Incorporating sustainable ideas into traditional infrastructure – a hands-on peacebuilding approach to help solve an international cottage-scale environmental issue

Marissa Jablonski

Photo-Fenton oxidation is a process that uses iron, hydrogen peroxide, acid, and UV radiation to decolorize dye wastewater. Currently I am working on a sustainable version of this technology using rusty metal, household-safe hydrogen peroxide, toilet bowl cleaner, and sunlight, followed by simple sand and charcoal filtration to decolorize dye wastewater for cottage industry silk dyers in rural India. I was asked by a local cottage industry to help clean their wastewater a few years ago and have since completed laboratory tests that show this photo-Fenton oxidation to be a sustainable wastewater treatment technology for dyers, both economically offering a lost-cost option using readily available materials, and a simple solution that can be easily applied to dyers' waste streams without altering their operations much.

Returning to the site after completing laboratory tests, I have come into some very interesting discussions with dyers where I have been asked to leave and speak with the government in order to introduce the technology from the top down. It is the belief of the dyers that my presence in their community brings unwanted attention to their untreated wastewater dumping that threatens their livelihood. After speaking with the state pollution board, it is apparent that the dyers are never consulted to discuss their options in pollution treatment. In fact, their exact locations are unknown and therefore unmonitored by the proper authorities—their role in the informal economy of the region is virtually undocumented. There is a sericulture cooperative located in the same region as the dyers that brings in all of the players involved in rearing moths, growing mulberry as food, spinning cocoons, reeling yarn, and weaving colored fabrics. The dyers, however, are only outside contractors to color the yarn before weaving into silk saris. The dyers create wastewater which has higher pollutant levels than are allowed by the state pollution board which greatly impacts the natural environment of the sericulture cooperative and yet are never brought into to the discussion. The sustainable photo-Fenton oxidation treatment process can act as the catalyst to open discussions between all players involved—offering a low-cost option for dyers and help the sericulture cooperative and state pollution board to acknowledge the importance of the informal economy of the cottage-scale dyers. This potentially will decrease fear and create more peace in the region.

This 60-minute workshop will start with a hands-on demonstration showing how the sustainable photo-Fenton oxidation of textile dye wastewater works in the field having participants help with each step of the process. The participants will then be split into four groups each mimicking a different player in the application of a sustainable technology in the real world. In this case there will be a group that is the 'dyer', a group that is the 'state pollution board', a group that is the 'sericulture cooperative', and a group that is the 'peacebuilding engineer'. Each group will know their goals, incentives for change, and limitations and will open a discussion with each other to work on preventing dumping colored dye wastewater directly onto local soil.

Conferencia de Ingeniería, Justicia Social y Paz (IJSP)

Titulo:

La Educación para el Desarrollo Sustentable como motor para lograr la justicia social. El programa de fortalecimiento de competencias académicas de la Universidad Nacional de Colombia y la Secretaría de Educación del Distrito Capital.

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Formato: Presentación

Resumen:

La justicia social puede alcanzarse enfrentando la desigualdad, en la búsqueda de calidad, igualdad de oportunidades y el reconocimiento de los méritos individuales (Cuenca, 2011), citado por (Cuenca, 2012). La educación superior cumple un papel estratégico en el proyecto de desarrollo económico, social y político en el que está comprometido el país (Misas Arango, 2004). Por ello, la equidad es planteada como reto de la educación superior, garantizando el ingreso, permanencia y conclusión de los estudios a los diferentes grupos sociales que acceden a la educación (Castaño Duque & García Serna, 2012). Sin embargo, en Colombia existe un consenso en que la actual formación universitaria no responde ni cualitativa ni cuantitativamente a las necesidades de la sociedad (Misas Arango, 2004).
Está demostrado que el problema básico de la equidad, entendida como justicia social y mayor acceso a mejor calidad de vida, está íntimamente ligado a la sustentabilidad (UNDP United Nations Development Programme, 2011) y la principal contribución de la Universidad a la

sustentabilidad es la provisión de la Educación para el Desarrollo Sustentable (EDS) (Arbo y Benneworth, 2007; Stephens et al, 2008 Karatzoglou, 2013).

Bajo este contexto, la Secretaria de Educación del Distrito Capital y la Facultad de Ingeniería de la Universidad Nacional de Colombia se encuentran desarrollando un programa de fortalecimiento académico para bachilleres o estudiantes de secundaria de último año con el objetivo de complementar su formación y facilitar su tránsito y permanencia al sistema de educación superior hasta su graduación. Esta presentación muestra el contexto, los desafíos, la implementación y los resultados del programa de fortalecimiento de competencias académicas sustentado en la EDS buscando la disminución de la brecha de desigualdad para alcanzar la justicia social.

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Social Justice in Engineering Curriculum: Course modules to address the problematics of capitalism, systematic inequality, and imperialism.

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Format: Presentation

John Sylvan, one of the inventors of the Kuerig cup, recently regretted publicly his invention because of its negative impact on the environment. Several companies that are regarded as the top places to work for engineers, like Google, Facebook, Apple, and Twitter, released figures at the end of 2014 describing their workforce composition, and unsurprisingly, they revealed that great disparity existed in both race and gender composition. Furthermore, recent news that the Brazilian government intends to build nine hydroelectric dams in the Amazon that will annihilate the indigenous tribes there. The government justifies the impending apocalypse of these tribes because it meets the larger national interest for electricity, ironically a national interest that does not include the tribes' own survival.

Each of these stories relates important problematics that are at the heart of engineering: capitalism, systematic inequality, utilitarianism, and imperialism. If engineers are truly to design for a better future, they must learn to grapple and mediate the effects of these problematics, otherwise risk their cyclical reproduction again and again. Currently, engineers are not taught how to deal with their consequences in their formal educations, which we argue must be changed.

In our paper, we therefore propose a set of course modules to address the problematics of capitalism, systemic inequality, utilitarianism, and imperialism with the goal of teaching engineers approaches to engineering that actually address these problems. The modules focus on topics related to environmental justice, humanitarian engineering, ethical engineering practices, critical and historical perspective of technology, and spirituality in engineering. In the paper, we discuss the pedagogy and assessment strategies that should be leveraged to address systematic forms of resistance from the students.

Our paper would be of interest to faculty who are looking for new and critical ways to teach social justice related topics in engineering.

Transforming Curricula and Community through Participatory Research and Engagement

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Marygrove College

Abstract

Community engagement has become increasingly important in curricula as higher education moves away from only "emphasizing product" and toward "emphasizing impact." [1] Therefore, students' engagement with their community has become a strong thread in many educational processes, starting with K-12 through higher education. By encouraging students to volunteer their time and talents through mandatory community service hours, students develop the sense of accomplishment, confidence, and belonging that comes from working toward the greater good for society. In addition to providing students with experiential learning opportunities, the community benefits from the students' efforts during students' formative years and beyond.

To maximize the impact from students' engagement, participatory research can be utilized. Participatory research can be dovetailed with engagement efforts to target students and faculty efforts toward the priority needs of the community. It can also be used to harvest the wisdom of community members, and identify collaborations while building trust and buy-in.

Due to emphasis on shared governance, faculty are often adept at using participatory techniques for decision making and scholarly studies. At Marygrove College in Detroit, participatory research is at the forefront of faculty expertise and practice while community engagement is integrated into all students' academic experiences, aligned with the institution's urban social justice mission. Building upon this foundation, Marygrove recently completed an intensive institutional initiative to infuse 'Urban Leadership' (UL) into all curricula, co-curricula and campus life. UL is now incorporated into all majors, general education and experiential learning, including the engagement activities, making Marygrove College the first to fully institutionalize UL.[2]

Within the context of Detroit's reemergence and emphasis on engineering and innovation, new science and engineering programming is being developed under the UL umbrella, aligned with all Marygrove's tenets and infused with community engagement and participatory research activities. In this paper, the Urban Leadership curricula development, the new engineering programming, and transformation processes will be discussed. Examples are provided to illustrate the utilization of participatory research and community engagement activities.

Key words: community engagement, participatory research, urban leadership

[1] H. Fitzgerald, K. Bruns, S. Sonka, A. Furco and L. Swanson, “The Centrality of Engagement in Higher Education”, Journal of Higher Education Outreach and Engagement, Volume 16, Number 3, p. 7, 2012

[2] “BOLD Evaluator’s Report”, University of Michigan, Ann Arbor, 2014

COVER PAGE

Engineering, Social Justice, and Peace Conference

Title:
The Engineering Profession as a Conduit to Change in Personal Social Economic Power -The Role of Community Engagement and K–12 Engineering Learning Experiences towards Social Justice

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The Engineering Profession as a Conduit to Change in Personal Social Economic Power – *The Role of Community Engagement and K–12 Engineering Learning Experiences towards Social Justice*

1. OVERVIEW 1 – Engineering Profession and Personal Social Economic Power

- Global impact of education and development of professional and technical skills.
- Economic impact and personal economic power.
- The role of the community.

2. OVERVIEW 2 - K12 Engineering Learning Experiences

Students who participate in repeated science, technology, engineering and mathematics (STEM) active learning experiences at a young age have the potential to develop a deeper understanding of STEM content and skills necessary to pursue a STEM career.

Figure 1. Third grade students in the *Centro – Little Engineers* summer program discussing environmental engineering issues.

In addressing the numerous factors that contribute to unequal participation of underrepresented groups in science, technology, engineering and mathematics fields (STEM), many are in agreement that early academic experiences in math and science and exposure to STEM careers is essential. Throughout the last decade, researchers have recommended that career exploration and awareness begin before high school (Castellano et al., 2002; Fouad, 1995; O'Brien, et al., 1999). A study that used nationally representative longitudinal data suggests that to attract students into the sciences and engineering, we should pay close attention to children's early exposure to science at the middle and even younger grades (Tai et al, 2006). In the last ten years, a decreasing number of students are choosing to pursue STEM careers. This is particularly true for U.S. students from historically underrepresented minority groups. A report from the President's Council of Advisors on Science and Technology (PCAST, 2012) predicts a shortage of approximately one million new STEM professionals in the next decade; the report also identifies low college enrollment in STEM disciplines and an even lower graduation rate (fewer than 40 percent). This problem is even more severe for women and members of minority groups, as stated in the report: "…women and members of minority groups…now constitute approximately 70 percent of college students while being underrepresented among students who receive undergraduate STEM degrees (approximately 45 percent). This underrepresented majority is a large potential source of STEM professionals." (PCAST, 2012).

Hispanics are the largest of the subgroups within the underrepresented groups in STEM. The composition of our national student population is shifting significantly with tremendous growth in the number of Hispanic students. According to the Pew Research Center (2012), one-in-four (24.7%) public elementary school students were Hispanic in 2011. Unfortunately, a growing number of Hispanics are also economically disadvantaged. An increasingly diverse student population coupled with larger percentages of economically disadvantaged students adds to the challenges faced by teachers and university faculty who prepare teachers. If the nation's

economic well being is dependent upon having a well-educated workforce, it will be necessary to provide instructors at all levels with advanced professional learning opportunities that will enable them to help students succeed. It is also important for this professional development to be in an area that is interesting and relevant to students of all backgrounds. Too many students and parents are reported to believe that STEM subjects are too difficult, boring or exclusionary (PCAST, 2010).

3. Framework for Designing STEM Community Programs for Elementary Aged Students

When designing a STEM program for elementary students, it is important to identify support at the school or community level. Research on cultural-historical factors and their influence on Latino student educational success point to community as a particularly important element (Goldenberg, Reese, & Gallimore, 1992). Research has indicated that engineering curriculum and instruction in the pre Kindergarten to the twelfth grade classroom can serve as a vehicle to teach other content areas in a cross-curricular fashion (Author, 2011). Additionally, certain engineering curricula have been found to impact learning in the specific content areas of mathematics and science. The Next Generation Science Standards (NGSS) call for a learning environment that is student-centered and engages students in asking their own questions and designing experiments to solve problems. They also call for students to make physical system models that demonstrate their

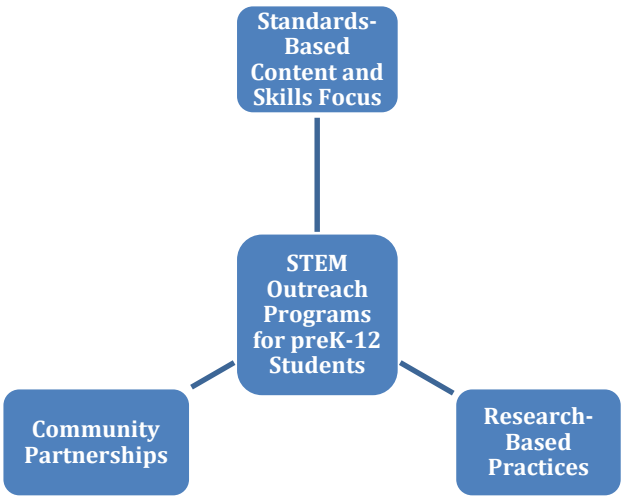

Figure 2. Framework for STEM Programs

learning and understanding. preK-12 engineering education may facilitate meeting these objectives, and efforts have already resulted in novel curricular approaches that have formally

structured activities and learning objectives around state curricular standards in mathematics and/or science (NGSS, 2014).

It is also a good idea to start off with a manageable program- a pilot, if you will, in order to collect direct input from all stakeholders, before expanding it to a large scale. In the following section, I will describe an early elementary outreach program called the ***Centro – Little Engineers* summer program**. It is a program that was designed to include a strong community partnership and features a career awareness component that exposes young children to role models found in EiE storybooks (Cunningham, et al. 2005), as well as to local Latina/o speakers who are professionals in the STEM fields. It is indeed powerful for children to hear from someone who looks like them and learn from their story—their journey—their career. Exposing children to STEM careers at a young age and over various experiences in and out of school, will reap enormous benefits for participating individuals and for the country as a whole. Such experiences are essential for students to learn the skills they need to succeed in the 21st century.

4. Detroit Area Pre-Engineering Program & Chicago Science and Engineering Program

5. The Texas State University/ Centro *Little Engineers Summer Program*

The *Centro – Little Engineers Program* was organized as an informal learning instructional summer program for third grade students. Since the program was designed for summer implementation, it was most important that it be attractively packaged and that it include fun hands-on activities without losing the academic focus. The five-day program was designed using backwards design curriculum development principles (Wiggins & McTighe, 2005). An environmental theme was selected and the theme and daily experience was aligned to select lessons from existing STEM curricula, such as *MOS Engineering is Elementary, and Tuft University's Early Algebra program. A* storybook-based lesson was used to introduce

engineering, technology, engineering design, and the field of engineering. Algebraic reasoning mini lessons were selected and State grade-level algebraic reasoning learning standards were presented to the participating students. As shown in figure 3 below, each day of the five-day *Centro – Little Engineers Program*, students worked in small teams, supported by a teacher facilitator, progressing through five inquiry-learning modules of approximately 5 hours each [with plenty of breaks for the kids!]. Each day, students were engaged in creating their own understanding by exploring and explaining algebraic ideas and processes, within the context of engineering problem solving.

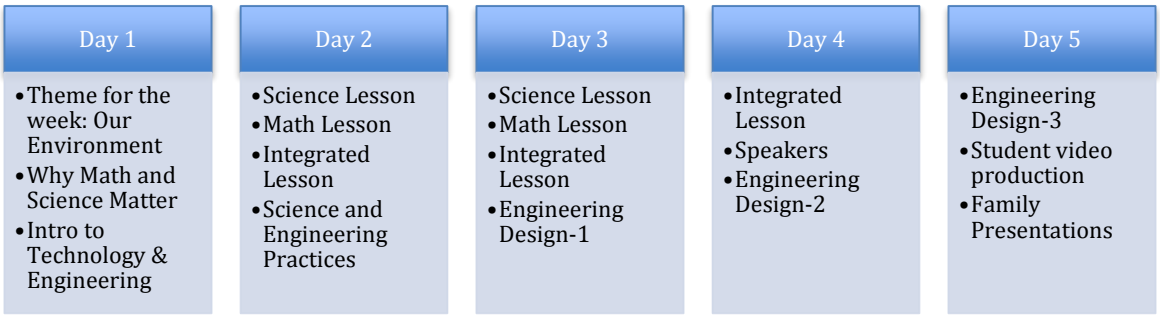

Figure 3. Five Day Program Overview

A culminating design activity allowed students the opportunity to practice their engineering design skills as an application of their new mathematical skills and understanding of science and engineering concepts.

6. The Student Participants and Guiding Research Questions

Under-served communities of Latino English Language Learner students from the same school district were targeted and recruited to participate not only to serve them, but also to further define and develop a research program to investigate the impact of integrated STEM learning experiences most effective with this student population. Twenty-five third grade students applied to participate. Students were selected based on academic achievement in order to give motivated and interested students from all backgrounds and skill levels an opportunity to benefit from this program. Students were recruited and selected based on parent and teacher recommendations and

students' interest and willingness to participate. The following research questions were used as guidance:

1 How does an integrated learning experience of engineering problem solving and design infused with early algebraic concepts promote students' exploration and generalization of phenomena, utilization of symbols, and justification of mathematical conjectures?

2 What additional approaches or scaffolding best support Latino students in the development of such algebraic reasoning?

7. Professional Development for the Teacher Facilitators

In order to develop additional preK-12 STEM expertise in the schools, the program instructors for students were in-service teachers trained in the curriculum and provided professional development in algebraic reasoning and engineering education. This program included a 1-day fall workshop, an 8 hour online supporting instruction module and a 2 day summer program. At its launch, 15 teachers participated in the professional development program. Up to 50 teachers will be invited to participate in future years. One program teacher for each cohort of 15 students was planned. Program teachers receive background content and instruction regarding the selected focus areas for these sessions, and they receive guidance in the facilitation of each engineering activity as well as the mathematics-learning objective. The learning objectives for the teachers include: a) to receive orientation regarding K-12 STEM learning opportunities and challenges, b) to receive an overview of engineering careers and to K-12 engineering education, c) to witness the interconnectedness of mathematics and science in the context of engineering design through hands-on practice, d) to realize the role of mathematics and science in collecting, recording, analyzing, and communicating observations, e) to utilize inquiry techniques in leading a STEM academic lesson, and f) to practice class management skills when leading class activities.

8. Program Assessment

Although the program described is relatively short (25 hours), it is intensive and changes in student attitude and learning can be assessed. The students' learning gains can be measured using pre- and post- assessments. Assessment tasks can be designed that are aligned to the State Standards for Science and Mathematics. These can be used as formative and summative assessment instruments to gauge the changes in children's learning of algebraic reasoning concepts as well as engineering concepts, processes and careers as shown in Table 1 below. In addition, classroom observational protocol and oral interviews can be utilized to collect qualitative data.

Table 1: Assessment Instruments

Name	Authors/ Organization	Learning Objective	Instrument Measurement	Method for Collecting Data
The Charles A. Dana Center-Algebra Formative Assessments	Dana Center and Texas Education Center Texas Mathematics Standards Reporting Category 2: Patterns, Relationships, and Algebraic Reasoning (Texas Education Agency, 2013)	Knowledge of Patterns, Relationships, and Algebraic Reasoning	Detects changes in knowledge over time or after intervention.	30 minute paper and pencil assessment. Pre/Post.
Museum of Science: Engineering is Elementary	Curricular Unit assessments: Environmental Engineering; Electrical Engineering; Industrial Engineering	Knowledge of technology definition; Understanding of the work of engineers; Understanding of the Engineering Design Process.	Detects changes in knowledge over time or after intervention.	30 minute paper and pencil assessment. Pre/Post. Clinical Interview adaptation-Pre/Post assessment.

9. Conclusion

The goal of this early elementary outreach program was to pilot the hypothesis that students who participate in repeated science, technology, engineering and mathematics (STEM) active learning experiences at a young age have the potential to develop a deeper understanding of STEM content and skills necessary to pursue a STEM career. The first year of a weeklong summer program was conducted and data has been collected for both students and teacher. During this pilot phase of the program, I was able to provide an integrated curricula and research-based learning experience to help students participate in rich learning sessions in an informal but culturally connected setting. Preliminary data is promising. Post data will be collected when these

students return for the 4th grade camp in the following summer. This program also engaged elementary teachers of English Language Learners in the learning of STEM content and instructional practices as professional development. This program has offered the opportunity for important community partnership development, hands-on opportunities for teacher professional development in preK-12 STEM and ultimately, for student preK–12 engineering learning experiences that foster student interest and skills in STEM.

Discussion of opportunities and changes via more students participating in engineering careers and key points to consider for communities and families.

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Reconstruct: Western and Noongar ways of knowing and practicing engineering: a community service learning program

Caroline Baillie, UWA (Interactive talk)

Project Team

UWA: Caroline Baillie, *Chair of Engineering School of Civil, Environmental and Mining Engineering and Project Director*, Grant Revell *A/Dean Teaching and Learning, School of Indigenous Studies*, Eric Feinblatt *SCEME, film maker and Director of NGO Waste for Life;* Aden Date*, Project Officer for Service Learning;* Community*:* Elders and Board of Management *Noongar Institute of Western Australia* Inc (NIWA).

Background

ENSC 2601 *A Critical Theory of Technological Development* founded and coordinated by Caroline Baillie, is a broadening elective offered to all undergraduate students at UWA. Engineering and Science students who take the unit are introduced to social and political critique of Western ways of knowing and practicing engineering. Arts and Social science students are introduced to the potential that engineering can offer in addressing Global challenges including those that it may have contributed to in the past. Together they enable the *critique* of the past and present with *the creation of sustainable and just alternatives* for the future.

Addressing issues of colonization becomes key to the necessary transformations arising in this class. The Noongar people are the traditional owners of the South West of Australia where UWA is located. In 2015 we were approached by The Noongar Institute of WA (NIWA) for assistance in developing its teaching and learning resources for **DIDARA WALGINER BURA MOGANG GUDJIR BALJARR** the *NIWA Centre for Excellence in Science and Technology*. NIWA is an inclusive centre for community advancement promoting Noongar excellence, leadership and innovation of the Noongar Nation. Following years of neglect from the traditional school system NIWA has been established by the community for the community - a new school for Noongar students, which will enable them to learn in culturally appropriate ways. They are unfunded and not supported by local educational authorities.

We accepted the challenge and proposed to develop a community service learning project with NIWA for the ENSC2601 students. In its pilot phase we expected to touch the surface of what might be possible. We hoped that ultimately engineering students would learn to question Western ways of knowing, develop an understanding of Noongar culture, and co- develop, with input from the community, some potentially useful learning materials for use by the NIWA community. The astonishing, transformatory experience of the engineering students in this pilot study far exceeded our expectations.

The NIWA representative wrote to me after the final student exhibition of work which the community helped to judge

This morning I believed in hope once again. It was a gift I will treasure for myself. Thank you. The Community was thrilled and proud. I only wish I could show them (the students) how wonderful they all were.. they spoke with depth and genuine care about the project (the future of our world is in good hands).

In this interactive talk I will describe the journey that students embarked on, the pedagogical techniques adopted to aid them on their journey, and the ways in which I mapped their movement through the liminal space of confusion and out into a new vision of complexity.

Universidad de Puerto Rico

Christopher M Papadopoulos <christopher.papadopoulos@upr.edu>

abstract for ESJP 2015

Donna Riley <dmriley@vt.edu> Thu, Jun 4, 2015 at 7:56 AM
To: Christopher M Papadopoulos <christopher.papadopoulos@upr.edu>

Educating for a Revolution: Discerning together the Highlander Idea and its Lessons for ESJP's Work

The Highlander Folk School was founded in 1932 in rural Tennessee to provide adult education and community empowerment to laborers in the Southern and Appalachian regions of the United States. Modeled after Danish folk schools, Highlander broke new ground by engaging racially integrated union organizing efforts among coal miners and other workers. The Highlander Folk School was one of very few integrated meeting places in the South in the 1940s and 1950s, and played a critical role in the Civil Rights Movement. It was shut down by the state of Tennessee in 1961, only to be reopened under a new charter as the Highlander Research and Education Center.

Highlander's methods of popular education, cultural organizing, language justice, intergenerational organizing, and participatory action research empower community members to identify issues, analyze their root causes in systems and structures, and lead change from communities most impacted by injustice. By creating spaces for personal and collective transformation, and for developing shared analysis and strategies for change across issues and identities, Highlander sustains activists in their work over the long haul for democratic participation and social justice.

As we think through possible models for social justice education among engineers,
the Highlander Idea may provide important lessons for us to take away individually and collectively. With support from the faciltator, participants will use cultural expression to illustrate and demonstrate Highlander's methodologies, and reflect together about their potential application in our individual and collective work for social justice in engineering.

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ESJP 2015 Proposal

Discourses of Development and the Language of University-Based Engineering-for-Development Program Websites

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Proposed Format:

Presentation

Abstract:

In this presentation, we present the results of a study of institutional culture in university-based, engineering-for-development programs that send students into developing communities. We study these programs' public sites of discourse formation toward understanding the culture of engagement they mediate—in the case of this paper, we focus on their websites. Through a qualitative content analysis of program websites, we test a methodological framework for developing insight into institutional cultures of community engagement. In our content analysis, we question if programs have different attitudes about the role of student and community expertise, methods of engagement, or pedagogical versus community outcomes? We distinguish between programs that send students to work in domestic versus foreign locations, and between those that engage urban versus remote communities. We discuss the extent to which evidence may be gleaned from websites as sites of public discourse. And we explore the significance of such sites as a public face of engineering-for-development programs that serve a function in student recruitment, outreach, and as an indicator of programs' ethical priorities.

In our investigation, we search for language and imagery that communicate specific ideas about community development work. We attend to such distinctions as working in, for, or with communities—as experts, as students, or as partners in collaboration. We attribute significance to how programs articulate priority between student learning objectives and community outcomes. We argue that program websites lend a partial view into cultures of university-based engineering-for-development programs and that triangulation of interview and program analysis data is required for more fully characterizing institutional culture.

METODOLOGÍA DE OBTENCIÓN DE BIOMASA PROBIÓTICA PARA LA ALIMENTACIÓN DE CABRAS EN COMUNIDADES RURALES

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Resumen

Para las comunidades rurales de países subdesarrollados se hace prácticamente imposible garantizar su seguridad alimentaria en la situación económica actual. La cría de rebaños de animales pequeños como las cabras (*Capra aegagrus hircus)*, constituye una alternativa viable para ese propósito. Se han obtenido resultados significativos enriqueciendo la dieta animal con microorganismos probióticos, pero los productores desconocen estos beneficios. Por tal motivo, el objetivo del siguiente trabajo fue diseñar una metodología simple para la obtención de biomasa probiótica en residuales líquidos para la alimentación de cabras en comunidades rurales. Para ello se emplearon cepas probióticas *Lactobacillus acidophilus*, *Klyuveromyces fragilis* en suero de leche de cabra así como *Saccharomyces cerevisiae var boulardii* P-1 y P-2 en melaza B con y sin adición de diferentes proporciones de urea. Cada sustrato pasteurizado (hervir por 5 min) se fermentó a 30ºC hasta 12 h sin aireación. Las variables de respuesta fueron: concentración celular viable (ufc/mL) mediante el conteo en placas de Petri con el medio de cultivo adecuado para cada especie microbiana, acidez (pH) y concentración de alcohol (% v/v) por densimetría digital. Se observaron diferencias estadísticamente significativas ($p \leq 0,05$) del crecimiento de la biomasa probiótica entre las cepas según el sustrato evaluado. Entre las cepas

capaces de degradar la lactosa, *L. acidophillus* tuvo mayor crecimiento en suero de leche de cabra (7,3 log ufc/mL) que *K. fragilis* (6,4 log ufc/mL) y *S. cerevisiae* P-1 superó a *S. cerevisiae* P-2 en melaza B sin urea. La adición de este nutriente aumentó la productividad de biomasa de P-1 (8,2 log ufc/mL/h) con producción máxima de alcohol (2,3 %v/v) que no es tóxico para las cabras. Se concluye que la biomasa probiótica obtenida con esta metodología facilita su aplicación por los criadores en sus comunidades, contribuyendo a su salud, su seguridad alimentaria y al aprovechamiento de residuales líquidos.

Palabras clave: *Lactobacillus*, *Klyuveromyces, Saccharomyces*, suero de leche, melaza, residuales líquidos, rumiantes, intolerancia a la lactosa.

METHODOLOGY OF OBTAINING OF PROBIOTIC BIOMASS FOR THE GOATS FEEDING IN RURAL COMMUNITIES

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Abstract

For the rural communities of developing countries it becomes practically impossible to guarantee their alimentary security in the current economic situation. The breeding of small livestock as the goats (*Capra aegagrus hircus*), it constitutes a viable alternative for that purpose. Significant results have been obtained by enriching of the animal diet with probiotic microorganisms, but the breeders/producers ignore these benefits. Thus, the aim of the following work was to design a simple methodology for the obtaining probiotic biomass in residual liquids for the feeding of goats in rural communities. Probiotic strains were used *Lactobacillus acidophilus*, *Klyuveromyces fragilis* in milk goat whey as well as *Saccharomyces cerevisiae* var. *boulardii* P-1 and P-2 in molasses B with and without addition of different urea proportions. Each pasteurized substrate (to boil for 5 min) was fermented (30ºC up to 12 h) without aeration. The response variables were: viable cellular concentration (ufc/mL) by count on Petri dishes with the appropriate culture medium for each microbial species, acidity (pH) and alcohol concentration (% v/v) for digital densimetry. Differences statistically significant ($p \leq 0.05$) were observed of the probiotic biomass growth among the strains according to the evaluated substrate. Among the strains able to degrade the lactose, in goat milk whey, *L. acidophillus* had

higher growth (7.3 log ufc/mL) that *K. fragilis* (6.4 log ufc/mL) and *S. cerevisiae* P-1 overcame *S. cerevisiae* P-2 in molasses B without urea. The addition of this nutrient increased the productivity of biomass (8.2 log ufc/mL/h) with maximum alcohol production (2.3 % v/v) that is not toxic for the goats. We were concluded that the P-1 probiotic biomass obtained with this methodology facilitates its application for the breeders in their communities, contributing to their health, their alimentary security and the use of liquid wastes as culture mediums.

Key words: *Lactobacillus*, *Klyuveromyces*, *Saccharomyces*, milk whey, molasses, liquid wastes, ruminant, lactose intolerance.

From Appropriate Technology to Wellbeing Engineering

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Technology is ever present in everyone's life and represents a major cultural aspect. Through the engineering design process the future is being built today in ways that represent major potential changes in the way we live, the way society is structured, and the possible ways to have a meaningful flourishing life. The technology innovation process usually does not include a critical analysis that considers the ways in which human flourishing is facilitated or the ways of life that might not be desirable.

The engineering education institutions across the United States, Puerto Rico, and in many countries have not included a consistent message to students in the engineering curriculum that clearly establishes the broad social responsibility of the engineering profession. While many important efforts in engineering ethics and related areas such as science-technology-society have provided a much needed insight, those efforts have not translated into a mainstream practice in some crucial aspects. For example it is possible for students to graduate from many engineering programs without ever being exposed to the notion that technology is not neutral. Engineering professionals might see the technology during the engineering design process as a tool that could be used for good and bad without realizing that it also has inherent characteristics that change the way we live and should not be categorized simply as good or bad depending on their use. Another important aspect that is usually absent from the technology innovation process is its impact to human wellbeing of the communities in which a type of technology is disseminated. The authors propose the concept of Wellbeing Engineering to include these important aspects into the technology innovation process.

The current work presents the use of ongoing efforts in Appropriate Technology and Responsible Wellbeing as a starting point to reflect upon the impact of technology on remote communities. These platforms in turn serve as a springboard to consider the same issues of quality of life to communities that are not poor. An example of energy access projects and smart grid development are used to examine the potential to translate appropriate technology criteria to spark the discussion on a wellbeing engineering framework.

Methods to engage communities in framing and solving humanitarian engineering challenges

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Format: Presentation

Humanitarian engineering (HE) is an interdisciplinary field that is rapidly emerging worldwide. Many higher education institutions are including HE and similar courses in the engineering curriculum, and students-led humanitarian organizations, like Engineers Without Borders (EWB), are rapidly increasing in number. Looking at the long history of HE projects, it emerges that humanitarian engineers, to be successful, must utilize problem framing and solving methods that meet the requirements of 1) involving community members at each stage of a project and of 2) integrating communities' culture, social norms, and politics in the proposed solutions. However, the HE literature still lacks of a widespread and unified repertoire of field-tested methods that can be easily accessible by less-experienced humanitarian engineers.

To address such a gap, for my doctoral research, I have undertaken a Scholarship of Integration to develop a toolkit that collects field-tested methods for properly framing as well as solving HE challenges. In this paper, I will present the results of the first step of my research, which comprised collecting and classifying methods (n = 54) that have been used in HE. The methods were collected from scholarly resources (i.e. journal papers and edited books) and from practitioner oriented resources, such as the IDEO HCD toolkit and the Peace Corps field guide. The result is a classification system that organizes the methods based on several dimensions, including the project stage in which to apply the method, the purpose of the method, and the degree of community involvement. Future research will focus on interviewing experts to understand what factors (e.g., local culture, philosophical commitments, time, and so on) enable the usage of the method.

This paper is designed for faculty and students who are engaged in humanitarian and similar projects and who are looking for effective field-methods to meaningfully engage community members in their projects.

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Proposed Format: Presentation.

Humanitarian Engineering: An open and collaborative field for a Post conflict scenario in Colombia[1].

This article aims to present a partial revision of the Humanitarian Engineering field, with various definitions and experiences of other paradigms gestation and levels of action. This approach as an object of inquiry in academia and professional practice and engineers, is recent. This has been discussed and built from institutions and individuals in the United States and some contributions European countries.

According to this context, the concept of Open Source Appropiate Technologies (Pearce, 2012b) is relevant in the dynamics of the Humanitarian Engineering. The OSAT are designed with the same open and collaborative approach to Open Source software. These technologies provide access to designs, specifications, drawings, photographs, circuits, drawings and material requirements, to be built by anyone (Buitenhuis, Zelenika, & Pearce, 2010). Appropriate open source technologies enable marginalized communities to have a voice and ownership of the technologies they use and create (Buitenhuis et al., 2010).

About the Colombian context, the current internal conflict in Colombia has been about 50 years long, facing various actors among institutional (Armed Forces and Police), and non-institutional groups. These processes generate expectations of a post-conflict scenario in Colombia, an event that would change the course of the Colombian population, generate new opportunities for young people and builds the way to address the priority needs of vulnerable communities.

Similarly, is expected to generate a reflection of engineering education for this period, as was the Report of the Committee on Engineering Education after the war (American Society of Engineering Education, 1944).

1 Proposal for Doctoral candidate in Industrial and Organizational Engineering PhD Program at Universidad Nacional de Colombia.

Natural Integration of Participatory and Value Sensitive Design in Product Realization

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Abstract

Participatory Design initiated in Norway in the early 1970s. With the introduction of computer systems to the workplace, the main concept was to enhance the quality of work life by assuring the participation of workers during the design process of the developed systems. For many products, such as tools, the user can provide experiences and insights during the design process. The challenge in the deployment of Participatory Design, as discussed in many research efforts, is in integrating the participatory input during the engineering product development process. This could even become more challenging when accounting for human values or adopting the philosophy of Value Sensitive Design during the product development and realization process.

The natural integration of Participatory Design and Value Sensitive Design with any engineering product development process depends on the process phases and flow. In this paper, the product realization process phases of inception, conception, and Maturation are utilized in the development of an approach for naturally integrating participatory and human value inputs during the different phases of the process. The realization phases, in this approach, can be considered as the natural phases of product creation in which innovation, analysis, and integration are necessary for the realization of the desired product attributes and characteristics.

In the presented approach, full participatory inputs start at the inception phase through idea inception, idea conception, and idea maturation. Human values are addressed during idea conception and maturation. Participatory and human values inputs are then injected during specific intervals of the product conception phase to assure achievement of desired product characteristics and attributes. Finally, Participatory and human values inputs are utilized for assessment and validation during product maturation and start of production. To illustrate and demonstrate the full implementation of the presented approach throughout the product development and realization process several examples are considered.

Developing Novel Practices of Somatic Learning to Enhance Empathic Perspective-Taking for Ethical Reasoning and Engineering Design

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***Abstract*—Empathic perspective-taking is central to human-centered, universal, user-centered, and participatory design approaches, as well as ethical reasoning. Designers and users have significant somatic (sensory, proprioceptive, and kinesthetic) knowledge about problems of technology utilization. However, engineering students are not currently taught to access, understand, or value this somatic knowledge in problem-solving processes such as design and ethics. To address this need, we are incorporating a series of developmentally-oriented experiences in enhanced somatosensory awareness adapted from somatics and performing arts into two short courses in the Summer of 2014. Both courses involve assistive technology design projects with community partners of differently-abled clients, but one is located internationally and the other domestically. We will utilize multiple measures of empathic perspective-taking in the context of engineering design and ethical reasoning before and after the courses to assess change. We believe this novel application of practices of somatic learning in the technical field of engineering design and ethical analysis will yield new insights into empathic perspective-taking. This work in progress paper describes our design, application, and testing of these somatosensory awareness practices in both an international and local context. At the conference we will present results from the completed study.**

Keywords—empathic design; engineering ethics; somatic awareness, universal design; assistive technology; ethical reasoning; perspective-taking

I. INTRODUCTION

While design has long been a core function of engineering, there is a significant paradigm shift occurring in engineering design from "technology-centered design" to "human-centered design" [1]. Examples of human-centered approaches include user-centered, participatory, inclusive, universal, and empathic design. Leading design firms such as IDEO also advocate human-centered design processes. IDEO described design thinking as:

> …a deeply human process that taps into abilities we all have but get overlooked by more conventional problem-solving practices. It relies on our ability to be intuitive, to recognize patterns, to construct ideas that are emotionally meaningful as well as functional, and to express ourselves through means beyond words or symbols. (http://www.ideo.com/about/)

IDEO further stated that the empathic design "approach to problem solving begins with peoples' thoughts and feelings" and involves working "to develop empathy and connect emotionally with the people you are designing for, in order to understand the problems and realities of their lives." (http://www.hcdconnect.org/methods/empathic-design)

Many different values, such as innovation or safety, that guide design decisions and processes, can impact how designers think about the ethical issues related to their designs and the implications of their "everyday" ethical decisions. Human-centered is a value that can influence the design process. For example, in their phenomenographic study of human-centered design, Zoltowski, Oakes, and Cardella [2] were able to identify seven distinct ways that students experience (and understand) human-centered design. The most comprehensive category was empathic design, characterized by a very broad and integrated understanding of the stakeholders and the social, cultural, political, technical and ethical issues associated with design. Design knowledge was gained through a direct connection with end users, not preconceived ideas and assumptions. Students in this study evidenced consideration of "everyday ethics" throughout their design process.

Empathic perspective-taking is central to human-centered design approaches. We propose that a more holistic approach to empathic perspective-taking must also include somatic (sensory, proprioceptive, and kinesthetic) knowledge. Designers and users have significant somatic knowledge about problems of technology utilization [3], [4], [5]. However, design and engineering students are not currently taught to access or value this somatic knowledge in problem-solving processes such as design and ethics.

Early efforts to develop empathic design used functional simulations (e.g. hazy goggles or oven gloves) to help designers empathize with users who are differently-abled [6] and "bodystorming" techniques to try to simulate user experiences and usage patterns [7]. The assumed but untested suggestion was these methods would result in better design of products for users. Genco and colleagues have tested the effect of an Empathic Experience Design (EED) method on the originality and quality of student designs [8]. They developed an approach that incorporated simulated experiences of usage, particularly in non-ideal settings, into the design process, to attempt to mimic the customer experience. They measured a small increase in the level of creativity in the EEDs compared to the control group, but no differences in quality of design were found. However, the students were not given any prior training to enhance their ability to perceive all the differences they were experiencing in those altered environments.