

AC 2010-767: STRATEGIES FOR FOSTERING THE ACADEMIC GROWTH AND PERSONAL DEVELOPMENT OF PRE-ENGINEERING AND PRE-APPLIED SCIENCE MAJORS

Elyce Winters, Stony Brook University

Imin Kao, Stony Brook University

Jennifer Dellaposta, SUNY Stony Brook College of Engineering and Applied Sciences

Christine Szaraz, SUNY Stony Brook College of Engineering and Applied Sciences

Strategies for Fostering the Academic Growth and Personal Development of Pre-Engineering and Pre-Applied Science Majors

Introduction

The purpose of this research is to explore the impact of advising interventions on the academic success of engineering and applied science pre-majors at a large, multicultural, top-tier research university. There is a growing body of literature addressing the impact of specific academic initiatives with respect to how higher education students are taught math, science, and engineering subjects, though there is less focus on the value of intensive psycho-social support on the retention and advancement of students pursuing the science, technology, engineering and math (STEM) disciplines. This paper seeks to address that issue and illustrate how early advising interventions can improve retention and graduation rates.

Kitzrow notes that colleges and universities in the United States have seen enormous changes in their student populations over the past decades, and that the role and practice of college counselors has evolved in response to these changes, which include shifting social, economic and political realities and increased diversity among college student populations. She also relates a shift among student presenting concerns from more "...benign developmental and informational needs to more severe psychological problems (Kitzrow, 2003 p.168)⁹;" these "more severe psychological problems" include substance abuse, eating disorders, depression, anxiety, and suicidality, and as a result, Levine and Cureton note that 69% of four-year school student affairs officers report that undergraduates "...are using psychological counseling services in record numbers and for longer periods of time than in the past (p.95)¹¹." In addition, students face increased anxiety as a result of uncertain economic circumstances, and greater exposure to violent incidents on campus and off, such as interpersonal and family dysfunction, sexual and physical assault, domestic and international terrorism, and disasters, natural or otherwise. "The bottom line..." relate Levine and Cureton in their exploration of the pressures and anxieties undergraduate students contend with, "...is that students are coming to college overwhelmed and more damaged than those of previous years (Levine and Cureton 1998, p.95)¹¹." In response to such conditions, Robotham and Julian contend that "A key role for universities...is the provision of appropriate resources to enable individuals to deal with stress," (2006, p.114)¹³. This research underscores the need for professionals with mental health training in advising roles, and demonstrates the value of psycho-social interventions as part of larger academic advising strategies.

Counselors and advisors working with science, technology, engineering, and mathematics (STEM) populations face additional challenges in addressing student wellness and success, due at least in part to the rigor of the disciplines these students have chosen to pursue. The level of academic and personal stress and anxiety faced by STEM students is regarded as generally more intense than that attributed to general undergraduate populations; for example, Hackett, et al assert that "Engineering programs are notorious for the pressure they exert on students," (1992, p. 529)⁸ illustrating the emotional strain STEM students may face as a result of their pursuit of academically and intellectually demanding disciplines. Greenfield, Halloway, and Remus presciently noted that "It is not sufficient to recruit students into engineering, counseling must be

able to support these students in their studies once they arrive (Greenfield, Holloway, and Remus, 1982, p. 513)⁷.” Hackett, et al further relate that “Stress and social support have been identified as important to the career development and academic progress of all students” (Hackett, et al, 1992, p. 528)⁸; they contend that the stress and anxiety “...experienced by students in engineering programs might be a source of lowered academic and career self-efficacy” (p. 529)⁷ and go on to argue that “... coping skills and social support may moderate the possibly detrimental effects of a stressful academic program,” (p.529)⁷. These findings “...provide some evidence for the relations of lower levels of stress and more social support to enhanced self-efficacy and academic achievement,” (Hackett, et al, 1992 p.535)⁸ and seem to anticipate the recommendations of the National Academies of Science (2005)¹² and others regarding the value of social support interventions, such as mentoring programs and wellness skills education, on the academic success of STEM and pre-STEM students.

Brainard and Carlin (1997)⁴, in their discussion of undergraduate women in engineering and science, also cite the significance of perceived social and academic support (including peer and faculty mentors as well as advisors) in the persistence of these students in completing science and engineering programs. Our University has a strong program for women entering the STEM fields and has seen a great increase not only in the number but in the academic performance of our female students, more must be done for students in other areas to match the recent progress of women.

Table 1: Freshman Cohort 2008 by Gender

Gender	Mean grade point average	Mean credits earned (two semesters)
Female	2.918	29.269
Male	2.718	26.092

Ethnicity, economic background, and status as the first in family to attend college are also factors impacting undergraduate students’ preparation for and experience of STEM study. For example, Trenor et al (2008)¹⁶ found that “...being a minority student was significantly related to not knowing an engineer (p. 454);” this finding is particularly relevant in light of research (for example, Amenkhienan, C. and Kogan, L., 2004³; Brainard and Carlin, 1997⁴; Felder, et al 1995⁶; and Summers and Hrabowski, 2006¹⁵) describing the value of mentoring and role models in STEM student success. In their discussion of science and engineering education targeting underrepresented minorities (URMs), Summers and Hrabowski expand on the relationship between a student’s socio-cultural background and his or her higher education experience, noting that “Factors that keep URMs from persisting with science include academic and cultural isolation, motivation and performance vulnerability in the face of low expectations, peers who are not supportive of academic success, and discrimination, whether perceived or actual (2006, p. 1870)¹⁴.” These findings further support the need for STEM and pre-STEM advising strategies that emphasize emotional and social as well as academic support.

Many underrepresented students in our College struggle with their academics compared with students traditionally served well in these fields. Data from the freshmen cohorts of students in our College illustrate that on average, Black and Hispanic students score lower grade point averages and earn fewer credits than White and Asian students. In addition, we see that international students routinely perform better than our domestic students in these areas.

Table 2: Freshman Cohort 2008 by Ethnicity

Ethnicity	Mean grade point average	Mean credits earned (two semester)
Asian	2.738	27.000
Black	2.402	24.905
Hispanic	2.690	25.080
White	2.753	26.250

Table 3: Freshman Cohort 2008 by Origin

Origin	Mean grade point average	Mean credits earned (two semesters)
Domestic	2.6760	26.4876
International	3.0864	29.2727

Students pursuing the STEM fields must confront the challenge of reconciling the goals they have for their educational and professional future with their own developmental history, and the academic preparation students receive prior to entering the higher-education arena must be considered in designing and implementing a pre-STEM advising program. Engineering and applied science students are often academically ill-prepared for the pursuit of STEM disciplines. Shuman, et al describe the failure of the educational “pipeline” through which elementary and secondary school students are encouraged to pursue science and engineering at the university level, and relate that “...only 7% of high school graduates are prepared for college-level science courses (2002, p. 2)¹⁴.” Advising activities aimed at helping students develop an awareness of their strengths and weaknesses in relation to the skills and required coursework necessary for success in the STEM fields, and focused on informing them of the resources available to support them in their academic endeavors, are integral to universities’ efforts toward meeting the goal of increasing “... the number and proportion of US citizens who earn bachelor’s degrees in the physical sciences, the life sciences, engineering, and mathematics...(NAS, 2005 p.165)¹².” The National Academies of Science endorsed a number of key approaches to expanding representation in the science and technology fields, including personal attention, peer support, and targeted recruitment. Our Area of Interest (AOI) program addresses the need to increase recruitment, retention and advancement in the STEM fields by delivering student services that address multiple aspects of student well-being and development.

The Area of Interest (AOI) program: Fostering the future

Recognizing that a particular group of students were at a disadvantage in gaining entry into engineering and applied science majors, in 2008, our College of Engineering and Applied Sciences (CEAS) created a comprehensive Area of Interest (AOI) program to address the needs and goals of students who were not directly admitted to a major within our College, but have an interest in these fields. AOI students require particular academic support as they not only have lower mean SAT scores (503 verbal, 562 math) than students directly admitted to an engineering or applied science major (566 verbal, 685 math) but many also are first in their families to attend college (45% of this AOI group indicated their parents’ highest grade level as high school or less) and have a significantly greater financial need than our major population (51% of AOI students are receiving Pell Grants in comparison to 32% of the major population). The AOI

program promotes academic excellence by providing support services for its participants; these supports fall into three broad categories, academic advising, psycho-social support, and academic support beyond the classroom. In its first year, the program has placed 52% of AOI students, 80% of whom entered engineering or other STEM fields.

Academic Advising

Students in the AOI program receive significant personal attention, and this is a key feature in the success of the program. Students and faculty alike perceive the value of the AOI program as largely related to its success in creating a sense of belonging among the pre-major students; students are encouraged to take an active role in the CEAS community, and are encouraged to reach out for support when they have questions or concerns. A plan is created for each student to help them achieve the goal of entry into an engineering, applied science or other appropriate major, and advising sessions provide AOI students with a clearly defined picture of the program and a list of criteria they must meet. Pre-major students relate that this personal guidance is especially valuable to them, and in addition to being a source of factual information the advisor and undergraduate office are perceived as sources for support and encouragement.

First-year students are a focus of the AOI program, as freshmen are vulnerable academically and socially during the transition to the responsibilities of higher education. Walter, et al. state “Some freshman are clear academic risks: they lack specific learning skills. Often, ... we involve them in comprehensive academic support programs...these freshman often do as well or sometimes better than other freshman (1989, p. 109)¹⁷.” During the fall 2009 semester, freshman AOI students were offered a special one semester long orientation seminar; many reported in their final reflection papers that they felt more confident in their academic pursuits as a result of the specialized attention and academic advising they’d taken part in regularly throughout the semester, and cited the value of interacting with other freshman AOI students facing similar challenges.

Individual advising sessions are also integral for freshmen as well as transfer and continuing students, and this structured contact allows the academic advisor to look for signs which may indicate a student’s limits in reaching the goal of major entry; some warning signs that indicate an obstruction to success in a STEM major include repeated courses and poor grades in math, physics or engineering courses along with stronger grades in other disciplines. The academic advisor assesses the students’ strengths and weaknesses and helps the student to recognize his/her strengths and choose a major that would best suite their skills and educational/career goals. In addition, the advisor recommends specific activities, such as tutoring sessions or student organization meetings, which will enhance the student’s understanding of their intended field and the material they are expected to master. In this way, the advisor is also able to foster peer networks and supportive relationships within the undergraduate community.

Support beyond the Classroom

“There is considerable evidence that many individuals do not seek help effectively or avoid seeking help altogether... those who are most in need of help are the least likely to get it at appropriate times (Aleven, McLaren, and Koedinger, 2006, 260)¹.” There are several proposed

reasons as to why students do not seek help early on in their collegiate careers. One reason is that these students often have an exaggerated view of their abilities. This often results in difficulties transitioning from high school to college, adjusting to an increased workload, managing time efficiently and a distorted view of academic expectations.

In an attempt to empower students to manage an increased workload and new teaching style, our College created a tutoring program in fall 2008 to address the foundation courses of engineering: calculus and physics. The intent of the tutoring sessions are to strengthen students' understanding of course material by modeling problem solving methodologies and techniques, rather than providing students with solutions to specific problems to be memorized and regurgitated for exams. Feedback from students, faculty and staff on this program has been positive; our College has since expanded the tutoring initiatives, and our current tutoring efforts include additional major specific courses.

Our College has found that some engineering and pre-engineering students are more reluctant to seek academic help in the form of group tutoring because of the stigma that is associated with displaying a lack of understanding of engineering fundamentals. In conjunction with the Department of Teaching, Learning and Technology on our campus, our College will begin to offer an online tutoring service in the spring of 2010, enabling students to seek help remotely. Students will be able to ask questions in real-time, and work through problems with tutors, while tutors will be provided with tablet PCs to simulate blackboard learning. With the introduction of this technology to the tutoring initiative, it is hoped that the fear of inadequacy will be eliminated.

Our College has also been utilizing available technology to provide additional academic support to the AOI population. A website dedicated to AOI students was created and is being used to promote relevant events, provide students with information regarding deadlines, University policies and procedures, internships and scholarship opportunities, as well as graduation requirements. Students can also use the site to communicate with each other and their advisor. Our College has also maintained presence on popular social networking sites such as Facebook, where students can chat with advisors live.

Working with the campus Career Center, our College is also developing an online summer preparatory course intended to target incoming AOI freshman. This course would utilize STEM - specific career exploration software to guide students through self-assessment exercises as well as discipline and industry inquiry. Students completing this course will have a clearer understanding of several engineering and applied science fields and be better prepared to align their academic interests with their career goals. The software will provide a detailed plan based on the assessments and other online exercises completed by the student, to be used as an advising tool when the student begins their undergraduate career.

Peer Support/Mentoring

All AOI students are encouraged to take advantage of opportunities for interaction with peers and professionals in their intended discipline. Our College has created a series of faculty/student workshops in which departmental faculty and staff provide valuable information and answer

questions on a variety of topics such as major and degree requirements, research and job opportunities, and academic study beyond the undergraduate degree. All AOI students are encouraged to participate in the larger community of scholars and professionals by visiting with faculty during their office hours, and attending campus lectures and panel discussions.

AOI students are encouraged to join the over eleven student societies and organizations that our College is home to, as well as the over 300 organizations available in the entire University. Through active membership in these societies they are exposed to students within their major field and, as a result, strengthen the sense of connection to their discipline and the University community. Additionally, students form peer networks and study groups within these organizations. The societies provide students with a sense of belonging, which, research shows is key in student success. Students are able to relate to one another since many may come from similar backgrounds and experiences. “The development of social ties with other students may even have a positive effect on academic performance (Alexitch, 2006, p.190)².” Through the organizations students develop valuable leadership skills, and are also encouraged to apply for various scholarships, participate in community outreach, develop mentoring relationships, as well as, have priority access to conferences, providing information and opportunities for internships and jobs in the broader STEM populace.

Our College’s student societies play an active role in many College-sponsored events, and through their participation they engage and encourage AOI students. For example, the Engineering Ball encourages social networking between students, faculty, staff and industry representatives. This formal event provides students with an exciting opportunity to socialize with peers while developing valuable professional insights. AOI students are encouraged to take part in this event, and have even served vital roles in organizing it. Our College also organizes less formal events, such as the annual Potluck, where faculty and staff cook a meal for students; in 2009, the Potluck embraced a charitable theme, and students “bought” their way into the event with a donation to any of a number of charities. This event was paired with an Engineering Carnival organized by our student societies, which featured activities designed to entertain and inform students about engineering concepts. The annual College barbeque provides students with an opportunity to visit faculty and all of the student organizations within the college. These events are well-attended and well-received, and foster identification within our College and University community, as well as with the community beyond campus.

Psycho-social Support

Our College utilizes a holistic approach to advising students with an emphasis on academic, personal and career development. Our College employs two academic advisors trained to address social and psychological wellness issues, one with a Master’s degree in Social Work, and one with a Master’s degree in Mental Health Counseling. Both are highly trained in the provision of interventions intended to support student well-being and growth, and are qualified to identify outside risks that may negatively impact a student’s success. Our College Undergraduate Office maintains strong working alliances with the offices on campus charged with the provision of mental health services, specifically with the University Counseling Center (UCC) and the Center for Prevention and Outreach (CPO), and through these connections our students are informed about the emotional and psychological support services available to them. In addition

to providing academic support services, our academic advisors are qualified to evaluate students for risk factors related to psychological and interpersonal dysfunction, and can refer students to the appropriate campus resources for treatment. Such actions benefit the individual student as well as the larger community by fostering the well-being and safety of all members.

Our College Undergraduate Office is also staffed with a graduate student intern in the Masters of Social Work program who focuses on providing personal support to our students. The intern is responsible for developing programs that address personal and social issues; examples of these programs include workshops on conflict resolution, time management, stress management and healthy relationships. In addition, workshops are conducted on study skills and various note taking practices aimed at increasing students' success throughout their collegiate careers. Due to the warm and inviting atmosphere, students are often found gathered at a conference table in the office with their laptops. They utilize this space to get work done, meet with other students, or relax and play board games provided by the office.

Participation in Career Center events, such as the "Engineering and Information Technology (IT) Job Fair," held throughout the semester, is promoted among AOI students. Students are encouraged early in their academics to consider their career options and opportunities, and to explore the internship opportunities available within their intended fields. Students are offered a realistic impression of the employment outlook, are motivated early and often to distinguish themselves as students and burgeoning professionals with internship and research opportunities, and are referred to appropriate departments or faculty members to foster those opportunities. In addition, our College is enhancing its involvement with the campus Career Center's Career Alumni Network. This collaboration is intended to increase the mentoring relationships between AOI students and our graduates and to foster their personal and professional development.

Recruitment

Our College is committed to increasing enrollment and retention in the STEM fields, and conducts outreach both within and beyond the campus community. The AOI program has earned a reputation on our campus for effective pre-engineering advising, and students are regularly referred by faculty for support. These connections increase the visibility and accessibility of our College among all undergraduate students, and increase the opportunity for our College to recruit students into our majors. Word of mouth among undergraduates themselves has likewise resulted in increased foot traffic to our College Undergraduate Office, as well as our undergraduate departments where students are directed to further explore their interests in specific majors. As a result, faculty have the opportunity to reach students who otherwise may not have considered a degree in the STEM fields.

Our academic advisors also participate in on- and off-campus opportunities aimed at recruiting bright high school students. One such event, the FIRST Robotics competition, allows high achieving and highly motivated high school students to demonstrate their academic talents and personal interests; parents and students both respond favorably to the description of the academic and psycho-social resources available to our undergraduate students, and participation in such events have increased freshman enrollment in our College.

As one method of maximizing student success in higher education, Kramer and Spencer suggest “beginning advising of college entry requirements as early as ninth grade (1989, p. 95)¹⁰.” Our academic advisors working with our chapter of the Society of Hispanic Professional Engineers (SHPE) have created a SHPE Jr. Chapter in a local high school with a high population of students underrepresented in the STEM fields. The goal of the SHPE Jr. Chapter is to expose students to the STEM fields, as well as provide them with opportunities to excel in the future. Through this program our University chapter of SHPE hopes to use mentoring as a way to remove doubts about the possibility of pursuing higher education. College students present information, bring in guest speakers and have fun hands-on activities for the younger students. Some of the programs have included: the college application process; SAT/ACT prep; scholarship opportunities; and financial aid information. Although the program is still in its infancy, based on the attendance at the SHPE Jr. events, this initiative has succeeded in reaching a population of students that may not have otherwise been exposed to the opportunities available for attending college. In addition, our College, in conjunction with our SHPE chapter, conducts an annual event entitled Pre-College Day. Students from underrepresented areas are invited to our University campus for a day of engineering activities. They participate in engineering lab activities, as well as lab tours, visits with faculty members, student panel discussions and informational sessions from the campus Admissions and Financial Aid offices.

Assessment and Accomplishments

The effectiveness of the aforementioned support system was assessed through analysis of a one-year retention study of AOI students as well as through feedback from students and professors both in panel settings, one-on-one meetings and annual surveys which seek to assess the qualitative value of the program. Results from the first year survey demonstrate that the advising support provided to students is perceived as having an overwhelmingly positive impact on student performance as well as student satisfaction with the program.

The AOI advisor conducts surveys with current and admitted AOI students as well the Undergraduate Program Directors in our College’s majors to assess the qualitative value of the program. The first survey, administered in spring 2009, found that 67% of current AOI students and 75% of AOI students admitted to a major reported that the individual advising component was “extremely valuable.” Faculty respondents universally expressed their positive regard for the initiatives put in place as part of the AOI program: comments include “excellent,” “very valuable,” and “great” when asked about overall impressions of and experience with the AOI program.

In addition, faculty were asked to relate their experiences with the AOI students, and their responses indicate that the AOI advising interventions are effective in improving student knowledge, preparation, and motivation for success in the STEM fields. The AOI advisor places particular emphasis on personal responsibility when meeting with students, and all AOI students are encouraged to advocate for themselves and their academic success by reaching out for support when they need it in order to get the information they may need to succeed. Faculty feedback indicates that this aspect of the AOI advising structure has been particularly successful: 60% of faculty surveyed report that as compared to direct admits to their majors; AOI students are “more active in seeking faculty feedback and support.”

Assessing the effectiveness of the advising initiatives put into place by our College to support the AOI population as well as the CEAS undergraduate community as a whole requires examining each major initiative individually; we explore below issues related to the utilization and perceived value of these services.

Individual Advising:

All AOI students are required to meet with the AOI advisor for individual advising at least once a semester, and a hold is placed on AOI student accounts to prevent them from registering for future classes if they have not satisfied their advising requirement; as a result, all AOI students utilize individual advising services. As reflected above, the majority of AOI students find individual advising worthwhile; data gleaned from the spring 2010 AOI survey indicates that 82% percent of responding students found it to be “valuable”. The qualitative feedback provided by students during their individual advising sessions demonstrates that this personal connection and attention is a source of motivation and encouragement. Students further relate finding comfort in having a place to discuss their questions and concerns regarding their major intent.

Tutoring:

The tutoring program created by our College offers tutoring for the core engineering subjects of calculus and physics to all CEAS students as well as non-CEAS students enrolled in the appropriate subjects, but the AOI population faces particular challenges in utilizing these services; many AOI students enter the University only prepared for the study of proficiency-level mathematics, and the majority of AOI students are not yet pursuing calculus and physics. Those AOI students who are enrolled in calculus and physics, as well as students already admitted to a major within our College who are enrolled in these subjects, report additional obstacles to using the tutoring services, including time conflicts with other courses and a lack of tutoring for the specific course a student is enrolled in. As a result, the CEAS tutoring program is underutilized by AOI students as well as by the general CEAS undergraduate population, and this is reflected in the survey data collected by our College in spring 2010: 88% of CEAS students report never having attended a CEAS tutoring session.

Among those students who do attend tutoring sessions, however, the feedback is consistently positive: 100% of those students indicated that they found the tutoring sessions to be “Useful” or better, with 50% rating the service as “Extremely useful,” and students further cite the knowledge and preparation of the tutors as well as the less-pressured setting as aspects of the tutoring program they particularly value. It is also important to note that students express overwhelming satisfaction with the fact that the CEAS offers tutoring support, even if they are not currently eligible to participate. Our College hopes to build on the foundation provided by current interventions to encompass a greater variety and extent of tutoring services, and as one means to foster such initiatives we have recently submitted a University grant proposal for an intensive “Engineering Boot Camp” which will target AOI’s specifically with tutoring in pre-calculus and physics concepts.

Workshops:

Our College has offered a number of workshops aimed at addressing some of the psycho-social needs of students. These workshops target both pre-majors and admitted CEAS students, and topics include time management, stress management, and healthy eating, as well as discipline-specific workshops addressing individual major requirements. Feedback regarding these events has been mixed: 90% of students rated these workshops as “Useful” or better, with 30% of respondents rating their workshop experience as “Extremely useful”, but 10% of students expressed feeling that the workshop they attended was “Not useful.” Students report happiness with and approval of the fact that our College is concerned with the health and well-being of its students, although this level of satisfaction is somewhat belied by attendance at such workshops.

Students in our College have typically regarded emotional and physical health as separate from or unrelated to their academic wellness, and often express more satisfaction with what they perceive as fact-based programming, such as workshops focused on major and graduation requirements or internship opportunities. One particular survey response concerning the CEAS workshops, “I like real world information,” illustrates this perspective, and our College seeks to expand student awareness of the “real-world” value of health and wellness information by increasing student knowledge regarding the impact of these matters on academic performance and success.

Survey responses demonstrate that students are interested in getting more information about how they can address their personal and academic wellness, and the charge of one respondent also illustrates the challenges professionals encounter in implementing such programming: “Advertise more, provide wider workshop topics.” As one means to enhance the effectiveness of these interventions, our College has included in its student surveys questions soliciting student feedback on topics for future workshop sessions, and also plans to expand its promotion of psycho-social workshops to include details on how the various topics addressed are related to student success. In addition, our College will continue to partner with other campus departments such as the Center for Prevention and Outreach (CPO) and the Career Center to address the student wellness in a variety of contexts.

A longitudinal study is underway to track each cohort of entering students and will provide valuable evidence of the continued effectiveness of these programs. In addition, weekly staff meetings are held to brainstorm and address the needs of the AOI population. Our College’s advising staff will continue to canvas focus groups to better serve this population of students and provide them with lasting tools for success in the STEM fields.

During its first year, the AOI program supported the placement of 166 students into a major (50% of the fall 2008/spring 2009 AOI population of 332 students). 160 of the remaining 166 students are continuing with the program for the fall 2009/spring 2010 academic year; of those six students who are not continuing, one has withdrawn from the University for personal reasons, and the others have been either suspended (N=4) or dismissed (N=1) from University for academic standing issues. It is important to note that in order to be suspended or dismissed from the University for academic standing the student must have earned below a 2.0 cumulative grade point average for multiple semesters. The number of suspended students above demonstrates

that these students were in academic jeopardy prior to their participation in the AOI program, with the implication being that earlier advising support may have had an impact in preventing such outcomes.

Of the 166 placed students, more than half (51%, N=86) entered their original or another engineering or applied science major; another 28% (N=47) declared a STEM-related major in another college at our University. Of those AOI students admitted to a non-STEM major (N=33), 27% (N=9) had been a pre-major for more than two academic years; this data underscores the value of the AOI program, and indicates that enrollment and retention in the STEM disciplines can be improved significantly with earlier advising interventions among pre-majors.

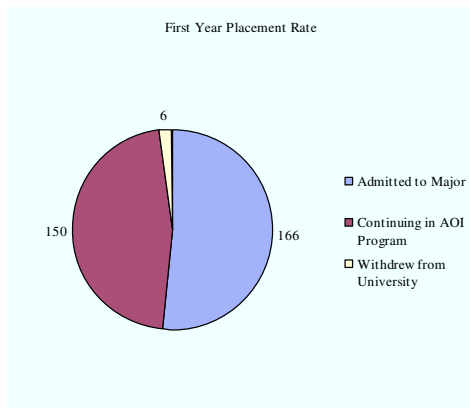


Figure 1: 50% of students in the AOI program were placed in an appropriate major in year one, with additional supports such as an expansion of tutoring programs and a first-year math camp, we expect the placement rate to increase further.

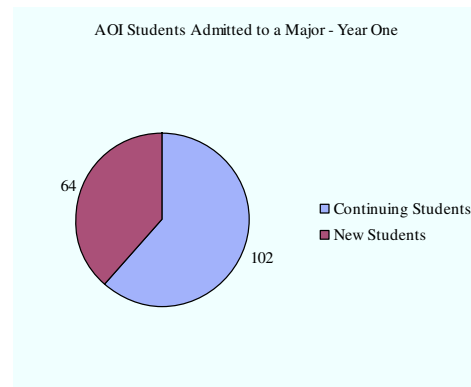


Figure 2: The rate of placement for continuing students also illustrates the importance of a specialized advising structure, before the institution of this program; students were without a major well into their junior and senior year

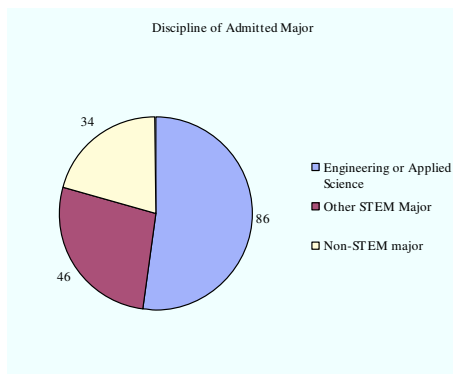


Figure 3: Majority of AOI students (52%) were successful in completing the requirements necessary to gain admission to their preferred engineering or applied science major.

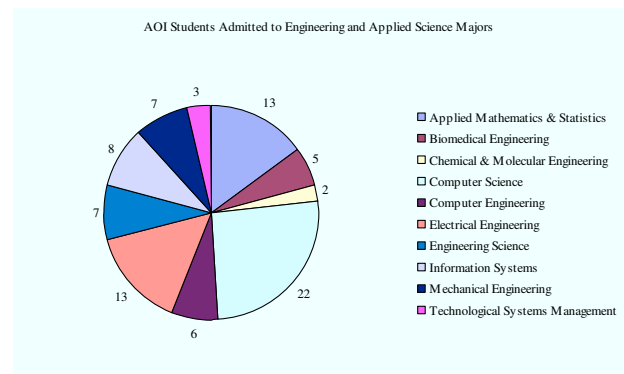


Figure 4: The success of the AOI program is contingent upon helping students develop the math and science skills necessary to be successful engineers and applied scientists.

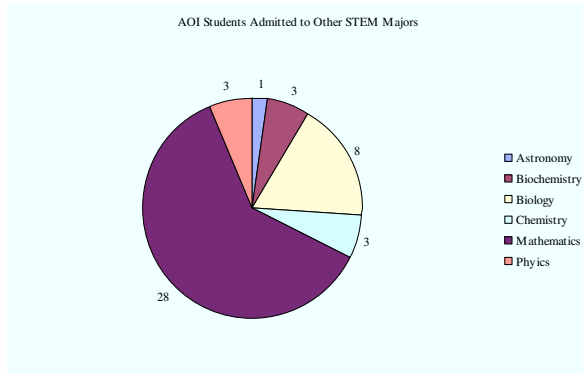


Figure 5: Another 28% of AOI placements were in other STEM fields. A total of 80% of AOI students placed into a major were placed in a STEM field.

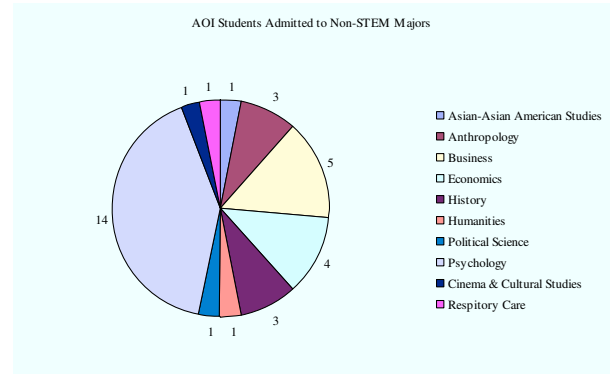


Figure 6: The placement of AOI students into non-STEM fields also illustrates the importance of early intervention to assess students' strengths and explore other areas in which they may find success.

Conclusion

The success of our AOI program lies largely in the individual attention provided to pre-majors. Our College has broken down an artificial wall between directly admitted students and pre-majors by allowing the AOI students to participate in all events; one group is no longer seen as superior to the other. Participating students develop a relationship with the AOI advisor and other College academic advisors through their satisfaction of the AOI advising requirement, and overwhelmingly report that this sense of belonging is an integral piece of their academic achievement. This sentiment is echoed by faculty, who relate that AOI students are generally more active in seeking out departmental feedback and support. In addition, students convey that they find tremendous value in the perception that University faculty and staff are personally invested in their academic success. As we have seen in its pilot year, the AOI program and accompanying student supports provide under-prepared students with the pathways to success in the engineering and applied science fields.

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