TEACHING AN ENGINEERING LECTURE IN AN OPEN TEACHING CONCEPT CLASSROOM

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Abstract
To properly respond to the economic, social and environmental challenges of the coming century, an increased number of engineers will be required. Moreover, global interconnectedness will require a more diverse population of engineers to work in unison towards finding solutions for new problems on a global level, as well as the initiative to do so. Diversity should never be limited to factors such as race or creed, rather, gender and culture must also be included to further engineering education as a whole. A truly diverse perspective is crucial in addressing the multi-disciplinary, global problems faced by contemporary societies. The classic days of old world belief and principles cannot sustain or survive in any modern, evolving scientific field and therefore must be allowed to pass to make way for programs that embrace new gender, personality and cultural diversity. The crux of education, especially in a field as ever changing as engineering, is its ability to change and adapt. Students must have cross-cultural exposure, diversity-related coursework. This paper will focus on providing information in conjunction with the "Open Teaching Concept that Texas Tech University that was founded in 2012 under the program of "Teaching Diversity Across the Curriculum: Open Teaching Concept" by the Cross-Cultural Academic Advancement Center (CCAAC) and faculty members involved in it's teaching, learning, and connecting (TLC) through the Diversity Advisory Council. The students involved had several opportunities to engage personally and professionally in meaningful cross-cultural explorations and other enlightening activities.

Keywords: Engineering education, Diversity, Open Teaching Concept

Introduction:

The rapid changes and increased complexity of today's world presents new challenges and demands educating engineering students as well as improving upon general education. There has been an increasing awareness of the necessity to change and improve the preparation of engineering students so that they can successfully function and excel in a modern climate [5-10-18]. What worked in the past may no longer be viable. Only some 15 years ago, most communication technologies were at primitive stages of development. The internet was not apparent, cellphones were in early stages and several modern touches were not yet implemented. Advances in technology brought challenges and opportunities, especially information technology and communications technology that have made possible new approaches to teaching, learning, and research that was previously unimagined [16]. As technology expands its grasp, particularly in the communication sector, its growth can be seen in several things. The mail system used to take weeks to transport a piece of mail during the period of the American Revolution, now you can mail objects across the globe instantaneously [3]. Companies can hold meetings via conference calls or instant messaging or applications such as Skype. Texting has become a common form of communication and social media's popularity has affected the world by bringing mass communication to the furthest reaches. Borders seem to have been demolished; we can speak with friends or family halfway across the world while an entire country experiences civil unrest. In fact, many modern examples of evolving societies have been greatly impacted with the use of twitter or Facebook to organize support and rally the populace, such as in Egypt of recent.

The growth of technology, as well as shifting demographics and globalization, are driving forces that are changing the role of engineering in society [34]. Engineering students should be prepared properly to function in a changing world. The inclusion of economic competitiveness, interdisciplinary information, and social diversity in globally and domestically is a necessity for a well-rounded engineer [4-27-28]. Although women and other underrepresented groups have made major breakthroughs in the fields of science, technology, engineering and mathematics (STEM), recent statistics show that scientific and engineering workforces are dominated by white men see figure 1.

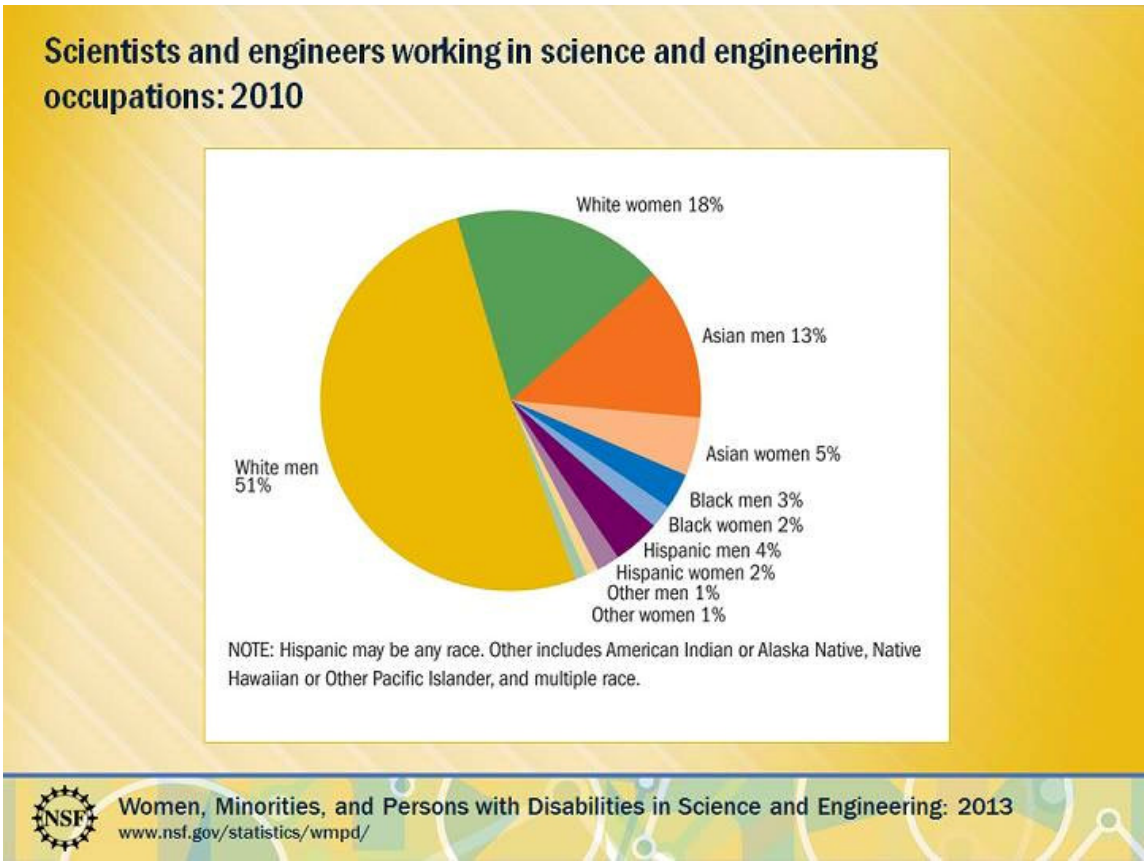

Fig1. Women, Minorities and Persons with Disabilities in Science and Engineering (Adopted from NSF Facebook, 2014)[21]

Not only are women a minority in engineering but overall, the US lacks a substantial amount of diversity. In 2006, the National Academies reported that African Americans, Latinos and American Indians made up to about 20% of the U.S. population. These groups accounted for just 9% of college educated Americans in SMET jobs [19].

The challenge to promote diversity amongst engineering colleges is still prevalent and on parallel is the need to teach existing students to appreciate the diversity. So many researchers have provided ample evidence that a diverse student body, faculty, and staff benefit the mission of universities teaching and research by increasing creativity, innovation and problem solving [8-9-23-34]. 21st-century technology and a knowledge-driven economy requires an evolving engineering education that recognizes the challenges and implements diversity and globalization topics in their curriculum or that can be implemented in existing curriculum in an innovative nature[20-21-25].

Professional outcomes

U.S Universities and the Accreditation Board for Engineering and Technology (ABET), the profession itself, and the industry are willing to embrace the changes in order to produce world-class engineers[1]. The director of ABET in 2002 reported that the future of the engineering profession may well depend on whether engineering education is able to initiate and implement

strategies to deal with future challenges, particularly in the international arena (ABET 2000 EC2000). Engineering Criteria, or EC2000, consist of several outcomes, eleven to fourteen depending on the program, one of which is "Outcome h". This criterion is the only one that refers to the requirement of global awareness [6].

So it can be said that responding to the economic, social, and environmental challenges of the coming century will take more than an increased number of engineers. It will require a more diverse population of engineers [13-14-17]. As we think about the challenges the next generation of engineers will face it is important to remember that students are driven by passion, curiosity, engagement and dreams. Although we can never be precise on a student's train of thoughts, we can focus on the environment in which they learn. We can, as educators, influence their ideas, inspirations, and expose them to empowering situations [4-11].

Teaching Diversity across the Curriculum: TTU Model

Part of Texas Tech University's vision is to create a community proud of its diversity, manifesting excellence, embracing diversity, inspiring confidence, and engaging on both a societal and global level. The Division of Institutional Diversity, Equity & Community Engagement (IDECE) and the Division of Undergraduate Education & Student Affairs (UESA) are committed to this vision [30].

IDECE strives for inclusive excellence across the university, and Texas Tech has become a national model for equity, access, social justice, and diversity in higher education. UESA is driven to increase student success and is creating an environment for students to pursue leadership opportunities, successfully transition to college, actively engage in scholarly research and find the best fit for their major and career[33].

The Cross-Cultural Academic Advancement Center Program

The Cross-Cultural Academic Advancement Center is a unit of Texas Tech University committed to working with faculty, staff, and students in designing meaningful cross-cultural dialogues intended to inculcate well-informed global understandings and cross-cultural competencies. "Teaching Diversity Across the Curriculum: Open Teaching Concept" is an initiative first undertaken in 2012 by the Cross-Cultural Academic Advancement Center (CCAAC) and faculty members that are part of its Teaching, Learning, and Connecting (TLC) Through Diversity Advisory Council. The TLC is composed of faculty and staff committed to the ideas of access to education, diversity, open and difficult dialogue, and the important intersection of curricular and co-curricular learning. Owing to the successful pilot in 2012, the TLC and CCAAC are expanding the OTC initiative in 2013 to broaden student learning by promoting open teaching [31]

Open Teaching Concept (OTC):

The aim of the Open Teaching Concept is to explore the issues of diversity and social justice, access and disparities, policy and poverty over a variety of disciplines, methods, theories, and paradigms. Looking at such topics as human rights, civil rights, hunger, multiculturalism, gender, labor and production, health, education, LGBT rights, economic opportunity, sexual violence, class, religious difference, environmental sustainability—OTC 2013 allows students, faculty, and staff to dialogue on the larger questions of social responsibility, global citizenship, and the ever-widening, ever-constricting local global nexus [31]

The Open Co-Curricular Experience

Considerable research strongly indicates that interactions with diverse peers, participation in well-informed and research-inspired diversity-related coursework, and substantive co-curricular activities animate students to challenge their own prejudices and promote inclusion and social justice. CCAAC continues to partner with other campus units to develop specific, co-curricular learning opportunities that engage students in personally and professionally meaningful cross-cultural explorations [30-31].

Procedure: How it works!

Selected faculty opened their classrooms on designated dates to other students interested in the topic. The faculty provided 50- to 70-minute lecture, presentation, or workshop related to the 2013 theme of Civil Rights, Human Rights: Questioning the 'Pursuit of Happiness".

- CCAAC staff provided additional resources needed by a faculty member, including logistics support (booking new classroom space, copies, ordering books, films, or other materials).
- The classes were recorded by the Teaching, Learning, and Professional Development Center for future use. Permissions were secured from both faculty and students in the classes. Dates and times were organized by faculty in collaboration with OTC faculty and CCAAC.

Faculty members of the Open Teaching program and general faculty, staff, and students had unique opportunities to engage in cross-cultural dialogue, explorations, and research as peers committed to advancing inclusive excellence and global citizenship [33]

2013 lectures Topics:

In 2013 in OTC program, 20 faculties across university from 7 colleges participated e lecture topics and colleges are giving below in Table 1.

Table 1. 2013 OTC program.

College	Lecture topic	Faculty
College of Human Sciences	Family Theory and Ethics/Morality	Jacki Fitzpatrick,
College of Arts &Sciences	These Meager Returns": Wage Labor, Relocation, and the Contemporary Native American Novel	Matt Hooley,
College of Arts &Sciences	Under the Sentence of Death: How African-Americans Survived Lynching	Karlos Hill,
College of Arts &Sciences	Poor People Don't Deserve a Clean World: The Call for Environmental Justice	Erica Morin,
College of Education	...and Justice for All: Examining the Work of Educating ALL students in U.S. Public Schools,	Fernando Valle,
TTU-SGA	Creating Opportunity through Diversity Leadership	Student Government Association
Edward E. Whitaker Jr. college of Engineering	Why sustainability and happiness belong together: Green building, healthier & happier life!	**Muge Mukaddes Darwish**
School of Law	Lawyers' Questioning and Rethinking the Notions of Negotiations and Culture in the Pursuit of Happiness	Wendy Ross,
Rawls College of Business	Business Success from Scratch: How to Get from Texas Tech Student to President of a Consulting Firm	Francisco Delgadillo,
College of Arts and Sciences	"James Baldwin, Civil Rights, and The Fire Next Time" - book that galvanized civil rights movement	Michael Borshuk,
College of Agric. Sciences and Natural Resources	Primary School for All Girls: A Secret Weapon in Economic Development and a Higher Happiness Index	Michael Farmer
College of Media and Communications	MTV and the Global Music Business - A New Pursuit of Happiness, College of Media and Communications Religious Freedom and the Pursuit of Happiness	Robert Peaslee,
School of Law	Religious Freedom and the Pursuit of Happiness	a debate with Donald May and Arnold Loewy
College of Education	The Impact of Human, Social, Cultural, and Civil Rights on Mental Health and the Pursuit of Happiness,	Aretha Marbley,
College of Media and Communications	Writing about America and Angels: An Intimate Conversation on Craft with Tony Kushner	Robert Peaslee,
School of Law	Celebrating Title IX after Forty Years in College Athletics	Brian Shannon,
College of Arts & Sciences	E.O. 9981, Integrating the U.S. Military: "How We Get to Fight with the White Guys",	Ron Milam,
College of Arts & Sciences;	What Happens After Social Movements Win?	Matthew Johnson,
College of Arts & Sciences	Slavery, Freedom, and the Origins of the British Empire	Abigail Swingen,
College of Education	Celebration and Struggle: American Dreams Undeterred	Mary Frances Agnello and Colette Taylor,
College of Visual & Performing	Gimme de Knee Bone & the Arms Akimbo! Cross-Cultural Creole Exchange & the Roots of American Popular Music	Christopher Smith,

Co-Curricular Events included: NBC comedy night, African –American lecture series, and Tony Kushner – Presidents performance & lecture series.

Welcoming the Prospects of Future Engineers:
Dr. Darwish's Construction Engineering (CONE3304) Sustainable development and Green Construction Course invited students to participate in an open class for non-engineering students in the fall of 2013. The 2013 Open Teaching Concept (OTC) course related to the lecture topic of"Why sustainability and happiness belong together: Green building, healthier & happier life!" A total of 110 students participated, 35 of the students were already enrolled and the rest of the students were from participating other OTC classes or read the activity through announcements.

Engineering and non-engineer students had the chance to interact with one another. Questions were asked by students of philosophy, English and other fields, as well as engineers, which brought about deep debate and conversations within the class. Several factors were woven into the class; structural aspects but also social contexts, environmental concerns and health issues were among the many issues touched upon within the coursework.

Unfortunately, the Texas Tech University Construction Engineering student body lacks diversity. The aim of this unique course brought about a student body that was truly diverse and altered the lecture atmosphere, leading to a much more positive and inspiring atmosphere for the students in class. By focusing on diversity on several levels, we can change the atmosphere of the coursework and invite in more prospective students and future engineers [9-35-36].

Fig2. Open teaching classroom – Dr. Darwish

Open Teaching Concept (OTC) is useful for exposing students of many disciplines to related courses and also in creating diverse students body in the classes. On the other hand, faculties also are exposed to different concepts and the pleasure of entertaining different context questions. This helps to bring to attention to the benefits of multicultural education, which aids in eliminating prejudice and sexism (gender discrimination). Some faculty members are not comfortable with talking about race and ethnicity, environmentalism and other cultural context, and as a result may limit their opportunities for diversity within their classroom(s) [12-15]. OTC provides students a broad lecture opportunity to attend and be exposed to be multicultural education amongst those who are comfortable talking about race and ethnicity.

Conclusions:

There is no doubt that a good engineer must first and foremost be good at engineering. He/she must have a solid background in science and mathematics and he/she must master a range of technological subjects related to his/her discipline. The engineer must operate in a world that uses technology, and must develop the relationship between future creative endeavors, technology and the foresight of a scientifically trained mind. A balanced relationship is required on many levels, and while a great engineer may be a genius in his or her field of expertise, if they lack the ability to balance the many issues of a contemporary society, they may be severely limited in their ability to affect the world positively. A diverse engineer is the sharpest tool in accessing the potential of a shifting scientific climate.

If engineering is to become truly engaged in understanding and solving societal problems, its practitioners must reflect society. Increasing diversity will facilitate new approaches and ways of thinking about engineering, while strengthening the link between technology and society. We must seek to create an educational environment that is relevant and appealing to a broader population and to make this education accessible to those from diverse cultural, ethnic and economic backgrounds.

The Cross-Cultural Academic Advancement Center (CCAAC) collaborating with faculty members that are part of its Teaching, Learning, and Connecting (TLC) Through Diversity Advisory Council launched "Teaching Diversity Across the Curriculum: Open Teaching Concept" in 2012. The TLC in Texas Tech University is composed of faculty and staff committed to the ideas of access to education, diversity, open and difficult dialogue, and the important intersection of curricular and co-curricular learning.

Dr. Darwish joined the Teaching, Learning, and Connecting (TLC) Through Diversity Advisory Council in 2013 and participated in the Open Teaching Concept (OTC) in the Fall of 2013. Dr Darwish's CONE 3304-Sustainable development and Green construction course was the only engineering class to participate in the OTC 2013 program. 35 students chose to attend at least one of the 20 remaining OTC classes. At the end of semester, interviews revealed that students were happy in participating and found the experience valuable. All participating student's feedback about the OTC was positive. Comments such as " I wish this was offered when I was in freshman, so I may have better way of understanding about different disciplines to help me choose my career path" by non–engineering students who participated in Dr. Darwish's CONE

3304 OTC class commented as" I thought engineering courses were boring and scary, attending to this class changed my view and as undecided college student made me to think transferring to engineering" revealed a deeper insight into prospective engineering students. There are those that fear engineering simply because it is presented as a cold and entirely mathematical field with a very uniform and pragmatic ideology. Diversity allows insight for prospective students and only further allows current students to flourish in their designated fields. By opening the doors, adapting to a contemporary society, engineering will see a gain in its potential.

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