Supporting Help-Seeking Among Today's Undergraduates in Gateway STEM Courses: A User-Centered Design Approach for Bridging Research to Practice

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Abstract: Adult and other *nontraditional* undergraduates (Horn, 1996) constitute a growing new undergraduate sub-population in science, technology, engineering, and mathematics (STEM) education. In today's STEM classrooms, undergraduates are no longer exclusively—or even majoritively—comprised of young high school graduates with few familial and/or work-related responsibilities. Today, increasing numbers of nontraditional students are entering STEM programs from diverse backgrounds, with varying levels of academic preparedness, and with substantial personal and work-related obligations. As policy makers emphasize the need for higher education to recruit and retain greater numbers of nontraditional undergraduates in STEM career pathways as means to strengthen and diversify the nation's engineering workforce, STEM educators are called upon to "acknowledge" and "work to accommodate" these student differences both in and out of the classroom—and most importantly in the context of gateway STEM courses (PCAST, 2012).

This engagement activity is designed to assist STEM faculty members, administrators, and graduate and undergraduate students, to (1) learn the varied characteristics of nontraditional undergraduates, (2) understand academic help-seeking behaviors and preferences of today's undergraduates engaged in STEM programs of study, and (3) identify strategies for providing effective support for all undergraduates, both nontraditional and traditional, within their own courses. This activity draws upon findings from a recent NSF-sponsored research study entitled "*Online Learning Forums for Improved Engineering Student Outcomes in Calculus*" (Minichiello & Hailey, 2013). During that study, we examined synchronous and asynchronous help-seeking behaviors and preferences of nontraditional undergraduates enrolled in the first-year calculus sequence (i.e., Calculus I and II) using a mixed-methods approach. The overall goal of the study was to promote nontraditional student success in gateway STEM courses via changes to course-level instructional support strategies.

During this 90-minute engagement activity, we will accomplish three goals. First, we will share findings and evidence-based recommendations for improving inclusivity and instructional support among contemporary undergraduates enrolled in gateway STEM courses. Second, we will introduce and generate discussion and feedback about a new, user-centered design (UCD) approach for sharing research findings with teaching practitioners in more accessible, memorable and empathic ways (Minichiello, Hood, & Harkness, 2017). Third, we will provide a collaborative opportunity for participants to use the UCD materials to ideate improvements to their current strategies for supporting help seeking among undergraduates in their own STEM courses. Participants' anonymous responses to the questions posed in this engagement activity will be gathered in accordance with an approved USU IRB protocol #10292 and used in our continuing research.

FOCUS

This active engagement session is STEM teaching practitioner-focused. The overall purpose is to create a space for STEM educators to identify and discuss the needs and preferences of STEM nontraditional undergraduates, as they pertain to classroom-based instruction, and then to assist STEM educators in collaboratively considering their own instructional strategies and course policies in light of these findings. As takeaways from this engagement activity, we would like participants to realize a heightened level of awareness and empathy of nontraditional undergraduates in STEM and be prepared to ideate new approaches for supporting today's undergraduates in their courses.

LEARNING OBJECTIVES

After completing the engagement activity, participants will be able to:

1. Describe common characteristics that serve to identify undergraduates as "nontraditional."
2. Discuss how the help-seeking behaviors and preferences of today's nontraditional undergraduates can differ from traditional student approaches to help seeking.
3. Ideate new/changes to current teaching strategies and course policies, based on evidence-based recommendations, for providing help-seeking support for today's undergraduates in the context of their own STEM courses.

INSTRUCTIONAL STRATEGIES

During this engagement activity, we will use the following instructional strategies: think-pair-share and small group discussion, large group discussion, collaborative review of evidence-based materials, and personal reflection.

Note: Because we will use the written responses of groups (i.e., completed group worksheets) as data in our ongoing research, we will provide participants with a letter of information from an approved IRB protocol at the beginning the workshop. Participants may leave the workshop or choose not to contribute to the anonymous data collection if they wish.

OUTLINE

The proposed 90-minute engagement activity will be comprised of seven segments:

Segment 1 (5 min): Introductions and discussion of the purpose and goals of the activity. Provide IRB Letter of Information for anonymous data collection activities (worksheets).

Segment 2 (10 min): Break into small groups of 3-4 around common teaching assignments (i.e., calculus, programming, mechanics, science, disciplinary engineering courses). Have small groups anonymously complete worksheet Part A while discussing the following questions:

1. Describe the nontraditional undergraduates in the STEM courses you teach?
2. What types of course-level supports do you offer?
3. To what extent do your students use these course level supports?

Segment 3 (10 min): Return to large group. Small group report out.

Segment 4 (10 min): Present research findings and recommendations related to nontraditional undergraduates support behaviors and preferences in a gateway STEM courses (Calculus I and II). Emphasize new knowledge provided by research findings.

Segment 5 (25 min): Describe the UCD approach for translating research to practice. Distribute model materials and break into small groups to review the materials. Small groups complete the worksheet Part B based on collaborative review of the UCD model.

1. What are your initial reactions to the materials?
2. What aspects of the materials, if any, do you find potentially useful for curricular/instructional design in STEM courses?
3. What aspects of the materials, if any, do you find useful for development of STEM course policies?
4. What did you learn, if anything, from reviewing these materials?
5. Do you/How can you envision making changes to your current teaching practices/course policies based on the information in these materials? If so, briefly describe the changes.

Segment 6 (20 min): Return to the large group and report out.

Segment 7 (10 min): Collect the worksheets, wrap up the discussion, and evaluate the session.

If we are asked to do this engagement activity within one hour (60 minutes), we will revise the activity segments as follows:

Segment 1 (5 min): Introductions and discussion of the purpose and goals of the activity. Provide Letter of Information for data collection (worksheets).

Segment 2 (10 min): Present research findings and recommendations related to nontraditional undergraduates support strategies. Emphasize new knowledge provided by research findings.

Segment 3 (25 min): Describe the UCD approach for translating research to practice. Distribute model materials and break into small groups to review the materials. Small groups complete the worksheet Part B based on collaborative review of the UCD model while discussing the following questions:

1. What are your initial reactions to the materials?
2. What aspects of the materials, if any, do you find useful for curricular/instructional design in STEM courses?
3. What aspects of the materials, if any, do you find useful for development of STEM course policies?
4. What did you learn, if anything, from these materials?
5. Do you envision making changes to your current teaching practices/course policies based on the information in these materials? If so, briefly describe the changes.

Segment 4 (15 min): Return to the large group and report out.

Segment 5 (5 min): Collect the worksheets and evaluate the session.

RMS ASEE TARGET AUDIENCE

This engagement activity targets science, technology, engineering, and mathematics (STEM) education faculty, administrators, postdoctoral scholars, and graduate students who have or are currently involved in instructing or providing support (i.e., tutors, teaching assistants, peer learning assistants, etc.) for STEM undergraduate engineering courses.

PRESENTER CREDENTIALS

Dr. Angela (Angie) Minichiello, P.E. is an assistant professor in the Department of Engineering Education at Utah State University (USU) and a registered professional mechanical engineer. Angie brings substantial practical experience as a practicing engineer and undergraduate instructor to her role as an engineering education researcher. Her research examines issues of access, diversity, and inclusivity in engineering education. In particular, she is interested in engineering learning, problem-solving, and the intersections of online learning and alternative pathways for adult, nontraditional, and veteran undergraduates in engineering.

Mr. Matthew Jouffray is an undergraduate researcher and senior in the Department of Mechanical and Aerospace Engineering at Utah State University. Matthew is a 2018 recipient of an Engineering Undergraduate Research Fellowship from the College of Engineering. He has conducted undergraduate research in several areas including heat transfer, thermal management, and engineering education. Matthew is a recipient of a NASA internship and will be attending graduate school in the fall to study aerospace engineering.

REQUIREMENTS

We will provide worksheets to be filled out, a slide presentation, UCD model handouts for review, and pencils/pens.
Participants do not need to bring anything.
Intended participant count: 25
Maximum participant count: 50

REFERENCES

Horn, L. (1996). *Nontraditional undergraduates: Trends in enrollment for 1986 to 1992 and persistence and attainment among 1989-1990 beginning postsecondary students (NCES 97-578)* National Center for Educational Statistics, Washington, DC: U.S. Government Printing Office.

Minichiello, A., & Hailey, C. (2013). *Engaging students for success in calculus with online learning forums.* Proceedings of the Frontiers in Education (FIE) Conference, Oklahoma City, OK.

Minichiello, A., Hood, J., & Harkness, D. (2017). *WIP: Methodological considerations for constructing nontraditional student personas with scenarios from online forum usage*

data in calculus. Proceedings of the ASEE Annual Conference & Exposition, Columbus, OH.

President's Council of Advisors on Science and Technology (PCAST). (2012). *Report to the President. Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics*. Washington, D.C.