Collaborative: IUSE: Cultivating Inclusive Identities of Engineers and Computer Scientists: Expanding Efforts to Infuse Inclusive Excellence in Undergraduate Curricula

Dr. Rebecca A. Atadero, Colorado State University

Rebecca Atadero is an associate professor in the Department of Civil and Environmental Engineering at Colorado State University, specializing in structural engineering. She conducts research on the inspection, management and renewal of existing structures, and on engineering education.

Dr. Karen E. Rambo-Hernandez, West Virginia University

Karen E. Rambo-Hernandez is an assistant professor at West Virginia University in the College of Education and Human Services in the department of Learning Sciences and Human Development. In her research, she is interested the assessment of student learning, particularly the assessment of academic growth, and evaluating the impact of curricular change.

Robin A. M. Hensel Ed.D., West Virginia University

Robin A. M. Hensel, Ed.D., is the Assistant Dean for Freshman Experience in the Benjamin M. Statler College of Engineering and Mineral Resources at West Virginia University. While her doctorate is in Curriculum and Instruction, focusing on higher education teaching in STEM fields, she also holds B.S. and M.A. degrees in Mathematics. Dr. Hensel has over seven years of experience working in engineering teams and in project management and administration as a Mathematician and Computer Systems Analyst for the U. S. Department of Energy as well as more than 25 years teaching mathematics, statistics, computer science, and freshman engineering courses in higher education institutions. Currently, she leads a team of faculty who are dedicated to providing first year engineering students with a high-quality, challenging, and engaging educational experience with the necessary advising, mentoring, and academic support to facilitate their transition to university life and to prepare them for success in their engineering discipline majors and future careers.

Dr. Melissa Lynn Morris, West Virginia University

Melissa Morris is currently a Teaching Associate Professor for the Freshman Engineering Program, in the Benjamin M. Statler College of Engineering and Mineral Resources at West Virginia University (WVU). She graduated Summa cum Laude with a BSME in 2006, earned a MSME in 2008, and completed her doctorate in mechanical engineering in 2011, all from WVU. At WVU, she has previously served as the Undergraduate and Outreach Advisor for the Mechanical and Aerospace Engineering department and the Assistant Director of the Center for Building Energy Efficiency. She has previously taught courses such as Thermodynamics, Thermal Fluids Laboratory, and Guided Missiles Systems, as well as serving as a Senior Design Project Advisor for Mechanical Engineering Students. Her research interests include energy and thermodynamic related topics. Since 2007 she has been actively involved in recruiting and outreach for the Statler College, as part of this involvement Dr. Morris frequently makes presentations to groups of K-12 students, as well as perspective WVU students and their families.

Dr. Morris was selected as a Statler College Outstanding Teacher for 2012, the WVU Honors College John R. Williams Outstanding Teacher for 2012, and the 2012 Statler College Teacher of the Year.

Mr. Amir Hedayati Mehdiabadi, Colorado State University

Amir Hedayati Mehdiabadi received a PhD degree in Human Resource Development from University of Illinois at Urbana-Champaign. He received his B.S. in Computer Engineering from Sharif University of Technology in 2008 and his M.B.A. from University of Tehran in 2011. He has presented his research in past years at multiple conferences including American Evaluation Association, International Congress of Qualitative Inquiry, and Academy of Human Resource Development. In His dissertation, he focused on ethical decision making processes among computer majors. His research interests include ethics education, computer ethics, talent development, online learning, and evaluation.

Mr. Jeremy Clinton Schwartz, West Virginia University

Jeremy C. Schwartz is a first-year Doctor of Audiology (Au.D.) student at West Virginia University.

Dr. Christina Paguyo, University of Denver

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Introduction

Broadening participation in the engineering and scientific workforce is an important national goal that will help maintain and increase the size and quality of the U.S. STEM (science, technology, engineering, and mathematics) enterprise while also introducing new perspectives to help spark innovation in how we address important societal issues. In addition to attracting and retaining more students from underrepresented groups, it is important that *all* students receive the necessary preparation to work with diverse peers in an effective and inclusive manner. In this IUSE (Improving Undergraduate STEM Education) project, we are developing, implementing, and assessing curriculum changes that are intended to cultivate inclusive professional identities in engineering and computer science students. The key tenants of inclusive profession identities as defined by this project are: (a) fluency with the necessary technical knowledge, skills, and abilities for students to work in their chosen field, (b) an appreciation for how all kinds of diversity (cognitive, identity, background, and experiences) strengthen engineering and computer science as disciplines, and (c) knowledge of how to act in inclusive ways to create inclusive, effective environments within their field.

Project Goal and Objectives

The ultimate goal of the project is to identify and disseminate a set of curriculum activities that can be adopted and adapted by a variety of engineering and computer science programs to help undergraduate students develop inclusive professional identities. The project is driven by three specific objectives:

1. Study the transfer of first-year activities developed and piloted for engineers at one institution to both engineering and computer science programs at a minimum of three other campuses.
2. Develop, pilot, and transfer new strategies to extend the first-year activities into the second and third years of degree programs to provide for more sustained engagement with the issues of diversity and inclusion, particularly in the context of the technical courses.
3. Conduct longitudinal assessments, both short term (of students in intervention courses) and long term (of students as they progress through their degree programs), of the impact of the integrated diversity and inclusion content on students and the learning environment to better understand the potential for long term impact.

Data Collection

The project uses a mixed-methods approach to evaluating the impact of new curriculum activities on students. Student responses to the overall course are measured through surveys

implemented four times during the semester. The survey includes a variety of scales asking students about topics such as their general appreciation for diversity, engineering identity, intention to enact inclusive behaviors, and perceived relevance of diversity to engineering. Data are collected in first-year courses at three institutions. At one institution, the use of a common first-year curriculum for all engineering majors and multiple small sections of the course has allowed for a quasi-experimental design using comparison and treatment sections of the course to assess the impact of the first-year curriculum. The final survey of the semester includes a set of qualitative questions asking students about course activities that helped them learn about diversity and inclusion.

In addition, new curriculum activities piloted during this year are assessed through open ended student responses to a set of evaluation questions. These questions ask students to comment on what they learned from the assignment, how their learning would impact their future interactions with peers, if the assignment impacted their view of the roles of engineers, what they appreciated about the assignment and what they would change.

Preliminary Findings – First-Year Curriculum

The first-year curriculum has been implemented in new courses at the pilot institution and at two new institutions. One of the new institutions has a common first-year experience with many sections of the introductory course, which allows for the direct comparison of students in the intervention sections to students in the comparison sections. The poster will display comparison graphs.

The process of disseminating new curriculum to different faculty and in new institutional climates has also taught the research team many lessons. For example, not all faculty are prepared to handle diversity and inclusion curriculum and they may be learning as much from the course assignments as students. Even faculty who might think they are fully supportive of inclusive climates in engineering and computer science might not initially recognize some of their own biases. The implementation of new curriculum in the first-year program both demonstrates the need for enhanced faculty training and provides an entry point to get faculty thinking and talking about diversity and inclusion in the context of their technical fields.

Preliminary Findings – New Course Activities

New course activities have been developed and piloted in two additional engineering courses during the Spring 2018 semester. The poster shares student responses to these pilot activities.

Introductory Computer Science – Three new activities have been developed for this course. One activity seeks to promote a growth mindset in students by introducing them to the concept of neuroplasticity. This assignment is intended to aid all students in understanding that they have the capacity to acquire new skills through effort. The second assignment uses a YouTube video and articles to make students aware of the biases that can be introduced into algorithms by

human programmers, and highlights the social implications of technical solutions. The final assignment gives students the opportunity to practice coding loops using the particular example of gender pay inequity in technical fields.

Engineering Mechanics: Statics – The new assignment developed for this course is intended to help students recognize and appreciate the value of cognitive diversity when solving difficult problems. A design situation that makes extensive use of basic Statics topics within a context beyond anything students would typically see in Statics is presented as an in-class activity. Before participating in the activity, students were asked to watch a YouTube video about the value of cognitive diversity in the knowledge economy and respond to a few short reflection questions. Next, students were presented with the design problem and asked to work in groups. After groups had the chance to understand the design problem, each student in a team was given one of four distinct hints addressing different aspects of the design problem. Students were asked to "own" their hint and help their team apply the hint to solving the problem.

Continuing Efforts

In the coming year, course activities piloted in Spring 2018 will be disseminated across the partner institutions. Activities for a variety of additional courses at the sophomore and junior level will be piloted. Longitudinal data collection will begin tracking student attitudes toward diversity and inclusion as they move through their degree programs. Students will be asked to respond to the same survey items collected during the first-year once in each subsequent semester.