AC 2012-4782: MENTORING OF UNDERREPRESENTED MINORITY SCHOLARS IN THE REINVIGORATING ENGINEERING AND CHANGING HISTORY (REACH) PROGRAM AND AGEP PROGRAM: DEVELOPMENT OF INTERACTIVE LEARNING MODULES

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Mentoring of Under-Represented Minority Scholars in the Reinvigorating Engineering and Changing History (REACH) Program and AGEP Program: Development of Interactive Learning Modules

Abstract

Geared towards serving underrepresented minority (URM) students who are on Master's or Ph.D. tracks in engineering, the Reinvigorating Engineering and Changing History (REACH) Scholars and the Midwest Crossroads Alliance for Graduate Education and the Professoriate (AGEP) program focus on enhancing the recruitment, retention and enrichment of these URM students. These programs provide URM students with opportunities to connect closely with peers and faculty members to form a scholarly community, to obtain key attributes and skill sets that are critical to academia success, and to explore multiple pathways to careers across different fields.

To allow our URM students from both REACH and AGEP programs to be prepared broadly for multiple career options, our research team developed a series of interactive learning modules that expose URM students to a variety of topics that are critical to students' preparation for future careers. Initial interactive learning modules will focus on the following three topics: (1) being a mentor and being mentored; (2) leadership and management; and (3) issues of diversity. The development of each learning module is guided by supportive teaching and learning strategies in STEM education, including the How People Learn framework by Bransford, Brown and Cocking (1999)[1], a "Backwards Design Approach" by Wiggins and McTighe (1998)[2], and other best practices in teaching and learning. Each learning module includes five consecutive components revised from training practices within other programs: Setting of Context; Warm-up, Experiential Exercise, Process, and Closure[3]. Within each module, URM students will be introduced to the key topics, will be encouraged to share values and attitudes towards these topics, will be exposed to theories, frameworks, or current best practices that are informed from research in these key areas, and will be encouraged to discuss their further concerns about these topics and the practices. This paper provides an overview of these interactive learning modules and showcases sample interactive learning modules that are being piloted among the REACH and AGEP scholars in the programs.

Background

According to a 2010 report issued by the American Society for Engineering Education (ASEE)[4], 45.1 % of enrolled engineering doctoral students were domestic. Although the representation of underrepresented minority (URM) students has shown slight increase from 2001 to 2009, the number were still very low, with 4.6% being African-American, 5.4% Hispanic, and 1.7% "other" (i.e., American Indians, Hawaiian/Pacific Islanders, and two or more combined groups)). Despite a variety of funding sources for underrepresented students to obtain doctoral degrees in engineering and an increased awareness of institutions and organizations supporting the entrance of URMs in higher education, only marginal increases have been observed in the percentage of URM students pursuing these degrees since 2001. For this reason, it is critical to understand the key challenges and obstacles facing these students and to identify ways to increase their representation among domestic Ph.D. degree recipients.

Authors have identified possible reasons that URMs continue to remain underrepresented in engineering doctoral programs. First, Redmond pointed out that stated that the limited understanding among URM students of how to mitigate through the graduate school and access academic resources can pontentially hinder these students from willingly and confidently pursuing a Ph.D. degree [5]. In addition, Hill et al. noted that that many URM students lack the opportunties to establish meaning mentoring relationship with positive mentors or role models so as to guide them through the doctoral process[6]. Without such mentoring, students' doctoral experiences can be void of career support, psychosocial support, or financial support.

The authors of this paper have been working with multiple mentoring programs and have mentored URM students across different engineering disciplines. In our efforts to help URM students pursuing a Ph.D. degree in engineering, we have observed similar obstacles among our own URM students[7] within two federally-supported fellowship programs for science, technology, engineering, and mathematics (STEM) graduate students. To bridge the gap and to further assist our students in their journeys to successful degree completion, we seek to apply supportive teaching and learning strategies in STEM education, including the "How People Learn" framework by Bransford, Brown and Cocking[1], a "Backwards Design" approach by Wiggins and McTighe[2], and other best practices in teaching and learning to develop interactive learning modules. These learning modules will cover the critical points and challenges that were identified in current literature and results in module topics such as "*Being a mentor and being mentored*," "*Leadership and management",* and "*Issues of diversity"*. This report will focus on the key concepts that were adopted from current literature in developing these interactive learning modules and using the module of "*Being a mentor and being mentored*" as an example to illustrate the concept.

Related Literature

Backwards Design

In the area of facilitating teaching and learning, the concept of "backwards design" by Wiggins and McTighe[2] has been adopted by multiple researchers, educators, and practioners because of its advantages in reforming currilum design. "Backwards design" entails a three-stage process for designing a certain teaching and learning task. These three stages are: (1) identify desired results, (2) determine acceptable evidence, and (3) plan learning experiences and instruction. The "backward design" process includes first thinking through the desible learning goals and students' outcomes, then thinking about assessment (i.e., what evidences will prove students' proficiency), and finally designing the learning activities and choosing appropirate resources or class materials.

In contrast to a conventional instructional method of starting directly from a given textbook, the "Backwardss design" framework demands a clearer understanding about the end goals of instruction efforts. This method allows instructors to "use curriculum as a means to an end" [2](p. 8) and also aligns with the concept of "outcome-based learning", whose validty has been acknowledged in a number of different recent national reports[8], research articles[9,10], and educational practices[11].

How People Learn

Bransford, Brown, and Cocking's "How People Learn" framework[1] originated from comprehensive work in learning science. The four dimensions of the HPL framework (i.e., knowledge-centered, learner-centered, assessment-centered, and community-centered) together promote an effective learning environment. The HPL framework has been found to promote students' learning in a variety of learning environments across different educational levels[12] and has been found to promote students' transitions from novice to experts in learning[13]. The characteristics of a learner-centered environment will help instructors understand learners' prior experiences and will also allow instructors to tailor their pedagogy and assessment to promote student learning.

In our effort to incoporating the "Backwardss design" and HPL frameworks and other best practices in teaching and learning into the design of our interactive learning module, we design each learning module to include five consecutive components that have been adapted from training conducted for undergraduate students affiliated with the Posse Foundation program Setting of the Context; Warm-up, Experiential Exercise, Process, and Closure.[3] The functions and its concept of design will be discussed respectively in the next section.

Project Design and Methods

Scope of topics

To allow our URM students from both REACH and AGEP programs to be prepared broadly for multiple career options, our research team developed a series of interactive learning modules that exposed URM students to a variety of topics critical to students' preparation for future careers. Sample topics and its rationale for each topic are as follows:

Being a mentor and being mentored

This module helps students to create mentoring networks and to identify ways that they can be effective mentors to others. Students will learn about the positive characteristics of good mentors and the process of initiating and maintaining a working mentoring relationship.

Leadership and Management

This module exposes students to best practices in leadership and management and provides students with strategies to take initiatives and develop desirable traits and characteristics of successful leaders or managers in academic and nonacademic settings.

Issues of diversity

This module provides students with strategies for being successful as minorities in majority environments. Among the areas of emphasis include isolation (i.e., being the only one), pioneerism (i.e., being the first one), and marginalization.

Flow of Interactive Learning Module

Embracing the key concepts of "Backwards design" and other best practices in teaching and learning, Table 1displays a general framework for implementing one to two hour interactive modules. The module elements and the purposes of each element are discussed in Table 1.

	Module Element	Purpose of This Element
1	*Setting the Context*	*Introduces the theme of the module along with what students should be able to do by the end of the module; Encourages students to reflect upon their values and attitudes about the topic (e.g., the best traits of a good mentor)*
2	*Warm-Up*	*An often light-hearted activity that gets students to think about a topic without using technical terms and connects students in the gorup of each other*
3	*Experiential Exercise*	*The body of the workshop that sets the group for a heightened exploration of the topic, used as a launch for new discoveries and discussion*
4	*Process*	*Discussion that allows students to explore their concerns about the topics; starts broad and flows to deeper discoveries*
5	*Closure*	*Wrap up the module, and leave the group with final thoughts about the topic*

Table 1 Sample Framework for Interactive Modules

Applications and Preliminary Findings

Being a mentor and being mentored-An Example of Interactive Learning Module

The authors have applied the concept introduced here in a recent workshop offered to provide professional guidance to engineering graduate students about mentoring. The learning goals of this module include helping students to identify the benefits of mentoring, to distinguish between positive and negative characteristics of mentors, to identify effective mentors based upon personal and professional goals and activities, to create mentoring networks, and to recognize the steps to finding the right mentor. The research team utilized the above-mentioned general framework. Here is a breakdown of the application of this framework and the actual implementation process of the mentoring learning module.

Setting the Context and *Warm-Up*
In implementing the first two elements, the research team asked students to write down their answers to three reflective questions about the benefits of mentoring and the characteristics of a good mentor. These prompt questions include, “Identify 3-5 benefits of mentoring”, “Identify 3-5 characteristics of a good mentor”, and “Identify 3-5 characteristics of a good protégé.” By implementing this embedded assessment, we tried to encourage students to reflect upon their values and attitudes about mentoring.

Students were given opportunities to share throughout the learning modules at different time points by answering questions such as, “What are the functions and benefits of mentoring?”

These sharing of ideas and experiences facilitated the establishment of a welcoming environment for the students and prepared them to learn more from the mentors and from each other about the essential characteristics of positive mentoring practices and effective measures to identify a mentor and keep a mentoring relationship beneficial for both the mentor and the protégé.

The designed activities not only help the students to open up later and share their prior lived mentoring experiences or experiences from their friends and colleagues but also allowed the research team to understand URM students' prior experiences. According to our assessment of students' prior understanding and experiences[14], most of our participants suggested that networking was one of the most important benefits of mentoring. This point resonates with our findings via one-on-one interviews with URM students[7] who talked about the value of connecting to faculty members outside of their own disciplines. The embedded assessment enabled us to help the research team to understand students' prior experiences. Because most of students graduated from minority-serving or small institutions, it is extremely valuable for them to expand their connections through the networks brought in through different activities and mentors.

Experiential Exercise and *Process*

In the body of the learning module, the group is prepared for a deeper exploration of the topic. One of our seasoned researchers guided students through the discussion process. The researcher also introduced recent research findings on mentoring and best mentoring practices around the nation. The introduction of these related topics serve as a launch for new discoveries and discussion in regards to mentoring. These discussions also allowed students to express their concerns about mentoring and fostered a friendly environment for the communication between students and seasoned mentors. One of the mentors shared a past experience about helping one former student to identify a professor who had certain equipment that the student needed to perform an experiment. The key idea was that students can be connected to the networks of their advisors and the related recourses which they won't be have access to otherwise. The students can also be introduced to new or unknown opportunities via the advisors' network.

In this learning module, students were encouraged to participate in the discussion, to learn from mentors, to learn from each other, to learn from established practices, and to learn from lived experiences. By so doing, the students could then identify the benefits of mentoring, distinguish positive and negative characteristics of mentors, and identify effective mentors based upon personal and professional goals and activities.

Closing

In the closing, the research team suggested some next steps for the students' action. Students were asked to reevaluate their individual development plans and to identify areas of improvement, to identify potential mentors for each area that they would like to improve, and to initiate meetings with potential mentors. By so doing, students could create mentoring networks to succeed in their current role as a graduate student and in their future role as a professional.

Discussion and Concluding Thoughts

The module within this paper provides one perspective o how to present a mentoring topic to URM students. In the future, the team will develop a comprehensive manual that represents additional topics that might be of interest to science, technology, engineering, and mathematics (STEM) graduate students. By framing the module in a non-lecture format and by engaging in learner-centered principles, the research team may provide content that can that frame in-depth conversations for students, particularly those from underrepresented groups. In programs in which role models from underrepresented groups might not be present, such a module provides an opportunity for URMs to engage in topics that will help them to succeed as graduate students. Meanwhile, the research team will also adopt appropriate assessment methods to understand participants' experiences and learning outcomes from the module in addition to the embedded assessment. Future findings on the assessments of these modules will provide further information as to the implementation of such modules for institutions wishing to adopt them.

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