AC 2009-864: CONNECTOR FACULTY: A FRIENDLY FACE FOR EARLY ENGINEERING STUDENTS

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Connector Faculty:
A Friendly Face for Early Engineering Students

Retention of early engineering students has been identified as a nation-wide concern that will affect the strength of the future engineering workforce and, hence, the role of the United States as a dominant world player in engineering and technology[6]. This requires that we increase the number of B.S. graduates in these disciplines. We must be particularly earnest about this given the current global fiscal downturn and the technological advances needed to stimulate the national and world economies. This paper describes one of a synergistic assembly of projects being undertaken at our institution to address the issue of retention in undergraduate engineering programs.

Over the last decade, enrollments have declined substantially in the College of Engineering at Michigan State University (MSU). The decline is exaggerated above and precedes the national decline largely due to the decline of the manufacturing industry in our state. Thus, our state is in a process of "reinventing" its economy, which will require an increased number of engineers graduated from our universities as a critical key to this process.

Increasing the number of undergraduate engineers can be accomplished by recruitment, retention, or a combination of both. This paper will address the preliminary phases of work being done in our college to address the *retention* of early engineering students. Recruitment efforts are outside the scope of this work and are being effectively addressed by other college faculty and staff. The project described in this paper is part of a larger, integrated retention effort that has been recently funded by a five-year NSF STEP (STEM **T**alent **E**xpansion **P**rogram) grant. The scope of the project transcends several colleges and two institutions, and includes a multidisciplinary research team of thirteen project investigators and personnel. The project goals are to increase student retention locally by 10 percentage points and to provide a transferable model for increasing retention at other large state institutions. Specifically this paper describes the background and preliminary work that has been implemented for a "Connector Faculty" mentoring program.

Background

Research-active universities award the majority of undergraduate degrees in the United States. Therefore, it is important that these large institutions implement effective means of retaining and educating students at all levels and in all disciplines. Our NSF project focuses mainly on the retention of early engineering students—those in the first one and one-half years of their degree programs.

Causes of attrition from STEM majors have been studied extensively and are fairly well known. The noted National Survey of Student Engagement (NSSE)[7] and a related report by Kuh[4] encourage institutions to critically examine practices that could engage or alienate students. Five benchmarks of effective education practice are used in the NSSE study, and two deal directly with various aspects of the work described in this paper—student-faculty interactions and a supportive campus environment. These studies also place special emphasis on beginning students and emphasize the importance of establishing positive interactions with students as soon as they

step over the threshold of the university campus. Young students in particular find it most difficult to discover who they should approach for which kinds of help.

Ohland *et al.*[9], in their analysis of National Survey of Student Engagement (NSSE)[7] data, discuss the fact that persistence in engineering may not be the major cause of a deficiency in the number of engineers being prepared in the United States. However, they do underscore the 40% departure rate of first-year students. While some movement is to be expected, particularly after the freshmen year, Ohland *et al*. also emphasize that benefits of retention programs and the culture change that they bring to engineering faculty have great potential for *attracting* more students to engineering, and have particular value for women and students of color.

The often-cited and perennially seminal work of Seymour and Hewitt[11] describes these early "leavers" as typically falling into one of two categories--those who leave because of inadequate academic qualifications and those who leave because they find the academic culture unsupportive or not engaging. MSU's College of Engineering NSF project presents a suite of four integrated programs that address both categories of leavers and their transition from high school into engineering undergraduate programs, thereby increasing retention. These components are shown on Figure 1. They are

- A peer-assisted learning program for key core courses taken by early engineering students; this is similar to a nationally known program called "Supplemental Instruction." It has been given an acronym PAL (Peer Assisted Learning) on our campus.
- Content cross-linkages among key technical core courses taken by early engineering students. This is an effort to provide relevance to the basic mathematics and science courses required for admission to the college.
- Formative course diagnostics and linked capability-building exercises that students can use to strengthen skills in the same prerequisite courses.
- "Connector Faculty:" Increased faculty connections and mentoring—a friendly face—for early engineering students.

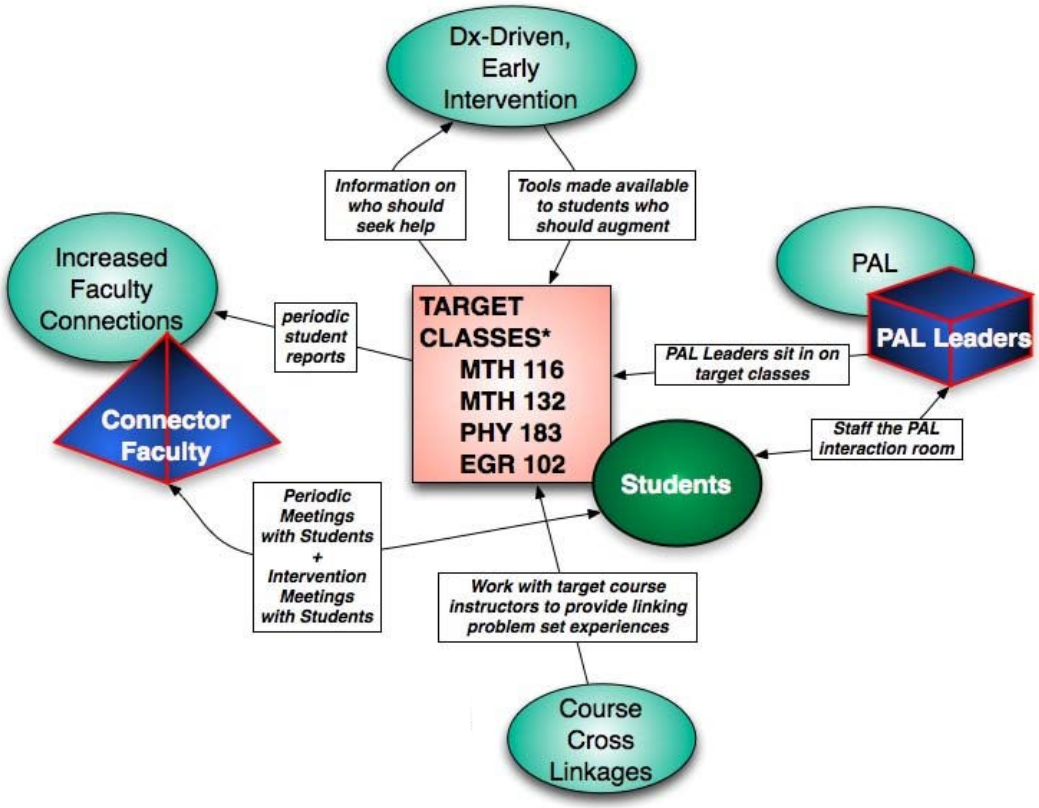

Figure 1. Integrated structure of project components

While such techniques have been used at other institutions and in other STEM disciplines, their use as a package addresses many of the benchmarks of effective educational practice described by Kuh[4]. The table below illustrates how the four project components integrate with each other to address the major concerns of student migration out of engineering. It is clear that Connector Faculty have a major role in the successful outcome of this project.

Table 1. How Project Components Address Retention

Project Component	Academic difficulty	Disconnected coursework	Isolated as individual student	Lack of faculty concern
Connector Faculty	✓	✓	✓	✓
Peer Assisted Learning	✓	✓	✓	
Course Cross-Linkages		✓	✓	
Diagnostic-Based Intervention	✓			

Connecting

Students have clear needs in their help-seeking behavior with faculty and advisors. These include the expected issues of advice on academic and career alternatives, accurate information on curriculum, help in understanding course material, and practical advice on personal matters that affect academics[11]. Relevant to the work described in this paper is the need that students have to have someone take an interest not only in their academic progress, but in them as a person[2,12]. Vogt[14] has shown that a faculty member's manner toward a student is critical to a student's perception of self-efficacy, a major determinant of student achievement. Even small attitudinal changes toward students can make a huge difference. Tinto[13] points out that "students are more likely to persist when they find themselves in settings that hold high expectations for their learning, provide needed academic and social support, and actively involve them with other students and faculty in learning."

Yet, there is also the fundamental conflict of the faculty's role as an academic or career advisor and their role as gatekeepers of solid talent for their professions. For this reason, the Connector Faculty in this project are volunteers who are neither directly instructors nor academic advisors of the students. They have no evaluative role, and their purpose is two-fold: (a) to serve as a role model for the engineering profession and (b) to project the core value of the college that engineering faculty really care about the early engineering students--to be the friendly "face" of the faculty and of the profession to their students.

Our college data reflect national trends in that our most significant attrition is from the early engineering students. Our "leavers" fit into the same two categories as described in the literature[11]: those who perform well academically, but choose to leave; and students who fall just short of the academic admissions threshold. The target of the Connector Faculty portion of this work is to address both groups of students through better interactions with faculty mentors. While the goal is not an "at all costs" rescue of each and every potential "leaver," our desire is to keep those students whose true desire is to study engineering. This will be done for all students, not just those deemed at risk.

Given that the enrollment of our first-year students is currently around 900 students and that we have about 160 tenure stream faculty who are involved in undergraduate education, the key to the success of the Connector Faculty component of our project is to establish a cadre of engineering faculty members who will be willing to serve in a significant way. This represents a significant culture change at our college that is addressed in the following section.

Developing a Climate for Connecting

The key element to the success of this program is not so much the project management as it is the cultural change that is needed both in the faculty and the students. MSU is a Carnegie Foundation RU/VH (Research University/Very High research activity), and the faculty reward system is typical of all other such institutions—significant reward for scholarly research with a nominal expectation for "good" teaching and service. This is a climate in which faculty may not be willing to spend additional hours connecting to first-year students.

Change is a process of moving an organization from its current state to a desired future state[3,10]. In our case, most of our faculty have never been engaged with early engineering students and have major concerns about adding student mentoring to their already overflowing schedules. Our goal over the course of the project is to move this culture to a state in which faculty-student interactions are common, expected, and enjoyable both within and outside of the classroom—a new *status quo*.

Change management literature suggests a staged approach, or process, to institutional change. The process must address participant denial, dealing with their resistance, supporting their willingness to experiment with change, and then solidifying the commitment to the change[3.10]. Careful planning is needed to obtain buy-in, support, and commitment. As the Connector Faculty project develops, several aspects of this process have already been successfully addressed with positive and highly encouraging results.

The climate for renewed emphasis on undergraduate program at our institution has undergone a recent thaw. Changes in the college's administration have brought significant and renewed emphasis to the historic importance of excellence in our undergraduate engineering programs. With major impetus provided by a supportive dean, the college has recently revitalized its freshman engineering offerings freshman courses expanding on the former ROSES program (Residential Option for Science and Engineering) to add two new courses: EGR 100, Introduction to Engineering Design, and EGR 102, Introduction to Engineering Modeling. Both courses are common and required in all but two engineering programs. They are taught by a group of disciplinary faculty and are managed by instructors dedicated to these courses.

In addition, the university has also approved and financially supported the significant expansion of a residential program in engineering. Our institution has a long history of outstanding residential programs, and engineering and business are the most recent additions; our residential program will receive its first residents in Fall, 2009.

Thus, the confluence of these activities and projects—the new freshmen courses, the residential program, and the five-year NSF grant--are mutually supportive and catalytic and provide the best possible environment in which to bring about a culture change.

MSU students may declare a major as they matriculate into the university, but they are not "admitted" to the College of Engineering until they satisfy several admission requirements: declaration of a degree-granting engineering major; at least12 credits in residence; completion of six core courses (math, science, EGR 100, EGR 102); and achievement of a minimum grade point average (2.8 to 3.0 depending on the major). Before being admitted to a college, students may change majors freely. After admission to a college, an application must be submitted to the new major. The former group includes the early engineering students we are working to retain.

After significant groundwork and preparation, the Connector Faculty project was piloted in the spring, 2009 semester. The students in EGR 100 served as the target student population, because it represented a smaller group of first-year students all within the confines of one course. The course enrollment in spring, 2009 was 195 students of whom 34 were women. The recruitment of Connector Faculty was done on a volunteer basis and is described below.

The Connector Faculty Effort to Date

In order to get the NSF project up to speed in a relatively short timeframe, several activities were operating in parallel. The project team was divided into overlapping working groups with an overall project manager and one co-PI leading each project component. A part-time project coordinator was hired for two thrust areas of this project, the peer-assisted learning area and the Connector Faculty project.

For the Connector Faculty group, the first step in our approach to change management was to inform faculty and college administrators of the "opportunities" that would present themselves as a result of the funding of our NSF grant. These steps were designed to help overcome faculty and administrator denial and resistance to involvement in the project.

We publicized the NSF grant to the college, the institution, and the community. This was accomplished through web postings, press releases, and announcements at faculty meetings. Important and influential subsets of the engineering faculty were addressed directly and separately by project team members. This included the college's administrative group (chairpersons and associate and assistant deans), where the college dean indicated that department faculty were going to be involved in various parts of the projects. Although the dean did not establish a requirement, the expectation for faculty involvement was clearly set. While the faculty reward system has not been changed at this point, we view strong administrative support as an important first step in raising faculty awareness and in changing faculty expectations about the need to support early engineering students. This type of administrative support is clearly critical in the success of this expansive of a project.

Several of the project team members also gave a presentation and led discussion at a monthly college noontime "Brown Bag" Symposium. The topic of the Brown Bag was announced to the entire college, and about twenty faculty members attended this event. The presenters were quick to emphasize the positive influence that Connector Faculty could have on the perceptions that students have of engineering careers and of the college. They also pointed out that the faculty involvement was fluid enough that they could, to some degree, tailor their student interactions to suit their schedules and their personalities. The promise of staff support and a small supplies stipend were also offered as enticement. Members of the project team also led discussions at faculty meetings in individual departments. After this early contact several faculty members stepped up as volunteers for the Connector Faculty program.

A strong project evaluation plan involving MSU's Institute for Public Policy and Social Research (IPPSR) is in place. One purpose of the evaluation aspect is to document our project activities, processes, products, and progress. In this role, our IPPSR collaborator distributed a survey to the faculty in engineering, mathematics, and physics to learn more about their awareness of the project and their willingness to participate. This survey further helped to broadly publicize opportunities for faculty involvement in the project. Response rates from the College of Engineering were high with 50 engineering faculty responding to the web-based survey. Responses from mathematics and physics were lower and, not being immediately relevant to this paper, are not cited.

We were most interested in the initial attitude of the respondents as to whether the program would meet the goal of increasing retention of students by 10% over five years. We asked for a response on a 7-point Likert scale with end points defined as Very Likely and Very Unlikey to succeed. The results for engineering faculty are shown in Table 2. The overall estimated probability of success based on engineering, physics, and math faculty attitudes is 71%.

Table 2. Faculty survey responses to the question on the feasibility of the project goal of increasing student retention by 10% over five years.

Very Likely			Uncertain			Very Unlikely
9%	32%	26%	23%	4%	2%	4%

Some comments provided by those who rated the program in one of the first two positive categories included the following:

> "When students feel more support and like they are part of a community, they are less likely to leave."
>
> "Early engineering students have not previously been the focus of much attention from engineering faculty, and a program that changes that should have some significant impact."
>
> "There is a significant level of enthusiasm and sound upper administrative support."

The outcome of the outreach to faculty was positive. Thirty-three faculty volunteered representing eight engineering programs in the College of Engineering. Of the 33 faculty, seven were women. One additional faculty volunteer was added at a later date.

Orientation

The first major Connector Faculty event was an orientation session for the volunteer faculty. This event had to occur quickly so as not to lose continuity with the Connector Faculty volunteers over the holiday break; therefore, the orientation was conducted early in the spring, 2009 semester. As indicate earlier in this paper, except for advising a small number of honors students, engineering faculty typically did not interact with students until the sophomore year. In order to support positive interactions between the Connector Faculty and their students, the faculty had to be made aware of who these young students were and how best to make them feel connected.

To help with this aspect of the project, the project team sought assistance from our institution's Counseling Center's Director. Because of her exceptional expertise in developing counseling programs that support academic success, student retention, and faculty development, she was uniquely qualified to lead the orientation and training. The fact that she was a voice of expertise

from outside the College of Engineering also carried significant weight with the Connector Faculty audience.

Two separate but nearly identical 1 ½-hour orientation sessions were conducted at times convenient to most faculty. Only six faculty members were unable to attend, and two decided to drop out of the program due to long-term time conflicts. The six faculty members who did not attend were provided with the same information in face-to-face meetings arranged between the faculty member and the project coordinator.

The one and one-half hour orientation session covered the following topics:

- Review of the 2008 NSSE findings on student engagement—a source of external validation for the project
    - Emphasis on the reluctance of young students to approach faculty either in or outside of class
    - Discussion of "student-faculty interactions" as a benchmark of effective educational practice
- Review of our institution's Cooperative Institution Research Program (CIRP) data[8]
    - Only 26% of our high school students asked a teacher for advice after class
    - Over half the students were frequently bored in their high school classes
    - 69.2% spent less than six hours per week studying or doing homework
- The viewing of connecting with students as an opportunity, not a burden
- Interactive discussion of what to do when the students showed up at the faculty's office
- Role-playing and scenarios that could be typical of a first-year engineering students comments
    - I'm afraid I won't get the grades to get into engineering.
    - I used to get As in high school, but now I am flunking chemistry!
    - I really get nervous for my tests, and I feel as if I don't show what I really know.
    - Engineering is too much work. My roommate never has any homework!
- Active listening skills
- Suggestions for informal meetings with students
- Using traditional classroom assessment techniques[1] (one-sentence summaries, minute papers, muddiest point, exam analysis) to encourage students to reflect on their learning during meetings with the faculty
- Resources and on-campus referrals
- Recognizing a troubled student

The sessions were highly interactive and generated an enthusiasm for the project because of the synergistic interactions among the faculty attending the sessions and the excellent session facilitation by the Director of the Counseling Center. As early participants in the project, this group of faculty was also encouraged to contribute to the design and evolution of the Connector Faculty program.

The orientation was also used to emphasize the close collaboration that must exist between faculty and the advisers. It is not the purpose of the Connector Faculty to take the role of the advisers. However, it is expected that occasions will arise in Connector Faculty-student interactions that require faculty knowledge of student records. Also, because Connector Faculty have a role in suggesting intervention for students who are struggling in their courses, the faculty were given access to a secure student records system. This allowed Connector Faculty to stay abreast of a student's academic progress and, if necessary, record informal notes about their interactions with students that would be available for academic advisers to view. The project leaders are particularly sensitive to the need to coordinate Connector Faculty efforts to academic advising.

Student-Faculty Interactions

The next major landmark in the Connector Faculty project was the first formal meeting between the faculty and their students. The project coordinator assigned three to seven students per faculty member. Several faculty volunteers, including the NSF project team, were assigned smaller groups of students. Typically, untenured tenure-stream faculty did not participate as Connector Faculty or were assigned smaller numbers of students. Three faculty members were assigned two students each, five faculty each received an assignment of four students, and the rest were assigned from six to seven each. Students were first matched to faculty according to declared major, but this was not possible for all students. Several women faculty members also requested that they be assigned only women students, but gender was used only as a secondary criterion for assignment.

As suggested by CIRP and NSSE data, getting students over the threshold of faculty offices may be one of the most difficult steps. Students often view faculty as having threatening personas, so enhancing the approachability of faculty is a major factor in establishing continuing relationships. To do this in a non-threatening way, the Connector Faculty met with the target student group (EGR 100) immediately following their class on a Friday, i.e., the faculty attended the EGR 100 class solely for the purpose of meeting with their students. Students had been briefed about and prepared for this meeting; the idea that these EGR 100 students would have the opportunity to be linked with and mentored by an engineering faculty member had already been introduced to them in classroom presentations early in the semester and again the week before this first meeting.

On the day of the meeting, all available Connector Faculty volunteers (28 out of 34) gathered in the large EGR 100 classroom and were introduced to the entire student group. After brief introductions, each faculty member met with his or her student group. Since the classroom is in a residence hall (the future site of our residential program), a cafeteria and coffee shop were readily available for informal first meetings. Each faculty member was provided with specially designed T-shirts in the school colors and emblazoned with the title "I'm Connected!" These were distributed to the students as a small token to mark the occasion (and to advertise the program!).

About two weeks after this initial meeting, IPPSR conducted a survey to obtain prompt feedback on a) the Connector Faculty orientation, b) the first large-group meeting in EGR 100, and c) the

progress of interactions between Connector Faculty and students. Seventy percent of Connector Faculty responded to the web-based survey. Of these respondents, 80% rated the orientation as either being excellent (38%) or good (42%). Faculty were most intrigued by what they learned about the general characteristics of the first-year students. They also indicated that a weakness of the orientation was the lack of explicit details on how to interact with their students. Regarding the "mass" meeting in EGR 100, seventy-eight percent of faculty rated it as successful (excellent or good), but some expressed a desire for a more organized setting. Most encouraging was the fact that, during the two-week period after the EGR 100 meeting, two-thirds of the faculty had met with at least one of their assigned students, and nine faculty had already met with students a second time.

Face to face meetings have continued through the semester. The project plan is that these occur at approximately two-week intervals. A formal field trip event to the MSU National Superconducting Cyclotron Laboratory is planned for the week of March 23, 2009. A final celebratory group activity will be scheduled for the end of the semester. Faculty will also meet for two debriefing and troubleshooting meetings, which will be facilitated by the Director of the Counseling Center. Project evaluation surveys will be conducted for both faculty and students. These pilot activities will be described during the presentation at the annual conference.

Conclusions

It appears that at least a core group of faculty, probably most already with significant commitment to excellence in undergraduate education, has cleared the final phases of the change process and has shown a willingness and commitment to participate in an academic culture that values student-faculty interactions. The sustainability of the project will depend on obtaining buy-in from the faculty at large. It is clear that a supportive administration at the college and department levels, faculty who understand that students are not the only ones who benefit from engagement, and effective project leadership and coordination will be vital to the sustainability of this project. We expect to report on the status of these efforts at a later date.

"Student success is the product of thousands of small gestures extended on a daily basis by caring, supportive educators sprinkled throughout the institution" George Kuh[5]

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