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Abstract

Milking the Rhino is an award-winning documentary that examines environmental conservation from the perspective of people who live in the midst of wildlife, and offers a complex, intimate portrait of two community-based conservation efforts in Kenya and Namibia. Penn State University developed and hosted a competition called Milking the Rhino: Innovative Solutions Showcase inviting students to develop appropriate, innovative and sustainable strategies to empower African indigenous communities to leverage natural resources for their self-determined development. The showcase was created for students from all majors as a venue to foster critical thinking about sustainable community development, indigenous communities’ self-determination, and the role technology in enabling new solutions to global inequities. This paper discusses the rationale and mechanics of the showcase, the key ethical issues that the teams grappled with, the solutions developed by the students, and (focus group) assessment results on the educational impact of the competition. Overall, the competition was successful in bringing compelling ethical design issues in the global arena into the classroom. Based on the success of the competition over two years, the feasibility of expanding it to a national competition is being assessed.

Introduction

The National Academy of Engineering envisions engineers to be leaders in the movement towards wise, informed, and economically sustainable development and has asked engineering educators to prepare students with a strong foundation and new knowledge of innovative technologies that advance society. In response, engineering education has seen a significant increase in emphasis on experiential education and on the development of “soft skills” that engineering students will need when they enter the workplace. This evolving vision of engineering education emphasizes the development of students as competent professionals and engaged citizens, equally at home with societal concerns as they are with technical issues. Ethics education is a significant aspect of making engineering education socially and globally relevant and preparing engineering students to excel in a globally interconnected world with tremendous diversity and inequities. Several strategies have been employed to bring ethics education to the engineering classroom – ranging from credit courses to learning modules to extra-curricular activities.

The Milking the Rhino: Innovative Solutions Showcase is inspired by the award-winning documentary with the same name and explores the relationship between people and wildlife in Africa. It examines environmental conservation from the perspective of people who live in the midst of wildlife and offers a complex, intimate portrait of two community-based conservation efforts in Kenya and Namibia. Students were invited to develop appropriate, innovative and sustainable solutions to empower indigenous communities to leverage wildlife and natural resources for self-determined development in Africa.
User-centered design (UCD) grounds the design process in information about the people who will use the product. UCD processes focus on users through the planning, design and development of a product. The showcase focused on attempting to understand the context of use and the specific requirements to develop technology-based solutions that address some of the challenges faced by the Maasai and Himba tribes in Kenya/Tanzania and Namibia respectively. The explicit goal was to teach students to unravel the sticky information related to the context of the problem because that step is critical in the design of meaningful, innovative, and sustainable solutions. Sticky information refers to information that is difficult to replicate and diffuse because it is embodied in the people, places, organizations, societal constructs, and other contextual dimensions. Sticky information may include intricacies in the power relations between key stakeholders, the silenced voices of marginalized factions, structural constraints to self-determination, and capitals of various forms that can be used in the design process.

In 2010, twelve student teams, consisting of students from engineering, health and human development, business, agriculture, and other colleges developed three-minute (YouTube) video pitches. In 2011, there were 20 participating teams. The pitches addressed specific problems related to the indigenous peoples' livelihoods, including wildlife and natural resource management, ethics, access to income, famine, gender inequity, and human rights. This paper discusses the rationale and mechanics of the showcase, the key ethical issues that the teams grappled with, the solutions developed by the students, and assessment results on the educational impact of the competition.

**Showcase Organizers**

The Milking the Rhino: Innovative Solutions Showcase was hosted by the Humanitarian Engineering and Social Entrepreneurship (HESE) Program in the College of Engineering and the Department of Recreation, Parks and Tourism Management in the College of Health and Human Development. Assessment of the educational outcomes of the project was conducted by the Leonhard Center for the Enhancement of Engineering Education. The basic philosophy of HESE is the “convergence of concepts, disciplines, cultures and countries towards a freer, fairer, friendlier and more sustainable world.” HESE brings together students and faculty from various disciplines to develop innovative and practical technology-based solutions to address compelling challenges facing marginalized communities in the developing world. All HESE initiatives aim at fostering developmental entrepreneurship and are grounded on long-term relationships with multi-sectoral partners. The ventures value and use knowledge of indigenous communities involved in the projects. HESE works closely with the Inter-institutional Consortium for Indigenous Knowledge (ICIK) at Penn State University on various teaching, research and entrepreneurial outreach initiatives.

**Rationale for the Showcase**

This section presents the rationale for hosting this competition from five different perspectives. The MTR Innovative Solutions Showcase strived to engage students in an experiential ethics education experience that engaged them emotionally, helped develop entrepreneurial mindsets,
provided a non-travel based global experience, developed their appreciation for indigenous knowledge, and ultimately fostered user-centered design.

**Engineering Ethics Education**

The ABET EC2000 accreditation criteria calls on engineering colleges to develop educational programs that foster understanding of ethical responsibility and an understanding of the global and social impact of engineering. Karl Stephan suggests that, “In the engineering world of the future, a sound understanding of the theoretical and practical sides of engineering ethics will be as necessary to the proper education of engineers as knowledge of differential equations is today.” Unfortunately, Herkert’s comprehensive survey of US engineering ethics education shows that the content of engineering ethics instruction has mainly focused on professional responsibility toward society—public safety and welfare, risk and the principles of informed consent, conflict of interest, and whistle blowing, among others. Engineering ethics education often focuses on individual and social responsibilities and overlooks the role of engineers in domestic and international humanitarian activities.

Curricular programs and extra-curricular student clubs that engage students in developing appropriate technology solutions for developing communities around the world are on the rise. The HESE Program at Penn State, Humanitarian Engineering Leadership Projects program at Dartmouth, the D-Lab at MIT, the Humanitarian Engineering program at the Colorado School of Mines, Global Resolve at Arizona State, and the Mortenson Center in Engineering for Developing Communities at the University of Colorado at Boulder are specific examples of curricular initiatives. Humanitarian engineering is being recognized as bearing significant potential for creating a new and meaningful approach to engineering ethics education.

**Ethics Education: The Challenge of Emotional Engagement**

Byron Newberry sorts the objectives of ethical instruction into three broad categories of emotional engagement, intellectual engagement, and particular knowledge. According to Newberry, emotional engagement deals with developing a student’s desire, on an affective level, to recognize, to care about, and to resolve ethical issues. Intellectual engagement refers to developing a student’s understanding, on an intellectual level, of the principles and application of moral reasoning and of strategies for grappling with conflict and ambiguity. Particular knowledge deals with developing a student’s knowledge of, and familiarity with, relevant ethical codes, common ethical issues, and cases of ethical precedent.

Newberry suggests that emotional engagement is the most important yet least tractable to achieve and to assess. The question is "how do we prepare students to want to make ethical decisions?" and "how do we do so without indoctrinating them?" Our team’s observations validate anecdotal claims by other similar programs that humanitarian engineering and social entrepreneurship programs draw passionate students that get emotionally attached to the projects, the people and their role in helping “make the world a better place”. This presents a unique opportunity to engage them in the ethical intricacies with the dual purpose of ethics education and ensuring that the projects themselves are being conducted in an ethical and appropriate manner.
manner that results in self-determined improvements in the lives of the end users or communities.

The MTR Innovative Solutions Showcase was designed to provide an environment for students to explore the ethical intricacies of engaging in social ventures in international contexts. For example, a Fundamental Canon of many engineering professional bodies is to “Hold paramount the safety, health, and welfare of the public”. If teams add safety features to a product for the developing world without regard to affordability, the target users may not be able to afford it - rendering the innovation meaningless! How do teams, then, design products for extreme affordability and live up to the Fundamental Canon at the same time? MTR Innovative Solutions Showcase aimed at eliciting discussions about the design trade-offs considering the nature of the product and the stakeholders’ profiles. The exercise attempted to engage students in debates on ethical issues related to science, technology and society in a seemingly “real” setting – thanks to the intimate connection to people and place provided by the viewing of the MTR film. In this exercise, the people were real, the ethical dilemma was real and most importantly, a consensus on ethical dilemmas and a suitable course of action was needed.

Non-Travel based Global Experience

As a result of globalization and the “flattening” of the world, recent literature in engineering education has emphasized the need for graduates to be aware of the world\textsuperscript{15, 16, 17}. Globalization has increased the interconnectedness between nations and peoples of the world. It has put increased pressure on educational institutions to prepare students for life in an increasingly connected and borderless world. The engineering profession is one of the most global professions with international design teams developing technologies for international markets. In response to this “flattening” of the world, there is a growing trend towards internationalizing the curriculum at universities.

Traditionally, adding global elements into the curriculum has been linked to experiences that require international travel, such as study abroad, international co-ops, and exchange programs. However, only a limited number of students are likely to be able or willing to participate in these types of experiences. In addition, rising travel costs and risk management concerns further limit the number of students who are able to have travel-based international experiences, especially to developing countries in Asia and Africa. Consequently, universities feel the need to develop non-travel based international experiences, in which students can still learn about the complexities of interacting with people from around the world and learn about global issues. The strategic plan for the College of Engineering at Penn State calls for all students to have a significant non-travel based international experience before graduation. Significant strides have been made towards this goal, with curricular elements such as the creation of teams of scholars with shared interests and expertise in particular regions of the world. The MTR Innovative Solutions Showcase is another non-travel based global experience that requires the students to understand a radically different context and culture and develop appropriate technology solutions and sustainability strategies.

Appreciation for Indigenous Knowledge
A summary of the definitions of the major scholars in the field provides a framework of global education consisting of eight elements. These elements are: human beliefs and values, global systems, global issues and problems, cross-cultural understanding, awareness of human choices, global history, acquisition of indigenous knowledge, and development of analytical, evaluative, and participatory skills. The MTR Solutions Showcase emphasized the importance of preservation of and respect for indigenous knowledge. Indigenous knowledge is about the ways of knowing, seeing, and thinking that are passed down from generation to generation, and which reflect thousands of years of experimentation and innovation in all aspects of life.

Over the course of human history, some communities have thrived without damaging or compromising the natural environment. Indigenous knowledge is gradually being re-evaluated and considered as an inspiring source of strategies for sustainable development. Indigenous knowledge has immense value for the culture in which it develops and also for entrepreneurs and problem-solvers seeking solutions to community problems across the world. For solutions to be successful and sustainable, they must be designed with the intimate involvement of all stakeholders so that the design meets their needs and use preferences and contributes to a self-determined improvement of their livelihoods and agency.

How can universities prepare students to be socially and globally conscious leaders and entrepreneurs that respect and appreciate indigenous knowledge? How do we bring the perspectives of indigenous people with different epistemologies and philosophies of life into the classroom? As discussed earlier, the university’s strategic focus on experiential, cross-disciplinary, international education with an entrepreneurial flavor is being harnessed by academic programs to develop technology products that help disadvantaged people in developing countries. The MTR Innovative Solutions Showcase encourages students to explore, appreciate, and leverage knowledge acquired and inherited by the Masai and Himba communities over time, to arrive at their proposed solutions to these communities’ livelihood/conservation dilemmas.

**User Centered Design (UCD)**

User-centered design (UCD) is an approach to design that grounds the design process in information about the people who will use the product. UCD processes focus on users throughout the planning, design and development of a product. ISO 13407: Human-centred design process is an international standard informing many UCD methodologies. This standard defines a general process for including human-centered activities throughout a development life-cycle. The four activities that form the main cycle of work include:

1. Specify the context of use: Identify the people who will use the product, what they will use it for, and under what conditions they will use it.
2. Specify requirements: Identify any business requirements or user goals that must be met for the product to be successful. (economic sustainability model, policy issues, etc)
3. Create design solutions: This part of the process may be done in stages, building from a rough concept to a complete design.
4. Evaluate designs: The most important part of this process is evaluation - ideally through usability testing with actual users.
The MTR Innovative Solutions Showcase focuses on attempting to understand the context of use and the specific requirements to develop technology-based solutions that address some of the challenges faced by the Maasai and Himba tribes in Kenya/Tanzania and Namibia respectively. The teams are encouraged to make an attempt to unravel the “sticky information” related to the context of the problem and develop effective and sustainable strategies to address developmental challenges.

**Innovation and Entrepreneurship**

The concept of Frugal Engineering refers to the notion that the product development process must be completely rethought and rebuilt in order to design, develop and deliver innovative solutions to customers at the Base-of-the-Pyramid (BOP). Instead of attempting to re-engineer products originally designed for wealthier markets, Frugal Engineering targets development of products that begin with the BOP population as the primary target customer. Frugal engineering addresses the billions of consumers at the bottom of the pyramid who are quickly moving out of poverty in Russia, China, India, Brazil, and other emerging nations. According to C.K. Prahalad, author of The Fortune at the Bottom of the Pyramid, these potential customers, “unserved or underserved by the large organized private sector, including multinational firms,” total 4 to 5 billion of the 6.7 billion people on Earth. Although the purchasing power of any of these new consumers as an individual is only a fraction of a consumer’s purchasing power in mature markets, in aggregate they represent a market nearly as large as that of the developed world.

Attracted by the size and rapid growth of emerging markets — concurrent with a growth slowdown in the developed world — companies in a range of industries are establishing distribution and manufacturing operations as well as research and development centers in these regions. Customers in these markets demand a different set of product features and functions than their developed-world counterparts, but still insist on high quality. Global companies, therefore, must change the way they think about product design and engineering. Simply selling the cheapest products on hand or reusing technologies from higher-priced products will not cut costs enough and is unlikely to result in the kind of products these new customers will buy. Engineering graduates developing products and services for emerging BOP markets or social ventures for extremely resource-constrained communities will need innovative thinking to succeed.

**Self-Determination**

Technological innovation focusing on the top of the pyramid and trickled down or recycled to the poor has arguably contributed to endemic global disparities and the continued dependency of southern or post-colonial people. The MTR Innovative Solutions Showcase prompted students to create strategies designed for those at the base of the pyramid to empower those individuals to lift themselves out of poverty and dependence. This approach is based on the notion that development should lead to freedom and that indigenous communities will thrive if they find themselves in an environment in which they can effectively influence their lives. Self-determination is defined as an individuals’ ability to pursue goals that are personally meaningful to them and may be conceptualized and operationalized at the individual or aggregate levels (e.g., a village or a sub-segment of a community). According to many development scholars,
individuals inherently seek their optimal development, but this kind of development is only attainable if individuals are supported by a nurturing environment that helps them meet three basic needs. Accordingly, social contexts that help individuals feel competent, autonomous and related will facilitate intrinsically motivated self-help behavior. The MTR Innovative Solutions Showcase explicitly requires teams to propose solutions that will free individuals from endemic dependence. The exercise requests multifaceted solutions to solve specific problems experienced by indigenous communities, and rewards solutions designed to contribute to a broader strategy to empower indigenous communities to secure and maintain control over their lives.

**Showcase Mechanics**

This section discusses the mechanics and logistics of the Milking the Rhino Innovative Solutions Showcase. The website for the showcase is [http://mtrsolutions.weebly.com/](http://mtrsolutions.weebly.com/). The showcase was open to undergraduate and graduate students from all disciplines across campus. The majority of the students were undergraduate students. The competition was incorporated into the syllabus of two regular classes – all students were required to come up with a pitch and they were encouraged to participate in the competition too. Students were recruited from specific classes in engineering, education and tourism management. The competition was promoted through relevant student clubs and mailing lists in all the colleges. Student volunteers helping with the organization of the competition also made quick pitches in various classes with the instructor’s approval.

Teams could include between one and four members, and could integrate external advisors (faculty members, students, industry professional, etc). An objective of the competition was to educate students on how to convey their ideas in a precise and concise manner. Articulating complex ideas to a general audience is a crucial skill for entrepreneurs and social media like YouTube provides an excellent medium to reach more people and garner more support. Video pitches of longer than three minutes were not accepted, though a few extra seconds were condoned by the referees. All video pitches were uploaded on YouTube - no other websites or video files were accepted. There were no project reports or presentations. It was also essential that all video pitches confirm with copyright regulations. The fact that the videos were in the public domain and the entire world could watch the pitches put additional pressure on the teams to ensure that the videos were professional and respectful towards all people. The students had the option of whether or not they wanted to identify themselves in the video pitches.

The preliminary means of understanding the context and challenge was viewing and reflecting on the “Milking the Rhino” documentary. The other resources included Milking the Rhino study guide, scholarly literature, and a discussion forum focused on the challenges illustrated in the film. Instructors participating in this competition had extensive personal connectedness, research insight and field experience with working with the Maasai people in Kenya and Tanzania and the Himbaa people in Namibia; and they actively shared their experience in structured and informal ways with students. Before viewing the documentary, students were encouraged to read the paper titled “Using Social Science to Unlock the Pan-Human Capacity for Innovation” and review the Milking the Rhino study guide. Students were provided a series of ten prompts which they were supposed to review before the screening. They were expected to discuss the...
documentary (with instructor) and the prompts (amongst themselves) and formulate their responses. Below are the prompts the students received:

1. Identify five characteristics of the Maasai people.
2. Identify five characteristics of the Himba people.
3. Identify ten characteristics of the context that the Maasai and Himba live in.
4. Identify five challenges that the Maasai and Himba face.
5. Identify five relationships between wildlife and rural livelihoods.
6. Identify five challenges to the conservation of wildlife and natural resources in Africa.
7. Identify three ethical issues encountered in the documentary.
8. Identify five opportunities for the local (Maasai and Himba) people to benefit from tourism.
9. Identify five problems that we share with the Maasai and Himbaa people.
10. Identify five technologies that the Maasai and Himba people currently use.

Students were challenged to understand and articulate the way the world looks from the Maasai or Himba people’s point of view. Their thoughts about the world or the people, places and problems in the two case-studies in the documentary were secondary. Students were expected to respond to the questions based on the documentary, literature sources and other information sources. The responses should have five/ten bullets with one (and only one) sentence for each bullet point – it was essential to be precise and concise. The documentary DVD was available for viewing in the library at anytime, and several teams availed of that offer.

The ultimate goal was to empathize with the stakeholders, understand their context of use, unravel the sticky information and derive innovative product ideas from the lives of the users themselves, and to design innovative and sustainable solutions that empower the stakeholders. Classroom discussions on varied topics like the concept and praxis of self-determination, role of indigenous knowledge, importance of “business models” to ensure economic sustainability, and unconventional ways of thinking of business models enriched the learning environment and led to deeper learning by the students, as evidenced by the quality of pitches.

Students were challenged to make three-minute video clips of their solution to “milk the rhino”, i.e. leverage local natural resources to address a specific constraint to local livelihoods. The video pitch could address any general or specific problem related to the indigenous peoples' livelihoods, including wildlife and natural resource management, access to income, famine, gender inequity, human rights, inter-generational conflict, child and maternal health, etc. The context could be either the Maasai or Himba people and their natural surroundings, or any other indigenous people with similar challenges in Africa. Students had to identify the problem themselves and convince the referees that the problem was critical to the community.

The student pitches were rated by a multi-disciplinary panel of five faculty members. These five referees represented the fields of engineering design, entrepreneurship, tourism and development, social structures in Africa, video production and human rights. The referees rated every team on a scale of 1-10 on ten rating criteria. An average pitch would get a score of 5, while a truly outstanding one would get the full ten points, for every metric. The rating criteria were:
Demonstrating an understanding of context, population, and problem

1. Does the team demonstrate reasonable understanding of the target population?
2. Does the team demonstrate reasonable understanding of the context?
3. Has the team clearly articulated the specific problem they are trying to address?

Quality of solution

4. Has the team articulated their specific solution well?
5. Is the solution practical / realizable / feasible?
6. Is the solution innovative?
7. Is the solution economically sustainable?
8. Does the solution have the potential for scale-up for regional implementation?

Quality of the video

9. Does the team's pitch have a logical flow?
10. Does the team use their media - audio and visuals nicely? (Does it entertain and intrigue the referees and audience?)

All the video pitches were screened in one of the University’s auditoriums for the participating students, their friends and the general public. Following the screening of the pitches, two teams were recognized for the most innovative pitch and the most sustainable pitch. During the first year, the awards were gift certificates cobbled together by the student volunteers from local businesses. During the second year, there were three winning teams and they received university mascot statuettes. The video pitches from the last two years can be viewed on YouTube at:

2009 Playlist:
http://www.youtube.com/user/HESEPSU?feature=mhum#p/c/4C860529248A1752

2010 Playlist:
http://www.youtube.com/user/HESEPSU?feature=mhum#p/c/462D6AC21E9B061E

Overview of Video Pitches

The student’s proposed solutions tried to optimize the utilization of the natural and local resources, and indigenous knowledge of the local people. They also calculated the cost and the benefit carefully to make sure that the solutions themselves are workable and sustainable in these African communities. In addition, these solutions were generally inexpensive, easy to build and implement, so that they can be sustained and scaled up in other African communities.

The video pitches addressed specific problems related to the indigenous peoples’ livelihoods, including wildlife and natural resource management, ethics, access to income, famine, gender inequity, and human rights. For example, research into these indigenous cultures showed that cattle are the main source of revenue and survival to the Maasai and Himba people in Africa. However, due to natural and other disasters, each year there are great losses of cattle. In some areas, cattle are constantly attacked and eaten by predators, causing the local people to kill those predators in an attempt to protect their cattle and their livelihoods. However, these predators are
endangered species protected by the government. So, students might debate on how to protect the cattle while also protecting wildlife. One group of students proposed using the local houses to circle around the cattle and the crops to keep people and livestock safe. Another group pitched for “auctioning problem lions”; where problem lions would be identified, the license to hunt it would be auctioned online to trophy hunters worldwide, and proceeds would be used on community projects to improve local facilities or education.

Another challenge to Masaai and Himba livelihoods is the health of their livestock. Veterinarians are rare in African countries so when cattle are sick, their owners have to travel a long distance to find a veterinarian, if they can find one. This is costly and time consuming, which can be valuable and crucial to the treatment of the cattle. Based on the fact that 97% of the Tanzanian people have access to a cell phone, a group of students proposed building a text-based system in which the owner of the sick cattle can text their questions or even pictures of the cattle to a veterinarian, who will text back treatment or a temporary solution. The team also proposed leveraging the time and altruistic motivation of veterinarian students as the “first responders” in this tele-vet-medicine system.

Another major problem in African communities is the lack of safe drinking water. Students pitched many innovative ideas addressing this problem. Students tried to use materials that are readily available to the local community to build water filtration systems. A team discovered that plastic waste accumulation is a big problem in some regions and proposed using plastic bottles to build a simple rainwater harvesting system with solar disinfection techniques. Another team demonstrated how to make a portable fog collector and solar still using wood, animal hide and otjize, a natural resource from the place, to capture fog or rain, and evaporate the contaminated water to make water potable.

Other pitches targeted poverty of the local tribes, lack of education, lack of steady access to income, gender inequality, and management of wasted natural resources. For example, one team proposed building a community-based home-stay product, potentially attractive to affluent markets, for tourists interested in traveling to and intimately experiencing everyday life within an African community. This tourism system could bring steady income to the community while helping the community preserve their culture and engage in cross-cultural exchange. Another team proposed setting up a school taught by U.S. study abroad interns for Maasai women to learn business practices and computer skills so that they could sell their home-made jewelry at a fair market price, thus gaining financial independence and agency. One of the winning teams built a machine to press avocado seeds so that the Maasai people could make use of millions of avocado that go wasted each year to produce rich oil and sell it to the cosmetic companies to bring in income to the community.

**Assessment Summary**

At the completion of the semester, students participated in focus groups to give them the opportunity to comment on the learning experience of the MTR Innovative Solutions Showcase. A total of three focus groups were conducted with 12-15 students in each group. The focus groups were facilitated by a team of consultants from the College of Engineering’s Office of Assessment and Instructional Support in the Leonhard Center for the Enhancement of
Engineering Education. The students were in groups with members from their own courses. Consequently students could share their perceptions of working on a team that was competing with students from a team in a different course.

The focus groups allowed for rich and thoughtful feedback from students in a safe share environment. Only the facilitator knew the identity of the students who participated in the focus groups. Students signed an informed consent document that stated all information to be shared regarding the focus groups discussion would be in summary form only. The students’ anonymity was assured because no identifying information was disclosed to the faculty and the facilitators were not involved in course instruction or the planning of the MTR Innovative Solutions Showcase. Since multiple students from several majors were present, the assessment team felt comfortable disclosing the student’s majors. The focus group interviews were captured using a digital audio recorder (for accurate transcription) and note-taking by the facilitator.

The purpose of the focus groups was to gain rich feedback on the students’ perceptions of participating in the showcase. The focus group protocol is available in the Appendix. The research team determined that each of the three focus groups would have one lead facilitator who was selected because of her experience in conducting focus groups. The focus group protocol centered on students’ perceptions on learning global awareness, teamwork, communication and collaboration skills, constraints and challenges of the competition and overall perceptions on the impact of student learning relative to the competition. The students, who participated in the focus groups discussion, were asked to give honest and constructive feedback. Although the entire focus group discussion was collected on a digital audio recorder, the data was used in summary form only and shared with the involved faculty.

All of the students agreed that this competition helped them better understand the challenges and, more importantly, opportunities facing indigenous people in Kenya and Namibia, and well as the complexities of using “authentic tourism” to help them improve their quality of life. Students reported that during the process of making the video pitches, they learned a lot about the cultures of the two African indigenous groups, which opened their eyes and sometimes shocked or saddened them in some way. They also learned how to fuse the indigenous knowledge and lifestyles with western knowledge systems to create sustainable value through appropriate technological solutions, which they identified as a precious real-world knowledge application experience.

A mechanical engineering student said, “I learned that designing low cost engineering solutions can be successful for people with economic hardship.” A second student stated, “The idea of learning about your users is important [in order] to know your users”. Students commented that time management and collaboration created challenges for the teams. They wanted clearly defined objectives and expectations. The students recommended more direction and instruction on the mechanics of participating in the competition, such as instruction on how to produce a video. An electrical engineering student recognized that “Video making is a tough job.” Students agreed that the team dynamics were different from previous team projects because “the group had to be together to make the project because we had to make a video and put ideas together”. Some students liked that the teams were self-selected because they felt more comfortable
working with friends. However, others felt that “the group was more open to a new idea when the group is not your friends” thus causing the team to be more creative.

When asked how participation in the competition shaped their awareness of other people and cultures, a Tourism Management student said that “tourism can be effective in moving a culture from their world to out of it.” The project caused the student to “think out of the box.” Recognizing the economics of the culture, a student said, “To us money equals power; a tribesman commented ‘why would you ask me the number of cattle I have? I don’t ask you what you make.’”

Conclusion

The MTR Innovative Solutions Showcase has been held twice with 12 and 20 teams participating in 2009 and 2010 respectively. The faculty members involved believe that it is a successful educational forum to explore the ethical aspects of globalization, design, humanitarian engineering and social entrepreneurship. Developing these competencies and mindsets is a long-term process and can involve a continuum of educational experiences ranging from intimate and prolonged stays abroad to virtual global engagement on campus – as modeled by MTR Innovative Solutions Showcase. Engagement in this exercise was the first formal introduction for many students to ethics, global engagement and social entrepreneurship. Penn State offers several opportunities for students to develop these competencies further. Ideally, this competition may enhance an awareness about humanitarian engineering and social entrepreneurship across campus which would help recruit students from various academic backgrounds into relevant courses offered by the HESE program and other curricular and extra-curricular global engagement opportunities at Penn State.

The competition generates a lot of interest amongst students and several teams worked on developing a pitch but were unable to get the video pitch together within the deadline. In the future, we are planning more resource sessions and “how-to’s” on ethical decision-making, business planning in BOP contexts, and making video pitches. We have received several requests from other universities to expand the showcase beyond Penn State. We are actively considering making this a national competition in 2011. The classroom discussions held by the instructors in the participating courses were pivotal and catalytic to initiating various debates amongst the students. Further in-depth assessment of the educational outcomes related to ethics and critical thinking are necessary to understand the impact of this kind of exercise on student learning. The faculty team is also interested in exploring the notion of emotional engagement with such challenges as an effective pedagogy for deeper engineering ethics education.

Appendix: Focus Group Protocol

Introduction: The purpose of this focus group session is to solicit student perceptions and experiences in the MTR course team project during this past Fall semester. The data collected will have no identifying information. Your feedback and ideas are very important to us and will help us improve and enhance the course in the future. This process will help us to understand your perceptions, both good and bad, of your learning experience this semester. We are primarily interested in perceptions on your experience with the team project. If you speak about the
contents of the focus group outside the group it is expected that you will not tell others what individual participants said. Please let us know what you think.

1. To start off this conversation, I’d like to know more about you:
   a. Please state your name, major(s), and minor(s)
   b. Please take a minute to explain the MTR project in your own words.
   c. List three things you learned (specifically) while working on this project.

2. In what way has participation in the MTR project shaped your global awareness and understanding (of other people and cultures). Please give an example.

3. You may consider yourself a citizen of the United States or your native country, or a citizen of the world. In what way has working on the MTR project influenced your opinion/attitude to become a global citizen?

4. How were the teams formed? How was working in the teams different from other team work experiences you may have had?
   a. A goal of this project was to practice communication and collaboration skills. Do you feel these two goals were met? Why or Why not?
   b. Did you feel that you really had to work together to meet a common goal? Why or why not?

5. How has the experience of unraveling the detailed information about the Maasai and Himba people and their lives - understanding your users and their context of use - impacted you personally and professionally?

6. Constraints spark Innovation: How have the constraints helped you exercise creativity and develop a more innovative solution? Give an example.

7. What are the biggest challenges you faced while working on this project?

8. What are your thoughts on the deliverable being a three-minute video pitch as the primary graded component of the project?

Bibliography


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