Pre-engineering Collaboration as a Tool to Facilitate Decolonization of Native American Students

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Mr. Haefner has 13 years' experience teaching college STEM courses. He has taught construction management at Westwood College in Chicago; mathematics at Mid-Michigan Community College and Cornerstone University in Grand Rapids, MI. Mr. Haefner has taught algebra, engineering statics, several HVAC courses, several CMT classes, as well as AutoCAD and Advanced Manufacturing using SolidWorks. Mr. Haefner also has over 15 years; experience in the fields of civil, geo-technical and environmental engineering at companies including: Testing Service Corporation in Carol Stream, IL; Singh & Associates in Chicago, IL, Weaver, Boos and Gordon in Chicago, IL; STS Ltd. In Grand Rapids, MI.

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She holds a Masters of Arts in Teaching Mathematics from Minot State University, a Bachelor of Science degree in Industrial Engineering and Management from North Dakota State University, and post-masters certificate in Experiential Education through Equine Assisted Learning from Prescott College.

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Her and her husband, Chris, live and raise Angus beef cattle, near Towner, ND. In her spare time, she enjoys riding horses and providing community outreach through relational horsemanship through the Nueta Hidatsa Sahnish College Horse Nation program. Currently she serves on the board of directors for an engineering firm that specializes in transportation engineering and materials testing.

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ABSTRACT:

The intent of this paper is to describe how a an NSF sponsored collaborative engineering education program, Pre-Engineering Education Collaborative, PEEC [1, 2], operating on a number of tribally controlled colleges and universities, TCU's, across North Dakota may, through thoughtful application of best educational practices including a community-based approach, be seen as a tool that moves decolonization within Native American communities and education systems forward. Put in terms of a research question: "How effective can PEEC be when considered as a method to move decolonization forward in Native American engineering education and could it increase enrollment?"

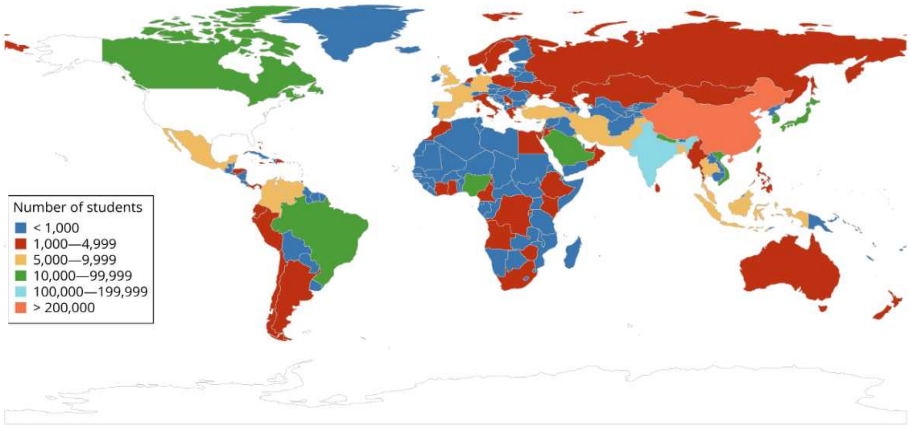
This PEEC which is been going on for the past 10 years and is soon to graduate its 10th student with a Baccalaureate of Science in either Civil, Mechanical, Electrical or Agricultural Engineering, is using this milestone as an opportunity to do some introspection on the program, its achievements, the processes that were used and some long-term outcomes.

In recent history great consideration has been given by indigenous peoples to the recognition of colonial influences on their current lives. Much discussion has taken place among Native Americans regarding efforts to mitigate or reverse these influences on their reservations and lives. This paper will offer a working definition of de-colonialization as it might be applied to educational activities and specifically engineering education involving Native Americans. The paper will present information about the effectiveness and costs of considering and supporting the "total student" and how it may be augmented to accomplish decolonization. The steps and procedures utilized to affect this transformation will be presented and discussed, along with basic numerics to indicate effectiveness. Relevancy of this activity to other situations in other underrepresented or under-resourced communities will be discussed.

DEFINITIONS / VOCABULARY: Words have meaning

This general topic is a bit out of the ordinary for mainstream engineering education. This profession has had a long history of addressing societal needs for housing, transportation and defense among other things [3]. And although most of our current methodologies and pedagogy's have worked for the last 200 to 500 years there have been innovations over the last 50 years or so that forced us to reevaluate some of these educational approaches. Of particular importance for this publication is to understand the application of colonialization to education and the implication of that for the students involved. Since this discussion is looking at institutions within the United States, the form of colonization we'll discuss is that applied to the original occupants of North America, American Indians. But in reality, as illustrated below, the educational opportunities afforded in the US not only colonize American Indians, but also do the same to all students within the programs.

The following graphic taken from the National Engineering Board Science and Engineering website [4] shows the distribution of international students attending higher education institutions within the United States in 2018. This graphic tries to illustrate the country or economy of origin for foreign students and gives approximate numbers of students from that region. For example, there is more than 200,000 Chinese students attending higher education in the United States. This graphic indicates that US higher education is the system of choice for science and engineering students from around the world.



Note(s)
Data include active foreign national students on F-1 visas and exclude those on optional practical training. Undergraduate level includes associate's and bachelor's degrees; graduate level includes master's and doctoral degrees. The data reflect fall enrollment in a given year and include students with "active" status as of 15 November of that year. Figure shading represents the natural log of the number of students.

Source(s)
U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, special tabulations (2018) of the Student and Exchange Visitor Information System (SEVIS) database.

Science and Engineering Indicators

Figure 1: International students enrolled in U. S. higher education institutions, by region, country, or economy of origin: 2018

This student selection should be viewed in light of the fact that our educational system is a derivative of the European system dating back more than 500 years to the opening of the first “public” universities. So if all of the students are traveling to the former colonies how could the educational system be considered colonizing? One has to consider the definition of colonization as a process of fragmenting and breaking things up so that they can be exploited or utilized to the largest extent possible. If the United States higher education system can absorb so many people from beyond our borders, it seems to stand to reason that it is because the system has multiple entry points and levels at which to engage students. This can be thought of as being very democratic and open to all, but it could also be interpreted as a fixed and repetitive way of conducting the education. That is to say, if you want to study X, Y or Z engineering there exist multiple institutions within the United States that can give the student an equivalent educational experience. Of course, admissions policies and traditions within any one institution as well as their geographical location may in fact modify that to some extent. The implication here is that the generalized curriculum for any major is somewhat standardized across the country, as our accrediting agency, ABET, would certify.

Looking at this from the student or educational consumers point of view, this educational opportunity does not necessarily have connection points that can be used to fortify connectivity between the educational experience and utilization to native culture for that student, whatever it may be other than mainstream North American.. There is an example of this in association with the College of William and

Mary around 1744. Iroquois Chief Conassatego wrote to the commissioners of William and Mary the following:

> "We know that you highly esteemed the kind of learning taught in those colleges, and that the maintenance of our young men, while with you, would be very expensive to you. We are convinced that you mean to do us good by your proposal, and we thank you heartily. But you, who are wise must know that different nations have different conceptions of things and you will therefore not make it a mess, if our ideas of this kind of education happened not to be the same as yours. We have's had some experience of it. Several of our young people were formally brought up at the colleges of the northern provinces, where they were instructed in all your sciences; but, when they came back they were bad runners, ignorant of every means of living in the woods; unable to bear either cold or hunger; knew neither how to build a cabin, take a deer, or kill an enemy; spoke our language in perfectly; where therefore neither fit for hunters, warriors, no counselors, they were totally good for nothing." [5] page 30.

K-12 education has recognized the utility of having cultural connection within the educational context. This has led authors such as Demmert to recognize the existence of three types of school systems: generic, meeting the academic needs "without regard to the multicultural or ethnic mix of the students", multicultural, intended "to meet the cultural as well as academic needs of the different student racial or ethnic group served by a school or system", or culture specific, intended "to meet the needs of the specific cultural or ethnic group of students" [6]. These connection points focus on linguistic but also considers the historic approach to initial education, for example guided discovery or hands-on experiential, etc. The point to be made here is that the generic type of school system is what most mainstream engineering programs supply. There are some exceptions notably historically black institutions or 1890 land-grant universities and all women's Smith College. Newer experimental engineering schools such as Odin School of Engineering would probably fall into multicultural classification. Dartmouth College and Thayer School of Engineering will be discussed below

BACKGROUND: 1491 to Yesterday, Briefly

This paper cannot possibly cover a comprehensive history of education in North America from pre-Columbian to the present, but it seems that there are some specific historic periods that should at least be mentioned. It is commonly overlooked that significant technological accomplishments existed pre-1492, such as Aztec pyramids in Mexico, the floating city of Tenochtitlán, Mayan calendar system, Hidatsa trading systems and earth lodges in the Dakotas. Since these accomplishments took multiple generations some educational process had to be in place likely in the form of Master-Apprentice. During the time period between 1492 and the beginning of the British influx of settlers to the East Coast, education and training mostly revolved around trade in its various forms. This resulted in tribes developing expertise in these business-based relationships, such as the Hidatsa. With the onset of colonial development on the East Coast, numerous institutions of education were chartered by members of the royalty in England, places such as William and Mary, Harvard, Dartmouth, Queens College (renamed to Columbia) etc. Each of these included within the charter words that required in outreach to American Indians to bring them to campus in order to introduce European Christianity to their culture [5]. This was a significant part of the work for early academic leaders such as Ebenezer Wheelock at Dartmouth. Evolving relationships of colonials with England frayed this chartered aspect of

"education" (actually more like seeking conversion to some Christian denomination). Post-revolution America wanted expansion to the West and that required access to lands that were already occupied, though viewed as empty through the mainstream mindset of 'Manifest Destiny' and the 'Doctrine of Discovery'. Educational opportunities were limited to technical trades which would get American Indians out of Western land expansion. This was also the time for establishment of treaties with American Indian tribes that would eventually limit the mobility of these tribes over historic migration routes. Educational opportunities for these reservation residents eventually evolved into what became known as the American Indian boarding school system. By 1880 the U.S. operated 60 boarding schools for 6,200 Indian students. Some were operated by government agencies, such as Fort Carlisle in Pennsylvania, while others were contracted to be operated by religious organizations. Stories about these boarding schools are impacting American Indian populations to this day. The primary operating rule for most of these "schools" was the assimilation of American Indians into white culture [6], [7] & [8]. These horrific stories of educational activities beyond the reservation was a significant contributing factor to the formation in the 70s of the tribal college movement starting with Diné College in Arizona. This eventually led to the establishment of the 1994 land-grant colleges. This gives three options for "public" education in the United States, see figure below [9].

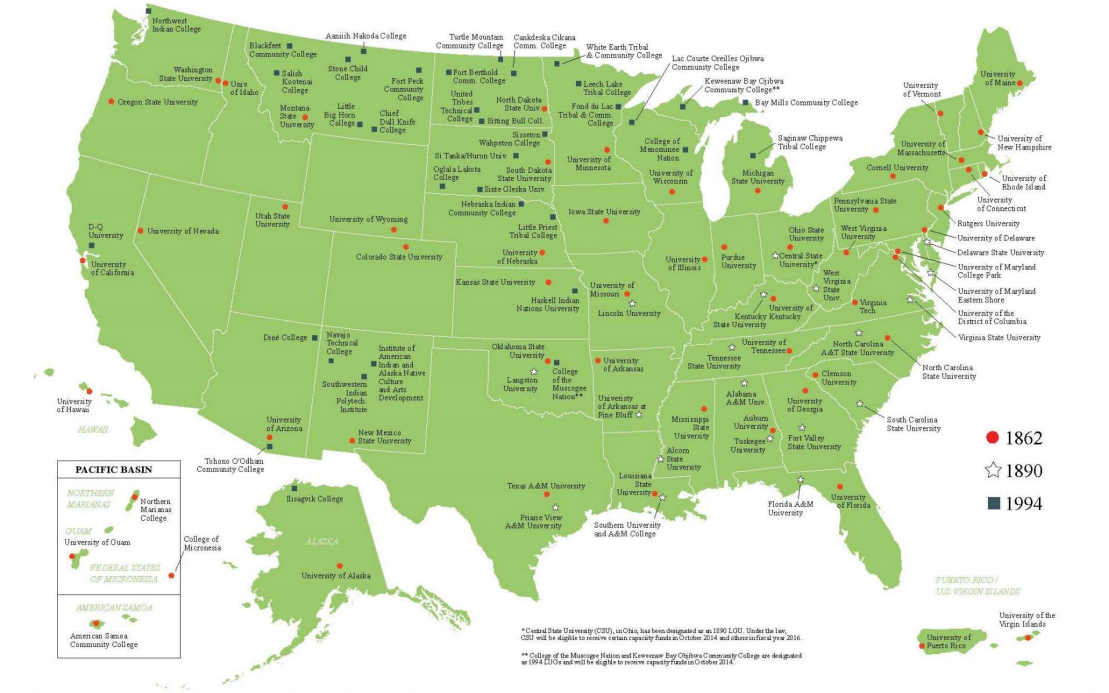


Figure 2: NIFA Land-Grant Colleges and Universities

TODAY & TOMORROW: What are we left with today?

The lingering system of education has become the gold standard for engineering education based on the "mechanical arts" wording of the original Morrill Act of 1862 [3], as stated above near the beginning of the boarding school history with Native Americans. The education that was available to Native American

students who might want to venture into this system of public institutions was based on a generic approach to teaching engineering, not what might be seen at Norwich University in Vermont or Thayer School at Dartmouth. The establishment of this system of institutions, with their funding secured by the appropriation of land is still being discussed from a different point of view in some sectors of the population [10]. This national educational approach derives from Greek education and viewed the students as empty vessels, with no preexisting knowledge or experiences, to be filled with new information, coined as the 'banking' model, [11]. The approach, modified through the centuries, requires the sequential progression through a number of prerequisites until eventually reaching the highest available undergraduate courses or graduate research. This approach was presented as though it were the only available curriculum. Through the expansion of education as a result of the G.I. Bill and engineering curriculums as results of the space race this proved to be an adequate way to provide education to large numbers of students at a somewhat fundamental level. This approach is lacking two important aspects that support stance of colonialization. One is that it provides no connection between nonmainstream students and cultural background or needs that they may bring to the classroom. The second is that it does not readily admit that these cultural variations may provide significant insights to all equal or more effective alternative educational pedagogy. A significant example would be the relatively recent emphasis on sustainable approach engineering. To a very large extent most Native Americans understand the utility of being aware and responsive to the environment that surrounds them. The majority of 1994 land-grant universities and colleges are the tribally controlled institutions of higher education, TCUs, mentioned above. These institutions are positioned to be able to more readily connect with cultural-based education because of their location and governance. The problem comes from the fact that engineering education programs are costly and would impose a significant fiscal strain on most if not all the TCU's. This is where a collaborative program between 1862 and 1994 land-grant institutions may provide a combination of cultural-based education that would mitigate colonialized approach of mainstream engineering education.

BEYOND TOMORROW: Options for the Future

What PEEC has been doing from its inception has been to acknowledge and respect the cultural origins of the primary communities of our students. This is been done by adapting some customs and practices native to reservations. These practices may include opening large activities with a prayer to "the creator", smudging (the practice of waving smoke generated from smoldering one of the four medicine grasses over each participant attending that ceremony), serving traditional foods, respecting extended family relationships, etc. An explicit operating procedure of the program has been to state to the students that the intent is to have them earn a baccalaureate degree in engineering, becoming a Native American who has an engineering degree. This is meant to imply that the degree will be obtained without losing any cultural identity of the graduate. In practice this comes about by using a mix of assignments that are identical to those in any engineering curriculum but also adding examples that reflect North American aboriginal experiences, such as Earth lodges, teepees, food cache, pre-1492 population centers, communication systems and structural entities (Machu Picchu, Aztec pyramids, etc.). The PEEC program tries to recognize the "total student". As such, administrators work with individual students to recognize their existing family and social connections and the story behind their progression to higher education. The program recognizes that academic perseverance may have to be 'developed' in some members of this population by leveraging existing examples of perseverance in

other social-economic situations. To support this strategy, PEEC encourages the use of cohorts to provide support, ethnic identity and a level of acceptance not always accessible to new students to a "large" institution. Cohorts appear to provide support that goes beyond the normal counseling centers available on mainstream institutions by having commonality with experiences and a familiarity with hometown culture.

By participating in a collaborative, as described above, the students enrolled at their local or regional TCU are able to keep those culturally significant contacts in their life and in their education world in ways that would support them as they become "Engineers who are American Indian". If successful, these degreed engineers would maintain their unique values and experiences that provide them the tools and confidence to contribute to engineering practice at the highest levels. These practicing American Indian engineers bring to the professional engineering workspace a diversity that strengthens proposed solutions to society's most complex problems. It is likely that this particularly tailored cultural solution may have elements that could be generalized to aspects of the solution for the mainstream educational practices. At a minimum it would make for a stronger multifaceted approach to problem-solving

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