From Community Data to Research Archive

Partnering to increase and sustain capacity within a native organisation

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Expanding interest in community engagement and participation in research by universities, researchers, community members and funders reflects a dramatic paradigm shift in the way that we understand the research enterprise. Somewhat counter-intuitively with respect to the expectations of traditional mainstream academic research approaches, community engagement and participation have been shown to improve the scientific quality of the research process in relation to research question relevance, informed consent, cultural sensitivity, reliability and validity of instruments, recruitment and retention of research participants, and accuracy of interpretations and findings (Minkler 2005). Research conducted using an engagement approach also increases the potential for findings to be translated into practice or to result in meaningful change (Ahmed & Palermo 2010; Barkin, Schlundt & Smith 2013). Community-engaged projects may take a number of different forms.

In this article, we share our experience of a collaborative project between a non-profit membership organisation and researchers from two universities. We focus on the importance of infrastructure development for moving towards truly equitable partnerships that expand forms of participation and bring together researchers and practitioners in ways that blur traditional power boundaries (Gutiérrez & Penuel 2014; Penuel 2015). Our collective work sits at the intersection of health research, STEM education research, and culturally based teaching and learning. The interdisciplinary nature of our team has allowed for the blending of community-engaged methodologies, which is reflected in our discussion of values in research, below.

VALUING COMMUNITY ENGAGEMENT AND PARTICIPATION IN RESEARCH

In a review of 20 community-engaged studies, Cook (2008) found that an engagement approach helped to integrate research and action, and that studies focusing on issues identified as priorities by the community and incorporating qualitative methods were more likely to lead to action. In health research, engaged research

design has become essential for uncovering the dynamics of complex, seemingly intransigent health problems, and has been demonstrated to be key to addressing health disparities and improving health outcomes (Wallerstein & Duran 2010). Community engagement has also become an integral dimension of education reform (Weiss, Lopez & Rosenberg 2010). In education research, knowledge co-constructed through a deliberative process of dialogue with parents, extended kin relations and other stakeholders has been shown to increase meaningful inter-generational involvement and to positively impact children's education (Bang et al. 2010; Bray & Kenney 2014). In addition, the process of conducting community-engaged research is seen to have educational and experiential value. Individuals who participate in a community-engaged research process are exposed to different, sometimes novel perspectives and often find themselves positively changed by the experience (Jacoby 2009). As such, community engagement has become a core part of professional education for health-care providers (Strasser 2010) and educators (Marin & Bang 2015; O'Meara & Jaeger 2006), and community-engaged research conducted as service-learning is understood to be beneficial for promoting student civic engagement (Jacoby 2009).

Capacity for Community-Engaged Research
Although the benefits of community engagement in research are increasingly acknowledged, community engagement does not just happen. Meaningful engagement requires development of capacity within the university and in the community — a continuing challenge (Goytia et al. 2013). Policy and infrastructure at academic institutions requires further alignment with engagement approaches in terms of academic culture, value of the work, criteria for faculty evaluation and institutional support mechanisms (Hoeft et al. 2013; Nyden 2003; Whitmer et al. 2010). Developing more academics with the particular skills to conduct research in an engaged way with community members and more academically trained professional researchers from the communities of study are key components of a truly 'engaged' academy (Wenger, Hawkins & Seifer 2012). And, despite apparent enthusiasm about and calls for community engagement, there continues to be a lack of coherence in support for what it really takes to conduct research using engagement principles. The priorities of funding agencies, the length of time allotted for conducting the research and the expertise of grant review committees do not necessarily align with the shift to an engagement paradigm (Smith, Kaufman & Dearlove 2013). As a result, proposed community-engaged research projects are often under-appreciated or misunderstood and therefore not funded, or are too brief and under-resourced when they are.

The capacity of academic researchers and the institutional environment of the university are clearly important for developing community-university relationships for research, but the need to recognise and support research capacity *in the community* is also essential for establishing successful and equitable research

partnerships (Goytia et al. 2013; Roberts et al. 2013). Like researchers, community members often require or are interested in obtaining education regarding the nature of scientific inquiry and instruction in the use of consent, ethics in research with human subjects, protocols, research design, data collection instruments and methods, data analysis, and interpretation of findings (Goytia et al. 2013). Emphasis has therefore been placed on the need to develop the skills and knowledge of community members so that they can participate in, conduct, or lead the research process (Wallerstein & Duran 2010). This type of knowledge development is seen as an emancipatory process (Lindsey & McGuinness 1998) that can change the nature of power dynamics that commonly exist in community-based and community-engaged research (Wallerstein 1999). In particular, Rubin and colleagues (2012) suggest that when approaches to training are based on co-learning and appreciate community funds of knowledge, they can engender respect, reciprocity and power-sharing. These are the first steps in empowering the community to control the research process. As a result, much of the literature on community capacity has focused on the need to develop human resources and competencies through educational forums and training events (Cunningham et al. 2015), how this capacity is 'empowering' (Lindsey & McGuiness 1998) and how it allows communities to increase their level of participation in research (Wallerstein & Duran 2010).

Community-Engaged Research with Indigenous Communities
Community engagement with Native communities has received a great deal of attention in the literature (e.g. Wallerstein & Duran 2010). Importantly, conducting engaged research with Native communities has its own particular dynamics. Indigenous researchers and their allies have done much to broaden conversations on community-engaged research by centring questions about research as an enterprise of colonialism and the history of research as defining who is human (Smith 1999). Research *on* tribal communities was often seen as a testing ground for determining the universality of theories of human intelligence and development. Cross-cultural research in this tradition took Western middle-class individuals and families as the starting point and default for comparisons. In this context, Native individuals and families were often painted as different and thus deficient. Medin and Bang (2014) have discussed this in terms of home-field disadvantage. Home-field status, being a member of the in-group and/or occupying a position of power, can cultivate a sense of psychological distance for researchers and lead to marking members of cultural groups other than the researchers as inferior.

In response to this history, and with the hope of moving towards justice, scholars have devoted energy to uncovering the deficit perspectives and colonial sensibilities that may be driving research orientations. These efforts are often motivated by a desire to create new forms of social relations and to see Indigenous futures that are not bound by historical and stereotypical images

of Native peoples. In addition, scholars invested in decolonising methodologies (Brayboy et al. 2012b) aim to develop theories and tools from within Indigenous communities that work toward self-determination. Many of these theories make visible the ethics and values associated with ways of producing knowledge through research as well as ways of being a researcher. For example, Brayboy and colleagues (2012b, p. 436) have outlined a framework for research that is motivated by service to community and 'the call by the indigenous researchers to (re)claim an indigenous intellectual life and thought-world'. Their framework highlights '4 Rs': relationality, responsibility, respect and reciprocity'. In this spirit, we argue that infrastructure development within communities is key to (re)claiming 'an indigenous intellectual life and thought-world' and should be a primary goal of community-engaged research projects with Indigenous communities.

Situating Knowledge: Infrastructure as a Component of Community Research Capacity

While human resources and knowledge are important dimensions of the power dynamic in community research, the tendency in the literature has been to under-appreciate the nature and dynamics of infrastructural resources. Although budgetary infrastructure (Hoeft, et al. 2013), grant peer review (Smith, Kaufman & Deerlove 2013) and Institutional Review Boards (Bang et al. 2010) have been discussed by a number of authors as components of infrastructural capacity for communities, broader treatment of these issues remains weak. Moreover, infrastructure involving data sets designed for research, data management tools, data collection protocols and data analysis software has received even less treatment. We find that much of the literature on community capacity in community-engaged research uses too narrow a lens, defining community capacity as resting primarily on internal personal mindsets or knowledge of individual community members. This leads to a problematic conceptualisation of the engagement process. For example, the focus on providing education and training for knowledge/skill development and 'transfer of competencies' (Suarez-Balcazar et al. 2008, p. 179) means that 'empowerment' becomes a mechanism by which researchers 'empower' community members through training, that 'participation' is often construed as researchers 'including' community members in the research process, and that 'control' over the process is often understood as control over the research agenda and approach rather than as the community and its members leading the research partnership—none of which appropriately reflect the power dynamics that an engagement paradigm purports to enact. Like Goodman et al. (1998, p. 262), we recognise the need to distinguish between 'participation' and 'leadership' in thinking about community power and agency in research.

Lack of attention to infrastructure for research in this context reflects the reality of community-engaged research. While there is a need to focus on training to ensure that all members of

a team share a common understanding of the research process, resources that could be used to invest in the development of infrastructure beyond human resources are hard to come by. Infrastructure for research, which can be costly, is assumed to exist within the university. As such, although power may inherently reside in the community, without sufficient infrastructure community agency is diminished and community power deflected. To address this conundrum, following Bray and Kenney (2014, p. 103), we believe there are ways to strategically structure community-engaged research efforts to support communities to develop their own capacity and agency in the research enterprise. Lindau and colleagues (2011) suggest that a strengths-based approach can be used to identify positive points of leverage to create research infrastructure in a community. For example, community organisations that may not have a mission focused on research may have assets that can be enhanced and deployed as infrastructure for research. Strategically tailoring capacity-building efforts (Cunningham et al. 2015) to develop these resources can increase the likelihood of communities taking the lead in research.

THE PARTNERSHIP

This article explores our experience working with a Native American organisation to transform documents gathered in the routine practice of the organisation's work into a database appropriate for research, thus building the capacity within the organisation to conduct its own research using its own data. We are undertaking this effort through a collaborative partnership between the American Indian Science and Engineering Society (AISES) and researchers from the University of New Mexico (UNM) and Northwestern University (NU). Our UNM team has extensive experience working with community-engaged projects in Albuquerque involving women residents of a historic downtown community who are concerned about food insecurity (Page-Reeves et al. 2014a, b), a community-run clinic and diabetes patients from the Latino immigrant community (Page-Reeves et al. 2013a, b), members of a Latina immigrant women's social isolation support group, a Health Coalition in Albuquerque's International District (Page-Reeves & Cardiel 2016), an organisation providing basic adult education services, and an organisation that provides educational opportunities and builds skills to promote economic and social justice for Latino immigrants. Our NU team has a long history of conducting Community-Based Design Research (CBDR) with community partners including the American Indian Center of Chicago and the Menominee Tribe of Wisconsin. Design Research is a methodology that employs iterative rounds of design and implementation with the goal of building learning theory and improving educational experiences. CBDR re-tools this method to include community members as decision makers in the research process and designers of educational environments (Bang et al. 2010). Both of our research teams have developed a variety of

strategies for working with communities that attempt to build or
sustain capacity in the community that will outlive time-limited
research funding.

The project we discuss here has funding from the National
Science Foundation (NSF) to understand factors related to success
among Native Americans in science, technology, engineering and
mathematics (STEM). In 2008, as a result of a prior relationship,
Pamala Silas, the then Executive Director (ED) of AISES, enlisted
the collaboration of a researcher at UNM (Page-Reeves) to develop
a project to address issues of interest to AISES using AISES data.
When it became clear that a comprehensive approach to the
project would require a multi-disciplinary team, Silas recruited
researchers at NU (Medin and Marin) with whom she also had
a prior relationship, and we added other UNM investigators
(Moffett and Bleecker) to round out our skill set. The structure of
our funded project has Co-Principal Investigators (Co-PIs) at each
of the three partner organisations, with the current AISES ED,
Sarah Echohawk, serving as the AISES Co-PI. After the start of the
project, AISES hired Kathy DeerInWater, who subsequently became
a project Co-Investigator. From the outset, then, AISES has driven
our community-engaged research – the idea for the research was
initiated by AISES, the team was recruited by AISES, AISES co-leads
the project and AISES staff participate as members of the team,
AISES data provides a foundation for the research, and separate
project budgets are administered by each of the partners (AISES,
UNM, NU).

Elsewhere we have discussed how budget infrastructure and
financial resources can be used to promote community control
over the research process (Bang et al. 2010). Here we describe how
we have structured our project design to leverage requisites of the
current research process to create permanent data infrastructure.
Our project will leave behind infrastructure for future research
that can be controlled by our community partners at AISES.

The American Indian Science and Engineering Society (AISES)
AISES is a national non-profit organisation whose mission is to
substantially increase the representation of American Indians,
Alaska Natives, Native Hawaiians, Pacific Islanders, First Nations,
and other Indigenous peoples of North America in STEM studies
and careers. To realise its mission, AISES offers STEM programs,
scholarships, internships, mentorship and in-person events as
well as incorporates Native cultures and traditions within STEM.
AISES' growing membership now exceeds 3800 students and
professionals, comprising 189 college chapters, 15 professional
chapters and 158 affiliated K–12 schools, representing over 200
tribal and Indigenous nations. Because AISES has seen so many
students and professionals utilise its services over its nearly 40
years of operation, AISES is committed to conducting research to
address important STEM education issues as they pertain to Native
American people and communities.

Office for Community Health (OCH) at the University of New Mexico (UNM)

The OCH at UNM focuses on addressing the socioeconomic factors that cause health disparities, particularly within minority communities. It has long been recognised that educational outcomes can be affected by individual health and wellbeing, but it is increasingly clear that educational success also significantly impacts long-term health outcomes (Winkleby et al. 1992). This understanding highlights the extent to which we can no longer afford to silo research into disconnected spheres of interest, and provides the foundation for the partnership between AISES and the OCH on this project. We now recognise that, in the long run, the interests of the community on multiple levels will be served by this holistic approach.

Northwestern University (NU)

The NU component of our research team draws from Education and Social Policy as well as Psychology. The present project is a natural extension of previous research on community and culturally based science education in a partnership that includes the American Indian Center of Chicago, the Menominee Nation of Wisconsin and the University of Washington (UW). NU's work has been supported by NSF grants involving parallel submission such that funding goes directly to the three partners rather than involving subcontracts. Direct funding necessitates and encourages the building of research administration capacity, and it means we do not rely solely on the NU Institutional Review Board for research protocol approval, but rather can seek approval from within our other two partnering entities as well (Bang et al. 2010).

PROJECT FOCUS

Our current research uses a resiliency-based model to counter deficit frameworks commonly employed to understand the under-representation of Native Americans in STEM. The focus is on the factors and dynamics that lead to success *as defined by* Native American science students, practising scientists and communities rather than on stories of damage and failure that are common in the literature (Tuck 2009). The analyses we are developing will shed light on how Native individuals leverage personal and cultural assets to embrace a congruency between Indigenous culture and Western science as they achieve success in STEM. Results of this research will provide guidance for institutional policy and programmatic efforts intended to increase Native participation in STEM.

A key component of our research involves analysis of AISES organisational data. Over the past 40 years, AISES has collected information about a national cohort of Native students and professionals, many of them extremely successful in STEM. These data are not available anywhere else, and have never previously been thoroughly analysed and evaluated, in part because much of the data existed in hard-copy format kept in boxes in

storage containers as we describe below. Our research using this data involves identifying correlates of STEM persistence, degree attainment, and employment among Native scholars.

However, in addition to using AISES data for our current investigation, it is also a stated objective of our project to build the capacity of AISES to engage in research more generally. To this end, we are transforming AISES' organisational documents into a permanent searchable archive. We are creating this infrastructure by: 1) scanning AISES hard-copy documents, 2) entering the scanned files in a coherent, organised database to allow for development of future research questions and structured investigation, 3) creating a list of potential research questions that the files could be used to answer, and 4) identifying ways to enhance the capacity of AISES to generate improved and ongoing information on Native Americans in STEM via the development of organisational data collection protocols and data collection tools. As the premier organisation for Native scientists and engineers, with the proper infrastructure, AISES is uniquely positioned to collect longitudinal data from a national cohort of Native STEM professionals. The research infrastructure we are developing will allow AISES to design future research to further illuminate the Native experience in STEM and connect research more concretely with the evolving needs of Native communities and individuals.

CREATING THE ARCHIVAL DATABASE

Data Sources

The AISES data collection includes a broad range of hard-copy and electronic document types dating back to 1977, including AISES membership applications, applications for primary, secondary and post-secondary scholarships, internships and camps, and applications to the National American Indian Science and Engineering Fair (NAISEF). Beginning in 2000, AISES began to store organisational data electronically. The data from 1976 to 1996 exists in hard-copy format housed in Denver at the Denver Public Library within their Western History/Genealogy Archives, and the later data was held in a storage facility in Albuquerque. Two hundred and forty-six boxes of these hard-copy files from 1997 to 2000 were in six containers. Most of these boxes were the standard size of 38 x 30 x 25 centimetres (15 x 12 x 10 inches). Of the 246 boxes, 80 held files related to scholarships (applications, awards, etc.), 40 contained administrative records (e.g. accounting), 35 contained science fair related files (applications, participants, etc.), 30 contained information on educational programs (including AISES-sponsored camps), 16 contained AISES membership data, 15 contained AISES conference files (including the National American Indian Science & Engineering Fair – NAISEF), 13 contained internship applications and information, and 17 contained miscellaneous data.

Establishing the Database

To establish protocols and priorities for scanning the documents
and for entering the scanned data into a database, members of the
research team looked through a sample of the various document
types at the storage unit in Albuquerque. For our current work,
we prioritised scholarship applications, as they would provide
the data most crucial to the research goals of the project. We also
realised that the files would need to be sorted before being scanned,
as many contained extraneous documents, such as duplicate
transcripts of scholarship applications.

Funds had been included in the project budget to hire a
company to scan the files, but a company had not been selected.
There were two potential options in Albuquerque that the research
team considered: a national for-profit company that could scan
the documents and also had the capacity to store the hard-
copy data, or a local non-profit social enterprise with a similar
document imaging and shredding service but with the explicit
social mission of employing developmentally disabled individuals.
Each company provided a sample scan of some of the documents
and it was determined that the non-profit organisation produced
a better product at a lower cost. The non-profit was chosen to do
the scanning because of the quality of their product, but we were
also happy that we had been able to use the research funds to
support the work of a local social enterprise. Through this process
of working with the two companies on a scanning sample, AISES
discovered that moving hard-copy data from the local storage
container facility to the national for-profit company would result in
significant cost savings over time. As a result, AISES used separate
non-research project funds to make this transfer.

The scholarship files included student essays and
demographic data such as age, sex and (in some years) place of
birth and tribal affiliation, as well as educational information
such as high school GPA, declared major, courses in STEM and
prior STEM experience. Two Native American students were hired
by AISES to do the file sorting at the AISES office. We then created
a rigorous scanning protocol. At the scanning company, a single
searchable PDF file was created for each application and saved to
a folder on the company's server. A naming convention for the PDF
files was created and the names of the folders into which they were
to be placed corresponded to the order of the boxes of files scanned.
The scanned files were then shredded. When all of the files in the
boxes were scanned, the scanning company used a secure file
transfer protocol to transfer them to a member of our research
team at UNM who created a Microsoft Access database, including
a data entry form. Four UNM undergraduate students, including
one Native engineering student, were hired to enter the data from
the scanned PDF files into the database. It took approximately
18 months to sort, scan and data enter all of the approximately
7400 scholarship files. Boxes containing other types of files took
an additional three months to scan. These will be entered into the
database in the future.

Challenges

As with many projects of this size, there were a number of logistical challenges. First, having the team spread out across different states (New Mexico, Colorado and Illinois) and at different locations in Albuquerque (AISES, UNM, the storage facility and the scanning facility are all in different parts of town) created a number of obstacles in terms of file sharing and management. Communication problems often arose around delivery and pick-up of boxes. This ultimately impacted the pace of workflow in sorting and organising the files. As the work continued, protocols were developed to minimise errors. For example, tracking forms were created and shared among the team and updated at key time points. At the same time that we were managing the sorting and digitising process, we were also grappling with questions about the organisation of the data itself. For example, we were faced with a number of options in terms of the form that the data might take and how to structure the database. Despite the challenges, we achieved our stated objective of creating an organised searchable database of approximately 8000 files at AISES. This infrastructural capacity will allow AISES to better track internal operations related to organisational activity, and will also lead to AISES-driven research projects in the future.

Current and Planned Research

Current research questions:
—Evaluate factors related to the success of Native American students in STEM
—Assess factors related to Native American STEM students switching universities
—Construct a path dependent model of STEM program choice
—Conduct a sub-group analysis of Native American students for whom STEM is the gateway to the health science professions
—Evaluate the extent to which including more questions in scholarship applications would affect recipient selection.

Planned future research:
—Conduct social network analysis to assess the influence of mentorship and AISES chapter support on Native American students' success in STEM
—Analyse how students' concept of science changes as they progress through undergraduate and graduate programs
—Assess internal decision-making with respect to scholarship awards
—Evaluate the extent to which participation in multiple AISES programs affects a student's likelihood of completing a STEM degree
—Assess the impact of long-term participation in and commitment to AISES on the pursuit of a STEM career by those individuals
—Assess correlation between the different types of AISES programs and a student's likelihood of completing a STEM degree and/or having a STEM career.

IMPACT, INSIGHTS AND IMPLICATIONS

An important goal of this project has been to strengthen the research capacity of AISES as a community organisation. AISES is committed to contributing significantly to the limited but growing body of literature on education research for Native people in STEM. Native Americans are often excluded from large data sets, or findings about them are deemed statistically insignificant (Faircloth, Alcantar & Stage 2015). While this may be an issue of sample size, marking Native data with an asterisk and placing notes about this data within footnotes actively contributes to the invisibility of the experiences of Native people and in doing so masks our own responsibilities as researchers (Shotton, Lowe & Waterman 2013). It is very important to AISES to not only evaluate its programs but to understand their short- and long-term impacts on Native students and professionals.

Of course, issues remain. The unique characteristics of the AISES database pose distinctive challenges. Given the small number of Native Americans in science, and especially in certain subfields, consent and de-identification may not be sufficient to protect confidentiality. There are increasingly strong demands to make all data publicly accessible, and Native organisations will need a form of ethical review to protect individuals and communities from misuse and misunderstandings of data that non-Native institutional review boards may not have considered. These are system-level issues and it will take system-level measures to prevent unintended consequences.

Through the strategic design of this project, AISES is poised to develop and launch its own research program utilising the database we have described above. Furthermore, AISES will be able to leverage the outcomes of this project to seek additional research funding in order to maintain and update the database and conduct new research. Beyond our current partnership, AISES has begun to pursue grant support for additional analysis of its archival database to direct its policies as a Native American serving institution, but also to address educational sciences issues concerning the chronic under-representation of Native American scholars in STEM disciplines.

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