

# Engineering for Developing Communities, Cultural Competency, and Diversity

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## Engineering for Developing Communities (EDC) program at the University of Colorado – Boulder (CU):

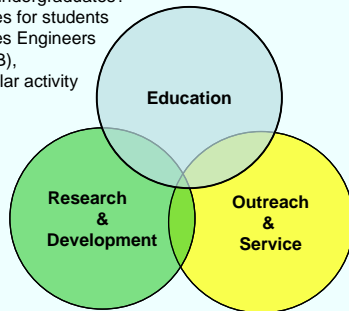
**Mission:** Educate globally responsible students and professionals who can offer sustainable and appropriate technology solutions to the endemic problems faced by developing communities at local, national and global levels.

### Education of engineers:

- 1) Who have the skills and tools appropriate to address the issues that our planet is facing today and is likely to face within the next 20 years
- 2) Who are aware of the needs of the developing world
- 3) Who can contribute to the relief of the endemic problems of poverty afflicting developing communities worldwide.

### EDC Program Elements:

- Graduate emphasis in Environmental/Civil Engineering
- Courses for graduate and undergraduate students
- Specialization for Civil Engineering undergrad students
- Future certificate for undergraduates?
- Research opportunities for students
- Program encompasses Engineers Without Borders (EWB), a popular extracurricular activity



### Personal Motivation:

I am one of 3 faculty at the CU leading the EDC program  
My motivation is largely that I see EDC as a way to attract greater diversity to engineering AND an excellent topic to emphasize many of the "soft skills" that are so important but often over-shadowed by technical skills for engineering student

### My role in EDC program:

- Integrate EDC into courses that I teach
- freshmen courses for Civil (CVEN) and Environmental (EVEN) engineers (required)
  - capstone design course for Environmental Engineering (EVEN)
  - possibly other courses

Mentor undergraduate and graduate students on EDC research

- Filtron

Former co-faculty mentor for EWB-CU (no longer in this role)

### Motivation from program perspective:

To grow and continue to garner University support and funding, need to document beneficial outcomes of the EDC program, in meeting University and College goals

### Summer 2006:

selected as an ISEE (Institute for Scholarship on Engineering Education) participant to learn about educational research and refine my research questions



Started with two separate research questions:

- 1) Does the EDC program attract/retain women and minorities into engineering?
- 2) Are students who participate in the EDC program more culturally competent than non-participant peers?

### Problems:

- Too broad!
- Which students are defined as "participants"?
  - Take a course into which an EDC module was added?
  - Take 1 EDC-specific course (sustainability, public health, etc)?
- "Fully" participate in EDC track for grads/ugrads?
  - Participate in an EWB project?
- Not very specific!
- How to measure?

*New research question that is specific, testable, and could be handled in a shorter period of time:*

**What is the impact of case studies illustrating "Engineering for Developing Communities" in freshmen courses on the students' "cultural competency"?**

- A case study related to EDC was developed from an Environmental Engineering capstone design project, and incorporated into EVEN freshman course

- An ethics case study on Fred Cuny, who worked on international development projects including refugee camps, from the Ethics Center for Engineering and Science website (<http://www.onlineethics.org>) has been an option for CVEN (since Fall 2003) and EVEN students (starting Fall 2006)

### Challenges:

- How to define "cultural competency"?
- that is relevant for engineering?
- Avoid difficulty of making own evaluation instrument
- validation difficult and time consuming
  - what instruments are available?
  - pros/cons, strengths/weaknesses of each particularly with regard to **engineering** and CC
- Combine research methods to provide richness (qualitative data) and statistically verifiable (quantitative data) results
- Student "control" populations – hard to remove content from existing courses to have intervention vs non-intervention populations given that there was specific motivation to add the content initially

### Synergy:

- Links with other summer '06 ISEE scholars
- Karen High interest in case studies, and teaches freshman courses
  - Larry Bland interested in international programs and cultural sensitivity
  - Lucena "humanitarian engineering" program at Colorado School of Mines and "Engineering Cultures" course
  - Others....

### Cultural Competency definitions?

CC is: the ability to effectively interact with people from diverse cultures and recognize the importance of cultural differences

Related to: Cultural Sensibility / Cultural Humility:  
-includes self-awareness and reflection

Downey, Lucena, et al. 2007 propose new engineering learning criterion:

Students will have the knowledge, ability, and predisposition to work effectively with people who define problems differently than they do

### Why is cultural competency important for Engineers?

Effectiveness in working on teams with engineers, scientists, etc. from diverse races and cultural backgrounds

Effectiveness in understanding the needs of worldwide clients who will use the engineered product or project

Deardorff PhD dissertation 2004, NC State

54% of the 24 participating institutions (33% survey response rate; 54% private, 67% teaching) said they were encouraging **cross-cultural development**, but did not assess the cross-cultural competence of students in their programs

Evaluation Tool pilot tested:

### Miville-Guzman Universality-Diversity Scale (MGUDS-S)

Universal-Diverse Orientation (UDO) = "an attitude toward all other persons which is inclusive yet differentiating in that similarities and differences are both recognized and accepted"

- Subscales assess 3 components:
- cognitive (relativistic appreciation of self and others),
  - behavioral (seeking diversity of contact with others), and
  - affective (sense of connection with larger society or humanity)
- Short form written survey is 15 questions; 6 pt Likert scale (derived from original 45 ? survey)
- Assessment instrument not specific to engineering – actually developed and used in medical settings (nurses, med school)

*Fuertes, Miville, et al. 2000. Factor structure and short form of the Miville-Guzman Universality-Diversity Scale. Meas Eval Counsel Develop. 33:157-170.*

Administered survey to ~200 CU freshmen and ~100 OSU freshmen early in semester fall 2006; ~100 CU freshman fall 2007  
re-administered to ~28 CU EVEN freshmen at end of semester F06  
Also surveyed ~40 CU senior CVEN/EVEN design students F06  
Attempted to add questions that see if engineers recognize importance of cultural diversity to written survey; results inconclusive....

See FIE paper 1254, Sat Oct 13, Session S2G: 10:00-11:30am, Juneau Rm  
Interviews probably needed to support findings

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