

Special Session: Culturally Responsive Practices in K-16 Engineering Education

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Abstract— Engineering education scholars have pointed to the need of cultural change in engineering education. To address this need, we propose this special session about the use of one strategy that bridges research and practice and has been underutilized in engineering education - culturally responsive practices. We aim to engage the audience in discussion about culturally responsive practices via collaborative case studies. The objectives of this session are to provide a space to reflect on what culturally responsive practices can be used in K-16 engineering education, to learn more and understand better the students, and to challenge deficit models in engineering classrooms.

Keywords—culturally responsive practices, special session, engineering culture

I. INTRODUCTION

Through this special session we aim to incite conversation about culturally responsive practices and their importance to engineering education. We developed three case studies to engage the audience in thinking about culturally responsive practices in K-16 engineering education via collaborative case studies. We will also discuss culturally responsive evaluation of engineering education practices. Through this special session, we hope to provide a space for the audience to discuss and deliberate about the ways in which they can use culturally responsive practices to address the larger goal of broadening participation and inclusion in engineering education.

Culturally relevant pedagogy (CRP) has been implemented in other STEM fields, primarily in K-12 scholarship [1]–[8]; however, in engineering there remains a lack of “buy-in” from educators. Part of the problem may be that engineering educators are unaware of the benefits CRP offers for all students. According to Ladson-Billings [9], three criteria must be met to provide CRP: 1) ability to develop students academically, 2) willingness to nurture and support cultural competence, and 3) development of a sociopolitical or critical consciousness. Engineering education scholars have pointed to the need of cultural change in engineering education. To address this need, we propose this special session about the use of one strategy that bridges research and practice and has been underutilized in engineering education - culturally responsive practices. We aim to engage the audience in discussion about culturally responsive practices via collaborative case studies. The objectives of this session are to provide a space to reflect on

what culturally responsive practices can be used in K-16 engineering education, to learn more and understand better the students, and to challenge deficit models in engineering classrooms.

We have four goals for our session: 1) introduce culturally responsive education and its importance to engineering education, 2) provide examples of culturally responsive practices, 3) engage the audience in conversation about culturally responsive practices in K-16 engineering education via collaborative case studies using group work, and 4) provide the audience with evaluation and assessment tools for culturally responsive practices.

II. DESCRIPTION OF SESSION

The session will consist of a brief introduction to culturally relevant pedagogy, followed by a presentation of the case studies. The case studies were developed by the authors and are meant to help the audience think of practical ways of implementing CRP to their own classrooms. Collaborative group work strategies will be used to ensure engaging conversation and discussion among attendees. The session will wrap up with a presentation of evaluation and assessment tools for culturally responsive practices in engineering education.

A. Case Study A

Case Study A uses the funds of knowledge framework [10] to develop engineering curricula in K-12 classrooms. A funds of knowledge, or the historically accumulated and culturally developed bodies of knowledge, skills, and practices, approach can be used to develop culturally responsive engineering education practices in the classroom. Teachers can create their own innovative instructional strategies by drawing from the different resources the students bring to the classroom. One example is to use household funds of knowledge (i.e., cooking) as a platform to introduce engineering concepts that are responsive, tangible, and familiar to the students.

B. Case Study B

Case Study B uses the community cultural wealth framework [11] to address engineering identity development in undergraduate engineering courses. This framework challenges educators to think about the assets and various forms of

capitals (i.e., inspirational, familial, navigational, resistant, linguistic, and social) that engineering students have in order to incorporate them in the classroom.

C. Case Study C

Case Study C focuses on linking principles of learning with deep understanding and appreciation of culture. This case study challenges engineering educators to shift the paradigm of deficit thinking which is projected on students of color. The presented case study involves middle schoolers who participated in a summer enrichment program. Part of the case study's effort was to expose students to mathematics and its relationship to engineering concepts.

III. EXPECTED OUTCOMES

We expect the following outcomes from our special session: a) understanding of CRP's benefits for all students; b) increased awareness of CRP and ways of implementing these practices in the classroom; and c) collaboration opportunities among audience members for implementing CRP in engineering.

REFERENCES

- [1] O. Lee, "Teacher change in beliefs and practices in science and literacy instruction with English language learners," *J. Res. Sci. Teach.*, vol. 41, no. 1, pp. 65–93, 2004.
- [2] O. Lee, A. Luykx, C. Buxton, and A. Shaver, "The challenge of altering elementary school teachers' beliefs and practices regarding linguistic and cultural diversity in science instruction," *J. Res. Sci. Teach.*, vol. 44, no. 9, pp. 1269–1291, Nov. 2007.
- [3] J. G. Irizarry, "Ethnic and urban intersections in the classroom: Latino students, hybrid identities, and culturally responsive pedagogy," *Multicult. Perspect.*, vol. 9, no. 3, pp. 21–28, 2007.
- [4] A. C. Barton, "Science education in urban settings: Seeking new ways of praxis through critical ethnography," *J. Res. Sci. Teach.*, vol. 38, no. 8, pp. 899–917, 2001.
- [5] A. C. Barton and E. Tan, "Funds of knowledge and discourses and hybrid space," *J. Res. Sci. Teach.*, vol. 46, no. 1, pp. 50–73, Jan. 2009.
- [6] A. C. Barton, E. Tan, and A. Rivet, "Creating hybrid spaces for engaging school science among urban middle school girls," *Am. Educ. Res. J.*, vol. 45, no. 1, pp. 68–103, 2008.
- [7] E. B. Moje, K. M. Ciechanowski, K. Kramer, L. Ellis, R. Carrillo, and T. Collazo, "Working toward third space in content area literacy: An examination of everyday funds of knowledge and discourse," *Read. Res. Q.*, vol. 39, no. 1, pp. 38–70, 2004.
- [8] E. B. Moje, T. Collazo, R. Carrillo, and R. W. Marx, "'Maestro, what is 'quality'?'": Language, literacy, and discourse in project-based science," *J. Res. Sci. Teach.*, vol. 38, no. 4, pp. 469–498, 2001.
- [9] G. Ladson-Billings, "Toward a theory of culturally relevant pedagogy," *Am. Educ. Res. J.*, vol. 32, no. 3, pp. 465–491, 1995.
- [10] L. C. Moll, C. Amanti, D. Neff, and N. Gonzalez, "Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms," *Theory Pract.*, vol. 31, no. 2, pp. 132–141, 1992.
- [11] T. J. Yosso*, "Whose culture has capital? A critical race theory discussion of community cultural wealth," *Race Ethn. Educ.*, vol. 8, no. 1, pp. 69–91, 2005.

AUTHOR INFORMATION

Dr. Renata A. Revelo received the B.S., M.S. in electrical and computer engineering, and Ph.D. in education organization and leadership in 2007, 2009, and 2015 respectively from the University of Illinois at Urbana-Champaign. She is currently a Clinical Assistant Professor of Electrical and Computer Engineering at the University of Illinois at Chicago. She previously worked as a graduate research assistant at the University of Illinois at Urbana-Champaign. Her research interests include engineering identity development, structural changes in engineering education, and success of underrepresented students in engineering.

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