

S-STEM: Mathematics, Engineering, and Physics Scholars

Dr. Lee Ann Jerome Clements, Jacksonville University

Dr. Lee Ann J. Clements is the Associate Provost for Accreditation at Jacksonville University. Prior to serving in this role she served for twelve years as the Chair the Division of Science and Mathematics. She received her B.A. in Biology from the University of Virginia, her M.S. and PhD from the University of South Carolina in Marine Science. Her research projects have included investigating the role of metallic pollutants in altering development, the effects of environmental variability on skeletal regeneration, and the effects of ocean acidification on marine organisms. She is also involved in projects that help communicate science to the general public and is one of the creators of The Science Of . . . a web-based video magazine. In addition to her role as Associate Provost Dr. Cements is also the Interim Dean of the College of Arts and Sciences and a tenured Professor of Biology and Marine Science at Jacksonville University.

Prof. Huihui Wang, Jacksonville University

Dr. Huihui Wang, one of Co-PIs, is an assistant professor and the Chair of the Engineering Department at JU. JU is a private, undergraduate liberal arts institution in northeast Florida. Within our College of Arts & Sciences, the STEM disciplines continually draw the largest student enrollment numbers. In 2015, the Engineering Department transitioned from its 30 year history as an engineering dual degree program to a four year onsite program. The former program was affiliated with seven well-known universities including Columbia University, the University of Florida, and the Georgia Institute of Technology. JU opted to establish the onsite engineering program based on students' needs and interests as identified through feedback from the previous dual degree program. This four-year program can confer a BS degree in mechanical engineering or electrical engineering. The new engineering department has added two more faculty positions, put \$200,000 towards upgrading equipment and facilities, increased retention rates and increased internship opportunities (Dr. Wang has supervised several interns). As a member of ASME, ASEE, IEEE, Florida Engineering Society (FES), and an advisor of NSPE JU Chapter, she actively participates in conferences, workshops and professional activities.

Anna Little, Jacksonville University

Anna Little is an Assistant Professor of Mathematics at Jacksonville University. She has a PhD in Mathematics from Duke University and her research interests include high-dimensional data analysis, clustering, and machine learning.

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Mathematics, Engineering, and Physics (MEP) Scholars

Introduction

There is a critical need for increasing the STEM workforce in the USA. In response, the NSF established the Scholarships for Science, Technology, Engineering and Mathematics program (S-STEM) to support academically capable but financially needy students in the STEM disciplines. Jacksonville University (JU) was awarded an S-STEM grant in summer 2014 to implement the Mathematics, Engineering and Physics (MEP)-Scholars program. The project includes scholarships that assist students with meeting their financial need and additional student support services to improve academic performance, retention and persistence in the STEM majors through graduation. The successful Jacksonville University grant application was based on a previous submission by Crittenden et al (2012).

The engineering program at the start of the program was a Dual Degree 3-2 program in which the students completed three years of courses in a STEM discipline and general engineering courses, and then transferred to an Affiliated Institutions (AIs) to complete the engineering degree. In fall of 2015 Jacksonville University began two four-year Bachelor of Science degrees in engineering and discontinued the dual degree program. The first class admitted to the MEPS program was under the dual degree curriculum, but in the past two years students have entered as freshmen desiring to pursue a BS in Electrical Engineering or Mechanical Engineering without a transfer to an AI, or majors in Mathematics, Physics or Computer Science.

The project has 3 major goals: 1) improve the enrollment of students in engineering related degree programs at Jacksonville University, 2) improve enrollment of underrepresented groups in engineering related disciplines at Jacksonville University and 3) improve retention through graduation or transfer to an affiliated institution in engineering-related disciplines. Program goals are met through targeted support of the student in co-curricular and extra-curricular areas.

Co-curricular Activities (Maria)

MEPS program arranged a number of co-curricular activities and facilities for the students so that the students can be better prepared for their careers. Career preparation and the relevance of outside of classroom activities is crucial to establishing student identification with professionals in their chosen careers. Development of professional identity is one of the indicators for persistence in a field, particularly in under-represented groups. Co-curricular activities are designed to enhance student knowledge in one or more areas of study and therefore improve their performance in classes. Retention studies at Jacksonville University have linked higher retention rates with better performance in courses within a student's major. Students are encouraged to participate in as many of these programs as possible within their schedules. Some are scheduled within class times, especially for the freshmen, but sophomore, junior and senior students are also welcomed to attend if they are available. In the past 18 months students have participated in orientation sessions, field trips, group advising, a resume workshop, tutoring

offered in the Academic Support Center and attendance at seminars focused on STEM topics. Specific activities are detailed below.

Each new group of students plus the continuing students is required to attend an orientation session for the program at the start of the fall term. The orientation sessions include some ice-breaker and introduction activities along with investigations of the learning cycle and discussion of how to develop into better learners. This latter was achieved using the Kolb Learning Styles Inventory (<http://www.haygroup.com>). An additional building activity was added this year. Students were placed into groups by their choice (bear, cat, duck, bison, lion, dragon, and skull) and given a paper mask to build as a group. The wintercrof 3-D masks (www.wintercroft.com) require significant spatial reasoning, manual dexterity and cooperation to construct as they are printed on flat paper and must be cut, folded and glued into the final shapes. At the end of the exercise, a short debrief explored the most important factors for the team project.

In November 2016, twenty students participated in a field trip to Applications Engineering Group, Inc. (AEGI). AEGI provides technical analyses and damage assessments for a wide range of vehicular, electrical, mechanical, material, industrial and construction failures, and accidents. They also provide expert witness testimony in cases involving these incidents. During the trip, the engineering team of AEGI explained the engineering tasks they perform. Students toured the facilities; saw the technical equipment (3D laser scanner and hardness indenter) and learned how these instruments work.

Group advising sessions have been held every term to assist students with preparing their academic schedules for the upcoming semester. During the sessions, faculty mentors from Mathematics (Dr. Mike Nancarrow), Computer Science (Dr. Tanja Magoc) and Engineering (Dr. Maria Javaid) advised students about the required courses, the rotation in which courses are offered, prerequisites, potential scheduling conflicts, and other possible pitfalls peculiar to their discipline. These sessions also introduce students to how and when they should look for internship and research opportunities.

The Director of Career Resource Center (Toni Higgs) and her staff worked with the students to help them prepare excellent resumes and improve their interviewing skills for internships and jobs.

Throughout the year MEPS tutoring is offered in the Academic Support Center for students who are members of the cohort, as well as other JU students. The primary assistance for the MEPS students has been in Physics and Math to assist these scholars on their path to success. Two students in the program now work as peer tutors for other students. This allows them to provide peer mentoring as well as academic help to others in the program.

The Science and Engineering Lecture Series (SELS) is an ongoing speaker series that brings in local and national speakers in all areas of STEM. Jacksonville University faculty also featured occasionally as part of the weekly program. Students are encouraged to attend by offering pizza and soda, but also through extra credit and required assignments in some of their classes. In addition to SELS, the MEPS program has brought in two speakers specifically to address issues of underrepresented groups in engineering and related fields. Dr. Beville Watford, Director,

Center for the Enhancement of Engineering Diversity, College of Engineering, Virginia Polytechnic Institute and State University visited Jacksonville University in fall 2015. She gave one hour presentation followed by discussion; the presentation was open to all the students. She had lunch with MEPS students and faculty mentors.

Dr. Kemi Ladeji-Osias, Associate Professor and Associate Chair for Graduate Studies, Department of Electrical and Computer Engineering, Morgan State University was a guest speaker in fall 2016. She presented “Academic Equinox: Defining the other Half” to students followed by discussion; the presentation was open to all the students. She also had dinner with faculty mentors.

Extra-curricular Activities (Emre)

Extra-curricular activities each term are designed to create a sense of community among the students and provide a context for informal student/faculty relationship building. As a result, these events improved a sense of belonging to the program and contributed to increase the retention.

Dinner with Faculty (Fall 2014): A dinner was given in a faculty member’s home and each faculty member cooked or provided food to share with students. The atmosphere, initially reserved, was loud and festive by the end of the evening as students and faculty interacted in a game of Mafia. The event definitely contributed to a stronger sense of community between MEPS students and faculty.

T-Shirt Design Contest (Fall 2015): Students were challenged to design a t-shirt for the MEPS program. Four different t-shirt designs were submitted by the students and faculty. In order to select the winner, everybody voted for his/her favorite design which surprisingly ended with a 3-way tie. Eventually, we combined all designs in one t-shirt and ordered our custom design. After receiving the t-shirts, students and faculty met together to have a group picture wearing the t-shirts.

Movie Night (Fall 2015): The event included watching a science/engineering related movie, having popcorn, and a discussion session. Also, before the event some faculty and students had dinner together at the cafeteria and headed to the event together. The movie “Box Trolls” was chosen for this purpose because it was created by using 3D printed objects and stop motion animation technique. After the movie, we also watched behind the scenes features which explained the techniques involving lots of engineering. Students and faculty discussed different aspects of movie and the technology involved. The importance of this particular event was the use of engineering principles in fields that many students would not have anticipated—the arts. Further, students had some experience with 3D printing capabilities on campus and would be using this new technology in the future. It was important for them to see the full scope of possibilities the technology affords.

Stress Relief and Game Night (Spring 2016): The event took place during the mid-terms period. The evening started with a “Stress Relief” presentation given by an expert from Student Counseling Center. The main emphasis of the presentation was providing students with

foundational knowledge of stress and helping them to handle the stresses they encounter. This was followed by refreshments and board games.

Mask Design (Fall 2016): On Halloween students and faculty showed off the masks prepared as part of the orientation. After a fun time talking about the mask designs and Halloween, we had casual conversation with students and listen their feedback about various subjects. Students also received their Halloween treats at the end, candies and chocolates!

Results

The program had a slower start than we initially proposed, and the first class admitted consisted of only 5 students, one of whom left the program in year two because of poor grades. In year two, the cohort was larger (seven students) but still lower than our target of admitting 14 academically strong students. In the fall 2016 we admitted an additional 16 students, however four from the previous cohort have left the program (one left because he was in 3/2 engineering dual degree program and he had to transfer to one of AIs by the end of the third year). We now have a total of 21 students in the program. The freshmen to sophomore retention rate was 75% for the first cohort and 50% for the second cohort. Two of the students who left the program did so by changing majors at the university. Although a loss from STEM, they changed to business-related majors, their change of direction was based on preference rather than grades. Students who actively participate in the co-curricular and extra-curricular activities are staying in the program. All of the students who have left, either due to poor grades or changing interests, have been less involved and active in the program than those who stayed.

Enrollment in targeted STEM majors has increased 24% over two years. This is compared with undergraduate enrollment growth of 5% university-wide.

Demographically the MEPS students are diverse. Women comprise 20% of the MEPS students, and 20% of the target STEM majors. The total number of women enrolled in targeted STEM majors is nearly double the number when the program started. 43% of the MEPS students self-identify as underrepresented racial/ethnic groups. Overall 40% of STEM majors (not including Biology, Marine Science & Chemistry) self-identify into underrepresented racial/ethnic groups.

Some Highlights of MEPS Students' Stories (Huihui)

More important than the statistics are the individual stories of students involved in the program. Several of the students are athletes while being involved in the program. Overall GPAs of MEPS students is 3.42, and the students actively participate in additional co-curricular and extra-curricular activities: the National Society of Professional Engineers JU chapter, the annual MEPS orientation and the field trips. Travis is the student ambassador at JU admission office, president of a fraternity, president of the JU student alumni association and our college representative at the JU student government. He loves JU and contributes a lot in different aspects. Jeremy was an intern at Jacksonville Electricity Authority in summer 2016. Courtney also does well in her school work besides her excellent performance in the JU sailing team. Aaron and Nicolas have been involved in undergraduate research developing an app for an e-

health system for patients with difficulty speaking loudly enough to be heard. Cindy and Misha actively participate in our MEPS events, are student leaders on campus and are working on STEM-lympics (STEM themed field day) which will be held in spring 2017.

Summary and future work

We are still in the middle of this project and we are exploring better practices for improving our scholars' learning, preparing them for their careers, increasing the number of technically qualified students in the next generation STEM workforce, and increasing the number of women and students from underrepresented groups. PIs, senior personnel, faculty mentors, and other personnel have learned lessons from participating in this project and have more self-reflections about the next step of this project as well as our professional development.

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