

Transforming STEM Education

A response to recommendations by the President's
Council of Advisors on Science and Technology



CLASS OF 2012

WorldsAhead

FIU grad

Be WorldsAhead

Today's students are creating the future. **WorldsAhead** is an attitude, one that commands each of us to think differently, exceed expectations and create new possibilities. It's what we challenge our students to become. At FIU, our students are surrounded by the educational and career opportunities needed to achieve their dreams. Award-winning faculty. State-of-the-art research facilities. A diverse student body. An incomparable location in one of America's most exciting cities.

Here education doesn't stop at the edge of campus. South Florida is a living laboratory. Our students immerse themselves in the lessons of our local communities. From the seagrass of the Atlantic Ocean to the sawgrass of the Everglades, from the boardrooms of downtown Miami to the operating rooms of area hospitals, our students explore a breathtaking array of real-life opportunities inside and outside the classroom. We challenge them to think differently. Go beyond what is expected. Take the opportunity they're given and do something great with it. ***Be WorldsAhead.***





In February 2012, the President's Council of Advisors on Science and Technology issued a report with five recommendations to increase the number of science, technology, engineering and math graduates by 1 million in the next decade. This document provides insight into Florida International University's experience in these areas and our commitment to national goals. As an urban public research university, FIU has long focused on the areas highlighted in the PCAST report by offering inspiring educational experiences that encourage our students to discover, educate and innovate. With \$20 million in active STEM education-related grants, our faculty members engage in life-altering research and mentor students who go on to conduct their own. Our active-learning approach opens our students' eyes and minds to opportunities they never knew existed. At FIU, it's not just about what we teach but how we teach.



Discover

Catalyze widespread adoption of empirically validated teaching practices

Jose Alberte was captivated by science at an early age, but it was a peer-learning program at FIU that helped him find his calling.

"I originally wanted to be a doctor, that was always the plan," said Alberte, whose brother has Down syndrome. "I wanted to learn more about the condition and how to improve his lifestyle and the lifestyles of others who have it."


As a freshman at FIU, he became involved with the Peer-Led Team Learning (PLTL) program in the General Biology I and II courses. The program, used in a variety of science, math and engineering courses, incorporates peer-led workshops and active learning activities to help engage students in the curriculum. Alberte, who embraced the program, eventually became a peer leader. After earning his bachelor's in biology, he became director of the FIU PLTL program.

"The program gave me the chance to

experience, first-hand, the teaching and learning process," Alberte said. "It went both ways. I learned from my students as much as they did from me. Interacting with faculty, peer leaders and students in an academic culture opened my eyes to other possibilities."

He is now preparing for the next phase of his education — a Ph.D. in curriculum and instruction, with an emphasis in biology education, from FIU's College of Education.

"It's the best of both worlds for me to merge science and education."



“One of my goals is to figure out how to interest more minority students in physics and encourage them to pursue a career in this field.”

Idaykis Rodriguez

PLTL was first implemented at FIU in 2000 in an effort to address concerns about student performance in first-year biology. The program, a nationally recognized pedagogy, was tailored to meet the needs of FIU’s unique student population.

While the PLTL model works in many disciplines, education reform is not a one-size-fits-all approach. FIU has implemented a variety of teaching practices to help students better prepare and become critical thinkers across its diverse programs. This includes the implementation of an Emporium Model to improve pass rates in College Algebra, as well as learning assistant programs in chemistry, physics, earth science and mathematics. The learning assistants program, which originated at the University of Colorado-Boulder, creates environments for interaction, collaboration and problem-solving. Today, with 152 learning assistants university-wide, FIU employs more learning assistants than any other university in the nation. The peer-learning component has proved particularly successful for FIU, one of the nation’s largest Hispanic-serving institutions.

In areas where models do not exist, FIU is exploring teaching practices to enhance the core competencies of students through Project Gateways, funded by the Department of Education’s Title V program. In addition, the FIU STEM Transformation Institute focuses on the creation, validation and implementation of inclusive models of STEM education to support all learners — pre-kindergarten through graduate education.

For students such as Jose Alberte, these initiatives have helped guide them to academic success and provided direction within their chosen career paths.

Advocate and provide support for replacing standard laboratory courses with discovery based research courses

For physics Ph.D. candidate Idaykis Rodriguez, the lack of minorities in her field has driven her to share her love for physics with more underrepresented minority students.

A Cuba-native, Rodriguez is part of the university’s Physics Education Research

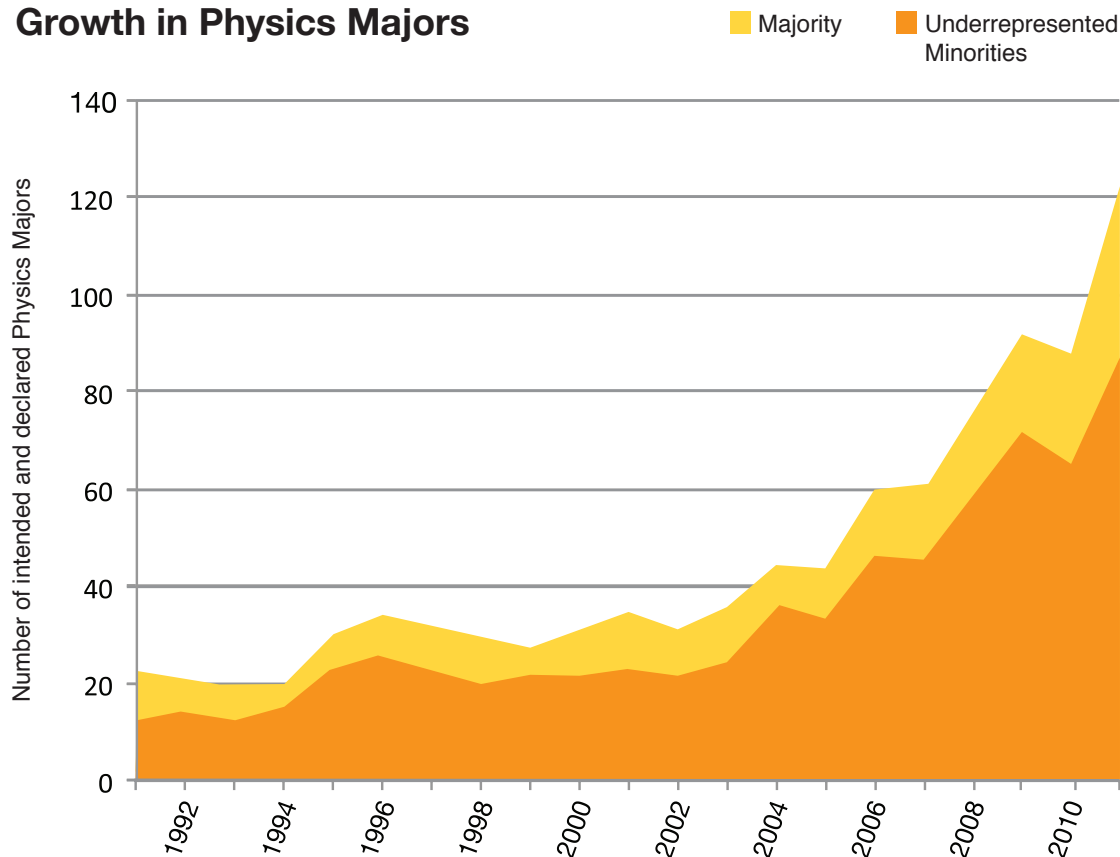
The FIU STEM Transformation Institute brings together faculty from the College of Arts & Sciences, College of Education, and College of Engineering and Computing to build a nationally recognized STEM education research group that develops effective instructional techniques for the classroom.

Group where she focuses on models of effective STEM instruction. She teaches modeling classes, which focus on hands-on experiments instead of traditional lectures.

“I have asked myself why there aren’t more Hispanic students in physics, or in the sciences for that matter,” Rodriguez said. “One of my goals is to figure out how to interest more minority students in physics and encourage them to pursue a career in this field.”

Rodriguez recently attended the 62nd Lindau Nobel Laureate Meeting in Germany. Her story is just one of the many STEM success stories at FIU. In recent years, the university has shifted the focus from traditional teaching methods to more innovative, discovery-based classroom experiences.

Growth in Physics Majors



Source: FLBOG interactive university database

This research-driven curricula has shown greater success for FIU's minority-majority population. By engaging the students through discovery, they are learning science by experiencing it as scientists. As a result, students have shown improved conceptual understanding and retention. In physics alone, grades have steadily improved for introductory physics courses and the number of physics majors has increased by nearly 800 percent since discovery-based learning was implemented.

Discovery-based labs have also been introduced in chemistry and the QBIC (Quantifying Biology in the Classroom) program. And as FIU builds for the future, discovery-based learning remains top of mind as new classroom spaces are being designed.

Currently, FIU has more than 7,500 undergraduate students majoring in STEM fields. To help these students be successful, and encourage more students like Idaykis to venture into STEM fields, momentum at the national level must be a priority for all.

Launch a national experiment in postsecondary mathematics education to address the mathematics-preparation gap

With a 30 to 35 percent pass rate, College Algebra has proved to be a challenging course for many students at FIU. Recognizing a critical need to take action, FIU focused on a modified Emporium Model to effect change.

The high-tech, high-touch approach to teaching College Algebra relies on faculty development, peer tutoring and a computer-based program to help students master the courses. FIU first rolled out the concept in 2011 as part of Project Gateways, a Title V-funded project developed to enhance core competencies at FIU.

The pilot project produced immediate results with a higher pass rate for students in the mastery program versus students in the non-mastery classes. The commitment from Project Gateways is to enact initiatives that increase the pass rate annually to

achieve an overall pass rate of 73 percent by 2015. Because of the definitive results from the pilot project, funds were awarded by the student's technology fee to build a state-of-the-art computer lab, effectively enabling the university to expand the high-tech, high-touch approach to all College Algebra students.

The Mastery Math Lab opened in the fall of 2012. With more than 200 stations, the lab engages students in doing math with the support of 29 learning assistants, eight faculty from the Department of Mathematics and Statistics, and a comprehensive online support package. Christian Otero is one of these students.

A Biological Sciences major, he is currently enrolled in a College Algebra course. Otero, who admits he was unprepared for the first test of the semester, scored a 37. With that rude awakening, Otero decided to take full advantage of the offerings in the Mastery Math Lab including help with his homework and practice problems. Otero surprised himself

Educate

FIU's Mastery Math Lab, a component of the university's Mastery Math Program, accommodates 1,100 students in basic algebra and 500 students in intermediate algebra.

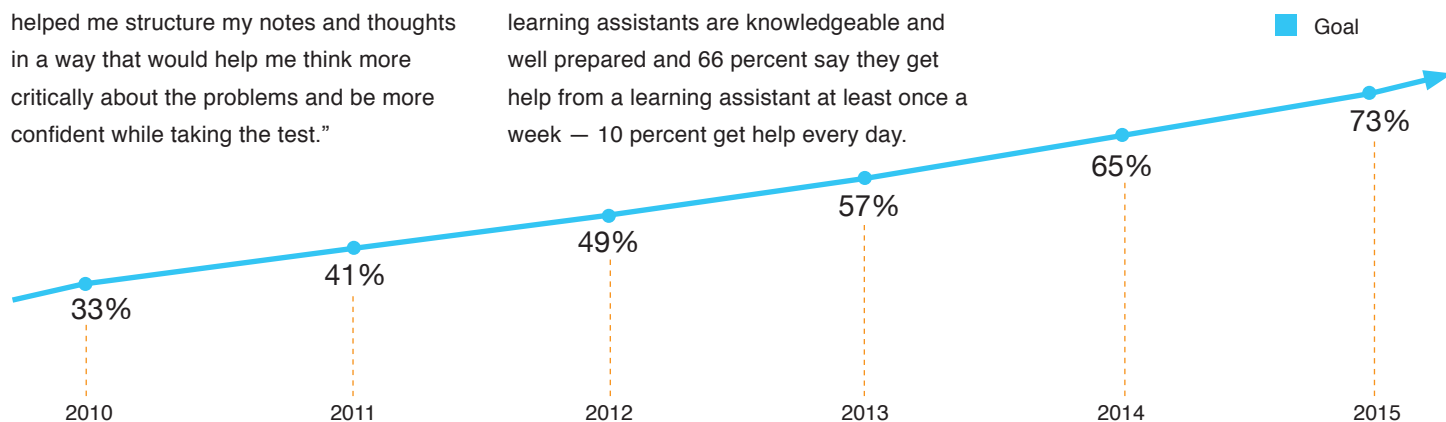
on the second test, earning a score of 108, including extra credit.

"The difference for me was in doing the review and practice test," Otero said. "It helped me structure my notes and thoughts in a way that would help me think more critically about the problems and be more confident while taking the test."

The Mastery Math Lab learning assistants attend a mandatory seminar where they learn cognitive theory, education research and best pedagogical practices for mathematics teaching. They also lead weekly sessions targeting student conceptions and common errors.

Of students surveyed, 89 percent say that learning assistants are knowledgeable and well prepared and 66 percent say they get help from a learning assistant at least once a week — 10 percent get help every day.

While still in the early stages of implementation, FIU's approach to improving pass rates for College Algebra is yielding positive results and could serve as a model for other universities nationwide.



Source: FIU Title V Project Gateways



Innovate

Encourage partnerships among stakeholders to diversify pathways to STEM careers

At FIU, university leaders are creating and expanding opportunities for students to enter STEM careers. The results are paving the way for a new generation of scientists from traditionally underrepresented backgrounds who will offer fresh perspectives about how best to solve the world's challenges.

Nurturing potential

The College of Engineering and Computing created the Center for Diversity in Engineering and Computing in 1996 to serve and engage students, teachers, families and communities in science, mathematics, engineering and technology education. The center provides myriad pre-college academic enrichment programs throughout the year for K-12 students. These programs

encompass mathematics tutoring services, reading assistance, and courses in science, technology, engineering and mathematics. The center also provides several scholarship programs to university students pursuing a degree in one of the STEM areas.

Creating an employment pipeline

In 2007, the university's Applied Research Center (ARC) partnered with the U.S. Department of Energy (DOE) to create the DOE-FIU Science and Technology Workforce Development Program. The initiative was designed to create a pipeline of minority engineers who are ready to enter the DOE's workforce in technical areas of need.

The majority of top 25 institutions awarding degrees to Hispanics are Hispanic-serving institutions. Nationally, 47% of STEM degrees and 60% of doctoral STEM degrees awarded to Hispanics are from these institutions.

Lee Brady was a four-year DOE Fellow.

While working toward an undergraduate degree in mechanical engineering, he dedicated time to a project designed to solve operational shortcomings in the current high-level waste processing strategy at the Hanford Site in southeastern Washington. As a master's student in engineering management, he contributed to multiple projects. Today he

65

Department of Energy
Fellows since 2007

26

fellows obtained
graduate degrees

12

hired by federal
agencies

100

percent of grads
working in the
energy industry



FIU students are graduating with promising career opportunities. Since the program's inception, 65 fellows have completed the program. All of the program's graduates are working within the industry, and 12 of them have been hired by federal agencies.

Establishing a biosciences industry in South Florida

In 2010, FIU President Mark B. Rosenberg and President Frank Nero of Miami-Dade County's Beacon Council convened a meeting with presidents of four public and private universities, four state colleges, three economic development councils and the presidents of Enterprise Florida, the Florida High Tech Corridor and the president of the Florida Network of Research, Science and Technology Parks. The goal — leverage existing regional life sciences assets in the area with public and private investment opportunities to develop a more resilient economy that will generate more stable, sustainable and high-paying jobs.

Today LifeSciences South Florida (LSSF) is establishing an industry cluster in South Florida focused on life sciences, biotechnology, pharmaceuticals, diagnostics, and information technology.

Moving the 100Kin10 movement forward

FIU's STEM Transformation Institute is leading South Florida's commitment to the

100Kin10 movement, an initiative that aims to train 100,000 excellent STEM teachers in the next 10 years. The university is working with Miami-Dade County Public Schools, the nation's fourth largest school district, to recruit, prepare and retain 200 local STEM teachers in 26 low-performing schools. Dubbed "Teach STEM Miami," the program provides high quality science and math teacher preparation for future elementary and secondary school teachers.

Reimagining engineering education

In March 2012, FIU's College of Engineering and Computing, with support from the National Science Foundation, organized and hosted a three-day workshop aimed at developing concrete steps to broaden participation among underrepresented minorities in engineering. Participants included a broad set of stakeholders from across the country in engineering education — school districts, community colleges, engineering schools, industry and government. The final session culminated in the development of a primary goal to increase the percentage of underrepresented minorities graduating with engineering degrees from its current 12.4 percent to 20 percent by 2025. The group identified 10 strategic initiatives required to achieve that goal.

works full time for the Department of Energy's Office of Deactivation and Decommissioning and Facility Engineering.

Students selected as DOE Fellows receive university lab assistantships during the academic year and serve 10-week summer internships at DOE labs such as Savannah River National Laboratory, Oak Ridge National Laboratory and Pacific Northwest National Laboratory, among other sites.

The program is an unqualified success. The DOE is replenishing its aging work force with qualified young engineers who come to their new roles with relevant field experience and

Meeting the Challenge

According to the PCAST report, meeting the 1 million more STEM graduates goal will require more than a 30 percent increase in the number of undergraduate STEM degrees over current rates. Underrepresented minorities should be a major thrust of the national plan and movement towards this goal.

Role of Hispanic Serving Institutions

For the United States to keep pace, STEM education must be successful at our urban, diverse research universities.

According to an Excelencia in Education report, the majority of the top 25 institutions awarding degrees to Hispanics at the bachelor degree level are Hispanic Serving Institutions. The majority of the 25 institutions by academic

level and sector in STEM are public institutions.

In an effort to make STEM education more accessible and effective for our students, a network of research-driven STEM centers focused on underrepresented minorities must be in place. At FIU, the STEM Transformation Institute provides strategic leadership for meaningful and sustainable changes in FIU's STEM undergraduate education and hopes to be a national model for STEM education.

FIU at a GLANCE

Rankings & Recognitions

FIU is #1 in the United States for awarding bachelor's and master's degrees to Hispanics.

FIU College of Law graduates were #1 in the state in their passage rate on the 2011 Florida Bar Exam.

The College of Business Administration's international business program ranked 16 in 2012 in *U.S. News & World Report's* "America's Best Colleges".

Robert Stempel College of Public Health and Social Work Associate Professor **Mary Jo Trepka** received the Presidential Early Career Award for Scientists and Engineers.

Engineering Professor **Arindam Chowdhury** is the recipient of a prestigious Faculty Early Career Development Award from the National Science Foundation.

Herbert Wertheim College of Medicine Assistant Dean **Pedro "Joe" Greer Jr.**, was awarded the Presidential Medal of Freedom.

Creative writing Professor **John Dufresne** has been named a 2012 Guggenheim Fellow, which recognizes exceptional capacity for productive scholarship or exceptional creative ability in the arts.

Architecture Professor **David Rifkind** received the Ackerman Prize, one of the most prestigious international awards for scholarly work in architectural history.

Herbert Wertheim College of Medicine Professor **Madhavan Nair** received a prestigious MERIT Award from the National Institutes of Health recognizing outstanding competence and productivity in research.

50,000 Fall 2012 enrollment

62,000 Projected enrollment for 2020

100,000 Students will graduate from FIU in the next decade

3,513 Dual enrollment students

167,000 Alumni

180 Bachelor's, master's and doctoral programs

96 Percent of faculty hold doctoral degrees or highest degree attainable in their field

12 Colleges and schools including Medicine, Law and Architecture







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