

Combining Assessment with the Experiential Engineering Education

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Abstract - The PEEC: PTiPS program is an NSF funded collaboration of four North Dakota tribal colleges and North Dakota State University (NDSU) that seeks to provide a pipeline for tribal students into engineering fields. In order to provide a valuable educational opportunity for the students, and also an opportunity for program assessment, instructors in the collaborative created an engineering role-playing scenario for students in the PEEC program. This engineering scenario is in the spirit of similar (non-engineering) assessments that routinely take place at Alverno College. The first engineering scenario, conducted in conjunction with other activities at an annual 12 day residential student program at NDSU in the summer 2012, had the students playing the roles of junior engineers in a firm that was contracted by the Fort Peck Reservation in Montana to consult on plans for flood management and prevention. After an initial questionnaire/pre-assessment, the students individually conducted background research and submitted initial draft executive summaries. After this submission the students collaborated in teams to discuss ideas and approaches resulting in the submission of a final executive summary report. In spite of the intensity of the general workload of the program, most of the students ranked this scenario as their favorite part of the residential program; many students found it valuable and highly rewarding to see how their engineering, science and mathematical knowledge could be applied to help solve real-world problems. Furthermore, the abundance of written documents and assessments from the students, in conjunction with videotaped recordings of selected group discussions, provided a very rich source of information for assessment of many of the learning outcomes typical of an ABET accredited engineering program. While much work remains to be done, particularly with regards to sharpening the assessment measures, we feel that such student scenarios could be valuable to engineering programs outside of the PEEC: PTiPS is collaborative.

Index Terms -Minority Engineering Education, Native American Engineering Education, Simulation Assessment, Engineering Collaborations

INTRODUCTION

The Pre-Engineering Education Collaborative: Pipeline for Tribal Pre-engineers into Society, PEEC: PTiPS, is in the third year of its five-year funding cycle from two divisions at NSF, the Engineering Education Division and the Human Resource Development Division. This creates unique opportunities to advance the presence of minority populations in engineering and also allows for investigations of educational approaches that may have an impact on expanding engineering education in general. More information on this program and its intent is presented in other publications. [1]

The PEEC program as embodied in PTiPS, includes a 12 day residence camp conducted at NDSU at the end of the summer. The residence camp includes teaching a three credit course (or four credits with the lab) with 45 contact hours. In addition there are activities to illustrate mathematical needs as well as sessions discussing strategies for improved success in the transfer to the mainstream engineering institution. The population of students at this residence camp is composed entirely of tribal college students from four of the five North Dakota tribal colleges. The collaborating institutions are Cankdeska Cikana Community College at Ft Totten, Fort Berthold Community College at New Town, Turtle Mountain Community College at Belcourt and Sitting Bull College at Ft. Yates. The participating students have all started studies at these schools with the intention of transferring to NDSU to complete their engineering degree requirements. One of the goals of this program is to allow students to begin the difficult engineering curriculum at the local college setting with a high possible comfort level it also allows the students advantage of instructors that are more familiar with cultural and particular family situations. This is not intended to provide special opportunities for the students but rather to allow normal student support functions to focus more effectively on actual individual student needs within the structure of that community.

One goal of the 12 day residence camp is to illustrate to the students that differences do exist between their local academic environments and a mainstream institution. Student activities during the residence camp occupy nearly 12 hours of the day and there is almost daily homework to complete. This makes for a very challenging situation; one that perhaps illustrates to the student a "worst week of the

semester" situation. Supporting functions are built into the residence camp that help the students survived during the activities and provide them a sense of accomplishment.

Besides working with native students, PEEC:PTiPS provides an opportunity to professionally develop the tribal college engineering instructors, most of whom are first-time college faculty. The PI's are always on the lookout for opportunities to provide such developmental experiences. One such opportunity was the NSF sponsored engineering education development program conducted at Alverno College (a small women's college in Milwaukee Wisconsin). Alverno has the reputation of being very progressive with respect to educational approaches and since it has a long tradition of offering a nursing degree program, it understands the complexities of STEM education. Instructors from the PEEC PTiPS program were invited to a workshop at the college in June of 2012 [2]. This workshop focused on two items. One was a demonstration of the Alverno process to include their method for evaluating effective communication among students. The second part of the workshop dealt with better engagement of engineering students' in their education process.

When the PEEC: PTiPS educators returned to North Dakota, they were involved in discussions about preparations at one of the tribal colleges for an accreditation visit and methods of assessment that but might be useful for that visit. It was suggested at that time that perhaps some of the concepts learned at the Alverno workshop could be applied to the PEEC program. The authors drew on some prior experience at the United States Air Force Academy for students in scenarios and the educational opportunities available. As a result it was decided to incorporate such a scenario into the 12 day residence camp.

ENACTMENT

The scenario planning involved the five instructors from tribal colleges and the mainstream University. The premise was to put the students in a situation which would allow examination of their basic problem solving skills as opposed to any particular engineering science skills. This approach was taken since the students at the camp were at several levels in the program, first-year students, first summer students and second summer students. It was also envisioned that the scenario could be used to illustrate to the students the need for developing effective communication skills between the students as well as with instructors and in their follow-on professional careers. As a result it was determined that the activity should have multiple levels so that the students could ease themselves into thinking as a newly minted engineer. It was also decided that the activity would include written and spoken forms of communication. There was also decided that since the PEEC program did not have access to the types of communication evaluators available in the Alverno community, the spoken interaction would be recorded for later review and analysis. Since a majority of the students at time were considering civil engineering it was thought that some aspect of that major

would be the basis of the scenario. The local history of North Dakota in the prior summer included multiple flooding events so it was believed that by including a flooding activity in the scenario, the experience would be more meaningful to the participating students. It was also thought that since participants were from the Native American culture it would be apropos to situate the scenario on a reservation with a significant river system but not a reservation upon which any participating students actually lived. A likely candidate was the Fort Peck Reservation on Missouri River in Montana. This would provide a location that the participating students could relate to and perhaps have visited but one that would be different from their home environment. The timing of the scenario within the 12 day camp schedule was to place it as a post-academic activity, usually conducted after the supper hour from about 6 to 8 in the evening.

So in the final form the scenario consisted of an initial session to introduce the problem, with immediate feedback about how the students felt. This was then followed by an assignment due within about three days for basic background on the situation and possible things to be considered. Several days later, there was another deadline submission for a document that would, within the constructs of the scenario, be responding to an initial request for proposals, RFP. Before the final form of that document was submitted, the scenario required a panel discussion of the items to be included in that final response to the RFP. This panel discussion was taped for later analysis. The participating students were broken into two teams of approximately 7 students each for these discussions, based upon personal traits, level within the program and social connections, i.e. break up cliques. This lent a bit of head-to-head competition to the scenario it was thought of as a mechanism to enhance student focus. Page limitations were invoked for all written submissions and the panel discussion was limited to 60 min. All the data has been compiled and archived but not yet analyzed. The scenario will have been repeated by the time of the conference..

CONCLUSIONS

The students quickly jumped at the opportunity for involvement in the scenario, even the very newest participants in the program felt that although they could not add much technically they wanted to participate in the thought process. The more advance students were a little more perplexed about what kind of technical expertise they could bring to the table but when they were assured that they did not have to bring the RFP to the level of verifying advanced equations their anxieties were relieved. The participants brought some of their individuality into the directions of the RFP's, for example one student was really focused on connecting with the local population and finding out their needs and attempting to meet their expectations in both physical and spiritual matters.. Other students proposed rather extensive options (several miles of interlocking steel levee work on both sides of the river) that

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were fine technical solutions but not necessarily practical solutions. If any of the students were totally confused or at a loss to propose anything, they did not voice their concerns. All the students responded to the mentors assurances in a positive fashion. These assurances could be considered as coaching steps to try to get participants to make some expression of the thought process involved with connecting the scenario to fundamental background research in the literature or personal real-life experience (some students had some construction experience).

One of the remarkable aspects of the scenario was the way it acted as a sort of "binder" for the individuals that made up the summer program. At the completion of the scenario, three or four days before the end of the program, the camaraderie amongst the entire group was extremely high and since self-support was a started goal of the overall PEEC PTIPS program, this was looked on as a positive unexpected benefit. The enactment of the scenario was in the context of a very small group with a rather large support structure around it, but the benefits in terms of expanded appreciation for the engineering profession, utility of work teams, general difficulty of communication, response to an unexpected situation, etc. were all aspects of the scenario that students seem to appreciate. Student appreciation for such items would be very hard to "teach" in a typical engineering curriculum or anything but a scenario. Given the right situation the authors believe that such an activity has much to recommend it.

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REFERENCES

- [1] "A Unique University-Tribal College Collaboration to Strengthen Native American Pathways to STEM Education", Padmanabhan G., Robert Pieri, Davis C. A., paper: AC2011-184, Accepted for Proceedings of 2011 Annual Conference of the American Society for Engineering Education, Vancouver, BC, June 26-29, 2011.
- [2] Connecting Student Learning Outcomes to Teaching Assessment and Curriculum, Alverno College Institute for educational outreach June 11-15, 2012

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