Indigenous Innovators: Creating Collaborative Student-Engineer Innovation Teams between Tribal Colleges and Research Institutions

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Abstract

This paper explores the potential advantages and disadvantages of partnerships between state-sponsored universities and tribal universities. Over the years, collaboration between these two types of institutions has been nearly nonexistent. However, recent initiatives, such as the collaboration between a group of student biomedical-engineers, have begun to shed light on the potential benefits of such partnerships. Through interviews with the students and faculty involved in the research, the paper aims to extract generalized feelings and insights into the experience of cross-institutional collaboration. The findings reveal that tribal colleges are underutilized, and that cross-institutional relationships can be highly beneficial in terms of education and development. This paper concludes that cross-institutional collaboration should be more widely promoted as a means of enhancing the education and development of diverse communities.

Introduction

Collaboration with a diverse team of individuals from different cultural and socioeconomic backgrounds is key when framing and solving complex engineering problems [1]. Specifically in the Native American community, their expertise and a view on a variety of complex problems is needed to form new ideas [2].

Cross-institutional barriers, lack of connectivity, work and family responsibilities, and loyalty to community of origin discourage participation on problem solving teams and contribute to the failure of forming interconnected services [3]. In fact, only 17% of Native American students continue their education after high school, which is significant when compared to the rest of the US population at a rate of 60% [4], [5], [6]. Even many academic journals lack representation for Native American students [7]. This repeatedly highlights the disparity of cultural diversity in many universities, and subsequently, white-collar jobs.

Another problem lies in the historically Eurocentric curriculum which ignores most minorities and their cultures [8]. This causes a mistrust between the historically Caucasian majority and people of color. In an act of self-determination, Tribal Colleges and Universities (TCU) were established, with most hosting two-year degrees [9]. The 39 TCUs primarily serve geographically isolated populations, hours away from other mainstream postsecondary institutions. Despite significant progress and a steady rise in enrollment, TCUs have funding that limits their ability to further their impact [10]. Their unique funding also provides them with opportunities they are ill-equipped to deploy, resulting in equipment and other resources that are underutilized.

Some Native American students, after completing a two-year degree at a TCU want to continue their education by obtaining a four-year degree. However, transferring from a TCU to a Research University (RU) proves to be difficult [11]. Because many TCUs can only be established after the state grants approval, often begrudgingly, a breakdown in communication between the two often results [12]. This again contributes to the low retainment rates of Native American students, causing a lack of diversity among the student body [13].

Some TCUs and RUs have since formed a matriculation agreement with each other, better known as two-plus-two programs. These agreements allow for students to start their education at a TCU

and then transfer to a RU after completing two years degrees [14]. Working together in this way is vital to increase the diversity of the campus and to foster growth overall in both environments.

This article explores the recent collaboration between a TCU and RU at the undergraduate level. The specific undergraduate program is biomedical engineering, a medical based STEM, and the program at the RU uses an educational technique called Innovation-Based Learning (IBL) that promotes a safe-to-fail environment [15]. This allows the student to learn and grow without fear of failing the course. With IBL, a student is allowed to produce an idea for a project and then gather a group of other students to bring that idea into fruition. One group chose to create a new type of challenge-style running blade that would be more affordable to children. Two individuals from this group graduated from a TCU and continued to an RU to receive a bachelor's degree in biomedical engineering and are employed at their respective TCUs. This perspective brought light to the inclusion of Native Americans. Together, the entire group learned of various resources that both TCUs and RUs have. One of the recent TCU graduates now serves as an instructor of advanced manufacturing at their TCU alma mater and informed the group of an opportunity to utilize the impressive array of equipment found there. Due to the high output capabilities of the equipment coupled with the lower student usage requests there was room on the schedule. This allowed the TCU to support the continuous adaptation and manufacturing of components on a proposed accelerated timetable. The collaboration between the TCU and RU aptly provided the opportunity to utilize otherwise static resources. Utilizing both institutions, the team were not only able to design and fabricate a prototype lower limb prosthesis in a matter of months but test its viability as well.

This paper will focus specifically on how each person's view of the collaboration helped them grow personally and professionally. It will conclude by analyzing whether these types of collaborations are useful by outlining what future work could be done with this style of collaboration.

Sample

The project started as part of an introduction to biomedical engineering program at a RU (unspecified university) that was debuting a new teaching style called Innovation Based Learning (IBL). In IBL, students were allowed to pitch projects they wanted to work on for class credit, and teams were formed based on the projects selected. The project to develop the new prosthetic device required advanced manufacturing methods, leading the team to form a relationship with a TCU (unspecified technical university) and its Advanced Manufacturing Laboratory. The people interviewed for the publication were volunteers from among the students, facility staff, administration, and technicians who were instrumental in the collaboration and made the project possible.

Methods

The data was collected through structured interviews, which lasted between 20 and 60 minutes. The interviews were transcribed to extract generalized themes about the project, and questions from Appendix 1 were used to guide the conversation. Clarifying questions were asked as needed. The responses were organized by question and summarized, and the results were included in the

discussion section. This information helps to provide a comprehensive understanding of the stakeholders' experiences and perspectives on the project.

Results

Q1 - What was your involvement in the project?

Individuals involved in the project included one TCU student (shown below in fig.1) that is also employed as a lab technician in the advanced manufacturing laboratory; one of the RU professors of biomedical engineering; the TCUs Engineering program director; three RU student engineers who were in charge of the design and the project as a whole; and an engineering consultant who worked as a mentor for the RU students working on the design.

Fig. 1. Pictured above is Laboratory-technician tribal-engineering student unpacking the powder-block, post fabrication. The un-sintered, loose material will be collected, sifted, and recycled for use on future projects. This is all done inside a negative airflow hood that filters out particulates, keeping the technicians safe.

Q2 - How would you describe this experience and its impact?

Project participants noted the positive impact of the collaboration between the TCU and the RU. The collaboration was effective and proficient. The delivery of a functional prototype, a custom mounting jig fabricated for the compression testing machine, plus the compression testing of the design was done within a single 16-week semester. This could only be achieved by both organizations collaborating in a well-coordinated way. The impact is showing that the TCU's can be an active partner with research institutions. The native population had their input into the project and gained valuable real-world experience. The non-native population were impressed by the lab capabilities.

"We were gladly surprised of the amount of equipment and manufacturing tools and the friendliness that they offer." -RU Faculty member, professor of biomedical engineering

Additionally, new relationships were made with people who have different perspectives. This helped all participants ruminate on new possibilities for their future careers and professional growth. Finally, they were inspired by the collaboration from this customized 3D printed project.

"I've never done a project like this before, but I feel like I learned a lot and I got to make new relationships and meet new people with different perspectives." - RU student engineer, design team member

"The impact is gone way further than I anticipated." – RU student engineer, design team member

Q3 - What did the project mean to you?

The central theme was of pride for completing a project that has never been done before and has a strong impact on the outside world, specifically the medical community and Reservations. It allowed a group of people who don't feel valued to have the opportunity to play a central role. Some participants expressed the project having a transformative effect, making them feel inspired and empowered.

"I never had the ability for doing biomedical stuff and it makes you look, like what else is out there?" -TCU student, lab technician

Participants expressed how they felt the project also could serve as a starting point for what could be the students' career.

"It was almost a kickoff to what I might possibly do for the rest of my professional life." - RU student engineer, design team member

The techniques used for prosthetic development, and the involvement of tribal colleges in developing research, emphasized the academics taught. It also emphasized cooperation with other colleges in creating and solving solutions to real world problems.

"You know, a lot of grants will allow colleges to buy equipment. And the equipment, for whatever purpose, can start to collect dust after a while. Or just be a curiosity in the academics and nothing more. But here with this advanced manufacturing lab they're not collecting dust; we're actually utilizing them for worthwhile projects. And not only is it emphasizing the academics of the students here, but it's also emphasizing our cooperation with other colleges into creating and solving solutions in the world." –TCU Faculty member, head of engineering department

Q4 - Did you find any part of the process rewarding?

Participants found the most rewarding part of the project was being involved in something successful. Working on a project that not only has academic significance but went beyond the walls of the classroom to address real world problems.

"Yes, especially the part where we exceeded the expectations of the prototype. It's nice to be able to be a part of something that you know is successful." -TCU Faculty member, head of engineering department

The experience of most TCUs is, not being an actual player but instead just a "footnote on a grant proposal." Many times, a Tribal entity will be cited as a partner or participant but, in the Tribal experience, will generally not be an equal partner, if included at all.

> *"It was great to see that the tribal colleges were finally being respected." -RU student engineer, design team member*

Participants also found being able to see a functioning physical product come out (seen in fig. 2) rewarding and validating.

> "*The most rewarding part, I think, was in how to really take a material and be able to combine that with a design and ultimate performance, [and to] be able to use additive manufacturing methods and choose something that was viable towards supply in a long-term medical device product. -TCU Faculty, mentor to design team*

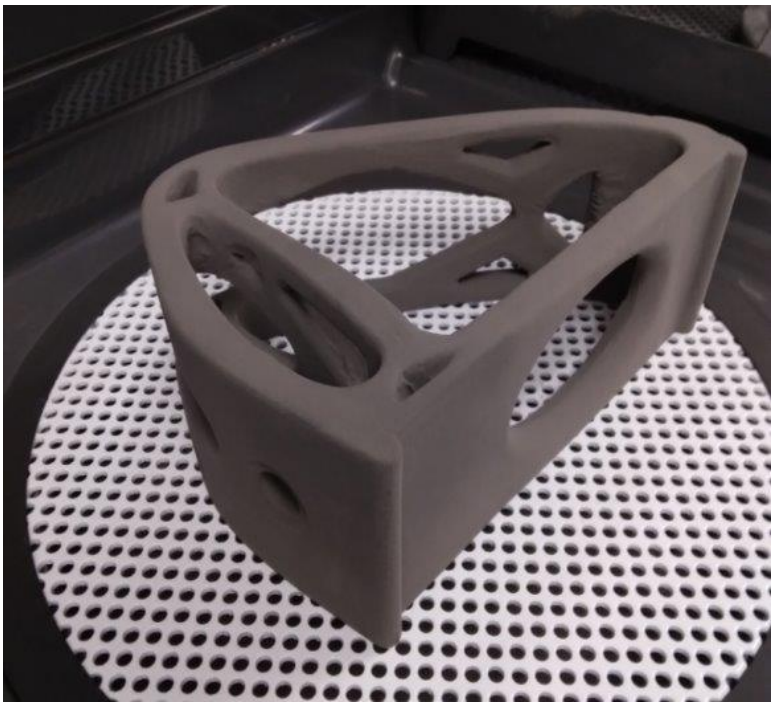

Fig. 2. After the material has cooled and undergone initial post-processing, our innovative prosthesis design is placed inside a sifting machine. Here, any unused powdered material is collected, sifted, and recycled for future use.

Q5 - Were there any challenges? If so, how would you mitigate them next time?

The biggest challenge was managing the communication efforts and grasping all the new material. In preparation for future projects, participants said they will do more investigation of the skills that add value. This is the level of personal ownership IBL is striving for. IBL leverages each teammates' knowledge base and has them take on more of an instructional role to educate the group as a whole, aggregating the group's skill beyond any individual.

> *"The biggest challenge was probably communication and learning how to do everything. For next time. I'll probably do a bit more research, learn how to do some more stuff before I jump into giant projects. Like I for example, I'm currently in a CAD class for mechanical*

engineering and so that's going to really help me with future projects." -RU student engineer, design team member

The project was accelerated due to the semester-based timetable. So, some of the fabrication steps and testing had to be performed even if the entire group wasn't available to participate. While it would have been better to have the groups from both parties involved more often.

"The fact that the schools are an hour apart was a big challenge for when it came time to get hands-on with tangible prototypes. Having students be able to travel between the schools was an issue because there were a lot of conflicts with time" – RU student engineer, design team member

There were issues with having proper attachments for the project, but accommodation was made. In the future the TCU would like to add more accessories to be better prepared for more projects in the future.

"Well, it's very technical challenges. You know, we had a little bit of problem with the jig as far not the jig itself, but as far as the bottom surface containing the prototype which we were able to rig up a nice little 2 by 4 jig to contain it. But I'd like to probably buy some more accessories for the Instron machine here in the future, so it's more prepared for whatever we throw at it." -TCU Faculty member, head of engineering department

Q6 - Were there any advantages? If so, how would you emphasize them next time?

The advantages include having the proper tools, being able to steer future purchases toward broader applications, and being able distribute a viable solution rapidly. The relationship between the TCU and the RU has had a positive impact on the student's outlook. The camaraderie that developed has driven everyone to succeed, and demonstrated to the TCU students that they can thrive at a larger school and even finish an advanced degree.

"There's so much stuff you could go into, and I if it wasn't for you going here and having to do stuff like that, I wouldn't even know it." -TCU student, lab technician

The most important details are that tribal colleges exist, that they have capabilities that even some research institutions lack (shown in fig. 3), and that each student can relate to one another. This gives the TCU students hope that they can be successful. Since they're working with examples of successful TCU graduates who have transferred to RU's.

"The advantage was definitely working with the TCU because, since they're so underutilized, we were able to get in there and do work with them to get our product out right away and really make a bigger impact than we would have." -RU student engineer, design team member

Fig. 3. The image shows the prosthetic device affixed to the personalized bracket used for compression tests. These assessments not only validated the chosen material but also assessed the leg's construction. The findings gathered were utilized to evaluate the correlation between the real-world dynamic tests and software stress simulations.

Q7 - Did the challenges in this project help you to grow personally?

Participants expressed that the challenge promoted personal growth. Teaching them how to work with a diverse group of people and how to present themselves professionally.

> *"I feel like it did. I learned a lot about working with other people and how to present myself more professionally. I've had experience with that in the past with Girl Scouts and my Gold Award project through Girl Scouts. But it's completely different when you're trying to get funding, get information just to help, even come up with an idea. Yeah, starting from scratch is a little different." -RU student engineer, design team member*

It also demonstrates to TCU students that they don't have to do everything themselves. There are support resources available, and to also be a resource for other TCU students.

> *"Remembering that I don't have to do everything myself anymore was a hurdle I had to overcome coming from a tribal college. Every engineering project I helped develop, it was me. I was one of the only people in the entire department, and the faculty are all spread so thin you it was a moral conundrum asking for them to do anything beyond what they were already were. Having a network of people, you can rely on, I've forgotten what that was like. Slowing down and incorporating more training for the people around me, getting them up to speed, and remembering that just because I have done it so many times or that it's something in my day-to-day, doesn't mean it's a normalized thing for everyone else. Give*

the people around you an opportunity to show what they can do is very humbling and vexatious undertaking. The growth that follows is simply astounding, just because its different from the way you would have solved it does not mean it is wrong, it simply means it's different. looking at it in terms of mathematics, there are an infinite number of equivalent answers to every question, none of them are less correct than the other." -RU student engineer, design team member

Giving student engineers experience in starting at the beginning of development for devices in a space where it is safe to fail, and the personal ownership of the projects, goes well beyond the classroom to promoting changes that can affect a community.

"Yes, they have been really enlightening me about things I've missed in what's so important in engineering that's biomechanics and biomedical engineering. For me this has been a love of my life and it's something that as an engineer you don't get these kinds of opportunities to start on ground floor and these types of medical devices." -RU student engineer, mentor to design team

Q8 - Did the advantages in this project help you to grow personally?

Participants found that working with experienced people from different backgrounds helped to foster new ideas and unconsidered directions. The experience also allowed students to network and develop new relationships.

"In a way, spiritually. It's been nice to see how a project like this is bringing more people together and the relationship that could be fostered. That is really what I'm drawing a lot of strength from. The where it could go, that this can't be just a footnote. That this is going to be a steppingstone to developing something great something that is charismatic enough to capture the minds of the next generation so they can build a brighter future by having the tools to fix tomorrow." -RU student engineer, design team member

The project also validated the TCU lab's ability to produce successful results. This confidence will help initiate more complex projects in the future. The success also reduces TCU's apprehensiveness to take on larger endeavors.

"Yes, it gave me more confidence in the abilities of our lab to produce successful results and therefore in the future, as far as expanding it, I have no qualms about that now." -TCU Faculty member, head of engineering department

The project has enhanced the students' knowledge in topology and general designing methods which they will apply to future endeavors, not just biomedical prosthetics.

"I think that they really enhanced what I presently knew in some of the areas of topology and general design as applied to medical solutions such as these types of prosthetics. I think they really enhance that in remembering the power of what they can do." -TCU Faculty member, mentor to design team

Q9 - What opportunities do you see happening in the future?

Participants found that the testing and application of new concepts and methods generated avid interest in what else could be done with additive manufacturing. TCUs intend to remain on the

cutting edge in order to offer opportunities beyond the RUs to attract students and resources to support increasingly complex projects.

> *"One of the things we should do is remain on the cutting edge of the R&D and not just sit on our laurels and say, well, we have this printer here. Now we'll just work with it for the next 10 years. I think the main thrust here is to always be on that on that edge of R&D that is leading everybody else." -TCU Faculty member, head of engineering department*

Participants expressed hopes that STEM programs developed between the TCU's and the RU's will help to deliver innovative individuals back into Tribal communities. Participants also expressed hopes of a streamlined transfer program so TCU students can start at the Junior level, often expected of a transfer student, and not be held up by years of prerequisite classes they were unable to take at a TCU.

> *"A 2 + 2 STEM engineering program developed between the tribal colleges and the research universities. Where they could go from their associates in engineering from one of the tribal colleges in the state and finish their bachelor's degree in engineering at one of the research institutions in the state would be a huge step. For the reservations, essentially, if you can bring more innovative people and more STEM technology driven people back into an environment where they're allowed to make advancements and are given the opportunity to make a difference. I think they will. And the only way I know how to help people make things better is by making stuff. And so, if I can show more people how to make stuff and give them the opportunity to make stuff that makes their communities better and their communities grow. That's where I hope this is going to lead." -TCU Faculty member, design team member*

Participants also expressed hopes to establish a process of design, optimization, and manufacturing optimization for a biomedical/biomechanical medical device, that can transform itself into other applications in prosthetics.

> *"With this project I feel like it'll launch whatever career path I end up taking into motion and give me a lot more opportunities to do what I want to do in the future." -RU student engineer, design team member*

> *"If you can really within the realm of what this product is intended to do and establish a process of doing that, the right concept to design, to optimization, to the manufacturing optimization step. If you can establish that as a biomedical, biomechanical medical device, this can transform itself into other applications in prosthetics too, that can use additive manufacturing as a as an optimal tool." -TCU Faculty member, mentor to design team*

Q10 - What do you wish to see in the future with the collaboration between universities and the tribal colleges?

Participants expressed excitement about the potential for a partnership between the TCU and the RU to produce physical prototypes (seen in fig. 4) of the institution's designs and teach concurrent academic classes.

> *"Not only the laboratory connection with the TCU's being able to produce physical prototypes of the institutions designs but also if we could have like concurrent academic classes being taught." RU Faculty*

Fig. 4. In this image, we can observe the latest prosthetic leg design undergoing post-processing, along with a specially-made mounting jig for conducting dynamic real-world testing. The connecting sleeve at the center increases the diameter of the prosthetic, allowing for more accurate force transfer to the stanchion arm above and ensuring precise load cell readings. The nuts and bolts visible in the picture serve only as keys to align the various components and are not structurally significant. Finally, the post on the right is designed to fit into the 50 kilonewton load cell of the testing apparatus.

They also hope to foster a working relationship between the departments in the colleges, which could lead to a symbiotic relationship between the two.

> *"I think I would like them to just work more together because they both have resources that the other doesn't."* - *RU student engineer, design team member*

> *"We need each other. And we could do really great things if we learn to treat each other as equals and got along."* -*RU student engineer, design team member*

Excitement to see what the future holds was conveyed.

> *"I feel like having just a partnership between the two can really expand on the educational aspects that they can give. Overall, I'm just really excited that I was able to work on a project like this and get to know such a variety of people, and I'm excited to see what the future holds."* -*RU student engineer, design team member*

Students could network and have access to additive manufacturing equipment and knowledge at the other institute. With more representation at RUs, those who have completed associate degrees at TCUs are more likely to continue their education by earning a bachelor's degree at an RU.

> *"Ohh, just connections or whatever, meet people. They make it easier to go to school down there."* -*TCU student, lab technician*

Throughout the whole experience, participants advanced both academically as well as personally. They were given a space to explore options and learn more about what it takes to collaborate and forge a new project. The experience has opened many avenues for future work between the two colleges and the participants are excited to see what happens next, citing this as a turning point between the two entities.

This initial collaboration is bringing the promise of new relationships to the two schools. It will be a steppingstone for future collaborations not just between this TCU and RU, but for every TCU and RU across the nation, sparking a movement for innovative, collaborative education.

Implementation Suggestions

Drawing from our collective experiences, we have identified several recommendations that we would like to propose. Specifically, we suggest implementing key actions within both the TCU and RU to achieve our goals. Additionally, we believe that a collaborative partnership between the TCU and RU is crucial, and have some suggestions for how best to approach this. In the following section, we outline these recommendations in greater detail.

At TCUs

- **Build confidence.** Reinforcing confidence is necessary for effective participation. TCU students and faculty may encounter imposter syndrome. Individuals at TCU's may incorrectly conclude that their institution's smaller scale and scope precludes participation in major research initiatives. Make a clear plan on how the TCU can best participate and what it is looking for in the partnership. Check in frequently and share feedback early and often with all members involved. Do not ignore cultural norms or traditions because the RU culture doesn't account for it. These are teaching moments and they should be celebrated, not shrouded.
- **Foster trust outside of TCUs.** Historic trauma and/or a fear of 'saying the wrong thing' have the potential to limit the free exchange of ideas. Pair up individuals with mentors when possible. Have informal get togethers with RU participants. Take time to listen before jumping to conclusions. It can be tiring being placed in yet another cultural-ambassador role, but over time this need should fade with the growth of the friendship.
- **Be patient.** RUs have more layers of administration and bureaucracy. Even high-priority initiatives will take time to secure approval at all required levels. This may cause timelines to extend beyond what is predicted. Be sure to keep in communication with RUs and have them give clear schedule expectations.
- **Don't be afraid to reach out.** You don't need a fully formed proposal in order to reach out. Most RUs would love to partner with a TCU but are either afraid to ask or have been directly told not to. If an RU has approached you previously with a completed research project, they probably felt as though they needed to show up with something in hand. Reach out to an RU that serves students from your institution or Tribe. Speak with different levels of authority. Ask individuals in different departments. There are many layers and not all have the authority to form a partnership.

At RUs

- **Equal partnership.** Historically, TCU's have been recruited as the "diversity partner" for otherwise fully-formed research teams or proposals. TCU's must be recruited based on actual research expertise and capabilities rather than to boost the probability of a proposal's receiving funding. Doing this right admittedly takes time. Do not approach a TCU with a finished proposal; instead come to a TCU with a spirit of reciprocity. Changing this is the first step in forming a working relationship.

- **Do your research.** Before approaching TCU partners, begin by researching whose ancestral lands the RU is built upon; reach out to those Tribes. RU faculty should start by visiting those TCU's, meeting with faculty, understanding existing initiatives and interests, and maintaining an ongoing dialogue regarding shared interests and opportunities. A genuine conversation, acknowledging shared history, is deeply appreciated in Native American Culture. Over time RU's should also invest in cultural education and consider opportunities to learn and blend indigenous ways of knowing with traditional research methods.
- **Common interests.** Deciding on a synergistic research topic where both parties can contribute is paramount in forming this relationship. Each party humbles itself to show mutual respect while allowing the TCU to allocate and contribute its typically more limited resources in the best, most meaningful way.
- **Prepare for the unknown.** Though TCU's smaller size often makes them nimbler, this is not always the case. Community stakeholders and traditions can alter decisions and timelines in unexpected ways. This factor cannot always be anticipated or mitigated, and the best advice is regular communication with TCU partners.

At Both Institutions

- **Setup and communication:** Having a point person at both institutions to be anchors for delegating work, coupled with a liaison that can fluidly report between them is paramount. The liaison keeps all involved members informed on the inner workings of the team, ensures that priority items are not forgotten, and helps the team function as a single multi-site team rather than two teams with limited interaction.
- **Logistics and learning opportunities.** When significant events take place at either institution, members from the partner institution should attend; this can be used as a learning event to educate and cross train each other. This goes deeper than technical skill; this is also an opportunity to educate collaborators about the culture and backgrounds of both institutions and their surrounding communities.
- **Equal partnership.** Outlining exactly what capabilities each group brings to the relationship will help lay out expectations directly and split the workload appropriately. Equal partnerships should be the goal; grants should be submitted collaboratively when possible. Alternatively, TCU and RU faculty may alternate between PI and Co-PI from one grant submission to the next. Grant budgets must also be allocated equitably.

Challenges to be Expected

- **Timeline discrepancies.** Large teams means many individuals with interdependent tasks. Consider using an open-format Gantt chart or visual online collaboration platform to keep track of everyone's commitments and deliverables in a central and transparent fashion.
- **Loss of capabilities.** The turnover rate is particularly high at TCUs; involve many members early in the project and make succession/continuation plans.
- **Data Management.** Consider tribal sensitivity toward the use of data. De-identifying may not be sufficient to ameliorate tribal concerns. Where possible, store and process tribal data in/on tribal computing systems. Communicate early and often regarding which data is accessible to whom.

- **Implicit bias.** TCU's are looking for an opportunity to perform, not a free pass. While acknowledging institutional differences, TCU's and RU's must maintain mutually high expectations for professionalism and performance. Expectations of professionalism and performance may differ; have open and honest communication about what is expected and what is being perceived. Both parties must be given meaningful/challenging roles within projects and must be held accountable for timely high-quality results.
- **Feast or famine.** TCUs are highly-reliant on term-limited subsidies rather than guaranteed income. Whereas RU's frequently fund graduate students and post-doctoral researchers with grants, many TCU faculty and staff are grant-funded. Because of this funding model, TCU faculty are more frequently part-time, adjunct, contract educators rather than full-time direct employees. Be prepared to pay for the extra hours needed for any individuals that you want working with you and allocate duties accordingly.

Future work

Students have always learned more by working with others. Forming a symbiotic relationship between the two entities would prove beneficial in many regards, but specifically fostering the minds of the students. TCUs and RUs can complement each other to achieve greater success in their respective areas of expertise. Together, they can create life-changing innovations that benefit many. The two schools plan to strengthen their partnership by establishing a two-plus-two agreement that integrates TCU's Advanced Manufacturing department with RU's biomedical engineering program. This collaboration not only fosters bonds between the schools, but also supports tribal nations in health initiatives and provides more opportunities for young people in STEM fields. When TCUs and RUs collaborate through grant opportunities, there are numerous potential benefits. For instance, interdisciplinary research may result in the creation of groundbreaking technologies that benefit both communities. Additionally, such collaborations can facilitate student and faculty exchanges, enabling participants to learn from one another and establish lasting relationships. Furthermore, engaging in such collaborations can promote diversity in STEM fields, which is crucial for promoting equity and expanding the knowledge base of the scientific community. In summary, grant opportunities for TCU-RU collaborations have great potential to create positive impacts for both institutions and the communities they serve.

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Appendix 1

Interview questions

1) What was your was your involvement in the project?
2) How would you describe this experience and its impact?
3) What did the project mean to you?
4) Did you find any part of the process rewarding?
5) Were there any challenges? If so, how would you mitigate them next time?
6) Were there any advantages? If so, how would you emphasize them next time?
7) Did the challenges in this project help you to grow personally?
8) Did the advantages in this project help you to grow personally?
9) What opportunities do you see happening in the future?
10) What do you wish to see in the future with the collaboration between universities and the tribal colleges?