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Abstract

Program success at tribal colleges and mainstream universities is often identified solely with matriculation and graduation rates. However, particularly for new STEM programs, capacity building is another key measure of success. In this paper, three of the co-authors, who are faculty members at a tribal college and participants in a multi-year collaborative pre-engineering education initiative between a tribal college and two Regental universities, provide their perspectives on capacity building in summer research activities within the alliance. The three each wrote essays reflecting on capacity building guided by pre-determined questions written by another co-author. Through qualitative analysis, we present common themes, divergent opinions, and quotations extracted from the essays from their unique perspective as faculty at a tribal college. We emphasize impacts among the partnering schools, faculty, students, and communities where the summer research activities took place. Three common themes dominated the essays including the importance of (1) building trust within the reservation community, (2) employing experiential and aspects of project-based service-learning approaches, and (3) encouraging tribal college and university leadership in the determination of research and educational foci in institutional collaborations such as ours.

Key words: Capacity building, evaluation, under-represented minorities

Introduction

Through NSF investments, the Oglala Lakota College (OLC) Science, Technology, Engineering, and Mathematics (STEM) Department established undergraduate science and engineering programs in which experiential learning is the central focus, and research projects meaningfully impact the quality of life on Pine Ridge Reservation (PRR). The OLC STEM Department's vision is to empower students with intellectual tools and experiences to mitigate environmental problems on the Pine Ridge Reservation (PRR) through mentorship, shared research, and classroom instruction. The newest initiative is the OLC, South Dakota State University, South Dakota School of Mines and Technology Pre-Engineering Education Collaborative (OSSPEEC)[1] grant, co-written by C. Jason Tinant (OLC), Bruce Berdanier (SDSU), and Hannan LaGarry (OLC). The vision of OSSPEEC is to incorporate recommendations for Tribal Colleges and Universities (TCUs) from the National Academy of Engineering (NAE) steering committee[2]. OSSPEEC follows a successful experimental learning model for science with an additional service component that fits closely with progressive engineering education andragogy and the Lakota concept of *Tiospaye* or extended family responsibility. In real terms, this means developing an undergraduate engineering program that focuses on the community articulated

needs for sustainable housing and greenhouses, healthy streams and aquifers, and renewable energy development. OSSPEEC is both more successful and more challenging than expected as reported by Fick et al.[3, 4, 5]; and by Kant et al.[6] and by Sawyer, et al.[7], both related articles in these proceedings.

Within OSSPEEC, faculty from OLC, South Dakota School of Mines and Technology (SDSMT) and South Dakota State University (SDSU) guided teams of graduate and undergraduate students from the participating institutions in research projects. Those included including testing water quality and stream health; mapping geological formations and stratigraphy; and sampling plants, soils, sediments, and water for parameters of concern (Figs. 1-3). The program relies on near-peer mentoring in which Regental faculty members mentor OLC faculty, and all faculty members mentor graduate students. In turn, graduate students mentor undergraduate students, and undergraduate students co-mentor one another.

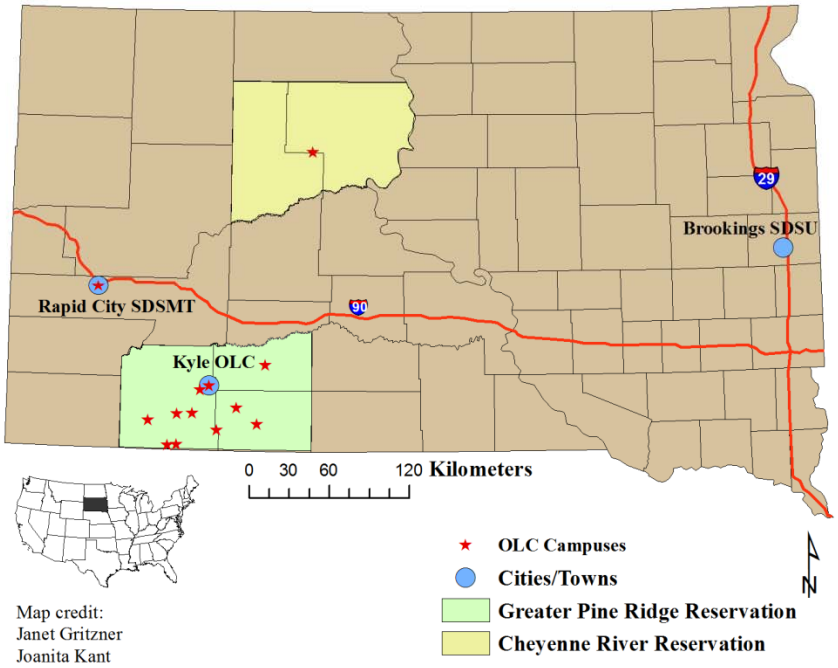

Figure 1. OSSPEEC collaborators include OLC, with 13 campuses in western South Dakota, along with SDSU in Brookings and SDSMT in Rapid City.

Figure 2. C. Jason Tinant, OLC faculty, and student interns collect macroinvertebrates to measure PRR stream health, 2013. (Photo by J. M. Kant)

Fig. 3. James Sanovia (left) and Hannan LaGarry (front center), OLC faculty, prepare to climb Slim Butte with OSSPEEC student interns, faculty, and staff in summer 2013. Participants are in the process of mapping the stratigraphy of southwestern PRR, including Slim Butte and testing rock samples for heavy metals concentrations. (Photo by J. M. Kant)

Capacity building is a precursor and necessary step in the early years of Tribal College and University (TCU) and Regental university collaborations. Native American students are often academically underprepared and are underrepresented in all the STEM disciplines[8-10]. Experiential and research-based learning initiatives similar to OSSPEEC have been shown to mitigate some of the academic challenges that underprepared students face[11-17]. TCU collaborations with Regental universities [3-5,18-32] are in line with NSF interest in including underrepresented minorities in STEM majors[1,33] and can reduce some of the initial challenges of beginning engineering programs including the costs and developing large initial student cohorts. We acknowledge the importance of enumerating the numbers of students achieving associate degrees and matriculating to baccalaureate engineering programs at Regental schools[1]. However, both OLC and NSF recognize the process and the value of capacity building as a central focus in establishing engineering program partnerships for Native American students with TCUs [1]. For OLC engineering education, capacity building includes relationship building through experiential learning, particularly aspects of research-based service learning, in collaboration with Tribal partners and Regental universities. The purpose of this article is to tell our story of capacity building through the OSSPEEC summer research program.

Methodology

Co-author Kant interviewed participating OLC faculty following the format of our research instrument (Fig. 4). We returned interviews to the research participants so that they could refine them into essays about how OSSPEEC summer research programs built capacity. Our methodology is qualitative and constructivist, since we interpret narratives for emerging consensus and non-consensus opinions. The technique is similar to the style in Lord et al.[34], based on concepts reported by Denzin[35] and Kemmis & McTaggart[36]. We present brief biographies of the research subjects (Appendix A), along with selected quotations from their essays representing consensus opinions under headings of the three dominant themes that emerged, identifying each author with italicized initials. Those include C. Jason Tinant (*CJT*), Hannan E. LaGarry (*HEL*), and James J. Sanovia (*JJS*). We briefly identify non-consensus opinions by topic.

CATEGORIES OF CAPACITY BUILDING CONCERNING OSSPEEC SUMMER RESEARCH EXPERIENCE FROM THE PERSPECTIVE OF OLC

1. Write a biography as the introductory part of your essay. It will be used to briefly describe why you are uniquely qualified to comment on the topic of capacity building through OSSPEEC summer camp experiences.

2. Comment on A-I in order to produce an essay explaining how we built capacity for each of the following through OSSPEEC summer research experiences:

   A. OLC as an institution

   B. Pine Ridge Reservation

   C. SDSU as an institution

D. SDSMT as an institution

E. Undergraduate students

F. Graduate students

G. Faculty and staff

H. Governmental agencies

I. Stem disciplines in general

Figure 4. Research instrument to produce essays.

Introducing the Subjects of the Research

While all five co-authors are researchers for this paper, three of the OLC co-authors are both researchers and the research subjects. Research participants are qualified to comment on capacity building within OSSPEEC summer research programs since they serve as instructors, project leaders, researchers, planners, and mentors, and were inextricably involved in OSSPEEC since its inception in 2010. The research subjects' perspectives are unique because their service to OLC occurred both before and after OSSPEEC. They are STEM instructors at OLC, a school with an average student population of 1,600 students across 13 campus locations, including satellite campuses in Rapid City and Eagle Butte, South Dakota (Fig. 1). The teaching experience at the college level for the three OLC instructors ranges from nine years for Tinant, to seven years for LaGarry, to four years for Sanovia. In Appendix A, we briefly describe our qualifications to comment on the subject of capacity building through OSSPEEC summer research experiences.

Capacity Building: Common Themes

Three common themes emerged from the essays of OLC instructors serving as OSSPEEC leaders as they presented their opinions about the role of capacity building through the summer research experience within the multi-year project. Those common themes included: (1) building trust within the reservation community, (2) employing experiential and project-based service-learning approaches, and (3) encouraging TCU leadership in the determination of research and educational foci in institutional collaborations such as OSSPEEC.

The following are the opinions and reflections within the three recurring and dominant themes in the essays. Opinions sometimes straddle more than one theme. We arranged the quotations from essays by selected themes in order, identified by italicized initials of the author. Each participant brings his own unique view to the project, based on his personal experience. All three concur that capacity building through OSSPEEC summer research experience has great value for building future success in bringing engineering to Native American students, and has the potential to strengthen tribal sovereignty through a shared responsibility between OST tribal agencies and the OLC STEM Department. Capacity building helps to create the critical mass about which Boyer writes[1] in assembling a foundation upon which to build, in meeting the task at hand: aiding

Native American students to complete associate degrees in engineering and to successfully transfer to Regental schools offering BS and advanced degrees.

1. Building Trust within the Pine Ridge Reservation Community

Building trust for the project within the PRR community means building trust for our collaborative as a whole, which includes our partner institutions, SDSU and SDSMT. We define the PRR community as community members, tribal agencies, and OLC academic and non-academic departments. OSSPEEC provided the OLC faculty and college with the opportunity to share summer research experiences with SDSU and SDSMT students, staff, and faculty on the reservation. The process of collaborative research builds capacity by encouraging OLC to improve programmatic structures and procedures. We need to use a different set of processes both within the STEM Department and the institution to handle the logistics of growing, changing, and collaborating.

- We developed a pre-engineering degree program with collaborative articulation components in place with SDSU and SDSMT. The articulation agreement is important for capacity building because the agreement is multidirectional and operating across all three schools, and not in just one direction. For example, SDSMT students comprise about half of the OLC upper level math class enrollees. The additional enrollment helps OLC, because with larger numbers, OLC can offer STEM classes more often. OLC students also enroll in classes at SDSMT before and after matriculation. The arrangement is a win-win for both institutions and their students (*CJT*).

- Broadly speaking, in a traditional engineering setting, teaching is done in a very narrow way. We learn math. We learn free-body diagrams. That is changing, because now questions become self-defined by the engineer based on the engineer's framework for understanding the context of the question. The best solution to an engineering problem depends on the social and ecological context. For OSSPEEC engineering projects, the question we ask our students is, "What would I need to know to answer an engineering-related question that could improve the quality of life on PRR?" Then we ask, "How should I gather this data?" Our students learn how to think about why we should use a particular engineering design. That encourages deep thinking skills. Students are better prepared for the real world in this type of learning situation. Furthermore, providing a frame for an engineering project provides a point for inclusion of the Lakota perspective and provides a basis for establishing trust (*CJT*).

- The American Society of Civil Engineers (ASCE) recently defined a new plank in their ethical code related to sustainability and the triple bottom line. They recommend that a project should be beneficial to those initiating the effort, to the affiliated institution, and, most importantly, to the community of people in the area of sustainability. Every OSSPEEC project has the theme of increasing the quality of life for local people. Our 2014 listening session with tribal agencies validated my opinion that OSSPEEC experiential learning activities are encouraging tribal community sustainability (*CJT*).

- While there are many needs on PRR, we found the greatest benefit in working with governmental agencies concerned water quality. Our students are collaborating to collect data to aid tribal government with current water quality needs and concerns. In the short term, the OST EPP [Oglala Sioux Tribe Environmental Protection Program] may benefit most directly in these areas because the data resulting is immediately applicable to their short-term programmatic objectives. For the Tribe, in general, OSSPEEC shows potential to produce a pipeline of educated engineers and scientists to work within their agencies in the future (*CJT*).

- On PRR, the comments of older relatives matter. If OSSPEEC continues, our college's ability to assess and manage our programs will improve through finding innovative ways to do what we do even better. It can be a slow process. These experiences are personal, and the time it takes is different with each student (*HEL*).

- We are developing trust on the reservation. In 2008, it was not necessarily the case that we had trust as the college professors at OLC on PRR. We changed how we did our mentoring and teaching and made it more personal. That built trust. We gradually become the reservation's source for expertise. So, now we are no longer a tool of the White establishment to change the minds of reservation residents (*HEL*).

- We are visible in the community as a source of hope and inspiration. We are out and about, running around the reservation, chipping away here and there. We are not now perceived as an ivory tower (*HEL*).

- SDSU and SDSMT for the first time in their histories are seen as collaborators and not as unwelcome outsiders by the community on PRR. Previously, all outside institutions came to PRR, did their research, left, and took something from the Reservation. They took our samples away, and who knows what they did with it? Now we have SDSU and SDSMT students and faculty running around the reservation with Native students and tribal agencies—all working to improve the quality of life on PRR. SDSU and SDSMT are not seen as threatening "takers." They are now seen as "givers." Students in OSSPEEC from SDSU and SDSMT are some of the few non-reservation students with whom OLC ever worked. That makes ambassadors of the SDSU and SDSMT faculty and students. Now those students have shared experiences. Now OLC students know someone on a mainstream campus. It helps to make OLC students feel welcome in other college and university settings (*HEL*).

- When our students see graduate students in the field, they see themselves in the future. Our students do not see many graduate students on PRR. In particular, there are not many graduate students in STEM on PRR. In these graduate students, OLC students see someone with whom they can identify. It helps for them to see role models. They see that they can be successful and still be themselves (*HEL*).

- The graduate students get a competition-free environment in which to pursue their research. By that, I mean that there are many things to study on PRR, and there is so little competition for scientific research topics. So students have tremendous room to operate.

It is a welcoming environment that is desperate for their contribution. The graduate students make a huge contribution, and we appreciate it. Their time is more valuable to the people they are serving here than it might be elsewhere. For example, PRR has had no regulations to manage their water supply, and now the tribe uses graduate student research to help them craft a plan (*HEL*).

- What motivates me is discovery. OSSPEEC has been a journey of discovery. That appeals to me. I am learning to do a better job of motivating students to be altruistic. Students need to feel safe in order for that to happen. I am learning to win my students' hearts before they will let me anywhere near their minds (*HEL*).

- We have only used constructivist pedagogies for five years. That is all the time we have had to build trust on PRR. We are increasing the independence and self-sufficiency of the OST. Eventually, there will be truly collaborative projects between State, Federal, and Tribal governments. We are working for peer to peer relationships, looking ahead to a time when OST representatives will have evidence they gathered so that they can show research to back their opinions and decisions. Right now, that is not how it works. But that will change. The OSSPEEC summer research experience builds capacity by encouraging empowerment of Native Americans on PRR (*HEL*).

- In another case, a landowner told us all about his land. He offered us water. He was very interested in what OLC students and faculty were doing. That builds respect for OLC. He had no idea that OLC could do geologic mapping. SDSMT faculty members were there, and SDSU students were with us. He was impressed with the collaboration. We sometimes give research maps to PRR landowners. It is important to them to know about their place, and it shows the increasing capabilities of OLC in meeting community needs (*JJS*).

- Location is the key thing in capacity building concerning SDSMT's involvement in OSSPEEC. Half or a third of the OLC STEM Department faculty are SDSMT graduates. It has been that way for fifteen years. The relationship is particularly strong because OLC has a campus in Rapid City, SD, and other places, too. Some students take courses at both school OLC and SDSMT. The new curriculum articulation agreement makes everything transferrable between the three collaborating schools (OLC, SDSU, and SDSMT). We also use their syllabus with slight adjustments (*JJS*).

- Until the advent of OSSPEEC, our pre-engineering degrees were nearly non-existent. I am a pre-engineering graduate of OLC, but the program then paused. Now it is up and going again. Our students hardly differentiate among themselves, but we are now making progress with STEM. Now we have formed a pre-engineering group, collaborating with the sustainable housing project (with a non-profit and with engineers from University of Colorado, Boulder). That establishes more relationships and more networking (*JJS*).

- I am working on an MS degree in Geological Engineering at SDSMT, and the research within OSSPEEC is essential. It helps me to use my undergraduate degree along with

graduate research, working with SDSMT professors who have the expertise I need to help me succeed. Much of that expertise does not exist here at OLC. I need SDSMT mentorship. I am learning project management, including grant writing (*JJS*).

- The OSSPEEC experience is helping me to earn my MS degree. It is important that we cooperate and network with other people at other colleges and universities, because it does not work very well to try to operate in a vacuum. There are so few people in the OLC STEM Department, and I need to find others with expertise and get to know them (*JJS*).

- In our White Clay Fault work, we need State and OST data concerning old (1950s, 1960s) oil drilling sites. We want to make the data useable for our purposes. I anticipate more networking and more alliances in the future, all sparked by the original OSSPEEC research projects (*JJS*).

- Most of the OSSPEEC projects generally revolve around water in one way or another. We are now mapping surface geology to understand sub-surface geology. We do not know what is contaminated and what is not because adequate research does not exist. Are pollutants naturally-occurring or not? Where is it unsafe to go? No one will know unless we go out and answer those questions. We may not want to know the answers now, but we need to know them (*JJS*).

2. Recognizing the Effectiveness of Experiential and Project-Based Service-Learning Approaches

The OLC STEM Department uses a constructivist philosophy in working with a high-risk student population. Like many other students, ours learn engineering best through hands-on experience. Summer research experience provides them with real-world experiences in engineering. We use experiential learning pedagogies, particularly aspects of service-learning that work for us. Thus far, however, the usual "reflection" component in service-learning has not been popular with students, and so it is not an integral part of the program.

- Implementation of OSSPEEC summer research is a great experience for all participating students. Project supervisors and instructors see the impact. Through hands-on engineering and science, students are involved in projects with solutions that are not easy. All of the students from all of the schools say that they have positive experiences with substantial impact (*CJT*).

- We produce research that is important to the community, and we made a difference for the community. This motivates and inspires the participants (*CJT*).

- Within the OSSPEEC summer research program, we are mapping the White Clay Fault on PRR, and making a significant contribution to geological engineering. We know that we need to understand the geology before we can understand the engineering (*CJT*).

- We made significant contributions through our surface water projects. The watershed hydrology on PRR is unique, and it causes unexpected responses in terms of stream health. Working out the biotic response to this watershed hydrology will lead to major contributions in the area of aquatic ecology and water resources engineering (*CJT*).

- When we show students a place where uranium is exposed in an outcrop, they eventually put together in their heads that their grandma lived within a few miles of this rock, and she died of cancer. That is experiential learning. Sometimes they go back to their families, and they talk about it. That changes their outlook and their learning behavior. Now they drink OST Rural Water (less uranium), not only well water (more uranium), even if well water tastes better. Our students are more intuitive than many others (*HEL*).

- The teaching method, using aspects of service-learning, got us out into the community and got students into the field, and it made us successful (*HEL*).

- We hope our students come back, after their experiential learning, and will be leaders on PRR, penetrating the tribal agencies in a kind of changing of the guard (*HEL*).

- The faculty of OLC is encouraged by working with the faculty from SDSU and SDSMT in motivating our students to take risks, poke around, and get students to come to an evidence-based conclusion on their own. Then we watch what happens. When we do that, we are successful. That is why experiential learning is important to build capacity within OSSPEEC. We made progress in moving engineering toward the traditional values of the Lakota. That builds capacity by motivating our students (*HEL*).

- We have been successful offering modified service-learning experiences for degrees in pre-engineering (AA Pre-Engineering), and research experiences in conservation biology and earth science (BS Natural Science). These opportunities provide our students with real-world experience tackling the many environmental challenges (some of them severe) facing reservation communities, such as toxic heavy metals contamination and habitat loss for culturally important animal and plant species. Based on community input, we are considering adding a cultural resource management path (archeology and paleontology) in our OLC program to assist with the preservation of OST's cultural heritage. Those are other disciplines that our students find engaging and motivating (*HEL*).

- OSSPEEC projects help the PRR community. For example, in a community service project, OLC student Calvin Cutshall helped with a small economic development project on Pine Ridge Reservation (PRR). He took out some maps to assist them at the location where they intended to build a store. He did a site evaluation (*JJS*).

- I think it is so important for our undergraduates to be involved in actual research. When they graduate from OLC, there is a high probability that they will be in a tribal office and in charge. They will instantly need to be able to write grants, understand research, and manage people. They may already be doing some of that because some already work for tribal agencies. Almost all are non-traditional students (*JJS*).

- OSSPEEC makes our faculty and students aware that there is more out there. Each instructor has his or her own neat project and way of doing things. Through OSSPEEC, we and our students know about cross-disciplinary areas that can enrich research. For example, Jennifer Benning set up a field trip for us to see a mechanical engineering laboratory at work at SDSMT. OSSPEEC covers many topics through research-based and experiential learning projects such as traditional plants, heavy metals, soils, rare turtles and their habitat, and a local veteran's monument, to name a few. Such a wide variety of research possibilities in a vast outdoor laboratory builds capacity for everyone involved (*JJS*).

3. Encouraging Tribal Colleges and Universities to Take Lead Roles in Determining Research and Educational Foci

We built a relationship with various agency regulatory divisions of OST government, in particular their Environmental Protection Program (OST EPP). We provide services and we are becoming the "go-to" institution for tribal government when they need advice about environmental engineering problems. For example, students and the OLC STEM Department head, Tinant, wrote the watershed protection program with best management practices for the PRR[37]. Each year, the tribe needs to report on non-point pollution for water resources. We stepped into that role through OSSPEEC.

- The OLC relationship is closer with SDSMT than with SDSU because of location. We have worked to create cohorts of students between OLC and SDSMT to promote success. For example, OSSPEEC collaborations drive some SDSMT senior engineering design classes (*CJT*).

- Faculty and staff increased networking and relationship building through OSSPEEC summer research experiences. For example, one outcome is that I have been asked to serve on a large National Science Foundation (NSF) proposal on stream health research. We are likely to all work together beyond OSSPEEC (*CJT*).

- Prior to my arrival in 2008, we had the standard array of classes, lectures, exams, homework, and assigned reading. While that may have worked elsewhere on campus to teach English and math, it did not work to teach or keep our students engaged in science. Now we have a more culturally sound curriculum, along with articulation agreements with SDSU and SDSMT. We had a mismatched pedagogy and curriculum before. Now we can deliver better teaching through hands-on learning in the field and laboratory. Our students are immersed in the wonder of nature. They then tell us what it is that matters to them. It works best when instructors use the lightest touch we possibly can (*HEL*).

- So, now we facilitate more and expose students to what is out there. We have learned that showing them one uranium mine and the scar it is on the land is a field trip that succeeds when a semester of lecturing fails. That is not how the typical mainstream educational system works. There are too many students for it to work for mainstreamers. It is the only thing that works where we are (*HEL*).

- Now we have people from within and outside the tribe who seek us out for expertise. Now we have people who come to the reservation who want to collaborate with us. We have so many, we cannot manage them all. Now we can pick and choose (*HEL*).

- The OLC students are the reservation's future. The OLC STEM Department never played that role before (*HEL*).

- As participants in this pre-engineering program, we are searching for culturally based reference points for our students. I look to the students to signal me that I am teaching in a way that is culturally accessible to them. I am trying to be a friend to the students. I am not trying to turn the students into someone just like me. Their job is to teach me how this is working in the cultural setting in which we are conducting this educational experiment. We are finding ways for engineering and Lakota culture to work together and not to be in conflict. (*HEL*).

- Many of our OLC graduates work in OST agencies. We need our math and science students to become 65 years old or so, since Lakota society is stratified by age. Then our students can take over and manage tribal agencies. Or they can go away to graduate school and bring their expertise back to PRR. For the first time, we are producing students who can advise the State and Federal governments, and our students are becoming knowledgeable enough to oppose them with evidence-based research, when necessary to maintain tribal sovereignty (*HEL*).

- In general, our students thrive on choice and variety. Previous attempts at being monolithic (as in an "Engineering Department") have been unsuccessful. Our students (both Native American and non-Native American) can be successful and engaged if studying what truly interests them, or what they see in the moment as being helpful. However, what mainstream society denotes as "proper" or "financially rewarding" or "necessary" means nothing. That is all "out there" but not "in here." We allow students tremendous flexibility to change their minds again and again until they settle into something they like. That takes time, patience, and a lot of freedom of choice. It is also a lot of scientific waterfront for us to cover. We need to be able to mentor students in a variety of disciplines, yet have deep enough local expertise to be of real help as our students learn to specialize (*HEL*).

- Another group heard about the capabilities of OLC, and they wanted our knowledge concerning digging a water well. They wanted to know what we knew about. That builds capacity for OLC on PRR. Before, I am not sure they knew we existed. When they see researchers out in the field, and students interacting with the community, now OLC is the place to go for expertise (*JJS*).

- When we are conducting fieldwork, it is expected that I (an enrolled tribal member and an instructor at OLC) go to the door of a house and knock, because I am Native American. I do not mind. It is helpful when others learn awareness and cultural sensitivity in a reservation setting and that they are comfortable with it (*JJS*).

- In addition, our interns from OLC are going to be working with two high school students from Red Cloud and Pine Ridge High Schools on PRR and with other interns from Ft. Peck University in Montana and with interns from Haskell Institute in Lawrence, KS. That all builds capacity for OLC (*JJS*).

- OSSPEEC builds capacity simply because graduate students are allowed to conduct summer research on the PRR, and their results help OLC to build expertise because they have evidence-based results (*JJS*).

- Because of my OSSPEEC alliances, I am a co-author for two publications. That is an exciting experience for me, as a graduate student and an OLC instructor. It is another part of professional development that builds capacity for me and for OLC (*JJS*).

- I can seek help from SDSMT and SDSU contacts to help me build a syllabus for a pre-engineering class at OLC. I want to be sure that it is done correctly and that it is transferrable within the three-way curriculum agreement. I can seek their advice if I am having trouble with a lecture or two. That is a really important to me. I want to work with people on that level (*JJS*).

- OSSPEEC has expanded my horizon to at least think about OLC's reaching a point where some governmental agency might produce deep geological cores and work with us. Our own core equipment can only reach a depth of 20 feet or so. We would need to go to the OST and through their Research Review Board (RRB) process even to accomplish that. It would be interesting to work through that process. The point is that in the past, we seldom speculated about those kinds of alliances. At least we talk about them, now. We need deep cores in order to understand our research. It could highly benefit OLC and PRR, and the State could also benefit from the data (*JJS*).
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Non-consensus Opinions

A few non-consensus opinions emerged after examining research participants' essays. Those included the importance of champion leaders embodying holistic thinking for collaborative success. Another co-author wrote about the value of outsiders becoming familiar with the required permissions, processes, and training required for working in a reservation setting. That familiarity included working with the OLC's Institutional Review Board (IRB) and the OST's RRB, as well as obtaining National Institutes of Health (NIH) or Collaborative Institutional Training Initiative (CITI) certifications.

Conclusion

OLC faculty members agree that capacity building is a necessary first step in growing an undergraduate engineering program at a TCU. Collaborative summer research experiences with Regental universities such as the OSSPEEC initiative provide a catalyst in engineering program development. We conclude that capacity building in engineering at OLC is dominated by: (1) building trust within the reservation community through collaboration, (2) employing experiential learning and aspects of project-based service-learning approaches, and (3)

encouraging TCU leadership in the determination of research and educational foci in institutional collaborations such as OSSPEEC.

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Appendix A, Qualifications of Research Subjects to Comment

C. Jason Tinant is the PI/PD for OSSPEEC, Department Chair for the OLC STEM Department and a PhD student in Environmental Science at SDSMT. OLC recruited Tinant to work with STEM distance education in 2004. Tinant found that OLC students were not engaged through distance education. He realized that his own most important educational experiences in STEM occurred outside of the classroom and began to work to revitalize OLC's STEM program by following a constructivist paradigm. As a recent baccalaureate graduate in Geological Engineering, Tinant's service-learning experience includes an initiative to survey a watershed in Haiti as part of a project to replace the existing water collection and distribution system for Hospital Albert Schweitzer with Bruce Berdanier (SDSU). Later, Tinant spent seven months at the Darkhan branch of the Mongolian University of Science and Technology as a visiting water resources instructor and researcher after graduating with a Master's degree in Water Resources Engineering. In the first three years of OSSPEEC, Tinant and his student mentees wrote the watershed protection and management plan for the PRR using field and laboratory data they collaboratively collected with the Oglala Sioux Tribe Environmental Protection Agency (OST EPA). They are now in the process of developing a biologically based Total Maximum Daily Load (TMDL) for nutrients.

Hannan E. LaGarry is a PhD in geology, a Co-PI for OSSPEEC and former Chair for the OLC STEM Department. LaGarry joined the STEM Department as a conservation biology instructor and researcher in 2008. Previously, LaGarry worked for the University of Nebraska State Museum, where he devised and conducted the first vertebrate fossil resource inventories on Federal lands in the United States. He then went on to the Nebraska Geological Survey where he led teams that produced 80, 1:24,000 geologic maps in western Nebraska. During this time, he began his principal work of revising and redefining the Cenozoic stratigraphy of the northern Great Plains. That work led LaGarry to OLC, where he continues to publish on stratigraphy and paleontology, teach classes in geology, paleontology, and soils, and to collaborate extensively with the Oglala Sioux Tribe's Natural Resources Regulation Agency (OST NRRA), the Oglala Sioux Tribe Parks and Recreation Authority (OST PRRA), and the Oglala Sioux Tribal Historical Preservation Office (THPO).

James J. Sanovia is the newest faculty member in the OLC STEM Department. However, Sanovia has the longest perspective of the tribal college movement. He is an enrolled member of the Rosebud Sioux Tribe, and he earned an Associate degree in Science, Engineering, and Mathematics (SEM) at OLC before transferring and earning a baccalaureate degree in Geological Engineering. Sanovia is a graduate student in a Geological Engineering Master's program at SDSMT. The OLC STEM program recruited Sanovia as a Geographic Information Systems (GIS) remote sensing specialist, and later he became a faculty member with the OSSPEEC program. He collaborates extensively with the OST NRRA (Natural Resources Regulatory Agency), the OSPRA (Oglala Sioux Parks and Recreation Authority), and the THPO (Tribal Historic Preservation Office) and other Tribal programs on mapping and GIS analysis needs.