A Cross-Cultural Noticeboard for a Remote Community: Design, Deployment, and Evaluation

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Abstract. Remote communities all over the world often face the problem of creating and sharing digital contents in ways that are appropriate for their values and customs while using tools that were designed for Western contexts. This paper advocates for a different approach that builds upon the own goals and ambitions of a specific community, leveraging existing skills, and reflecting local ways of knowing in spite of the higher costs. We present the design of a digital noticeboard tailored to the needs and values of the Australian Aboriginal community of Groote Eylandt. The noticeboard was designed to support communication and promote literacy by offering bi-lingual multimodal content creation and sharing. The final design mirrors the preference for orality and storytelling, is well suited to working in groups, and pays special attention to issues of moderation. The noticeboard does not rely on a stable connectivity, and notices can be shared to many locations using low-tech opportunistic mechanisms. Because the value of custom designs can hardly be assessed only in terms of cost and efficiency in this paper we propose to focus on community engagement as a measure of success for HCI4D projects.

Keywords: Aboriginal, Australia, Remote, Community, Noticeboard, HCI4D, ICT4D, Literacy, Reading, Writing, Multimedia, Story.

1 Introduction

We acknowledge the Australian Aboriginal peoples and in particular the Anindilyakwa people of Groote Eylandt who were partners in this project, and whose knowledge, traditions and language date back countless generations.

This paper reports on a design project undertaken as collaboration between our research team and institution and the Anindilyakwa people of Groote Eylandt, a very remote Aboriginal community located in Arnhem Land (Northern Territory, Australia). A strategic goal of the community is to create opportunities for the youth to "stand in both worlds" [1], by creating community owned and managed "culture-

based enterprises as a key way to engage youth within the education, training and employment system" working in synergy with schools to empower youth to use old and new media "to speak to the outside world on their own terms" [1].

Supporting these aims using off-the-shelf services and technologies (e.g. social media) can be problematic because these tools are often biased towards Western ways of working and learning and take the control and ownership of the data away from the community. For these reasons, and in spite of their apparently higher costs, in this paper we advocate for local HCI4D projects that leverage existing skills, reflect local preferences for ways of knowing, and build upon the own goals and ambitions of the community. We thereby contribute a reflection on community engagement as a measure of success of these projects, beyond other immediately measurable outcomes.

People living in developing regions of the world are embracing information and communication technologies at a fast pace. Initially stimulated by the diffusion of mobile phones, these countries are increasing the penetration of ICTs at a pace faster than the developed economies, regardless of their generally lower incomes (see e.g. the UNCTAD reports figures on broadband internet access [2] and e-commerce [3]).

While this growth offers an opportunity to share in a global market of goods, services and knowledge, users coming from a non-Western background encounter the problem of creating and sharing digital contents in ways that are appropriate for their values and customs, using tools that were mostly designed for (and from) Western, highly urbanized and connected, generally English speaking contexts.

In fact, it has been observed that social networking websites promote Western perspectives about personhood and individuality [4], user interfaces can embed modernist conceptions of time [5, 6], and even design methods can reflect Western biases in their epistemological positioning [7, 8]. On the other hand, non-Western perspectives on (e.g.) togetherness [9], relation to land [10], reciprocity [11], and collectivism [12] are often marginalized in mainstream ICTs.

In this broader context, this paper focuses on a project that was initially conceived in response to a request coming from the Elders of Groote Eylandt for a tool capable of supporting communication and promoting literacy across the community. The Elders manifested a concern over using existing social media sites or sharing platforms, because these tools are owned and controlled by distant corporations, seen as promoting values in opposition to local cultures and traditions.

Existing tools also lack clear support for several features that were identified during the initial conversations with the Elders: offering bi-lingual multimodal content creation and sharing; reflecting the preference for orality and storytelling, and paying special attention to issues of community based moderation.

Other aspects that came into focus during the project are also at odds with existing social media services: ownership of the contents as well as of the content management system, a social and relational approach to time management, strong bond to land and physical space, preference for working in groups [13–15] and sharing devices, and a diversity of infrastructure across the three townships where the community lives.

This paper reports on a novel design for a digital noticeboard conceived specifically to accommodate the goals of communication and support for literacy put forward by community members, as introduced above. These goals represents a new opportunity for cross-cultural design, that under the ICT4D and HCI4D endeavours has largely focused rather on capturing and preserving cultural heritage, or on translating and adapting information technologies to local contexts to 'bridge the gap', than on supporting creativity by growing existing designs [16] and considering local sensibilities.

The paper is organized as follows: first we present the community context and review the related research on initiatives aimed at supporting literacy and media production and sharing in remote communities. Then we present the interaction design of Groote's digital noticeboard and introduce the many technical challenges that we encountered while developing the noticeboard. Finally we present how those challenges were addressed in the final design, and discuss the current deployment of the noticeboards at local community hubs.

We contribute our reflection on how HCI4D can support remote indigenous communities in the design of ICTs that align with local ways of knowing, particular sensibilities and existing skills. Particularly, we reflect on the risks faced by HCI4D project of becoming a proverbial 'white elephant': a tool whose cost largely overshadows the usefulness, thus reflecting a poor long term engagement and sustainability strategy.

We propose that in spite of the greater challenges faced to develop and manage custom designs, remote indigenous communities have good reasons to create, maintain, and evolve their own ICTs in ways that align with their ways of making and sharing knowledge, as this involves designing, together with the technology, the community's own future [15]. A custom platform may be less cost-effective, but has better chances to engage the broader community in continued use, provided that the community is actively involved in its conceptualization, design and refinement.

Since this engagement is a key motivation towards working out sustainability issues, and therefore ensuring the continuity of the project, we propose that community engagement should be taken not just as a mean towards, but as the measure of success for HCI4D.

2 Background

As mentioned above the digital noticeboard was initially developed in response to a request coming from the community Elders and local Land Council[1] for a tool that

[1] A Land Council is an Australian community organization that defends and represents the interests of Indigenous Australians. The Anindilyakwa Land Council is governed by a Board of Traditional Owners of the Land and Sea of Groote Eylandt, and is responsible for the administration of Land Trusts, protection of sacred sites, preservation of culture, and overall implementing the directives given by the community through the Clans' Elders (see http://anindilyakwa.com.au/about-us).

could foster communication of upcoming events, support educational activities and gather cultural information.

Education in particular is a key objective of the Land Council that explicitly aims to “Create pathways for youth to stand in both worlds" by engaging youth through education, training and employment with a focus on culture and culture-based enterprises [1]. These pathways will strengthen the capacity of community members young and old to “positively engage in protecting, maintaining and promoting their culture to the wider world” [1].

The initiative described in this paper is part of this broader endeavour. While there is evidence of a growing appropriation of digital and mobile technologies by indigenous people [17–19], fewer projects have explored specifically the design of interactive content creation and sharing platforms harmonized with local ways of knowing, values and cultural practices (some examples are [9, 20]).

The very first designs were informed by consultations with key stakeholders. We asked people to narrate or draw their idea of what a digital noticeboard may be used for (see Fig 1). Such meetings involved the participation of Aboriginal linguists, Aboriginal rangers, coordinators from the local land Council, and staff from the local schools coming from a Western background.

The initial picture emerging from these consultations helped us to understand the potential uses, context and locations; the community was clearly envisaging the noticeboards as being located at key community hubs, such as shops, schools, cultural centres, to share information about news, health, land conservation, but also to offer a Welcome to visitors (a feature always identified as crucial by Aboriginal participants), support literacy and numeracy, collect narratives about the culture.

Cultural centres were identified as places to serve potentially as community hubs, where youth could meet to produce original material to share within the community. In this context, the need for a large screen, around which people can gather to browse or simply watch the noticeboard stories, was considered a necessity.

Photos of family and ancestors were identified as a big focus and reason for engagement, and participants mentioned the need to share photos in an easy way. Specifically, the noticeboard was seen as a repository to host and display contents created by and about the community.

The problem of future maintenance and ongoing management of the contents was also raised, with particular emphasis on issues of moderation, to avoid inappropriate content from being displayed. Based on these initial insights we developed a number of subsequent prototypes that we demonstrated over the following months at each new visit to the community. At the same time we began exploring the particular issues and opportunities that related to languages spoken and levels of literacy, infrastructure, type of devices available, and issues of cost.

Language and Literacy. The people of Groote Eylandt speak the traditional Anindilyakwa language as mother tongue, and are fluent in English as a second language. Anindilyakwa is traditionally an oral language that was first written down in the mid twentieth century. The Groote Eylandt Linguistics Centre is active in the study and preservation of the language, that otherwise is rarely used in written form.

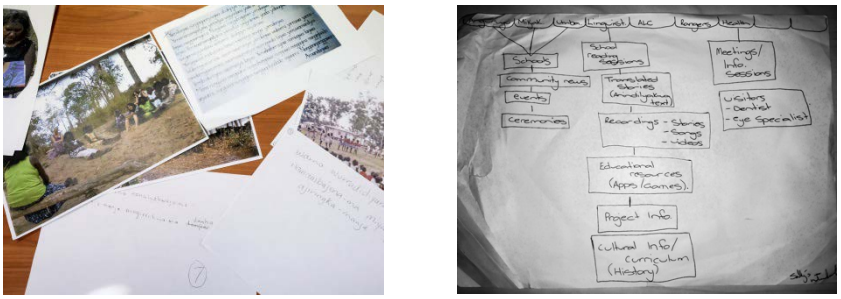

Fig 1. Design sketches of the Digital Noticeboard created during workshops with community members.

While people are generally fluent in spoken English, proficiency in reading and writing varies. Literacy and numeracy are indicated as major issues to address in order to improve the capacity to obtain and retain qualified jobs and enhance the quality of life in the community [1]. A noticeboard that presents content in both written and spoken form was seen as a way to facilitate the use by people with varying levels of reading competency. With this type of interface, it is possible for people to create and share notices regardless of their level of literacy by uploading visual/spoken content, leaving the task of typing the written version to others. Same language subtitling (SLS) has been used with great success [21] in related research, and it was suggested to adopt this technique here as a mean to enhance accessibility and encourage literacy.

Internet, Social Media, and Electricity. Internet connectivity in Groote is in general a premium resource. Although some dwellings have broadband connectivity, for the most part, Internet is only available to public offices and schools. These institution sometimes share their connectivity by opening discontinuous public access Wi-Fi access points.

Mobile broadband is available in the major towns of Angurugu and Alyangula, but at a cost that is prohibitive for many locals. Mobile phone reception rapidly fades when driving away from town, so the largest majority of the 2300 Km^2 of land (and the two towns of Umbakumba and Milyakburra) have no phone or connectivity besides very costly and slow satellite links.

A large part of the young people connects regularly to social media sites using mobile phones or tablets. The Elders however expressed a concern about the use of social media, as young users are often bullied or teased, which in a close community can easily escalate to confrontations in real life. There is also a perception from the Elders that social media promote values in opposition to the local culture, for example focusing on smaller groups of family/friends instead of the wider community, and are under the control of distant and powerful interests.

Electricity is available at very little cost in all urbanized areas as part of the terms of the lease contract with a mining company that extracts manganese from an area of Groote Eylandt. Fuel too is provided at subsidized cost, which allows people to run their own generators when necessary at comparatively little cost.

Devices available. Possibly in contrast with other rural communities, personal device and computers in general are largely available and frequently used where an infrastructure is present. Most people carry a feature phone, as these devices often the better reception with limited signal power, but smartphones and tablets are not uncommon. Reports from the local shops suggest that at least one iPad is available in each household. Tablets and phones are generally shared within a family. Often people will work in groups, even on tasks (and on user interfaces) that are meant to be individual, so as to reach a sense of agreement and collective ownership on the work that is done [14]. Some of the schools have iPads and personal computers used for activities with the students, as well as wide screen displays that are made available to students and occasional visitors. The displays possibilities for browsing the contents of the digital noticeboard vary accordingly to the available devices. At community hubs (e.g. at cultural centres) electricity and shelter make it possible to deploy big touch screens. At more casual locations, such as at shops, smaller screens can be made available for public use. In public places, or at night, the touch screens may be relocated indoors to avoid weather damage, theft or vandalism, but the service can still be made available as a public Wi-Fi hotspot to which users connect using their own device.

The context of use determines in part the nature of the notices and the kind of device used. It was pointed out that a noticeboard hosted at the Land Council offices would often display institutional information, health news, job offers, etc. At the Rangers' notices would focus on land conservation, weather warnings, Rangers' activities, land closures. In these situations a wide touch screen was seen as a preferred interface for browsing, while upload of contents by the general public would be only marginal. At the schools or cultural centres, notices would mainly focus on educational and cultural activities, festivals and community gatherings, school attendance, etc. In addition to these, it was suggested that a considerable stream of *user generated* notices could be uploaded from personal devices, such as smartphones and iPads.

Issues of cost. The cost of computers and other electronics can be prohibitive for many people. A large proportion of the cost of equipment depends on the cost of transport from the mainland, and of course impacts more on the overall cost of large and heavy screens, than on small portable devices. Maintenance and system administration is performed remotely, or by fly-in fly-out technicians at a huge cost. Decommissioned and broken equipment is often stacked in storage rooms because shipping it back to the mainland for proper disposal would have a huge cost.

A solution based on compact and low cost hardware emerged as a way to cut the cost of maintenance and reduce the environmental impact. Platforms such as the Intel NUC can easily host the digital noticeboard and provide adequate performance. Cheaper solutions, such as Raspberry Pi and Android based Stick PCs, though they have less processing power, can be implemented for under $100. All such solutions would allow shipment of self-contained upgrades with ordinary post parcels, reducing drastically the cost of maintenance. An open source platform limits the cost of software licensing and facilitates the potential future transfer of the noticeboard to different communities and contexts.

3 Related Research

Two main goals of the digital noticeboard are to support communication and promote literacy. The project addresses these goals by, on the one hand, encouraging community members to create multimedia stories and notices, also leveraging a collaborative model where different people contribute different aspects of notices based on their own confidence and competence. On the other hand, the project aims to facilitate people's approach to reading English and Anindilyakwa by positioning the noticeboard at common gathering points, offering multimedia contents and their literal transcription, with the additional aid of synchronized same language subtitling.

To the best of our knowledge, no previous work has explored the intersection of community digital noticeboards and educational systems to promote literacy in the context of remote communities. However, several projects have studied or proposed designs to address these issues individually; a detailed review is presented below.

3.1 ICTs and remote communities

The need for digital communication is surely not restricted to people living in highly urbanized areas. Studies conducted in rural areas and developing regions show that the uptake of ICTs is steadily growing [2, 3], although sometimes use is adapted to local needs or available infrastructure (e.g. [13, 15, 17, 22, 23]).

In the Australian context several studies exist that map the adoption of ICTs by users from remote Indigenous Communities. Brady and co-workers report that only a few weeks after mobile services become available to a remote community in the Torres Strait, a majority of adults had already bought mobile phones [17] to exchange messages in indigenous languages and to take pictures (mostly of children and events relative to the community) to show to family and friends on the mobile itself.

The use of existing online services or social networking sites for sharing information is common in many remote communities, and the recent explosion of affordable and relatively ubiquitous devices and connectivity is facilitating the uptake of new media by Aboriginal youth [24]. Our consultations however, as detailed above, have revealed a tension between the widespread adoption on online social media and the cultural values and practices of the community.

Several projects have explored the use of customized sharing platforms. Maunder and colleagues discuss a sharing system deployed in South Africa consisting in a shared screen/repository from which users can download media at no cost to their own devices [23]. They found that users wanted to consume media in ways and places that they had not anticipated, but that were consistent with the lifestyles of the communities involved in the project.

While examples of noticeboards designed with remote indigenous communities are limited, some insights come from projects that targeted rural communities. Noticeboards can work as a social icebreaker, being generally hosted in central and busy places, and given their role of containers of information of public and general interest [25]. Redhead and Brereton discuss the design and use of a digital community noticeboard situated in an Australian suburb [26]. They describe a number of barriers and

issues faced during the long term development and deployment, together with the strategies they applied in response. They stress the importance of fostering participation and interest by means of iteratively evolved situated prototypes [27]. Taylor and Cheverst describe the design and deployment of a digital community photo repository in rural UK [28]. They also observe that encouraging participation and creating a system that is inclusive of all interested users is a major challenge in the development of community social media.

In the context of underserved regions and communities, however, issues arise that make the development and sustainable deployment of social technologies particularly challenging. It has been observed for example that a design biased towards formal service delivery or perfunctory information, when targeted at remote communities, can result in greater costs of deployment, extensive monitoring and ultimately limited success [29–31].

3.2 ICTs and orality/literacy

Since low levels of literacy are a barrier to the adoption of information technologies, a number of projects have looked at ways to enable ICT access for users with low literacy by tweaking the user interfaces so as to limit or remove the textual component, in favour of icons and pictograms [32–34], or using speech based interfaces, for example to search audio contents [35]. However, promoting literacy is generally not a specific goal of these initiatives that rather aim at providing alternatives to text-heavy interfaces.

The use of ICTs for supporting and improving literacy is also well documented, although different contexts call for different technological interventions.

Initiatives specifically targeted at promoting literacy have involved both the design of interactive technologies and traditional media. In rural Namibia, Itenge-Wheeler and colleagues applied participatory methods to foster a reading culture among children [36], by inviting them to design their own ideal reading experience. In India same language subtitles (SLS) on music based TV shows [21] and on regional folk-songs [37] were used to encourage and support early literates to improve their reading/writing skills.

There is in general solid evidence that technology, particularly multimodal/multimedia material e.g. interactive books, can improve text comprehension in learners [38–40]. Education is consistently indicated as one of the main goals of ICT4D/HCI4D initiatives [41–43] and even mobile games have been explored as a vehicle to promote learning with children in rural India [44], China [45], and Aboriginal Australia [46]. There are however many challenges to face in order to deliver effective applications to support learning and literacy and engage potential users in remote communities.

In the Australian context, Johnson and Oliver [47] argue that traditional Western pedagogy (based e.g. on teacher's authority, sequential/analytic learning, individual tasks) proves often ineffective and disengaging.

On the contrary, Aboriginal learning styles (e.g. observation and imitation, group processes, spontaneous and hands-on) and life circumstances (e.g. rural/remote, oral

traditions, extended community, ancestral focused) fit well with participative and group based online activities, such as social networking and content sharing [47].

In this context, mobile devices, particularly web enabled mobile phones, are often considered a preferred platform for applications aimed at supporting education, particularly for young learners [47].

Various aspects of ICTs and orality/literacy in remote/developing regions have been explored as well. Initiatives range from supporting storytelling, e.g. [9, 48–50], to improving access to technology for users with limited literacy skills (e.g. [35, 44, 51]) to fostering reading and writing (e.g. [21, 36, 44]).

Several projects have focused on how oral traditions can inform the design of interfaces or repositories [42]. Examples include support for storytelling in rural Africa [9, 50], rural India [49], and Aboriginal Australia [52]. These initiatives mirror a consistently increasing number of reports showing that people from rural regions and with limited literacy skills are successfully approaching digital technologies [53] and appropriating such technologies fitting them into their cultural practices [17–19, 22, 54–56].

3.3 Cross-cultural design

Design is inherently grounded in culture and there is evidence that people from different cultural backgrounds may have different views, not just on what solutions work best, but even on what *engaging in design* actually means [57]. Irani and colleagues underline that design is culturally situated [58] and discuss the difficulty of transferring technological solutions across cultures.

Such difficulties become evident when design encounters involve users and designers from different backgrounds, for example in terms of different understandings of time [5, 6], different conceptions of personhood [4], different attitudes towards collaboration [7], and more. For example, Taylor and colleagues illustrate the potential for ICTs that privilege Western values to operate in tension with a community's own values and ways of knowing. They discuss the example of calendars and clocks that reflect modernist views of time and efficiency [6] and marginalize social and situational aspects that contribute to defining 'the right time' for events to take place.

In practice, several methods have been proposed to more effectively engage in design with remote communities. Brereton and colleagues suggest to leverage existing local designs as a way to valorise local expertise and achieve results that are relevant and that can be successfully appropriated by the intended users [16].

These works emerge from an understanding that different ontological and epistemological positions often exist between community members and designers, that can result in designs that poorly reflect the community's long term needs [11].

We embrace these calls as a methodological stance to promote engagement and reciprocity in our research and design activity. A key aspect of our approach is to engage in research through design with a participatory design sensibility, i.e. we engage with community members trying to understand the existing issues (including uneven power relations), goals, and needs. As experts of interactive technologies we

offer to the community our skills as designers and developers. By designing and building the noticeboard together the research team and the community members get to know and trust each other, in a process of co-creation of knowledge that goes beyond the technology, to include the cross-cultural design process itself, and insights into the cultural context in which the new technology will be embedded.

This approach, described by Soro and colleagues as cross-cultural dialogical probes [8] allows to legitimate the researchers' participation in the design discourse, engage members of the community in design activities, create a relationship of mutual trust by working in cooperation with the community, and overall open up possibilities for learning on culture at large.

One key consequence of this approach is that it foregrounds issues of sustainability and forces to revisit the very concept of evaluation, as discussed by Taylor and Soro et al. [15], who propose to reframe design evaluation in cross-cultural contexts, from a focus on validating artefacts (as typical in HCI research) to a focus on mapping progress towards a desired future. We will elaborate further on the implications of this approach in the final discussion.

3.4 Summary

To summarize, while individual aspects of our research have been explored before in related research, more work is needed to fully unpack the subtleties of how digital community repositories can be adopted to foster literacy and promote communication in remote regions. In particular, the harmonization of the novel technology with local designs, existing skills, and cultural values depends on the goals and vision for the future that the community puts forward.

Previous works have explored ICTs in remote communities largely as repositories for traditional knowledge, rather than as tools to foster communication and sharing mundane contents. While exceptions exist (e.g. the StoryBank project in rural India [49]) these did not generally attempt to encourage literacy, but rather to offer a workaround through privileging audio/visual contents. Initiative specifically aimed at supporting literacy by providing TV contents with same language subtitles (e.g. [21]) faced high costs [37] and would be anyway problematic in the context of indigenous Australia. Here Indigenous communities represent a smaller minority of the population, with ~145 different Indigenous languages, many of which are spoken by only a few hundred people [59].

There are opportunities for design in combining large situated displays, personal mobile devices, and user generated multilingual/multimodal contents to engage users. Existing examples (e.g. [26, 28]) have not considered issues of literacy, but there is evidence that such an approach may gain the interest of Aboriginal youth, who have manifested a preference for mobile Web over television and personal computers [55] and for educational platforms based on collaborative Web 2.0 applications over more authoritarian oriented teaching models [47].

Our research was informed by the previous works described so far, yet the socio-cultural context of Groote Eylandt called for novel solutions, particularly in terms of

1) supporting both local and English language; 2) catering for collaboration in a way that suits the distribution of skills and authority; 3) evaluating the technology in use, rather than with artificial tasks. We have used technology prototypes as means to engage with the community, legitimate our participation to community events, and support design discourse with hands-on activities [8]. Then, by focusing on empowering and enhancing the users' possibilities for action, building on existing designs and culturally situated methods, and involving users as co-creators and co-owners of the new technologies, our aim is to maximize the chances of appropriation and sustainable use of the product [11].

4 Groote Eylandt's Digital Noticeboard

Above we have discussed the many technical constraints and challenges that are encountered in Groote Eylandt. Although these challenges were identified from discussions with the people of Groote, similar issues have been described in many related projects that deployed interactive technologies in rural areas. Groote's Digital Noticeboard is implemented in Ruby on Rails and runs on the compact Intel NUC mini PC. A typical setup will include a steel stand mounted on wheels with a wide touch screen. The mini PC is hidden within the steel support.

4.1 User Interface

The noticeboards use a 50" touch screen that allows visibility at a distance, but also allows users to gather in groups in front of the screen and browse collaboratively. The user interface is intended to both showcase the noticeboard's contents, and to allow interactive access (Figure 2). When the noticeboard is not used (no one has touched the screen) for a period of time, it starts showcasing its notices, playing automatically all audio and video content available.

The screen is organized in channels; each channel can contain many stories that in turn are potentially composed of several pages. The terminology alludes to the practice of storytelling, so as to suggest possible ways to host information in the noticeboard.

Both institutional and user generated content can be uploaded, with configurable options for the visibility and moderation of new uploads. To upload user generated content, users can connect using their tablets or mobiles to a dedicated Wi-Fi network, and create new stories using pictures, videos and audio recordings from their local storage (Figure 3).

A *story* can contain a picture or video, text descriptions in both local language and English and spoken description, again in both languages. An animation highlights the elements of the user interface that are involved in selecting a given story before playing it, so as to demonstrate to bystanders how to use the touch screen, and therefore to invite people in to try for themselves.

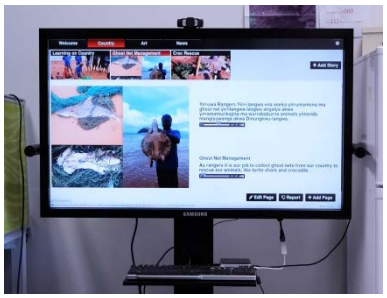

Fig. 2. A working prototype of the Digital noticeboard shown on a wide touch screen mounted on wheels. On the shelf below the screen is the Intel NUC mini PC that runs the noticeboard: this is the 'package' that is shipped for deployment.

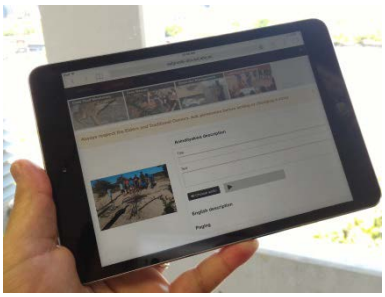

Fig 3. It is possible to access the noticeboard using personal devices by connecting to a Wi Fi hotspot that is created by the NUC mini PC. Contents can therefore be accessed even when the screens are locked up for the night.

The editing interface is structured in such a way as to resemble the final page as closely as possible (Figure 4), and when operated through one's own mobile or tablet it allows to record video and audio just in time, using the features built in to the device. By providing a coherent layout in both modes the noticeboard delivers an intuitive experience. Navigation controls are greyed out in the editing interface to avoid confusion.

Many design choices were dictated by the concerns of community members that offensive or inappropriate contents may be posted to the noticeboard. Therefore various kinds of community moderation mechanisms were proposed, each one with its own pros and cons in terms of efficacy and usability. The following one was finally implemented and deployed: when a new story is created, it undergoes a process of moderation. New stories will not be displayed on the big screen (but will be visible on the device that was used to create them) until a *champion* reviews and approves its contents. Additionally, users have the opportunity to flag a story or page deemed inappropriate, hiding it temporarily until and requesting a new review, therefore implementing a form of community moderation. This functionality was used to hide (or *rest*) pictures of community members that had recently passed away.

4.2 Backend

Stories are uploaded by users or administrators one page at a time using the editing interface. A page can contain a picture or video (shown on the left hand side of the page); a textual description in Anindilyakwa (split in two parts, title and content) and an analogous one in English; an audio recording with a spoken description in Anindilyakwa and one in English; a validity interval that details when the notice has to be displayed; several flags to detail what channel the story belongs to, if it is going to be shared among all noticeboards, and the ordering of pages in a story.

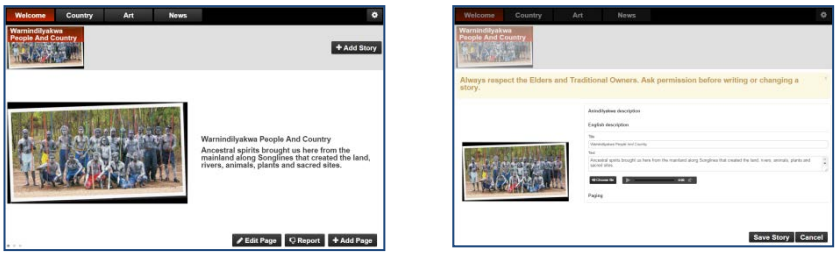

Fig 4. The browsing interface and the editing interface of the digital noticeboard juxtapposed.

Notices that are marked as *shared* will be mirrored by all noticeboards that are deployed at various locations on the Island. This will happen automatically when connectivity is available; when no connection is available or using it would not be practical for the limited bandwidth and high costs (as is the case for satellite links), notices can be moved from one noticeboard to another by saving them to a portable storage, e.g. a USB key. From the administrative section of each noticeboard, authorized users can select which notices to copy. The noticeboard will store on the USB key all contents in a compressed human readable form, than can be later restored through the same administrative interface.

4.3 Deployment

Several noticeboards have been progressively deployed around different sites on the island. There have been three main criteria used for choosing sites for the noticeboards within the community: 1) the location serves as a 'community hub' where it is exposed to and accessed by a broad range of different community members, 2) there is a noticeboard 'champion' present who can encourage the creation of new content, and oversee the moderation of new and existing notices, and 3) the noticeboard can be recovered under shelter for the night.

Presently, there are five noticeboards in use around the island at two schools in the Groote Eylandt Archipelago, one at a local Land Council office, one with rangers, and one at the Arts Centre. The NUC computers are connected to large touchscreens, some that are wall mounted, while others are mounted on mobile trolleys. Four of the noticeboards are used indoors while the other is situated in an undercover outdoor location but retrieved overnight. Environmental factors such as heat, humidity, and wildlife pose challenges for using the noticeboard outside without the development of more robust and weather-proof casings.

The research team has worked with community members such as rangers, linguists, school students, and Community Development Program staff to develop initial content and refine the noticeboard interface and functionality. The notice creation process and types of content posted are detailed in [8]. Consistent with Hagen and Robertson's observations [60], the development of "seed content" as a repository of existing notices functioned as "building blocks" for supporting users to develop skills in creat-

ing notices, inspiring other users as to the potential content and structure of notices, and identifying functionality and usability issues.

The social practices surrounding bilingual content creation were particularly interesting. The noticeboard interface allows users to upload any combination of text and audio content both in English and Anindilyakwa. However, rather than creating Anindilyakwa content directly, the descriptions were often first drafted in English then translated in Anindilyakwa, and only afterwards both versions were recorded and uploaded. Both older and younger users were reluctant to write in Anindilyakwa without reference material such as the dictionary produced by the linguists.

This may be due to courtesy towards the research team, as none of us speaks Anindilyakwa, or may be due to the fact that writing Anindilyakwa, a traditionally spoken language, is perceived as artificial by many people. There were also different levels of enthusiasm for creating voice recordings; while some people were enthusiastic to narrate their notices, others refused to create audio recordings, due to shyness, not wishing to stand out, and possibly other reasons that were not stated to the research team. In almost all cases people preferred to work in groups. Only very senior people felt comfortable making notices alone, as they are recognised as able to speak on behalf of others.

Previous work on community displays highlights the challenges of evaluating the impact of social media technology use in the community. One approach to evaluation is to capture usage log data that shows when and how the noticeboard features are used, such as the sequence of operations carried out by particular users. However, Taylor and Cheverst note the limitation of this approach for identifying the social practices involved in creating and reviewing noticeboard content given that log data cannot reveal the presence of participants who do not interact directly with the interface [28].

Recording usage logs has been considered for the Digital Community Noticeboard on Groote Eylandt. However, similar limitations were identified in terms of meaningfully capturing and interpreting user behaviours, particularly since the noticeboard interface enables the public to submit content for moderation without needing to log in with a user account. However, the noticeboard does retain an account of the process of creating and evolving stories by maintaining a 'backlog' of all content uploaded that can by hidden from view by the users but not deleted from the noticeboard databases completely.

Instead of systematically logging raw usage, feedback is gathered from participants through in-situ discussions of the noticeboard during public demonstrations or story creation activities with particular users such as the linguists and the rangers. In this way, the noticeboard prototype serves as a cross-cultural dialogical probe [8] for engaging in discussion with users, in which the usability aspects are a secondary consideration. The noticeboard interface is thus "co-evolved" [60] in use with community members through an ongoing participatory design process, and evaluation is aimed at mapping progress towards the community's goals [15] of communication and education, rather than validating the design against technical requirements.

Some examples of these activities that have been conducted for the purpose of gathering feedback on the noticeboard include a demonstration that we gave at a

community centre, workshops with school students and teachers to create notices about life on the island and activities taking place in the school community. Additionally, noticeboard paper and digital prototype evaluations have been carried on with the Linguists, and small group meetings and demonstrations were held with other users such as Land Council staff.

Feedback gathered so far on the latest implementation of the noticeboard interface has been positive. During community demonstrations, users expressed their appreciation of an interface that enables text and audio content to be recorded in both languages, and provoked discussion about the spellings and meanings of particular words and their translation. The 'passive display mode' that automatically cycles through the noticeboard content encouraged users to be seated and watch the content as though it is a television, serving the dual purposes of being informative and entertaining, whilst also not singling out a particular person as using the noticeboard. Photographs inspired conversation and anecdotes between community members about the people depicted, often beyond the specific topic of the notice.

Participants suggested many potential future use cases for the noticeboard such as recording extracurricular activities and facilitating classroom activities with school students, displaying old photos and their associated genealogical information, and communicating a broad range of information about community services offered by the Land Council and government organisations. Additional sites were identified for deployment of the noticeboard and touchscreens.

Users also expressed an interest in transporting a NUC to different locations around the island and accessing the noticeboard through iPads only (without the touchscreen display) to provide greater flexibility in terms of where and how the noticeboard can be used. There is ongoing research concerning the potential for the NUCs to be solar powered and positioned in public locations (for example at picnic areas or in the bush) for being accessible even in less institutional contexts, and away from government buildings.

5 Discussion and Conclusions

We have presented the detailed design and ongoing deployment of a digital noticeboard for a remote community. The noticeboard was designed to meet the needs and expectations of the Anindilyakwa People of Groote Eylandt, and is funded as a collaborative project between our institution and the Anindilyakwa Land Council.

We have reviewed the literature on information and communication technologies aimed at remote communities and technical interventions to improve literacy, and in collaboration with several members of the community, we have proposed an architecture for a digital noticeboard tailored to the local ways of working in groups, the need to accommodate bi-lingual content, the preference for oral communication and at the same time the aim of promoting literacy.

We reported on several technical aspects and issues related to the particular sociocultural context, and the available infrastructure on Groote Eylandt.

In Groote, as in many remote communities, electricity is only available in the main townships, and connectivity is only available at public offices, while mobile phone reception disappears a few kilometres out of town.

The language and culture of public institutions is not the traditional language and culture of the Aboriginal community. While people are generally fluent in both English and Anindilyakwa, this latter is rarely written, except by the linguists. Nevertheless hosting contents in both languages and support for oral and written content in addition to pictures and videos are key features of the noticeboard, that were implemented in the form of bi-lingual stories that users can create, share and browse.

While it is too early to assess the efficacy of the noticeboard for promoting literacy, which is however a key area of future work, we want to offer here a reflection based on how the noticeboard was received, and to what uses it has been put.

5.1 The noticeboards in use

Users in schools, cultural centres and other institutions are investing time and resources to appropriate the noticeboard into their daily work practices. This initial uptake is a very positive response, and indicates that the noticeboard is in fact fulfilling a useful role.

The loose structure of the content, other than the arrangements in channels, stories and pages, allows all users to customize the content and the process of content creation to their own needs. Thus the schools are using the noticeboard to support group activities to follow up the trips on country with the rangers, whereas for example the Land Council is mainly publishing information notices on upcoming meetings and community events.

Having a single platform to support both uses means that content can be migrated from one noticeboard to another, therefore allowing the Land Council to showcase content created by the schools occasionally. Content created by community members, such as the rangers or the students is in fact capable of attracting the attention of the broader community, thereby delivering on the primary goal of fostering communication across the community.

The possibility to host spoken and written content in Anindilyakwa is also appreciated, as ‘official’ channels do not normally support communication in Anindilyakwa.

There are of course several limitations, and issues to address in future releases of the software. For example there is a need to *rest* stories that mention or portray deceased people, for a period of mourning (traditionally one year from the death), and to moderate and if necessary remove offensive or disrespectful contents.

What is perhaps important, however, beyond the more immediate (although clearly important) technical considerations, is to ask what should be the measure success in a cross-cultural design project, and by extension, to what extent the noticeboard project is a successful and sustainable project?

5.2 Lessons learnt

In this final section we summarize the main lessons learnt and why we think these should resonate beyond this particular case study. Although this project was conducted in a very specific context and location, minority populations provide different perspectives and shine a new light on how technology use and social relations intertwine, from which the mainstream HCI discipline can learn.

Many designs available off the shelf for content creation and sharing take inspiration from philosophies of networked individualism, that cannot capture all the nuances of social interaction, even in the context of the Western workplace where they originated. The uniqueness of Groote Eylandt is the key to bring to the surface a range of issues that affect existing platforms, making them unsuitable for particular uses and users.

Online social platforms, e.g. social networking and blogging sites, provide their users with constant updates, robust handling of many formats for contents, ubiquitous access, and the potential to reach out of one's inner community, to potentially engage a world-wide audience. Furthermore, using off the shelf technologies that are readily available and have already been appropriated by participants is a key strategy to encourage adoption and foster engagement [63] whereas designing one's own platform opens up a risk of acquiring an asset whose usefulness is too small in comparison to its maintenance cost.

Winschiers-Theophilus and colleagues noted that ICT4D is scattered with proverbial 'white elephants' [61], projects that are generated with not enough attention to the needs of the community, but are nevertheless imported into the communities to be tested, and immediately abandoned.

Even the projects that are conducted in participation with the community in order to identify and reflect existing needs, still risk to turn into successful failures. As discussed by Mosse [62], the 'needs' even when expressed through a participatory process, can reflect more the expectations of what the research team can likely deliver, rather than a real aspiration existing on the community's part.

Yet, as this case study shows, there are reasons to also explore alternative paths, and create customized designs that are independent from the technical constraints, business models, and design biases of globalized enterprises.

The digital noticeboard was designed to fill a gap in the communication needs of the community that existing technologies or available social networking services were unable to address. As we have discussed, the community Elders are reluctant to embrace social media to engage with the youth, because these services are seen as promoting values that are in conflict with the local culture, and pose issues of who owns the platform, and therefore who controls the information in it.

A custom platform designed with the community, and for the community to manage and own, was then seen as a viable alternative to support communication within the community and between the Elders and the youth, promoting at the same time the community's own identity and values, and the broader goals of education and literacy devised by the Land Council.

By owning the platform the community can prioritize its own goals and problems in future developments, which may be impossible with external services. The flip side of the coin, of course, is that the community will be responsible for maintaining and updating the noticeboard software, fixing and replacing the hardware as it fails, and responding to possible demands for new features or modifications.

Given the above, how should we assess whether the project is deemed to succeed, providing value to the community and supporting the need for communication, or if we are facing just another white elephant?

Taylor, Soro and colleagues propose to shift the focus of evaluation from testing artefacts against needs and wants, to mapping progress towards desired futures [15], therefore foregrounding, among others, the problem of sustainability.

In fact, those issues that are of more interest to the community can hardly emerge by focusing on the artefacts alone [15]. How does the design fit (or disrupt) existing workflows? Who is going to maintain the software and hardware? Who will take ownership of the designs and champion its adoption within the community?

Nurturing and fostering community engagement has been repeatedly indicated as a means to better design outcomes [8, 11, 26–28, 61]. We further contribute to this ongoing discourse a view that *community engagement should be regarded as the measure of success* in cross cultural design projects, and therefore, more than a means, as an end in and of itself. In fact, questions such as the ones above are predicated on members from the community having a motivation for taking ownership, maintaining and continuing to use the noticeboards in the first place. As we have presented in the paper, engagement can materialize in many forms. In our case we observed an appropriation of the noticeboard into new contexts, sometimes not envisaged in the initial designs, such as for hosting media productions and distributing them in community gatherings. Also, the willingness to be part of the many discussions and the interest for the demonstrations of the noticeboard functionalities, that we observed multiple times. Finally, many people voicing ideas for future iterations of the interface that indicate an intention for further engagement and an interest for continuing evolution of the design.

All these, we argue, represent a positive sign that the community is imagining a future where the noticeboards have been adopted and adapted, rather than disposed of and abandoned.

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