaa Aboriginal Language & Technology Centre (MALTC) of the Awakabal people. The program comprises database and language tool software that assists in language reclamation, preservation and dissemination work while maintaining good archival practices. Initially aimed at supporting the Awakabal language, the MALTC now offers support to other Indigenous communities trying to revitalise their languages.

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

Musqueam Place Names Web Mapping portal

Location: B.C., Canada

Language: **hən̓q̓əmi̓n̓əm̓**

Developed out of a collaboration between the Musqueam Indian Band's Language and Culture Department, the Treaty, Lands and Resources Department and community members, the interactive map features place names within [Musqueam](#) territory. The community has selected a large number of traditional and significant Musqueam locations, archival photographs and voice recordings to be shared through the place names portal.

<http://www.musqueam.bc.ca/applications/map/index.html>

My Grandmother's Lingo

Location: Northern Australia

Language: Marra

Angelina Joshua of the [Ngukurr](#) community developed this digital installation to raise awareness of her heritage language, Marra, and other endangered languages. As visitors to the site move through it, they encounter Marra words, illustrated through interactive artwork. The visitor must speak the words aloud into a microphone to continue through the levels of the installation. The aims of My Grandmother's Lingo are emotional and symbolic—to raise awareness by encouraging others to engage personally with the language, speaking it aloud.

<https://www.sbs.com.au/mygrandmotherslingo/>

Never Alone

Location: Inupiat Nation, Alaska

Language: Iñupiaq

Never Alone, also known as **Kisima Inŋitchuŋa** ("I am not alone"), is a puzzle-platformer video game and a landmark in game development. Built in collaboration with the Iñupiat Nation in Alaska, and made with contributions from around 40 Alaska elders, storytellers, and community members, Never Alone was produced by [Upper One Games](#), the first Indigenous-owned commercial game company in the United States. Following an Iñupiaq girl named Nuna and her companion, an Arctic fox, the player completes puzzles in a story, based on a traditional Iñupiaq story, told across eight chapters. By developing a

modern tool to engage people with Indigenous knowledge and culture, the designers make clear that: “we are not a museum piece, the Iñupiat people are a living people and living culture”.
<http://neveralonegame.com/game/>

Ogoki Learning Systems Inc.

Location: Canada

Language: Various

Ogoki Learning Systems produce Indigenous-generated language-learning tools to assist in technical instruction. All of the language-learning tools are designed to work offline. The project works with local language knowledge-holders to create the sites' content.

<http://www.ogokilearning.com/>

Ōiwi TV

Location : Hawai'i

Language: Hawaiian

Ōiwi Television produces Hawaiian documentaries, news and multimedia content from a Hawaiian perspective. Ōiwi sees media as a crucial aspect in the movement to revitalize the Hawaiian language and has over 900 videos, produced entirely in Hawaiian.

<http://oiwi.tv/>

The Puyallup Language Program

Location: USA

Language: tɬʷəlšucid

The Puyallup Language Program was created to revitalize tɬʷəlšucid language using online language learning resources, such as an interactive blog, speech clips, phrase of the day, and YouTube videos. The program aims to support the daily use of tɬʷəlšucid language.

<http://puyalluptriballanguage.org/blog/>

Resource Network for Linguistic Diversity

Location: Australia/Worldwide

Language: Various

This international non-profit organisation, founded in 2004, aims to advance the sustainability of the world's Indigenous endangered languages, and to support Indigenous peoples' participation in all aspects of language documentation and revitalisation through [training](#), resource sharing, networking, and advocacy. This network provides interactive online lists of Indigenous language projects, blogs, and [relevant links](#), as well as teaching resources to support language documentation and revitalisation projects.

<http://www.rnld.org/>

Rosetta Stone Endangered Language Project

Location: North America

Language: Various

Launching in 2004, the Rosetta Stone Endangered Languages project adapted the popular Rosetta Stone language learning software to suit individual communities and their endangered languages. The resulting products are based on the Rosetta Stone immersion concept, supporting language acquisition through pictures, audio clips and rating users on their pronunciation. Rosetta Stone Endangered Language Projects have partnered with [communities](#) across the USA and Canada to support Inuittitut, Mohawk, Navajo, Chitimacha and three dialects of Iñupiaq. In 2011, Rosetta Stone suspended the Endangered Languages Project and, while it continues to support existing partners, it is no longer accepting applications for new software projects.

<http://www.rosettastone.com/endangered>

Talking Dictionaries by the Enduring Voices Project

Location: Worldwide

Language: Various

The Enduring Voices Project is jointly supported by the [National Geographic](#) and the [Living Tongues Institute for Endangered Languages](#). The project aims to understand language distribution and diversity, document endangered languages and bring attention to language loss. They have worked with communities to assist in revitalisation efforts and have produced a series of talking online dictionaries. These dictionaries aim to make the products of language documentation more accessible through the use of audio recordings. Audio files attached to the dictionary entries speak the word aloud to help language learners with pronunciation.

<http://travel.nationalgeographic.com/travel/enduring-voices/talking-dictionaries/>

Ulukau: Hawaiian Electronic Library

Location: Hawai'i

Language: Hawaiian

This Hawaiian Electronic Library resource, and natural language repository aims to make Hawaiian language resources available for the use, teaching, and revitalization of the Hawaiian language, as well as help users of the site better understand the Hawaiian culture. The site contains dictionaries, curriculum resources, genealogy, newspapers, photographs, historical documents, and Hawaiian place names. Ulukau uses the multi-lingual and open-sourced [Greenstone](#) software, which is designed specifically for building and distributing digital library collections.

<http://ulukau.org/>

Waldayu

Location: Worldwide

Language: Various

Waldayu and its mobile counterpart Waldayu Mobile make the first dictionary app suite for endangered languages to combine a language agnostic design, customizable approximate search,

cross-platform deployability (Web/Android/iOS), and open-source access. Waldayu, meaning “word-tool” in Kwak’wala, allows language communities with pre-existing lexical data and materials to quickly create web and mobile apps that display their data in an engaging way. Additionally, Waldayu can be used on- or off-line, making it useful for remote communities. Waldayu has been implemented and is in beta testing for over 6 different languages from different language families, including Tsimshianic, Wakashan, Salishan, Sino-Tibetan and Iroquoian. <http://waldayu.org/>

The Ways

Location: Central Great Lakes, Wisconsin, USA

Language: Ojibwe, Menominee, Ho-Chunk

This online educational resource offers learning materials for 6-12 grade students. The interactive site features [story videos](#), [an interactive map](#), and digital media exploring contemporary Native culture and language. The Ways supports educators, meeting the requirements of [Wisconsin Act 31](#), seeking to expand and challenge current understanding of Native identity and communities. The Ways is a production of [Wisconsin Media Lab](#) <http://theways.org/>

Wóihanble

Location: South Dakota, USA

Language: Lakota

Set up by Peter Hill and Matthew Rama, of the **Lakǰótiyapi** Press, **Wóihanble** is the first 100% Lakota-language news site, where all articles are written in the Lakota language with no option for translation. Articles are translated from local newspapers and cover some current events as well as historical, local and cultural articles, and weather reports. <http://www.woihanble.com/>

APPENDIX C

HEILTSUK FIRST NATION LANGUAGE AND CULTURE INITIATIVES

The Heiltsuk Nation in Bella Bella, BC, offer a compelling example of how Indigenous communities have long made use of emergent technologies to support language mobilization. The Heiltsuk Nation initiated formal, extensive language research and documentation starting in 1973.

Heiltsuk language is rooted in its territories, millennia deep. Knowledge of the land and Heiltsuk relationships with the spirit world are encoded in the language; it is also shaped by a long history of sharing knowledge and technology with neighbours on the coast and inland. As with other Indigenous cultures, it is misleading to describe Heiltsuk knowledge systems as only oral tradition. Spoken word and interpersonal communication are important, but they are strongly connected to the knowledge embodied in ceremonies, performances and technologies, and encoded in Heiltsuk art and language.

Sharing knowledge and technological innovation are part of Heiltsuk history and culture. Relationships between people are central to the Heiltsuk knowledge system: within and between families, communities and Nations. Neighbouring chiefs witness Heiltsuk laws and governance; and family relationships cross cultural and political boundaries. In more recent history, for complex individual and social reasons, many Heiltsuk moved away from their land and home communities. Some lived with relatives in other Nations and others moved to cities and more distant communities. The distance strained family and community cohesion, but postal services and technology such as phones and CB radios helped bridge the distance. Individuals had cameras and video cameras for personal and family use, and for documentation, resource management and research. A recent exhibit at the Museum of Anthropology, *Speaking to Memory: Images and Voices from St. Michael's Indian Residential School*, drew on photos by a student at St. Michael's Indian Residential School in the 1930s, which were taken on a camera given to her by her father.

The social and political context of Heiltsuk language continuance and growth—recently characterized by resistance to historical and continued effects of colonial suppression of Heiltsuk identity, knowledge and language—is difficult,

emotional and mainly undocumented. Heiltsuk life changed profoundly over the past few centuries, and this represents only a very small period of Heiltsuk history. Many dark decades for Heiltsuk—traumatic on many levels—greatly impacted speaking and learning Heiltsuk language. They countered these disruptions in many ways, including through the use of new technologies. Individuals and groups continued to maintain Heiltsuk law, protocols and ceremonies, even though Canadian laws considered them illegal under the Indian Act and many other political and social means were used to suppress them. Generations of Heiltsuk learned and practiced cultural knowledge in secret.

Heiltsuk chiefs and other leaders advocate and develop political alliances, such as joining the Native Indian Brotherhood (a fishing union), the Indian Homemakers, the Union of BC Indian Chiefs, and the National Indian Brotherhood (now the Assembly of First Nations). Many language projects have grown out of Bella Bella's local work related to the national initiatives around the National Indian Brotherhood's (1972) policy document, *Indian Control of Indian Education*. The community created the local school board, now the Bella Bella Community School Society, and built both a K-12 school and the Heiltsuk College on reserve. In 1973, the Heiltsuk Nation (then called the Bella Bella Indian Band) established the Heiltsuk Cultural Education Centre (HCEC) with a broad mandate to support Heiltsuk identity, education and knowledge. Its mandate encompassed the support of the Yifistis Elders' group; language projects; research projects; development of facilities, professional skills and administrative structure for knowledge keeping (library, archives and museum); and varied methods of sharing Heiltsuk knowledge, including museum exhibits and support of curricula development. In 1978, the Bella Bella Community School instituted Heiltsuk language instruction as a formal part of school curriculum, and has focused its attention on curriculum development, Heiltsuk language teacher certification and the pursuit of effective language teaching strategies since then.

Technology and Heiltsuk Language

Text and writing is a technology that has been used to document Heiltsuk language and knowledge by outsiders dating back to the 1830s, including documentation projects by explorers, traders, missionaries and anthropologists. Heiltsuk individuals have used writing, audio and video recording for their own family and shared use for many decades. Language work within community intensified in the 1970s. In addition to identifying Heiltsuk objects, photos and records located elsewhere, the HCEC documented local Heiltsuk knowledge and language. Through its Heiltsuk Language Studies program, the Heiltsuk Cultural Education Centre has a mandate to continue the documentation and revitalization of the Heiltsuk language and

has created and compiled extensive resources in the following focus areas:

- Developing a practical orthography (alphabet) for writing down the Heiltsuk language; recording and analyzing words in order to produce comprehensive word lists, bilingual dictionaries, and taxonomies; analyzing and identifying the basic structure of the Heiltsuk language; recording an extensive body of oral traditions, narratives, and discourses, and transcribing and translating these into English;
- Assisting and promoting the understanding and interpretation of Heiltsuk culture through linguistic analysis of information recorded or transmitted in Heiltsuk;
- Promoting and assisting in the development of Heiltsuk language instruction programs and documentation of curriculum and instructional work, (including video recording of instruction on use of the orthography);
- Maximizing use of available and emerging technologies to promote the preservation of and access to Heiltsuk language materials including audio, video and textual documentation of stories, histories and autobiographies.

Since then, the Heiltsuk Community School (K-12), the Heiltsuk College and the Heiltsuk Integrated Resource Management Department (HIRMD) have all had language documentation and/or curriculum projects. Many of these have been undertaken in collaboration with other educational and academic organizations. The HCEC collections include audio and video recordings of language in many formats, including audio—reel, cassette, analogue recordings on cardstock (Bell and Howard Language Master) and computer disk—and analogue and digital video recordings. Digital materials include computer files from PC and Mac operating systems and projects such as a flash version of the Heiltsuk alphabet chart. Heiltsuk professionals, like MOA curator Pam Brown and filmmaker Zoe Hopkins, have used their professional work to strengthen Heiltsuk language and make it more visible. Pam Brown’s development of a collaborative, community-based approach to the exhibit *Káxláya Gv!ás* “The ones who uphold the laws of our ancestors” in 2000 was innovative for its incorporation of Heiltsuk language. Zoe Hopkins’ 2010 short film, *Airplane*, documents a project by language teachers in Bella Bella to have the passenger safety announcement given in Heiltsuk language on the local airlines.

Through a Memorandum of Understanding signed in 2016, the Heiltsuk Cultural Education Centre, Bella Bella Community School and the First Nations and Endangered Languages Program at the University of British Columbia are partnering in an effort to collaboratively create new opportunities for speaking, writing and reading the **Hítzaqv** (Heiltsuk) language

by expanding existing community language revitalization and cultural documentation in a digital environment.

This collaborative mobilization of existing language recordings and archival and cultural resources has resulted in the release of a cross-platform **Hítzaqv** Unicode keyboard and a beta version of a fully searchable online **Hítzaqv** Digital Dictionary. Next steps include releasing the dictionary through Waldayu Mobile, a free, open source language revitalization tool that visualizes lexical terms for community revitalization goals.