2006-893: A TEN YEAR PERSPECTIVE ON CHANGES IN ENGINEERING EDUCATION

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A Ten-Year Perspective on Changes in Engineering Education

Abstract

The Model Institutions for Excellence (MIE) program at the University of Texas at El Paso (UTEP) was implemented with the goal of increasing the number of underrepresented minorities in science, technology, engineering and mathematics (STEM). Funded by the National Science Foundation, this 11-year program challenged UTEP to improve the first-year experience of its entering freshmen, to develop good study habits, to enhance instruction across the STEM curricula, and to promote career options and encourage graduate school. The MIE program's success is based on changing the University culture by promoting early contact with faculty, active learning to engage students, a "home" to study and interact with peers, and exposure to research at the undergraduate level. These MIE activities are key in achieving the University's mission of providing a diverse, commuter-student population in a geographically isolated bi-national location with the two ideals of excellence and access. Results from these activities show an increased number of undergraduate Engineering degrees awarded from 153 in 1997-1998 to 254 in 2004-2005. The number of underrepresented minorities receiving these degrees has increased from 99 in 1997-1998 to 162 in 2004-2005. Additionally, the number of graduate degrees awarded in Engineering has nearly doubled annual production from 65 to 129.

Introduction

The way scientists and engineers of the 21st century work has changed dramatically and will continue to do so. Our engineers and scientists need to be versatile and flexible, with multidisciplinary skills.[3] Biotechnology, nanotechnology, genomics, and proteomics are just a few of the multidisciplinary fields taking hold in this century. "Innovation and technological breakthroughs are far more likely to be the product of convergence — accomplishments occurring where disciplines meet," said Dr. Shirley Ann Jackson, President of Rennselear Polytechnic Institute, during her speech at the Society for Women Engineers annual conference.[15] The challenge to produce these scientists and engineers lies in an educational system that engages these future scientists and engineers in team-oriented real-world exercises that solve real problems. Concepts and methods drawn from many different sciences must be applied to solve these problems. It is the interrelationships between these disciplines and individuals that must be developed in our educational preparation for the next generation of scientists and engineers.

The University of Texas at El Paso has been changing its educational practices over the past decade for future engineering graduates. However, no different than many public institutions with liberal admissions policies, the University of Texas at El Paso has faced rising public concern from state and federal government agencies on the low retention and graduation rates of its student body. With a primarily Hispanic student population, where more than half are first-generation college students and nearly all commute to school daily and hold outside jobs, a change in educational practices and policies was required by students, faculty, and administrators in teaching and learning that support a non-traditional student. One concern in changing educational practice was the need to maintain high standards that ensured the engineering graduate was capable of meeting the demands and challenges of the 21st century. All of the implemented changes required a fresh, new outlook capable of supporting the multidisciplinary educational needs, communications and technology changes from the 20th century.

The Model Institutions for Excellence (MIE) program, funded by the National Science Foundation, began at the University of Texas at El Paso (UTEP) 11 years ago with the goal of increasing the number of underrepresented minorities in science, technology, engineering and mathematics (STEM). The first year of the program was spent strategizing and planning to accomplish this goal with an outside Advisory Board that was developed with nationally recognized academicians and industry leaders in science and engineering. Their assistance was used in identifying curricular and co-curricular changes needed in STEM undergraduate education that would result in qualified and capable engineers and scientists of the future. Curriculum could not be 'watered down' to improve student retention and graduation rates. Instead, other solutions were sought.

Ideas for change in engineering education at UTEP began forming during the proposal stage and first phase of MIE, a three-phase project. These ideas were based on the literature citing the need for intensive academic planning through intrusive advising, freshman orientation, academic reviews for low-performing students, special programs that provide academic support including tutoring, group study, and a study center, a sense of belonging on campus, small classes, exposure to faculty during the first years, supplemental (developmental) educational instruction, meaningful undergraduate research, a freshman seminar course, and support of new teaching methodologies for faculty.[9],[10] Cultural changes at the University were led by the University President centering on UTEP's vision and mission of providing quality higher education to a diverse student population. UTEP, a regional University that primarily provides a higher education to the residents of El Paso and the surrounding region, continued to focus on the preparation of its students to meet lifelong intellectual, ethical, and career challenges and to be leaders in the 21st century. Paramount is the need to provide high-quality educational opportunities to students that otherwise would never have access to them. This commitment to access and excellence is the foundation of emerging trends in UTEP's engineering education.

UTEP is the largest Mexican-American majority university in the nation. Over 70 percent of our student population is of Mexican-American descent. Many must work to support themselves and their families and 98 percent commute daily. The majority are first-generation college students who lack the support network to encourage their success. Given its mission to serve one of the poorest cities in the country,[1] UTEP has adopted an inclusive, open admission policy, which has led to an acceptance rate of over 90 percent. The mean Scholastic Aptitude Test (SAT) score at UTEP is lower than the national average by nearly 100 points.[2] UTEP based its reform efforts to fit these non-traditional students, building upon traditional strengths recognized in science and engineering and developing innovative new programs to help its students accomplish the University mission. Six programs were identified and targeted specifically for this student population's needs: Circles of Learning for Entering Students, Course Curriculum and Laboratory Improvement, Academic Center for Engineers and Scientists, Women in Science and Engineering, Research Experience for Undergraduates, and The Center for Effective Teaching and Learning.

Circles of Learning for Entering Students (CircLES)

The Circles of Learning for Entering Students Program (CircLES) was designed to increase the success of incoming students during their first year of college, building on the idea that the first year experience is crucial to student success in college. CircLES combined curricular innovations and restructuring of the first semester with co-curricular activities designed to support students as they become acquainted and integrated into the university. CircLES incorporated three intervention activities: a weeklong summer orientation, course clustering, and proactive advising and scheduling. Curricular innovations and restructuring included first-year science or engineering learning communities that now also includes a first-year University Seminar course and an introductory science or engineering course, dependent on the level of mathematics. Students interested in science, technology, engineering and mathematics (STEM) are admitted into the University in an initial pre-science or pre-engineering major.

STEM students begin their introduction to the University during a one-week summer orientation divided into groups of interest by science and engineering. In addition to the general university-wide orientation content, STEM students receive intensive advising and course registration that links to a first semester science or engineering oriented learning community (course cluster). Intensive math reviews, science and engineering laboratory activities designed in teams, and lunch with engineering and science faculty occur throughout the week of orientation to benefit the students' placement in learning communities.

Course Content for STEM Students

The course content for the introductory science and engineering learning communities has been continually modified throughout the years. Placement in these courses is based on math and English levels of preparedness. Typically, the majority of UTEP entering science and engineering students do not initially place into college-level mathematics courses. This phenomenon, shared by many institutions nationwide, is especially common to public institutions that have generous access policies. In 2001, the National Commission on the High School Senior Year reported that, on average, one-third of high school graduates were unprepared for college-level courses and had to enroll in at least one developmental course.[19] The Commission attributed much of this problem to a combination of attitudes and behaviors of students, parents, teachers, and school administrators that did not view the senior year as a critical time to strengthen and enhance academic skills of students in preparation for college.[18,19]

At UTEP, other factors contribute to low placement scores. Many students are first-generation college students and do not have a good understanding of what is necessary to be successful in college. Unless they receive adequate guidance in high school, many students fail to see the relevance of mathematics to their degree completion and, consequently, may spend six to eight years pursuing a college degree. The fact remained that acquiring mathematics skills was crucial for success in science and engineering. At UTEP, students could not even begin to take for-credit engineering courses until they were eligible to enroll in Calculus I. For this reason, introductory engineering and introductory science courses were developed to apply mathematics principles and acquaint students with engineering and science faculty during their first year, a critical time period affecting retention.

In order to remedy some of the problem of developmental mathematics placement, a mathematics review program was implemented in 1998 and made a part of the Summer Orientation for all pre-science and pre-engineering students. In 2005, the mathematics review program was offered independently of the week-long orientation and offered to all entering UTEP students, rather than just STEM students. The goal of the intervention was to increase mathematics placement scores and increase the number of students taking college-level mathematics during their first college semester.

The mathematics review was used to refresh students' mathematics skills and to stress the importance of mathematics placement. The mathematics review consists of three two-hour sessions. The students are broken up into three groups of 20 to 25 students each, according to their initial placement on the mathematics placement test. Two peer facilitators, upper division science or engineering students, assist each group. Peer facilitators receive basic training in cooperative learning techniques and are involved in planning and teaching orientation activities.[5] Each entering student receives a review booklet broken up into 13 sections covering material on the placement test, with practice exercises. During the review session, the students work on solving exercises in groups of 4 to 5 students. The peer facilitators check the correctness of the students' solutions, give explanations if necessary, and keep track of timely progress within the groups. On the final day of orientation, students retake the placement test and are placed in the mathematics course according to their math re-take score. Figure 1 shows math course placement before and after the math review.

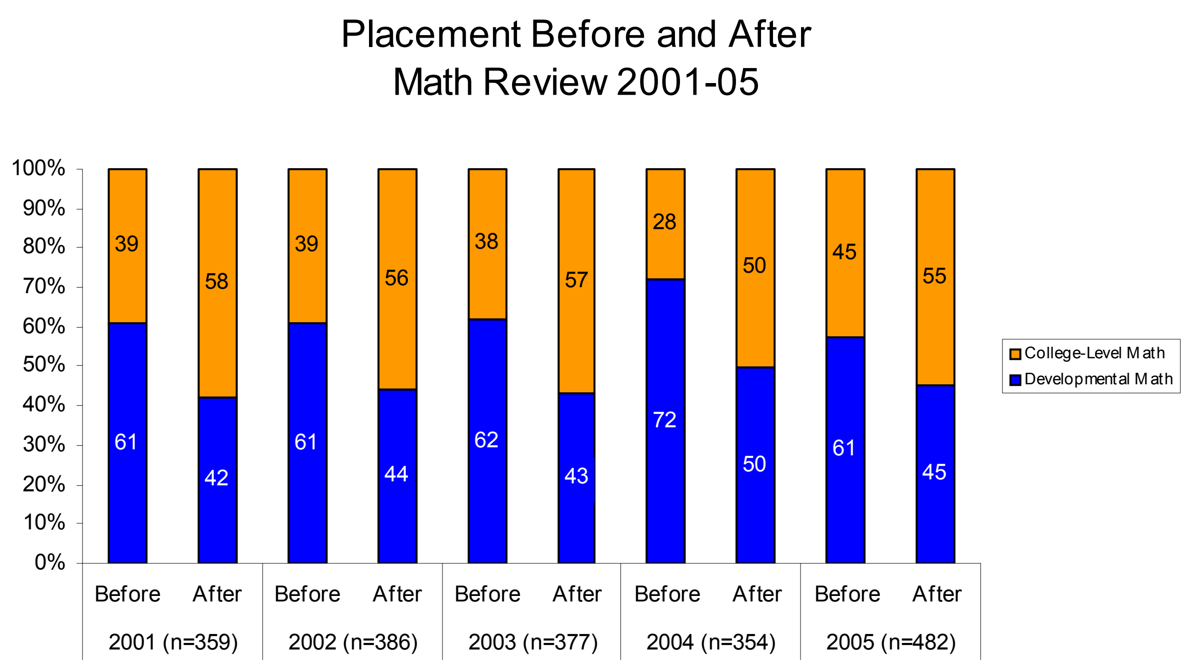

Figure 1. Placement Before and After Math Review 2001 -05

Approximately 20 percent of students initially placing into developmental math that took the math review placed into college level math after completing the review. The mathematics sequence at UTEP offers Introductory Algebra and Intermediate Algebra courses as developmental courses. Many students, while not improving their placement scores enough to get into college-level (pre-calculus and calculus) mathematics, did improve their score enough to advance one course level into Intermediate Algebra. This resulted in saving at least one semester of math and allowed students to advance to their major courses at least a semester earlier. Figure 2 shows the initial mathematics course taken by entering engineering and science students.

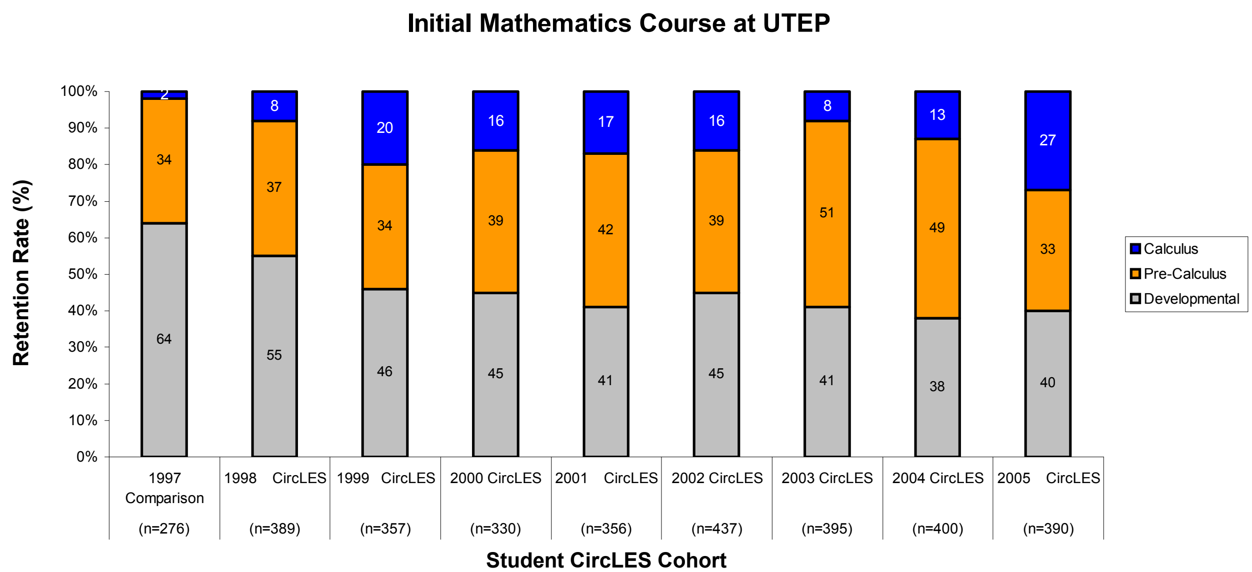

Figure 2. Initial Mathematics Course at UTEP

On the final day, students register for classes with the assistance of coordinators who specialize in advising engineering and science students. At this time, students are put into course clusters based on their mathematics and English placement scores. The course clusters include a mathematics course, an English course, a University Seminar, and an introductory science or engineering course.[20,21]

Assessment of the success of students enrolling in a higher level mathematics course based on an increased placement score after the math review shows that the majority of the students successfully pass their math course the first time enrolled. This intervention has allowed more students to enroll and succeed in a higher initial level of mathematics, thus decreasing the number enrolled in developmental courses and enabling more students to begin for-credit engineering courses earlier. This is just one of the interventions that has been introduced to decrease the length of time necessary to earn an undergraduate degree.

Course Clustering and Curriculum Modification

The need to improve students' curricular experiences, retention and success drove the development, design, and re-design of a number of courses at UTEP. Courses with low passing rates in science and engineering were identified and reviewed. Several critical 'gatekeeper' courses were entirely revamped. A general chemistry course was re-designed to include less lecture and more laboratory time, with the laboratory sessions conducted in small sessions with trained student peer facilitators conducting these sessions. Pre-calculus, which most of our engineering students are required to take, was modularized into four modules utilizing cooperative learning techniques. Students are given three opportunities to pass each of the four modules in order to pass the course; however, students who have not passed all modules by the end of the semester have a chance to finish during the winter break or the following semester. Trained peer facilitators are also utilized for this course. This reform has substantially improved overall passing rates in Pre-Calculus over the past years. Based on its success, Pre-Calculus was used as the basis for the re-design of the first-level Calculus course, currently being implemented in a modular format.

A number of other courses have been modified to include new technology, hybrid course offerings, active learning techniques, new laboratory exercises, student peer facilitators, and integrated subject content within a course and between linked courses. A first-year University Seminar course was added to the core curriculum as a three credit-hour academic seminar in critical inquiry, with instructor-determined themes. College transition and success skills are addressed with each course section. The seminar often acts as an integrator course taught by an instructional team consisting of a faculty member (preferably science or engineering faculty), a librarian, and a peer (upper-division student) facilitator. The seminar addresses the following five goals: (1) strengthening students' academic performance and facilitating their transition to college; (2) enhancing students' essential academic skills; (3) increasing student-student and student-faculty interaction both in and outside of the classroom; (4) encouraging students' self-assessment and goal clarification; and (5) increasing students' involvement with UTEP activities and resources. Data from surveys administered indicate that most students reported that their academic survival skills, sense of comfort, campus participation, and use of essential student services improved as a result of the seminar (Table 1). Results from the 2003 (n=1484) and 2004 surveys (n=1474) administered to all students that completed the course, rather than just full-time first time freshmen, show similar results as the Fall 2000 through Fall 2002 survey results. Instructors reported increased use of instructional innovations and student development strategies; peer leaders indicated increased knowledge about teaching and leadership (Table 2).

First-Time Full-Time Freshmen (FTFTF) Seminar Completer Respondents	**Fall 2000** n = 382	**Fall 2001** n = 607	**Fall 2002** n = 892
% of seminar completers who report their academic survival skills increased	83.1%	80.8%	75.1%
% of seminar completers who report they feel more comfortable at UTEP	71.4%	75.5%	73.9%
% of seminar completers who report that the seminar helps freshmen learn to succeed at UTEP	74.0%	76.7%	75.8%
% of seminar completers who report having participated in at least three campus activities	74.6%	61.2%	61.3%
% of seminar completers who report using at least two essential support services	90.8%	95.4%	92.7%

Table 1. UTEP's Student-Reported Seminar Outcomes (2000-2002)

Seminar Instructor Respondents[1]	2000	2001	2002
	n = 27	n = 30	n = 31
% of seminar instructors reporting using one or more targeted instructional innovations (e.g., cooperative learning, electronic technology)	100%	100%	100%
% of seminar instructors reporting using one or more student development strategies (e.g., career exploration, learning style sessions)	100%	95.7%	97.7%
% of seminar instructors reporting using one or more cultural awareness strategies	88%	63%	79.1%
Peer Leader Respondents[1]	**2000**	**2001**	**2002**
	n = 21	n = 20	n = 48
% of new peer leader reporting increased knowledge about teaching	100%	100%	94.9%
% of new peer leaders reporting increased competence in seminar responsibilities	100%	96.8%	100%
% of new peer leaders reporting increased knowledge about leadership	94.4%	100%	100%
% of new peer leaders reporting increased confidence about assuming a leadership role	88.9%	96.8%	97.4%

Table 2. UTEP Seminar Instructor/Peer Leader-Reported Seminar Outcomes (2000-2002)

[1]Instructors and peer leaders are encouraged but not required to complete the survey, so the number of respondents does not represent 100% of either group.

Surveys were again administered in the fall of 2003 and fall 2004; however, they were not identified by student to permit detailed tracking of full time entering students.
Overall results of the seminar survey report similar response rates. As of fall 2005, surveys are no longer being administered.

Students and faculty have been "teamed" for various types of learning communities. Some learning communities, such as CircLES, have primarily focused on forming student cohorts in a math, English, University Seminar, and an introductory science or engineering course. The objective of this type of clustering was to provide students with a peer support group during their transition to college and to provide early contact with engineering and science faculty. Other learning communities have focused on integrating course content, with faculty collaborating between courses. The implementation of the learning communities has been modified with CircLES students throughout the duration of this program as assessment results obtained through both quantitative and qualitative studies have been examined.

Academic Center for Engineers and Scientists

Students can find a place to meet and study at the Academic Center for Engineers and Scientists (ACES), strategically located in the Engineering and Science buildings. Complete with test banks, state-of-the-art engineering and scientific software and hardware, tutors, individual and group study rooms, and fully equipped large meeting rooms, students were provided with an atmosphere conducive to receiving the support they needed to successfully complete their coursework. ACES grew to become a student support center for all undergraduates, as well as graduates, in STEM. ACES, the first place on campus to offer laptops to students along with wireless access, continues to respond to students academic needs and career preparation. Students also meet representatives from major companies that are recruiting or offering summer internships. Information is available at ACES for graduate school testing and admissions, internships, and co-ops. Workshops held at ACES provide help to students in their academic and professional skills, such as interview skills, resume building, and presentation skills. Student staff training also prepares them academically and professionally with independent/interdependent training, conflict resolution, communication skills, leadership, and specific program and technology training.

Student staff responsibilities have grown to include tutoring, system administration, and team leadership. Tutors attend workshops in order to be certified; furthermore, tutors meet with faculty in order to communicate problems students are having with STEM gatekeeper courses. System Administrators learn to troubleshoot and maintain network printers, servers, workstations, PocketPC's, laptops, and TabletPC's. ACES team leaders are trained in leadership roles and provide assistance for all major functions in the Center. The success of ACES in student academic and professional performance ensures its continued usage and growth.

Research Experiences for Undergraduates

Undergraduate research is a powerful tool to retain high quality engineering graduate students. Students with undergraduate research experience have improved observation skills, critical reading skills, library research experience, oral and written communications, improved time management skills, and greater awareness and teamwork skills.[22] The investment made in science and engineering research in industry, universities, and government laboratories has benefited the U.S. many times over in exports sold, jobs created, and productivity.[8] The overall goal of the undergraduate research model is to train STEM students to operationalize the terms "interdisciplinary, flexibility, and marketability beyond their undergraduate experience."[23]

UTEP's need to increase graduation rates and the number of students advancing into graduate STEM studies served as the foundation to offer a high quality, centralized, meaningful research program. A model was created based on UTEP student demographics and institutional policies and literature citing that undergraduate research programs desiring to increase the participation of minorities in undergraduate research should provide the following:

- Exposure to graduate school opportunities
- Linkages between undergraduate studies and graduate school opportunities
- Undergraduate opportunities to interact with faculty mentors and others who decided to pursue technical research-oriented careers. Linkages and partnerships between

institutions, graduate students, faculty, researchers, businesses, and administrators should be part of this effort.

- As most graduate programs are research-oriented, candidates must gain some experience in doing research.

Since 1995, a total of 303 STEM undergraduates received financial support, have been mentored in research activities, and have been encouraged to pursue graduate degrees. A concerted effort has been made to track these students beyond graduation. Over half of the students were reached. When these students were contacted, they were asked if they perceived REU made a difference in their future plans. Overwhelmingly, the students responded that the REU program had opened their eyes to the possibility of graduate school, that had they not engaged in undergraduate research, they would have never considered going to graduate school, and that a meaningful undergraduate experience was necessary to enable them to be accepted at premiere institutions throughout the United States, Mexico, and Canada.

- Of the 303 participants, 275 (90.8%) have graduated with a BS from UTEP, 12 (4.0%) are still pursuing a BS at UTEP, and 16 (5.2%) have stopped out.
- 133 are either pursuing graduate degrees or have received a graduate degree: 40 have received MS degrees; 43 are currently pursuing MS degrees; 32 are either currently pursuing or have earned a Ph.D. degree; and 18 are either pursuing a professional degree (i.e., MD, JD) or have earned a professional degree.
- The Geodiversity, Biology REU Programs (RISE, REU), and LSAMP continue to provide research opportunities to undergraduates during the academic year and summer.
- Six REU students presented their research to the National Science Board and NSF President, Arden Bement, during their visit to the UTEP campus in Spring 05.

Women in Science and Engineering

The Women in Science and Engineering (WiSE) program was initiated in 2001 to increase the interest and enrollment of women in engineering through early exposure initiated by outreach activities. Several activities conducted by WiSE members target young minority women. These activities include an Expanding Your Horizons in Science and Math Conference to middle school girls, a “Think College Now” presentation to middle and high schools, and a Mother-Daughter/Father-Son Open House at the University. All WiSE members demonstrate an interest in community service.

While it is still too early to tell if this program is making a difference, several new initiatives and suggestions are being implemented and considered for increasing the number of women studying engineering. One involves adding new engineering majors that are more appealing to women. Women faculty in engineering are beginning to mentor more females and encouraging them to conduct undergraduate research. A new chapter of the Society for Women Engineers (SWE) was reinstated this past year. More efforts are needed to recruit and support women interested in pursuing a career in engineering.

The Center for Effective Teaching and Learning

Developed through the NSF MIE grant, the Center for Effective Teaching and Learning (CETaL), now institutionalized, continues to support UTEP faculty and departments with teaching and learning by providing individual consultations, support in preparation for SACs accreditation, hosting of the Fall Faculty Retreat, the 2005 SUN Conference, the Faculty Mentoring Program for Women, support for the Graduate Student Professional Development Program, and Leadership Development for Chairs and Faculty. The focus to advance UTEP's teaching mission through innovation and transformation providing faculty, instructional, and curriculum development, remains strong.

Evaluation Model

The MIE evaluation model consists of quantitative and qualitative assessment. Quantitative assessment was designed to longitudinally track student cohorts in the Entering Student Program for STEM students (CircLES), the undergraduate research program, peer facilitators for various courses, student success in new and modified courses, and student staff. Students in specific interventions were tracked and compared to STEM majors as a whole. Because so many students receive multiple interventions introduced over the past 11 years, it is difficult to determine causality; however, as a whole, student retention and graduation in STEM has increased over the last 11 years, providing the desired outcome. Qualitative assessment included surveys (both online and paper surveys), focus groups, and interviews, used to obtain student and faculty impressions and suggestions of these MIE initiatives.

To determine retention rates for students beginning at the University in the CircLES program receiving orientation, advising and clustering in courses, cohorts were formed. Students included in a cohort had to be full time (12 or more credit hours), first-time entering college students pursuing a degree in STEM. Full scale implementation of CircLES began in 1998 after a pilot program of 60 self-selected students was found successful in 1997. The comparison group (full time, first time entering STEM students who did not participate in CircLES orientation, advising, and learning communities) was used to determine this initial pilot's success. Indicators of success were student retention rates, number of course hours attempted and earned the first semester[1] and first semester grade point average (GPA). Figure 3 depicts first year retention for the 1997 comparison group and all future cohorts.

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[1] Some cohort participants may have attended a summer term prior to their first year. These students are included in the cohort and all cohort graphs and tables.

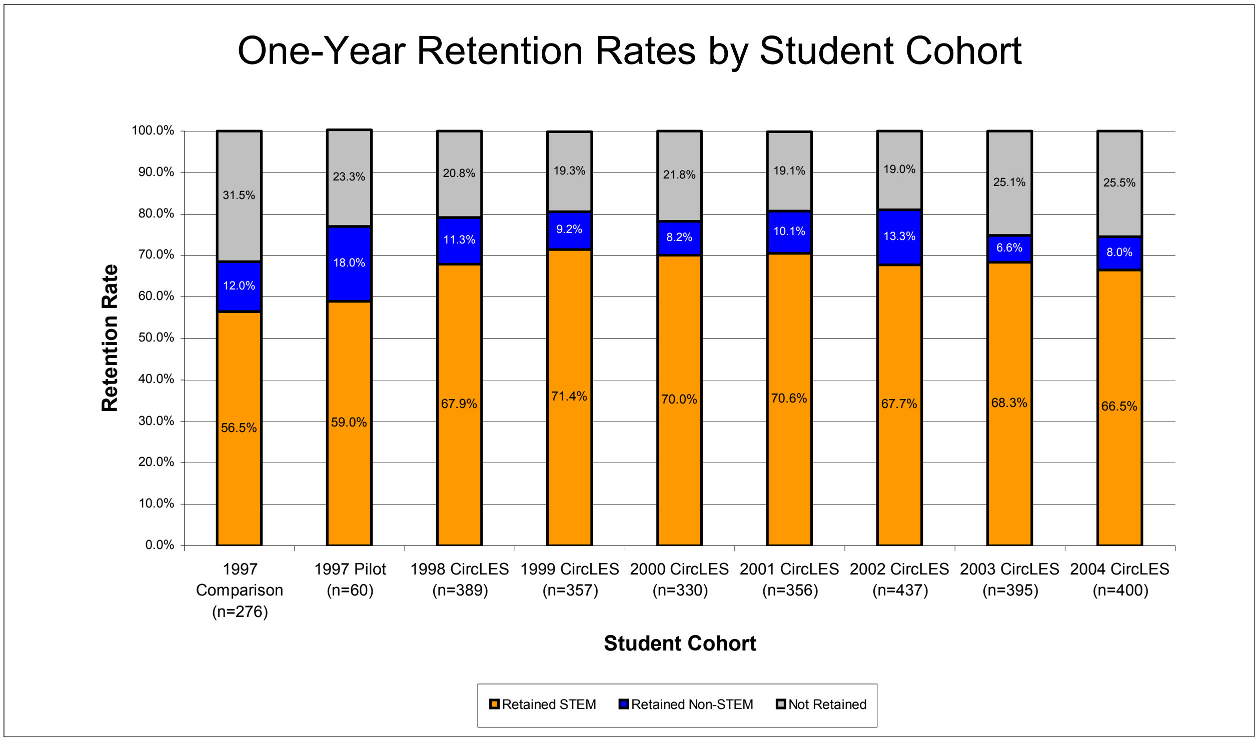

Figure 3. One – Year Retention Rates by Student Cohort

Degrees Awarded and Time to Degree

STEM undergraduate degrees continue to increase each year. The 2004 – 2005 academic year awarded 440 undergraduate degrees. Under-represented minorities (Hispanic, African American, and Native American) received 302 of these degrees. Figure 4 shows the number of degrees conferred since 1999 – 2000.

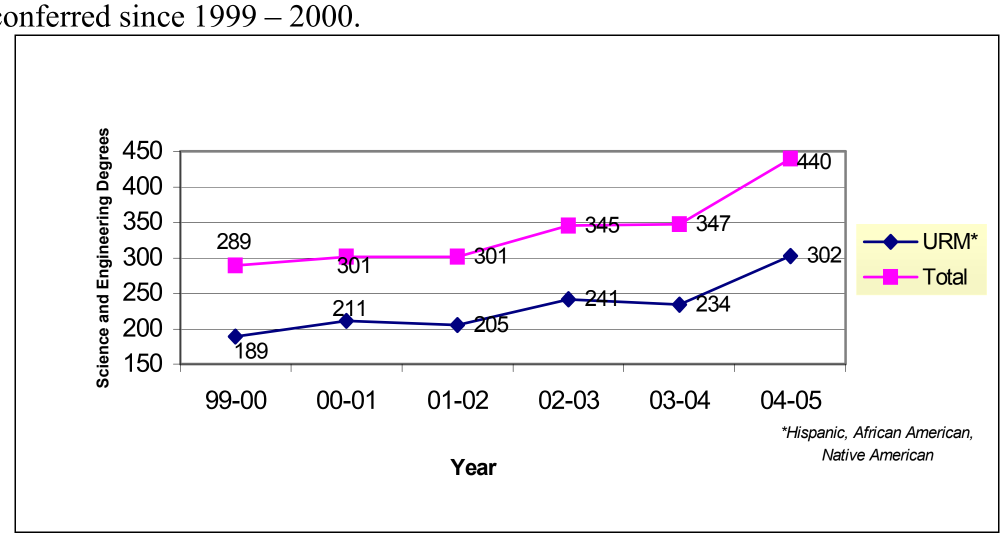

Figure 4. STEM Degrees Awarded

The length of time to earn a degree for the average undergraduate STEM student has decreased from 6.6 years in 1997–1998 to 5.1 years in 2004–2005 (Figures 5). This is partially attributable to the increase in the number of transfer students beginning at community college or elsewhere. Additional examinations were done of students with no transfer hours and with less than 30 transfer hours (those students entering as freshmen). All three scenarios show a decrease in the length of time to earn a STEM undergraduate degree.

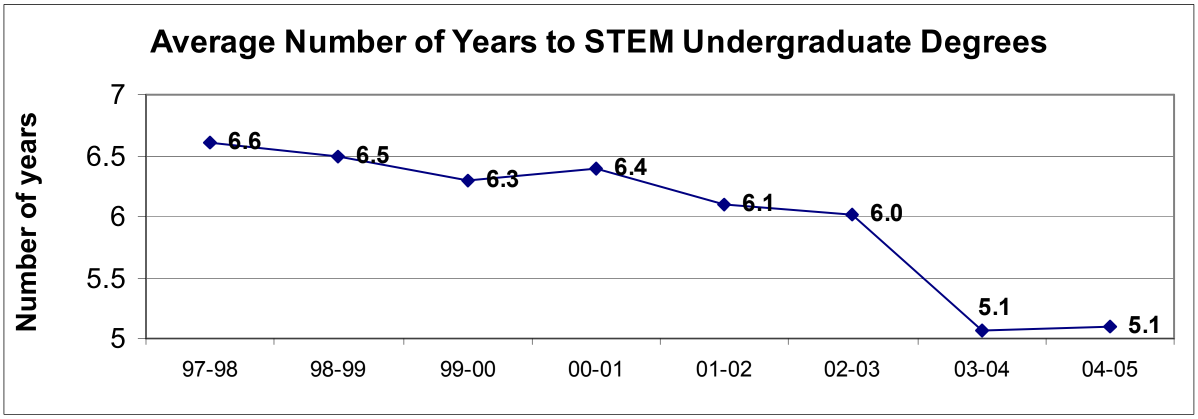

Figure 5. Average Number of years to STEM Undergraduate Degrees

Conclusion

The method by which scientists and engineers learn from each other, communicate, and interact is undergoing rapid and dramatic transformation. Today, data and software are shared extensively over the Internet. Libraries are becoming virtual tools. The MIE Advisory Board at UTEP was incisive in foreseeing this transformation, suggesting adaptation for many of the emerging engineering trends such as inquiry-based learning, interdisciplinary integrated course content, undergraduate research, communication, presentation, and leadership skills development. As Dr. Shirley Ann Jackson, President of Rensselaer Polytechnic Institute said in her keynote address to the Society of Women Engineers, "Over a decade ago, the U. S. engineering community - including industry, academe, and government – collectively concluded that it was time to make a change in engineering education. They came to this conclusion for several reasons. First and foremost, industry leaders had for years been voicing concerns to the community that engineering graduates were not adequately prepared to function within modern American industry. They lacked the ability to team effectively, said industry leaders. They had little grasp of concepts such as customer service, environmental sensitivity, social responsibility, and continuous quality improvement. At the same time and just as strongly, these same concerns were expressed by forward-thinking educational leaders: Our graduates are facing a new engineering environment, and we must prepare them for it."

Through the 11-year MIE initiative, UTEP was able to respond to the US engineering community's concerns and STEM students' needs. Students need an academic support system. Students need a 'place' to study and meet on campus. They need technology resources, supplemental instruction, peer support, a more extensive orientation, academic advising, graduate school preparation support, and a stronger understanding of higher education and "University life". Students also need the curriculum to "meet them" at their level of entry to the University. Critical thinking skills and mathematical entry level are two areas where major adaptation needs to occur to prepare students for college success. Support for the transition from high school to college is necessary for most UTEP students, as their family and friends have frequently never experienced this transition to assist them in the process. These required changes drive UTEP's adaptation in engineering and science education concomitantly with the adopted University mission.

Through course clustering and other intervention activities, retention and graduation rates in STEM have improved. Summer orientation was expanded to include a mathematics review, effective in increasing mathematics placement scores and increasing the number of students who enroll in college-level mathematics. This summer mathematics review delivers the necessary mathematics refresher materials to enable the majority of science and engineering students to successfully enroll in a college-level mathematics course and reduce the length of time required to earn a degree by at least one semester.

Consequently, STEM degrees awarded are at an all time high. Curriculum modifications continue to focus on active learning, hybrid courses, peer tutoring and mentoring, and faculty mentoring and support. Four of the six MIE activities are now institutionalized. Research for undergraduates is being funded by new grants. ACES student centers are being utilized by STEM students and new student centers are being modeled after these facilities. A close look at retention data is resulting in policy and curriculum changes within STEM and CircLES Learning Communities.

Many challenges remain in sustaining the improvements made to STEM undergraduate education through the Model Institutions for Excellence initiative at UTEP. The increased retention and graduation rate, the increasing number of under-represented minority students pursuing graduate STEM degrees, and the decreasing length of time to earn degrees have all been made possible by the curricular and co-curricular reform that has been enabled by MIE. As UTEP attempts to fund the institutionalization of these successful MIE activities, it continues to face ever-increasing demands to provide an improved educational experience in light of decreased state funding. The commitment remains strong to look at all options to maintain this heightened cultural transformation.

Acknowledgment

This work was funded by the National Science Foundation's Model Institutions for Excellence Program under cooperative agreement No. EEC-9550502.

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