How Do You Engage and Retain Diverse Students? EngageCSEdu Can Help

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ABSTRACT

We know that engaging and meaningful introductory courses are important to drawing and keeping diverse students in computing (e.g., [3]). But what practices are most likely to have the biggest impact on retaining diverse students? And why? To help the computing education community share their answers to these questions, the National Center for Women & Information Technology (NCWIT) teamed with Google to create EngageCSEdu, a comprehensive collection of peer-reviewed CS1/2 course materials designed to engage diverse students (www.engage-csedu.org). All materials in EngageCSEdu collection have been peer reviewed for the quality of their CS content and for their use of high impact "Engagement Practices": a set of practices that research suggests help both improve instruction and retain diverse students. This article overviews several of these practices and highlights some of the materials in the collection that use them.

What--and Why--is "ENGAGECSEDU?"

While enrollment in Computer Science (CS) has dramatically increased across the country in recent years [1], the representation of women in the major remains remarkably low: In 2013 woman earned only 18% of the bachelor's degrees in Computer Science. As a point of contrast, in thex same year women represented 50% of all science and engineering degree recipients [2]. There are many possible reasons for the low number of women pursuing computing degrees but research suggests that the first year experience, especially in introductory computing courses, are important pivot points for retaining women.

The National Center for Women & Information Technology (NCWIT) developed *EngageCSEdu* in collaboration with Google because we recognize the importance of introductory undergraduate courses in recruiting and retaining women to the field. EngageCSEdu (www.engage-csedu.org) has three parts:

1. A collection of individual open source course materials curated for their alignment to practices that research suggests help engage and retain women in computing.
2. An "Engagement Practices Framework" that helps faculty explore teaching practices that have the biggest impact on recruiting and retaining women in computing majors.
3. A community of faculty who use, submit, remix, comment on, and review items in the collection.

The Collection

The collection is currently focused on college-level introductory course materials (i.e., CS1/2) and contains primarily homework, assignments, and projects. Collection materials are separately catalogued (e.g., an individual homework assignment is one collection item), and

tagged (e.g., by CS topic(s), programming language, and Engagement Practice(s) employed). This means that users can quickly find materials for immediate use. At the same time, the collection is large--almost 1500 individual materials--and comprehensive, containing materials that employ all the major programming languages and cover hundreds of introductory CS topics. Materials come from faculty from across the nation and many different institutional contexts.

The collection grows and stays current as faculty submit their teaching materials for consideration for inclusion. All materials undergo an interdisciplinary peer review process before being published to the collection in a process similar to that used for peer-reviewed journals. This both ensures the continued quality of the collection and provides a way for faculty to demonstrate *teaching* excellence through peer review. It is unique in that materials are reviewed by at least one computer scientist and one expert in diversity and education, providing authors with valuable feedback on how to improve their work from the perspective of computer science *and* inclusive pedagogy. Materials that the reviewers find particularly compelling may be given the "Engagement Excellence" designation. Currently, only 5% of the collection is so designated. Authors of materials accepted into the collection are eligible for an NCWIT Engagement Excellence award which comes with a $5000 prize and an invitation to NCWIT's annual Summit. (Read about the 2015 winners here: https://www.ncwit.org/project/ncwit-engagecsedu-engagement-excellence-awards.)

If you would like to submit your course materials for review, simply set up a faculty account on www.engage-csedu.org, and select "Submit Materials." If you have any questions, need assistance, or would like to volunteer to be a reviewer, please contact us at engagecsedu@ncwit.org.

The Engagement Practices Framework: Good teaching practices that help retain women
EngageCSEdu offers one of the first systematic compilations of research-based teaching and learning practices for computer science education: the "***Engagement Practices***" (EPs). The EPs were selected by the project's interdisciplinary faculty because they are great teaching practices that research suggests also help engage and retain women in computing. On the EngageCSEdu site (www.engage-csedu.org) users can explore the EPs, find examples of how to implement them, search for collection materials by EP, and find related NCWIT resources.

The set of Engagement Practices can be broken into three categories, each informed by a general principle for retaining women:

<u>**Build student confidence and professional identity**</u>. Key techniques for doing this are:
- Avoid gender, racial, and other pernicious stereotypes
- Provide opportunities for students to interact with faculty inside and outside the classroom
- Provide effective encouragement to all students
- Provide feedback on class work that helps students understand how they are performing relative to other students

Build a positive student community. Pedagogical techniques that contribute to building connections among students include:
- Structured, collaborative learning, such as:
  - Pair Programming
  - Peer-led Team Instruction
- Encouraging and supporting informal student-to-student interaction (e.g., with well-designed ice breakers, providing opportunities for out of class interaction, and creating welcoming informal spaces for all students)
- Grouping students by level of ability

Help students understand the relevance of computing to their lives. Ways you can do this in class include:
- Including content that is meaningful & relevant to students' lives
- Making explicit connections to other disciplines
- Dispelling misunderstandings about the field of computing (e.g., it's all about coding; it's for loners; there are few opportunities to "make a difference")

The Community
EngageCSEdu is not just a collection of course materials, it's quickly becoming a community of faculty committed to engaging teaching and supporting women's meaningful participation in computing. There are many ways to get involved. Simply browse the collection to get inspiration from your colleagues. Download materials to use in your course. Most authors allow remixing of their materials, so you can adapt things to your situation. If you're logged into an account, you can leave comments and rate the materials. Complete the circle by submitting your own materials for consideration. Through the EngageCSEdu review process, you'll get valuable feedback from computer science educators and experts in diversity and education. These reviewers also recommend the very best materials for the Engagement Excellence designation. These are materials that are particularly creative or innovative, and/or make excellent use of multiple Engagement Practices. As explained above, authors whose materials are given the Engagement Excellence designation are eligible for an NCWIT Engagement Excellence award.

Here are some examples from the Engagement Excellence Collection
"Breast Cancer Classifier" by Bill Punch and Richard Enbody of Michigan State University. Teaches functions, dictionary, and lists. Makes interdisciplinary connections and uses relevant and meaningful content. https://www.engage-csedu.org/find-resources/breast-cancer-classifier

Text Analysis of 'Green Eggs and Ham'" by Sarah Diesburg and Ben Schafer of University of Northern Iowa. Teaches functions, dictionary, and lists. Uses meaningful and relevant content and encourages student-to-student interaction. https://www.engage-csedu.org/find-resources/lab-12-using-lists-text-analysis-green-eggs-and-ham

"Simulating Virus Populating Dynamics" by Eric Grimson of MIT. Teaches problem decomposition, object-oriented programming, and simulation. Makes interdisciplinary connections, uses relevant and meaningful content, and encourages student-to-student

interaction. https://www.engage-csedu.org/find-resources/assignment-12-simulating-virus-populating-dynamics

REFERENCES AND OTHER RESOURCES

[1] Bizot, Betsy. Counting Computing: CRA Taulbee Survey and NSF Statistics. Computing Research News, 24 (5). Retrieved from http://cra.org/resources/crn-archive-view-detail/counting_computing_cra_taulbee_survey_and_nsf_statistics.

[2] National Science Foundation, National Center for Science and Engineering Statistics. 2015. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2015. Special Report NSF 15-311.* Arlington, VA. Available at http://www.nsf.gov/statistics/wmpd/.

[3] Barker, L.J., Hovey, C.L. and Thompson, L.D. 2014. Results of a Large-Scale, Multi-Institutional Study of Undergraduate Retention in Computing. The 44th Annual Frontiers in Education Conference, Madrid, Spain.

See the ***EngageCSEdu*** site (www.engage-csedu.org) for other research citations around particular Engagement Practices.