TEACHING FOR RETENTION IN SCIENCE, ENGINEERING, AND MATH DISCIPLINES: A GUIDE FOR FACULTY

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Introduction

A number of recent national reports have called upon higher education to improve instruction in science, technology, engineering, and mathematics (STEM) as a means of safeguarding U.S. global leadership in these fields (National Academy of Engineering [NAE], 2005; National Academy of Sciences [NAS], 2007b; National Science Board [NSB], 2004). These reports emphasize the importance of preparing a diverse student body for the science and engineering challenges of the twenty-first century. However, statistics indicate that neither the number of students who graduate with STEM[1] degrees, nor the diversity of the graduates is sufficient to meet the needs of a global workforce. Although the overall number of bachelor's degrees awarded annually in the U.S. has risen by nearly 50% over the last twenty years, (NSF, 2008), the proportion of university students achieving bachelor's degrees in STEM fields has declined by almost 40% (NAS, 2007a). Further, even though women now make up over half of the U.S. undergraduate population (U.S. Census Bureau, 2004), they earned just 21% of the bachelor's degrees awarded in engineering and 25% of bachelor's computer science degrees in 2004 (NSF, 2008).

[1] The National Science Foundation (NSF) defines science and engineering as the following educational fields: computer and mathematical sciences, life sciences, physical sciences, psychology, social sciences and engineering (Kannankutty & Wilkinson, 1999). In this paper, we do not include psychology and social sciences (e.g., sociology, economics, and political science) in our definition of STEM. Nevertheless, most of the principles and teaching guidelines offered here might usefully be applied to students from other disciplinary backgrounds.

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CRLT Occasional Papers

Center for Research on Learning and Teaching

University of Michigan

No. 25

African-American and Hispanic students also continue to be substantially underrepresented in STEM majors. In 2004 African-American students earned just 7% of the bachelor's degrees awarded in science and engineering and Latino students just 6% (NSF, 2008) despite comprising 14% and 13%, respectively, of the U.S. population between 18 and 30 years of age (U.S. Census Bureau, 2004). These numbers represent a serious loss of potential talent at a time when the U.S. is struggling to compete in the global marketplace (NAS, 2007b).

Besides responding to the needs of a global economy, research shows that there are a number of educational benefits associated with having a diverse undergraduate student body. Gurin, Nagda, and Lopez (2004) found that students who had experiences with diversity in college were more likely to analyze reasons for behavior, seek out complex explanations, and aspire to post-graduate degrees. Other benefits include increased productivity and problem-solving capacities, higher levels of active thinking and intellectual engagement, and a greater likelihood of seeking out diverse friendships and workplaces in the future (Gurin, Dey, Hurtado, & Gurin, 2002).

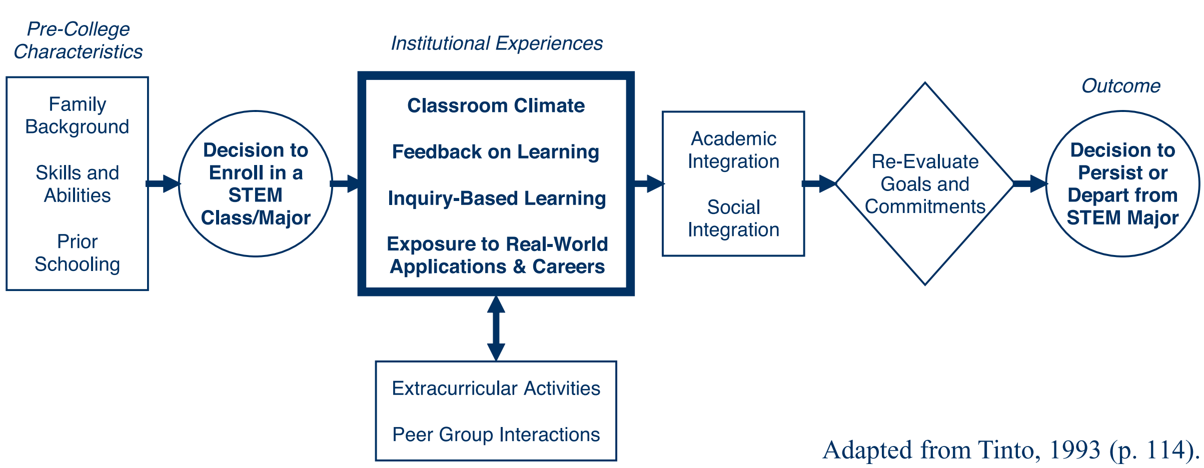
Extensive research on why students leave STEM fields (e.g., Seymour & Hewitt, 1997; Tobias, 1990) suggests that individual faculty can play a key role in supporting and retaining a diverse student body in STEM. In this CRLT Occasional Paper, we describe specific classroom strategies and teaching behaviors that have been demonstrated to improve student success in STEM. We also provide practical advice to individual faculty members who are seeking to implement these teaching strategies. Although underrepresented groups may have the most to gain, retention-conscious teaching practices are likely to have a positive impact on the persistence of all students in STEM.[2] When done well, high-impact activities (such as those described in this paper) engage *all students* in ways that enhance their academic performance across multiple learning outcomes (Kuh, 2008).

Understanding Student Departure

A number of scholars from a wide range of disciplinary backgrounds have examined factors that influence student persistence in college. Much of this research is informed by Tinto's Longitudinal Model of Institutional Departure, which acknowledges that a variety of personal and institutional factors influence students' decision-making processes. The model notes that pre-college characteristics and institutional experiences have an effect on students' academic and social integration, and their degree of integration, in turn, influences students' goals and intentions to persist. We have adapted Tinto's model to represent a subset of the factors that influence students' decisions to stay in or leave STEM, and we have highlighted four factors that faculty members can influence through their classroom teaching (see the box labeled

[2] We use the terms "retention" and "persistence" interchangeably to describe college students' continued enrollment in STEM courses and majors.

Figure 1. Model of Factors Influencing Persistence in or Departure from STEM



Adapted from Tinto, 1993 (p. 114).

Institutional Experiences in Figure 1). In the following sections, we focus on each of these factors in turn, offering a specific set of guidelines and practical recommendations for how individual STEM faculty can provide the types of in-class experiences that have been demonstrated to enhance student retention.

While this paper focuses on faculty-based practices, improving undergraduate retention in STEM requires sustained collaboration and commitment at the departmental, college, and institutional levels as well. The Appendix on page 9 provides additional information about some of U-M's ongoing retention efforts.

Classroom climate: Create a welcoming and supportive learning environment.

In 2004 and 2007, CRLT surveyed U-M undergraduate students enrolled in fourteen gateway courses in four STEM departments to identify factors associated with retention in and attrition from STEM majors (Hershock & O'Neal, 2008; O'Neal, Wright, Cook, Perorazio, & Purkiss, 2007). Students reported that classroom climate (including their anxiety levels, how welcome they felt in class, how well supported they were by instructors, and instructor rapport with students) significantly influenced their decisions to stay in or leave STEM disciplines. For example, one student noted:

> *My interest in a science career increased because my instructor always came off as eager to teach the subject matter and sincerely interested that his students learned the material, which gave me the desire to do well in the class and to pursue my current interests in the science field.*

In contrast, when students perceived instructors as disengaged, disrespectful, or uncommitted to student learning, it had a negative impact on their impressions of classroom climate and on their interest in taking STEM courses in the future.

Another issue related to classroom climate, *stereotype threat,* can also interfere with some students' learning and desire to persist in STEM. The primary hypothesis of stereotype threat is that students' (often subconscious) concern about fulfilling a negative stereotype that exists about their social identity group (e.g., the stereotype that women and minority students have inferior math abilities) may interfere with their academic performance (Bell, Spencer, Iserman, & Logel, 2003; Steele, 1999).

Research has demonstrated that stereotype threat hampers the performance of African-American college students on difficult standardized tests (Steele, 1999), Asian-American women's performance on math tests (O'Brien & Crandall, 2003), and women's performance on standardized math and engineering exams (Bell et al., 2003; Keifer & Sekaquaptewa, 2006, 2007; Steele, 1999). Therefore, when an instructor makes the effort to eliminate stereotype threat by consciously using examples that feature successful women scientists, for example, or by describing tests as a measure of students' problem-solving skills (rather than as a measure of innate ability), the learning environment improves for all students.

A number of classroom strategies and interventions have been shown to be effective in creating a supportive learning environment and in addressing possible issues of stereotype threat. Successful strategies are those that affirm students' capabilities, provide challenging learning opportunities, encourage students to work collaboratively across racial groups, and foster an atmosphere of trust within the classroom environment (Bain, 2004; Steele, 1999). For example, Cohen, Steele, and Ross (1999) found that stereotype threat was significantly reduced for high achieving African-American students when critical feedback was "accompanied by an invocation of high standards and by an assurance of the student's capacity to reach those standards" (p. 1302). Similarly, Fullilove and Treisman (1990) found that African-American students who participated in two hour-long, bi-weekly discussion sections in which they worked collaboratively to solve unusually difficult math problems demonstrated high levels of academic achievement and persistence. Though described here as ways to reduce stereotype threat, strategies such as these (setting high standards, conveying a strong sense of trust in students' ability to meet them, and offering opportunities for collaborative activities) have powerful benefits for all students (Bain, 2004). Below, we offer additional suggestions to further guide the efforts of STEM instructors relative to creating a welcoming classroom climate for all students while reducing the potential for stereotype threat:

- *Assign challenging (not trivial) work at a challenging (not overwhelming) pace.*

You can help students succeed by setting high standards and providing challenging, yet attainable tasks. Help eliminate stereotype threat by communicating trust in your students' abilities to meet your high expectations. Because successful experience is the most important source of fostering self-confidence, it is important to determine students' current level of understanding on a topic and teach concepts just beyond their understanding so they are challenged (rather than frustrated or bored) by new information. This approach helps students remain motivated and thus exert the effort required to succeed academically. Additionally, when administering tests or other assessments, work to reduce the activation of negative stereotypes among student groups who are most likely to experience them by presenting tests as a measure of students' effort and level of preparation on a particular set of topics (not as a measure of innate ability or aptitude).

- *Be strategic in organizing and using teams.*

Assign students to diverse work groups that meet regularly to discuss and work through difficult problem sets, assignments, or other issues. Ensure that students instruct one another as to how solutions are derived. Encourage students to think out loud with their teammates. Don't isolate students from underrepresented student populations. Assign and rotate roles within teams, and include ways for students to rate the contributions of all team members.

- *Advertise and recommend that all students use available support and resources.*

Because many classes will include students representing a range of ability and skill levels, clearly (and repeatedly) communicate the support and resources that are available to assist them in their learning. This should be done both verbally and in your course syllabus. Do not assume that students will seek help when they are struggling with a class. Request meetings with students (or have GSIs request them) as problems arise. If feasible, make office hour meetings part of the course requirement (e.g., after graded assignments or during the development of student projects and assignments).

- *Actively cultivate instructor-student rapport.*

Be on time (or early) to class and make yourself available to students immediately before and after class; engage students about the course or their lives to show your interest in them. Learn and use students' names (as many as feasible). Even using some names communicates commitment to students. Share your genuine enthusiasm and interest in the subject matter and teaching. Actively solicit and encourage questions about the course content and its relevance. Recent CRLT research has shown that soliciting midterm student feedback (and acting upon it) can be a powerful way to positively impact the level of instructor-student rapport in the classroom (Finelli, Ott, Gottfried, Hershock, O'Neal, & Kaplan, 2008).

- *Become aware of unconscious biases and subtle messages given to students.*

Unconscious social cues and overt and subtle behaviors (such as giving disingenuous praise to a student perceived to be less capable or assuming that a student will be unable to succeed) can activate stereotype threat. This may decrease students' self-confidence about their academic performance and subtly dissuade some students from pursuing STEM courses, majors, and careers (Woolfolk, 2005). Avoid labeling some students as better than others; they may simply be more confident, not brighter, and be careful not to respond to comments or questions in ways that students might interpret as dismissive or judgmental. Additionally, be aware of gender dynamics and be sensitive to the experiences of visibly underrepresented students in your class. To help create an inclusive classroom, use diverse examples that represent a variety of perspectives and backgrounds and do not bring unwanted attention to students by asking them to speak on behalf of a particular social identity group to which they belong.

Feedback on learning: Clearly communicate grading policies and provide frequent feedback on student learning.

Students rate their perceived ability to succeed as a primary factor in their decisions to persist in or leave

STEM majors (Hershock & O'Neal, 2008; O'Neal et al., 2007; Seymour & Hewitt, 1997). Because course grades are not always indicative of ability to succeed, students' decisions are often ill informed. A study of U-M undergraduates found that more than half of the approximately 300 students who reported becoming less interested in STEM received a course grade of 3.0 (out of 4.0) or better, and many of these students reported that course grade was an influence in their decision. For example, consider the comments of a female, first-year U-M student who received a B+ in a gateway STEM course (O'Neal et al., 2007, p. 27):

> *Although I struggled with this class greatly, I very much appreciated it as I love [science]. However, my seeming incapability to understand it has rendered it impossible for me to major in [science], sadly enough.*

Students' attitudes about the relationship between grades and ability are closely connected to the concept of *self-efficacy*, an individual's confidence about his or her capability to perform a specific task within a particular context (Bandura, 1986). Ample research among STEM undergraduates has linked positive self-efficacy with increased persistence and achievement (cf. Besterfield-Sacre, Atman, & Shuman, 1997; Eccles & Wigfield, 2002; Lent, Brown, Schmidt, Brenner, Lyons, & Treistman, 2003) and has demonstrated that women are especially sensitive to issues of self-efficacy. For instance, researchers have documented that, despite earning similar grades, many women who leave STEM programs have less confidence in their abilities than those who persist (Hutchison-Green, Follman, & Bodner, 2008), and women who do stay in STEM disciplines have lower self-efficacy than their male peers (Hutchison, Follman, Sumpter, & Bodner, 2006; Pajares & Miller, 1994).

Thus, efforts to help students more accurately evaluate their academic performance and capacity for success in STEM, especially by better connecting actual ability with measures of assessment to bolster self-efficacy, may improve retention. The following list includes a variety of ways to accomplish this.

- *Reiterate that effort is the most important component of success, and that all students must work hard to succeed.*

Students should be encouraged to view their performance as a measure of their effort, not their innate ability in STEM. Students must understand that they are capable and that sustained effort is needed to achieve. Most research takes years to perfect, no matter how bright an individual may be. Point this out to students by using examples from history (such as the hundreds of attempts by Edison to create the light bulb) or your own work. Expect that *all* students have strengths and will succeed with effort, and articulate this expectation frequently.

- *Be transparent about your grading policies and communicate that the tests are fair.*

Clearly explain grading policies—and how students should interpret grades—in your course syllabus, verbally, and when describing course assignments or exam results. Using a grading rubric is an excellent way to communicate learning goals, instructor expectations, and criteria for student mastery. Providing grading rubrics to students in advance of assignments and exams is a good way to be transparent about how points or grades will be assigned. And, because tests that accurately reflect student ability may both promote self-efficacy and reduce stereotype threat, carefully consider how your tests and assignments align with the course goals (and, in turn, the grading rubrics). Other information about best practices for designing and grading exams can be found in CRLT Occasional Paper No. 24 (Piontek, 2008).

- *Provide students with frequent feedback about their learning.*

In surveys of undergraduates in U-M STEM courses, many students were discouraged by courses having only a few, high-stakes assignments and by instructors not providing timely, high-quality feedback on assignments and projects (Hershock & O'Neal, 2008). High-quality feedback and more frequent, low-stakes assignments (quizzes, problems sets, online homework) can emphasize the strengths of student work and provide concrete guidance for ways to improve. Instructors can also use basic "Classroom Assessment Techniques" (Angelo & Cross, 1993) to collect formative course-level data on students' comprehension. For example, periodically ask students to write anonymously for a minute about the concept most confusing to them, and then analyze student responses and allocate future class time to address the most common student concerns or misconceptions. Or have students make concept maps to diagram the connections between major course concepts and other material, and use the results to guide class conversation.

- *Teach students to rely less on performance comparisons and more on content mastery.*

Use exams and assignments that allow students to focus on content mastery in order to combat students' tendency to place undue emphasis on comparing their performance with that of their peers. Grade using explicit criteria to establish mastery and enable students to recognize when they have satisfied these criteria by providing them with clear, informative, and in-depth feedback. Avoid using norm-referenced grading (a.k.a. "grading on a curve") because it significantly impacts students' decisions to leave STEM, especially women and minority students (Seymour & Hewitt, 1997). It also increases student stress and anxiety, and it makes it difficult for students to gauge their true performance because their grade is dependent on the performance of other students, rather than on their own achievement (Piontek, 2008).

Inquiry-based learning: Encourage students to engage in the scientific method.

Engaging undergraduates in the process of inquiry is a key component of fostering their interest in and excitement about science and engineering. For a limited number of undergraduate STEM students, this engagement with inquiry happens in an actual research lab. The benefits of this sort of experience are many: according to the NSB's *Science and Engineering Indicators 2008*, "students who participated in an undergraduate research experience reported, in general, a greater interest in STEM research, greater understanding of the research process and the strategies and tools that scientists use to solve problems, and a broader sense of career options in the field" (p. 24). Similarly, research conducted to assess the Undergraduate Research Opportunity Program (UROP) at U-M demonstrated that participation in undergraduate research positively influenced students' academic achievement and persistence, level of engagement, and post-graduate academic pursuits (Gregerman, 1999; Hathaway, Nagda, & Gregerman, 2002; Nagda, Gregerman, Jonides, von Hippel, & Lerner, 1998).

Inquiry-based learning replicates the process and excitement of research in the classroom by replacing traditional lectures with open-ended, exploratory activities that ask students to investigate problems or phenomena. There are many variations (controlled experimentation, modeling, synthesis of primary sources, and exploration of quantitative data, to name a few; see also Gaffney 2008; Edelson, Gordin, & Pea, 1999), but all inquiry-based learning allows students to construct their own understanding of concepts, rather than simply being told information.

Inquiry-based courses offer many advantages. Students develop stronger problem-solving and critical thinking skills, demonstrate greater understanding of concepts, retain information longer, and have a more positive view towards science than their peers in traditional courses, and these gains come without any deficit in factual information (Gabel, 1994: Mazur, 2009; Wieman, 2007). Inquiry-based learning programs also lead to positive outcomes in student persistence compared to traditional classrooms. One such program in physics at North Carolina State University saw a drop of 60-80% in failure rates (across ethnic groups) and a significant increase in students' positive views of science (Gaffney, 2008).

Although inquiry-based course designs promote gains in student achievement, courses need not be completely revised to profit from the inquiry-based approach, nor do inquiry-based experiences need to be limited to lab or discussion sections of courses. Below, we suggest several strategies for infusing inquiry-based learning experiences into traditional lectures. Such strategies allow students to delve deeper into the content while modeling and practicing inquiry skills associated with the scientific method. In Figure 2, we offer an example of a brief inquiry exercise that incorporates several of the suggestions listed below.

- *Ask students to generate hypotheses and ways to test them.*

When explaining research findings, don't begin by showing the results or conclusions. Instead, introduce the problem, observations, or data that generate the underlying scientific question, and ask students to generate and critique hypotheses to explain the phenomenon. Encourage students to identify data that would support alternate hypotheses or to brainstorm experiments that could generate the data to test these hypotheses.

- *Invite students to practice interpreting data and drawing their own conclusions.*

Display graphs or tables of data from research literature or popular media, and model your thought process and way of making sense of the data. Provide students with additional examples and ask them to practice interpreting the data to test hypotheses or research questions. Before explaining what you or other expert researchers concluded from the data, ask students to assess critically the implications of the data for research or practical application.

- *Ask students to make predictions by applying course concepts to unfamiliar situations*.

Before doing classroom demonstrations or simulations, invite students to make predictions and explain them, rather than telling them what should happen. After the demonstration, ask students to describe what they observed before telling them what happened and why.

Many instructors have effectively adapted these techniques for use in large lectures, executing them in five minutes or less (see also Gaffney, 2008; Mazur, 2009; Wieman, 2007). Students may engage in the tasks individually (through writing) or collaboratively (through discussion in pairs or small groups) while the instructors and GSIs circulate and interact with students (if the classroom layout allows) to clarify instructions, answer questions, probe for understanding, and keep students on task. Instructors may debrief the activities by soliciting responses from students and leading a discussion, or by asking students to vote on a variety of possible answers using flash cards or personal response systems or "clickers." (More information about teaching with clickers is contained in CRLT Occasional Paper No. 22 [Zhu, 2008]). Whatever method you ultimately choose, keep in mind that inquiry-based learning is most successful when it is designed around key learning outcomes and when it promotes thoughtful engagement on the part of students (Prince, 2004).

Figure 2. A 5-8 Minute Inquiry Learning Exercise

- **Introduction** (1 minute): An instructor who conducts research on predator-prey relationships opens class by showing a graph of tadpole pheromone production in the presence and in the absence of a predator.
- **Observation and Hypothesizing** (1 minute): The instructor asks students to individually take a moment to write down their observations about the graph and to hypothesize about the function of different pheromones.
- **Discussion in Pairs** (2-3 minutes): Students are instructed to turn to a neighbor and share their observations and hypotheses and to speculate on an experiment that would support or refute one hypothesis.
- **Debrief** (1-3 minutes): The instructor brings the class back together, and asks 1-3 student pairs to describe their hypothesis and an idea for an experiment. The debrief can be extended, time permitting.
- **Integration:** When the exercise is over, the instructor starts the lecture and discusses the actual data collection process that he or she employed.

Exposure to real-world applications and careers: Demonstrate relevance of course content and highlight careers in STEM.

Students' perception of the usefulness of their learning affects their motivation to engage with course material and therefore their desire to persist in STEM majors (Davis & Finelli, 2007; Pintrich & Zusho, 2002; Wigfield & Eccles, 2000; Winter, 2007). For many students, interest in STEM may be influenced by how readily they make connections between course content and its relevance or usefulness in the "real world." For example, research conducted by CRLT (Hershock & O'Neal, 2008) revealed that students who learned about career opportunities related to course content were significantly more likely to report interest in majoring in STEM ($p < 0.05$). That research also showed that engaging students in discussions about real-world applications of course concepts or modeling STEM careers in the classroom was associated with increased student interest in pursuing STEM majors. For example:

> *I enjoyed how my [instructor] always tried to expand what we were learning in class to real life. He really emphasized the fact that we were laying our foundation upon which we can expand our knowledge and possibly continue with research to expand the knowledge of all mankind.*
>
> *[My instructor] told us about the practical sides of physics (jobs and its use in the real world), which made me want to learn more!*
>
> *The applications of calculus shown throughout the term interested me further in pursuing an engineering career.*

Initiatives that intentionally introduce real-world contexts into traditional STEM courses at U-M have had positive impacts on both student perceptions of course content and other variables. For example, Burn and Holloway (2006) describe an experiment involving two sections of an introduction to computers course, one using a "traditional" approach and one emphasizing real-world contexts. Students' perceptions of the importance and relevance of the course material were markedly greater in the "real-world" course. Moreover, gaps in academic performance on exams and homework assignments between males and females and between students of color and white students were smaller in the section integrating real-world contexts.

Similarly, Winter (2007) found that students in sections of pre-calculus that integrated real-world problems (e.g., racial and gender imbalance in HIV infection rates and the impacts of climate change on agriculture) were significantly more likely to complete the course and to finish the course with a grade of C- or better (based on standardized course exams) than students in sections taught with more conventional materials. Likewise, Davis and Finelli (2007) documented the benefits associated with introducing a service-learning component into an introductory engineering course. Using service learning to connect course content with real-world applications not only made the curriculum more relevant, it also improved students' level of social awareness and increased their overall level of satisfaction with both the course and instructor.

Instructors wishing to encourage student interest and persistence by bringing the real world into the classroom might consider the following strategies:

- *Highlight connections between STEM learning and real-world applications.*

Intentionally situate classroom activities or assignments in the context of current events and real-world technologies. Ask students to apply STEM concepts and skills to understand, evaluate, or solve real-world problems (e.g., use polynomial functions to estimate how quickly a disease could be eradicated). To harness students' enthusiasm for learning about current scientific, technical, and social problems, devote class time and student preparation to learning about the background and relevance of the real-world issue, controversy, or problem. Similarly, provide media or printed resources during class to introduce an assignment or in-class exercise or to highlight the connection between underlying theories and principles that you discuss in your course and their practical applications. Use real-world examples to illustrate abstract concepts, or help students derive abstract concepts from sets of real-world examples.

- *Introduce students to career opportunities related to STEM learning.*

Highlight career options related to course content. Advertise and discuss the professional development value of opportunities for summer employment, internships, and undergraduate research in STEM disciplines. Explain how STEM professionals employ course concepts and skill-based learning in their work. Highlight and discuss your research (and that of others), its application and relationship to course content at a level that is accessible to your students. Convey your excitement about your own research when relevant, and share how you became interested in your field of study.

Summary

The United States (and the American college-going population) is becoming increasingly diverse, but the diversity of STEM students and graduates does not reflect the nation's demographics. Considerable research shows that faculty can have a significant impact in the support and retention of a diverse student body. In this Occasional Paper we have offered a number of research-based teaching practices and classroom strategies that faculty can adopt to complement departmental and institutional efforts to support and retain undergraduate students in STEM. While not an exhaustive list of approaches, the concrete teaching strategies described here should assist faculty efforts to address retention issues in their STEM classes while enhancing the learning of all students. Faculty who would like additional help are invited to contact the Center for Research on Learning and Teaching.

Appendix. Institutional Approaches to Improving STEM Retention at U-M

These programs share a number of features that have been demonstrated to be effective in retaining undergraduates, underrepresented students, and at-risk students in STEM disciplines: personalized attention, meaningful faculty-student interactions, research opportunities, welcoming learning environments, and access to information about opportunities and careers in STEM.

The **Douglass Houghton Scholars Program,** co-sponsored by the Department of Mathematics and the LSA Dean's Office, offers highly motivated students with an interest in scientific or mathematical careers the opportunity to work closely with faculty and other high-achieving students on stimulating work in mathematics. Students participate in individualized biweekly workshops where they receive academic support and guidance in career planning. http://sitemaker.umich.edu/dhsp/home

The **Michigan Science, Technology, Engineering and Mathematics (M-STEM) Academy** is designed to prepare high-achieving students for the global workforce. The academy comprises a six-week transition program the summer before students start at U-M and a variety of support programs (including customized academic advising, peer mentoring, academic learning activities, and group scheduling) over the course of participants' freshman and sophomore years. Participants are guaranteed a paid career exploration experience during the summer between their first and second years.

The **Undergraduate Research Opportunity Program (UROP)** has won national awards for its creation of research partnerships between first- and second-year students and U-M faculty and research scientists. All U-M schools and colleges participate in UROP, thereby providing a wealth of research topics from which a student can choose. Begun in 1989 with 14 student/faculty partnerships, the program continues to grow, now engaging 1000 students in unique hands-on learning collaborations with 600 research sponsors.
http://www.lsa.umich.edu/urop/

The **Women in Science and Engineering (WISE) Program** at U-M is a cooperative effort between the College of Engineering, LSA, the Office of the Vice President for Research, and the Housing Division. The Program is designed to increase the number of women pursing degrees and careers in science, technology, engineering, and mathematics while fostering their future success. WISE Programs encourage and support women and girls by serving as a catalyst in the development of inclusive campus environments. The programs introduce girls, young women, and their supporters to careers and opportunities in STEM fields, provide professional development and leadership opportunities for women in STEM degree programs, and encourage undergraduate women to pursue graduate degrees. http://www.wise.umich.edu/

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