AC 2008-2441: STUDENT ASSISTED GUIDANCE IN ENGINEERING (SAGE): A MENTORING COURSE TO RETAIN FRESHMEN ON ACADEMIC PROBATION

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Student Assisted Guidance in Engineering (SAGE): A Mentoring Course to Retain Freshmen on Academic Probation

Abstract

From 2005-06 to 2006-07, the College of Engineering at the University of Illinois at Urbana-Champaign realized a 30 percent overall increase of underserved populations in engineering due to more aggressive recruitment efforts. Successful recruitment of students; however, does not guarantee successful retention. At the end of the fall 2006 semester, 33.3% of the Black freshmen and 17.3% of the Hispanic freshmen were on academic probation. Overall, 9.3% of engineering freshmen were on probation. SAGE – Student Assisted Guidance in Engineering) was a three-hour class initiated in the spring semester of 2007 to increase retention among these students on probation.

The major outcome of the qualitative analysis was that students’ probation experience extended beyond the academic realm. When asked what the most pressing issues were in their lives, students discussed family issues, relationship difficulties, financial stresses and so on – above and beyond their probation status. As such, above and beyond the academic assistance, SAGE represented a form of caring by the college, addressing probation students in a more comprehensive and responsive manner.

Overall, the retention rate of the enrollees was 72.9%, which was seen as a substantial success. However, by the end of the subsequent semester, many students were back on probation or were dropped from the university. This paper examines what happened during SAGE and reflects on what must be improved upon.

Introduction

The underrepresentation of minority students in science, technology, engineering and mathematics (hereafter STEM) has been an enduring crisis in U.S. education. Decrying such inequity, efforts increased from the late 1960’s and early 1970’s to educate and train minority students in the technical fields. To that end, one would be hard pressed to find a higher education institution that had not developed some sort of program to support minority students’ STEM participation. Though the rate at which students seek to study STEM is increasingly comparable by race/ethnicity, the rate of students graduating with STEM degrees is still disparate. The challenge remains to continue and accelerate the growth of underrepresented students successfully traversing the STEM pipeline.

Used to discuss the processes of student attrition and retention, the notion of the educational pipeline is “perhaps one of the most enduring metaphors in all of education”, particularly in post-compulsory education. Those still participating in the educational system are described as being “in the pipeline” thus identifying those who depart from schools as “leaks” from it. In the context of higher education, this underrepresentation is commonly understood as the result of the dearth of minority students choosing to study STEM as well as the excess number of minority students leaving STEM. Though many enter the STEM pipeline at the college level, not all successfully make it through. This outward movement is both expected and accepted. However,
the numbers of students leaving the STEM fields remains disproportionate by race/ethnicity. This paper’s focus is to explore minority student “leakage” from the STEM pipeline during the first year of college. Such “leakage” most commonly occurs as students are placed on academic probation, thus putting them at risk from being dropped from the university if they don’t first choose to leave engineering.

Support for Minority Students in Engineering

We will begin with a brief exploration of how universities have responded to minority underrepresentation in STEM. Upon examination of literature introducing or evaluating such programs, four arenas of support were prevalent: a) academic support, b) psychosocial support, c) financial support, and d) professional support.

Academic Support

It has been a widespread assumption that minority students are ill equipped for university level course material and course work. And “it goes without saying that the under-prepared student is a kind of pariah in American higher education.” Fingers quickly point to the primary and secondary levels of education for this deficiency in readiness. Many would argue that one could only assume that minority students will fail in higher education because of their lack of groundwork and the many educational needs they bring. Therefore, the common strategy is to remediate the minority students through various academic support programs. With the rationale that these students must be brought up to speed with their white counterparts, preparatory classes are provided to help them gain a basic understanding of mathematics, an absolute necessity for most introductory STEM courses. Pre-college programs, often during the summer before the students’ freshmen year are designed for students to drill and re-drill those skills they had not mastered while in high school.

Psychosocial Support

Few other areas of study are associated with “the fear and anxiety that (its) courses can trigger in the minds of students” as the STEM fields from which students are often left to consider themselves illegitimate participants. While minority students suffer from low expectations all around, many would contend that teachers and faculty in the STEM fields are especially known for the notion that minority students are simply incapable of performing well in the rigorous technical fields. Therefore, “to ‘protect’ them from failure” students are discouraged from these fields. Minority students in STEM must therefore overcome a double jeopardy of sorts in that they face alienation from both institution and content area. As a result, several programs have been designed to address these psychosocial needs of minority students through community building and mentoring programs.

Financial Support

There is a curious absence of financial assistance in many support programs, especially as one considers that from the 1980’s, federal and state support of higher education have consistently decreased, thereby increasing the financial burden placed upon students. The provision of
financial support is one of the primary factors towards enabling minority students to attend universities. In its absence, the rate of minority student participation quickly drops\(^\text{19}\). Yet, the inability of many minority students to afford higher education costs remains ill addressed. Rather, programs are touted for how little funding is needed to keep it running\(^\text{20}\). Some programs offer full and partial scholarships for its participants\(^\text{21}\). However, such efforts are still limited, suggesting that many universities and corporations remain hesitant to invest financial resources towards minority participation in the STEM fields.

*Professional/Research Support*

Some university programs have sought to develop partnerships between students and faculty in research, and as well between students and corporations. Such efforts have been shown to be of great benefit for those students who are involved. A dual purpose is served in that the student is not only able to gain valuable research experience and knowledge but as well to establish valuable ties with the university\(^\text{22}\). However, for many of these students, entrance into such a realm must involve a departure from their home environment and culture.

*Support for Students on Probation in Engineering*

It would seem that each of the models described above are rooted in the student deficit model, in which the problems at hand can be traced to different ways in which the students are lacking. Similarly, probation models are built around remediating and accommodating students’ deficiencies - whether academic or otherwise. After all, the students on academic probation have “proven” that they were not able to succeed in a system where other students had. As such, the discussions surrounding support efforts for students on probation include such ideas as the “probation dilemma” in which the students that need the most assistance (i.e. those on academic probation) are the students that are the least likely to seek and to receive assistance\(^\text{23}\). For these reasons, the intrusiveness of a support program is commonly considered – whether students should be required to participate or whether the participation should be voluntary\(^\text{24}\). And given the overrepresentation of minority students among those who are “typically” on probation, the strategies for support often align with one another.

*Context of Program*

The University of Illinois at Urbana-Champaign is the flagship campus of Illinois’ public higher education institutions; the College of Engineering at the University of Illinois at Urbana-Champaign is consistently ranked among the top engineering programs in the nation. The university as a whole and the College of Engineering have identified increased student diversity as one of the major goals within its strategic plan (Adesida, 2007; *University of Illinois at Urbana-Champaign Strategic Plan*, 2007). However, the percentages of students who are African American and Latino/a in the College of Engineering at the University of Illinois at Urbana-Champaign have remained consistently low in comparison to the other top engineering schools in the nation and the national average as illustrated in Figures 1 and 2 below (*Engineering and technology enrollments*, 2005).
Figure 1. Percentage of African Americans in B.S. Programs at Top Engineering Schools in the Nation (Engineering and technology enrollments, 2005)

Figure 2. Percentage of Hispanics in B.S. Programs at Top Engineering Schools in the Nation (Engineering and technology enrollments, 2005)

Per the university and college strategic plan, increased efforts were made to attract underrepresented students to Engineering at Illinois. These aggressive recruiting efforts were not without effect. However, successful recruitment of students does not guarantee successful retention. While the percentages of underrepresented populations in the College of Engineering were gradually rising (see Table 1), minority students struggled greatly while at the university. Their difficulties are reflected in the overrepresentation of minority students on academic probation following their first semester on campus (see Table 1). Retention has been shown to be impacted by students’ academic performances at the outset of their college careers\textsuperscript{25}. 
Table 1

First-Year Students in the College of Engineering at the University of Illinois at Urbana-Champaign, Fall 2003-Fall 2006

<table>
<thead>
<tr>
<th>Entrance Term</th>
<th>First-Year Students</th>
<th>First-Year Students on Probation Following Fall Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (Total)</td>
<td>N (Minority)</td>
</tr>
<tr>
<td>Fall 2003</td>
<td>1227</td>
<td>72</td>
</tr>
<tr>
<td>Fall 2004</td>
<td>1199</td>
<td>63</td>
</tr>
<tr>
<td>Fall 2005</td>
<td>1232</td>
<td>104</td>
</tr>
<tr>
<td>Fall 2006</td>
<td>1307</td>
<td>139</td>
</tr>
</tbody>
</table>

These numbers demonstrate how first-year minority students are consistently overrepresented among first-year students on academic probation, by nearly a factor of four in some cases. As previously mentioned, providing support for students on academic probation is part and parcel with supporting underrepresented students in engineering at the University of Illinois at Urbana-Champaign.

Program: SAGE: Student Assisted Guidance in Engineering (SAGE)

During the Spring 2007 semester, the College of Engineering initiated a three-hour course, SAGE: Student Assisted Guidance in Engineering (SAGE). The overall goal of the course was to increase the retention of students in the College of Engineering at the University of Illinois at Urbana-Champaign. The target groups were first-year students on probation with a particular emphasis on students who were African Americans, Hispanic, and females. The reason for this focus was due to the large representation of minority students among students on academic probation (see Table 2). Though female students were not overrepresented among students on probation, they were certainly underrepresented among students in the freshman class.
Table 2

Composition of First-Year Students/First-Year Students on Probation in the College of Engineering at the University of Illinois at Urbana-Champaign, Fall 2006

<table>
<thead>
<tr>
<th>Group</th>
<th>First-Year Students in Fall 2006</th>
<th>First-Year Students on Probation Following Fall 2006 Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>% of 1st Year Students</td>
</tr>
<tr>
<td>Total</td>
<td>1307</td>
<td>100.0</td>
</tr>
<tr>
<td>Male</td>
<td>1056</td>
<td>80.8</td>
</tr>
<tr>
<td>Female</td>
<td>251</td>
<td>19.2</td>
</tr>
<tr>
<td>Asian/Asian American</td>
<td>279</td>
<td>21.3</td>
</tr>
<tr>
<td>African American</td>
<td>57</td>
<td>4.4</td>
</tr>
<tr>
<td>Hispanic</td>
<td>81</td>
<td>6.2</td>
</tr>
<tr>
<td>Native American</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>White</td>
<td>868</td>
<td>66.4</td>
</tr>
<tr>
<td>Unknown</td>
<td>21</td>
<td>1.6</td>
</tr>
</tbody>
</table>

There were a total of 70 students in SAGE. The breakdown was 65 first-year students (N = 23 with GPA < 1.00, N = 38 with 1.00 ≤ GPA ≤ 2.00; N = 4 with GPA (technical courses) ≤ 2.00. There were five upperclasspersons with GPA ≤ 2.00. The composition of the first-year mentees in ENG 199M is summarized in Table 3.
Table 3

**ENG 199M: Composition of 1st Year Students**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>65</td>
<td>100.0</td>
</tr>
<tr>
<td>Male</td>
<td>50</td>
<td>76.9</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td>23.1</td>
</tr>
<tr>
<td>Asian/Asian American</td>
<td>10</td>
<td>15.4</td>
</tr>
<tr>
<td>African American</td>
<td>17</td>
<td>26.2</td>
</tr>
<tr>
<td>Hispanic</td>
<td>14</td>
<td>21.5</td>
</tr>
<tr>
<td>White</td>
<td>24</td>
<td>36.9</td>
</tr>
</tbody>
</table>

*Course Components*

All activities are designed to provide comprehensive support for the struggling student with mentoring being the featured component. Mentoring can be a powerful tool for establishing connections between incoming freshmen and older engineering students. The first-year students are able to build a relationship with a student who had gone through what they would be currently experiencing. The mentoring component of SAGE is based upon a model that has been used with women in the College of Engineering at the University of Illinois at Urbana-Champaign for the past eight years. In a longitudinal study of the program, 192 past participants in the mentoring program were matched with women who did not participate. Matching was completed on entry-level scores to the University of Illinois at Urbana-Champaign, ethnicity, educational achievement, etc. The researchers found that first-year participants were three times more likely to remain in engineering than women who did not participate. The same result was determined for sophomores, juniors, and seniors who served as mentors.

All the mentors were students in engineering with good academic standing. Second-year students and above with GPA’s over 3.0 were contacted via email about the opportunity to mentor a first-year student. The mentees were matched with upperclasspersons in the same department. Mentees and mentors met twice weekly, at required two-hour study sessions and for informal activities. The informal activities included such things as having a study session together, inviting a faculty member or corporate representative for lunch and going to an instructor’s office hours. In addition, each student received an electronic mentor who is a professional engineer from industry. Mentors were obtained through MentorNet, a national electronic mentoring program.

The students met weekly in lecture to learn about academic and professional success strategies and skills. Speakers for the class included professors, academic professionals, and representatives from industry. The students were placed in groups of four or five to discuss and apply the topics presented. Each group was led by a mentor who served as a discussion facilitator.
The mentees also had weekly study sessions in various residence halls on campus with both mentors and tutors present. In high school, students are accustomed to working independently. However, learning to study and work in teams is continually cited as a critical skill for success as an engineering student and as an engineer. Therefore, SAGE students were encouraged to work with one another, especially in introductory science and mathematics courses at the structured evening study sessions.

The students working on teams to complete a Rube Goldberg (www.rube-goldberg.com) project. We have found that students during their first two years of college often do not have the opportunity to apply what they are learning in their basic science and math courses. Through this activity, students were able to visualize and exercise engineering principles as well as to again learn to work effectively in groups.

Evaluation

Both quantitative and qualitative methods were employed in order to evaluate the course in terms of the students’ performances as well as their experiences in the course and as an engineering student.

Statistical analyses were performed on the students’ performances as well as on pre- and post assessments that were administered to both mentees and mentors at the start and end of the semester respectively. These tests assessed students’ academic performance and their attitudes toward mentoring and engineering. It also included a self-assessment of the students’ academic and professional skills. The post assessment included questions about the quality of the mentor/mentee relationship, the weekly seminar speakers and the tutors who worked with the mentees in the required study sessions.

Interviews were also conducted with both mentees and mentors at the end of the semester that covered topics concerning the SAGE course, student support (tutoring, mentoring) and programmatic resources (study skills, mentorship, instructor’s advising). Mentees submitted weekly journals in response to specific prompts each week that explored their thoughts and feelings about their past and current experiences as an engineering student. Mentors also submitted weekly journals on the progress of their relationship with their mentees.

The following sections summarize some of the major themes drawn from the evaluation.

SAGE as a Demonstration of College Support

The common perception of the College of Engineering at the University of Illinois at Urbana-Champaign is one of rigid admission standards and competitive and even ruthless academic offerings. SAGE served to show a different “face” to the college. Overall, mentees appreciated the college’s academic support with students on probation. Mentees acknowledged the college’s support, recognizing the college’s genuine interest in probation students.
“I think that it is good that the college of engineering has done this to provide freshman and a couple of other upperclassmen lets you know that they are not exactly just trying to weed everyone out. They are going to help you try to stay...not willing to give up on the students” (Mentee Interview, 5/10/2007).

“I really like it. It shows that they are not willing to give up on the students. They know that some people have a tough time...they are not dropping you out. They are going to try to help you out (Mentee Interview, 5/10/2007).

“Yeah. I really did feel like they want me to succeed...I felt like the college actually cared. I felt like the college was just going to let me be and just fix your own problems. But knowing that they are trying to actually get us out of probation. By giving us some courses, I felt like they really want me to stay, they really want me to succeed. I felt like that was a really good move. It gave us that were on probation a kinda different insight. This is a different motivation not only do I want to stay here but the college of engineering wants me to stay here too (Mentee Interview, 5/8/2007).

Mentors also described SAGE as a form of caring on behalf of the College of Engineering. They respected student support for mentees struggling with their academics. A mentor described SAGE’s effort as a structural form of support. “I think its good, (saying) ‘We care about you, and we care that you do well here.’ I think that the course is valuable for kids, and, ‘We want you to succeed. Your parents aren’t the only ones who have an investment in your plan. We want you to stay here. We want you to do well here. We want you to go out and be successful’” (Mentor Interview, 5/10/2007). Mentors also expressed that class support efforts such as SAGE demonstrated that the college at the selective institution is dedicated to students.

The course also challenged preconceptions that students had about those who would end up on academic probation. By meeting with other students in SAGE, mentees were relieved to know that they were not alone in academic probation. Mentors believed that spending time with students assisted in improving the stigma for bright probation students.

Mentees repeatedly commented on their appreciation for the college’s concern for their future academic progress. Such concern was provided via their mentors and the course instructor. One mentee described SAGE as a “light tower” for her because she realized who to turn to for help. Another mentee described SAGE as the “most productive class so far” because it challenged his college study strategies. One mentee stated “The fact that we had mentors made this course different from any other course I have taken here at the University of Illinois at Urbana-Champaign. My mentor was always willing to help however he could” (Mentee Interview, 5/8/2007). Another mentee described SAGE as “the only thing that has helped me stay within this University. If I didn’t have a program like this to guide me towards the right path, I would probably be back at home regretting all of the decisions that I’ve made my first year in college.” The program provided hope and helped form good study habits” (Mentee Interview, 5/8/2007).
Effect of SAGE on Students’ Academic Skills

The mentees held a positive outlook of SAGE and its resources, particularly in relation to the assistance it provided for them academically. One mentee described the positive overall benefits of the course, “I know that this course has helped me a lot this semester. All the experience that I've gained from the different mentoring relationships is invaluable and all the academic skills that I've learned with help me make it through the rest of my college years” (Mentee Interview, 5/18/2007).

The Monday night study sessions were helpful to facilitate time management and higher academic achievement. A mentee described the benefits of study sessions, “I liked the study sessions. It gave me a time to study and I knew that I could bring my homework. And there would be tutors and mentors. I knew that I could bring tutors and mentors. I had the help that I needed” (Mentee, 5/18/2007). The mentors also felt that the study sessions were beneficial because it was an occasion for mentees to complete their homework, receive class assistance, and provide conceptual clarification with difficult concepts and coursework expectations.

Several students in the study also described Tuesday lectures as useful because they reviewed helpful study tips and learning practices to succeed as an engineer. One mentee stated that she has gathered a better idea of positive strategies. She noted, “Some strategies that have worked for my classes so far include writing down solutions to homework problems, reviewing notes before going to class, e-mailing the professor and TA for critique on papers and assignments” (Mentee, 5/18/2007). Mentees generally attained a better understanding of time management and a good balance between schoolwork and socializing.

Effect of SAGE on Students’ Academic Performance

While students enrolled in the course realized a 72.9% retention rate, the students’ academic standing remained precarious as there would be the continued risk of probation. At the conclusion of the fall 2007 semester, a substantial portion of these students went back on probation or were dropped from the university.

Course and grade data were available for 39 mentees for each of the following semester: Fall 2006, Spring 2007, and Fall 2007. These included the students who had given consent as well as those who were retained following the Spring 2007 semester. A preliminary review of descriptive statistics seemed to indicate a spike in GPA at the end of the Spring 2007 semester, and a corresponding dip in total technical credit hours attempted (see Table 4). This pattern would seem to suggest that a) technical credit hours were less because students took SAGE, and b) student academic achievement improved at least in part because of participation in SAGE. One alternative explanation for (b) is that good grades earned in SAGE artificially boosted Spring 2007 GPA’s. However, when GPA’s were calculated without SAGE grades, they were lessened by less than half a standard deviation and remained substantially higher than GPA’s for Fall 2006 or Fall 2007.
Table 4

Mean, Standard Deviation, Minimum, and Maximum for GPA and Total Technical Credit Hours by Semester (N = 39)

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>36</td>
<td>1.336</td>
<td>0.525</td>
<td>0.25</td>
<td>2.48</td>
</tr>
<tr>
<td>Technical Credit Hours</td>
<td>39</td>
<td>9.08</td>
<td>3.46</td>
<td>0.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Spring 2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>39</td>
<td>2.678</td>
<td>0.477</td>
<td>1.62</td>
<td>3.82</td>
</tr>
<tr>
<td>Adjusted GPA</td>
<td>36</td>
<td>2.498</td>
<td>0.567</td>
<td>0.97</td>
<td>3.78</td>
</tr>
<tr>
<td>Technical Credit Hours</td>
<td>39</td>
<td>8.67</td>
<td>2.95</td>
<td>0.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Fall 2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>34</td>
<td>1.564</td>
<td>0.931</td>
<td>0.00</td>
<td>3.53</td>
</tr>
<tr>
<td>Technical Credit Hours</td>
<td>39</td>
<td>9.60</td>
<td>5.06</td>
<td>0.0</td>
<td>17.0</td>
</tr>
</tbody>
</table>

*Spring 2007 GPA calculated without the grade for SAGE.

Another alternative explanation for (b) is (a) itself. If students took fewer technical credit hours, they may have boosted their GPA’s by taking less challenging elective courses. However, there was no significant correlation between Spring 2007 GPA, adjusted or not, and technical credit hours taken that semester. Additionally, the lower number of technical credit hours was not statistically different from the number taken in either Fall 2006 or Fall 2007. A repeated measures general linear model was used in SPSS 15.0 to ascertain this result (Lower bound $F = 0.554, df = 1, p = .461$). The lower bound epsilon adjustment to $F$ was used because of a violation of the assumption of sphericity (Mauchly’s $W = 0.778, df = 2, p = .010$).

In order to test the difference in semester GPA against random error, a repeated measures linear mixed-model was tested with an unstructured covariance matrix. This type of model was chosen because of the ability to include cases with missing data (Tables 3 shows GPA’s were missing for several students) and to control for technical credit hours on a semester-by-semester basis. Fixed factors were semester, technical credit hours, and the interaction of semester with technical credit hours. There was no random element in the model because including it resulted in a Hessian matrix that was not positive definite. A model with an autoregressive heterogeneous covariance matrix was also tested (a simpler model that accounts for the heterogeneous variances of the semester GPA’s and their interrelations), but did not fit as well (likelihood ratio test: $\chi^2 = \ldots$)
Model results are summarized in Table 5. A significant interaction was found between technical credit hours, as well as main effects for credit hours and semester.

Table 5

Type III Tests of Fixed Effects on GPA (N = 39)

<table>
<thead>
<tr>
<th>Source</th>
<th>Numerator</th>
<th>Denominator</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1</td>
<td>58.731</td>
<td>167.290</td>
<td>&lt; .0005</td>
</tr>
<tr>
<td>Semester</td>
<td>2</td>
<td>56.478</td>
<td>9.877</td>
<td>&lt; .0005</td>
</tr>
<tr>
<td>Tech. Credit Hrs.</td>
<td>1</td>
<td>61.635</td>
<td>7.719</td>
<td>.007</td>
</tr>
<tr>
<td>Semester * Tech.</td>
<td>2</td>
<td>56.734</td>
<td>6.125</td>
<td>.004</td>
</tr>
</tbody>
</table>

Note. Spring 2007 GPA was calculated without SAGE.

The main effect for semester is illustrated in Figure 3. The adjusted means for each semester are plotted with their 95% confidence intervals. The means were adjusted for technical credit hours, and were as follows: a) Fall 2006, 1.328 (SE = 0.087); b) Spring 2007, 2.418 (0.098); c) Fall 2007, 1.699 (0.142). The GPA for Spring 2007 was significantly higher than the other two semesters, which were statistically no different from one another, despite being calculated without SAGE.
Figure 3. Mean student GPA by semester adjusted for total technical hours taken that semester (M = 9.65, N = 39). Spring 2007 GPA Adj. was calculated without the grades for ENG 199M. The error bars represent the upper and lower bounds of the 95% confidence intervals.

The interaction between semester and technical credit hours is explained by the correlations in Table 6. Although GPA and technical credit hours are uncorrelated in Fall 2006 and Spring 2007, they are negatively correlated in Fall 2007 (-.519, p < .01). If technical credit hours remains statistically the same across semesters, why would it be unrelated to GPA until Fall 2007? Possible explanations will be discussed at the conclusion of this section.
Table 6

Bivariate Correlations of GPA and Total Technical Credit Hours by Semester (N = 39)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2006 GPA</th>
<th>Technical Credit Hrs.</th>
<th>Spring 2007 GPA</th>
<th>Technical Credit Hrs.</th>
<th>Fall 2007 GPA</th>
</tr>
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<td>Fall 2006</td>
<td></td>
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<tr>
<td>Technical Credit Hrs.</td>
<td>.091</td>
<td>(36)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Spring 2007</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>GPA</td>
<td>-.411*</td>
<td>(.36)</td>
<td>-.042</td>
<td>(39)</td>
<td>—</td>
</tr>
<tr>
<td>Adjusted GPAa</td>
<td>-.552**</td>
<td>(34)</td>
<td>.064</td>
<td>(36)</td>
<td>.931**</td>
</tr>
<tr>
<td>Technical Credit Hrs.</td>
<td>.118</td>
<td>(36)</td>
<td>-.228</td>
<td>(39)</td>
<td>-.262</td>
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<td>Fall 2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>-.034</td>
<td>(31)</td>
<td>.070</td>
<td>(39)</td>
<td>.168</td>
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<tr>
<td>Adjusted GPAa</td>
<td>-.098</td>
<td>(36)</td>
<td>-.143</td>
<td>(39)</td>
<td>.058</td>
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<td>Technical Credit Hrs.</td>
<td>-.143</td>
<td>(36)</td>
<td>.084</td>
<td>(39)</td>
<td>.142</td>
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Note. The sample size for each correlation is in parentheses.

aSpring 2007 GPA calculated without the grade for SAGE.
*p < .05. **p < .01. ***p < .001.

The students’ average GPA increased significantly at the end of Spring 2007, and there is no evidence for the alternative explanations of beneficial grades in SAGE or fewer technical credits attempted. Table 6 provides some insight into what did cause the increase, a significant correlation between Fall 2006 GPA and Spring 2007 adjusted GPA (−.552, p < .01). Figure 4 is a scatterplot of these two variables, and shows a strong negative relationship between them. The coefficient of determination is .305, meaning that 30% of the variance in Spring 2007 GPA is explained by Fall 2006 GPA. On closer inspection, one can see that those students with GPA’s in the range of 1.50 to 2.50 in Fall 2006 generally stayed in the same range in Spring 2007.
However, those who earned less an a 1.50 in Fall 2006 increased substantially in Spring 2007, generally greater than 2.00. And the lowest earners in the fall tended to have the highest GPA’s in the spring. One possibility is that participating in the program had a much greater effect on lower achieving students, the ones who needed it the most. This explanation may also partially account for the crash in GPA’s in Fall 2007, after program participation had ended in the spring. Another explanation that can’t be ruled out is the effect of the summer layoff.

The academic achievement literature offers several explanations for the decline in GPA in Fall 2007, one semester after SAGE. Attributional theory states that teachers can unknowingly communicate their own attitudes about whether academic ability is mutable or immutable through their expectations for individuals as expressed in their teaching practices\textsuperscript{28}. In other words, without the counterweight of encouragement from SAGE, instructor attitudes toward program students might have had a deleterious effect. One version of goal theory agrees with this interpretation, ability goal orientation. In this theory, individuals believe the purpose of achievement is to demonstrate innate ability, or hide the lack thereof\textsuperscript{29}. Because the individual

![Figure 4. Scatterplot of Fall 2006 GPA by Spring 2007 adjusted GPA (N = 34). Spring 2007 GPA was adjusted by leaving out the grade for SAGE. The Pearson correlation was -.552 (p < .01). The lines are the best fit linear regression line and 95% confidence bands about the mean.](image-url)
believes achievement is rooted in ability, there is a tendency to view it as immutable. Populations that have historically faced discrimination may be more prone to this goal orientation.

A third theory, self-determination theory, provides an alternative explanation to the fall in GPA. The theory postulates that individuals have three types of need: a) a sense of competence, b) a sense of belonging, and c) a sense of autonomy\textsuperscript{30}. If courses did in fact get more difficult for students in Fall 2007, their average sense of competency may have declined. Because they no longer had a support class to attend, their sense of belonging may have suffered, as well. Finally, if in the second year of their academic program they had less freedom to choose courses (i.e.: they had fewer electives from which to choose) or felt they did, their sense of autonomy may have declined. A decline in any one of these aspects could have led to a decline in motivation, and in turn, a decline in performance.

\textbf{Lessons Learned/Implications}

While it was disheartening to see how the students had done during the Fall 2007 semester, it has also prompted deeper reflection on what would be considered optimal support for students on academic probation. Was it that we did not provide what students needed during the Spring 2007 semester? Was it that we did not provide sustained support through the Fall 2007 semester? The following summarizes some of the lessons learned during SAGE course itself as well as during the subsequent semester.

\textit{Efforts need to start earlier}

Even during the course itself, it seemed as if it was an intervention that was too little, too late. There was an interesting combination of students in the course. There were those that fit the expected profile based on their incoming entrance exam scores and such, students that came from less than stellar high schools. But there were also a fair number of students with high ACT scores, who had come from top schools in the state. The course seemed to provide the latter group time and opportunity to get back on their feet academically. However, it did not appear that adequate support was provided for those students who were simply under-prepared.

The College of Engineering has since established a new summer program, Illinois Connections in Engineering, in order to work with underrepresented students before they arrived on campus. The rigorous six-week residential program was designed to assist students’ adjustment to college such that they could begin the school year with a running start. Students took preparatory math and chemistry courses as well as workshops in physics, CAD modeling and computer programming. The courses and workshops were taught to give the students a sense of the level and pace of university coursework. Students also participated in study sessions at night with tutors available. Further, the summer program gave students the opportunity to become accustomed to the campus (housing, student life, resources, etc.).

The SAGE course was again offered, this time targeting first-semester freshmen with lower ACT-Math scores as well as underrepresented students. Most of the students who had participated in the summer program also enrolled in SAGE. The fall course incorporated many of the same elements as the spring SAGE course, with a greater emphasis on cultivating strong
academic and leadership skills as an engineering student. We were pleased to find that the proportion of minority students coming in during the Fall 2007 semester matched the proportion of minority students on academic probation (6.3% and 6.6% respectively). While this is only one cohort of students, it does provide encouraging results to earlier and more proactive efforts on the part of the College of Engineering.

Efforts need to extend further

There needs to be continued support for students in subsequent semesters. The SAGE students had been invited to come to the Monday study sessions during the Fall 2007 semester. Two students responded positively to this invitation, but came out only once each. During the Spring 2007 semester, several students were repeating courses they had done poorly in from the Fall 2006 semester. In the Fall 2007 semester, students were not only taking courses that were more advanced, but they were taking them for the first time. Whether it’s the continuation of the mentoring relationship or of participation in the Monday study sessions, some follow-up with the students seems warranted.

Support programs need to be more responsive to students

All students in SAGE were required to enroll in the course as part of their probation conditions. Final grades were made available about two weeks before classes began. Decisions regarding students’ academic statuses were made about 10 days before classes began. As a result, students received notification of their probation status about one week before the start of classes. Those students who were required to take SAGE had to fit the course into their schedules that had been selected a couple months back. Further, students on probation are required to repeat required classes in which they earned below a C-. This process proved to be quite disruptive to the students’ schedules and sense of self-management.

That students were required to take the course was born out of the desire to ensure that those students who needed support would receive it. An unintended message of this decision was that we knew what the students needed more than the students themselves. Consequently, the first several weeks of the course involved “convincing” the students that the course and mentoring could indeed be beneficial. As earnest as we were in designing the course, there was minimal input from the students themselves. We need to be more responsive to where the students are at and the factors for their academic struggles. This ranges from making the course voluntary, and thus including the possibility of students’ deciding not to participate, to receiving their input in shaping the course itself (topics covered, etc.). For example, we found that certain informal activities worked well for some mentor/mentee pairs and did not work as well for others. Rather than dictating what would be the “best” activities to do, we propose that we still provide suggestions for weekly meetings but allow mentors and mentees choose what they feel would be most beneficial.

Mentoring requires guidance and support

The greatest assets that mentors have are their prior knowledge and experience as first-year engineering students. However, these are not sufficient qualities to be a high-quality mentor.
There were instances when we struggled with the advice that the mentors were offering their mentees or when we were not certain if the mentors and mentees were even meeting regularly. While met with mentors at the beginning of the course for an orientation, there was not directed support given throughout the semester. We recognize that holding meetings with the mentors during the semester allows mentors to share what they have learned as well as to provide further guidance.

*Success is a reflection of both the student and the college*

The students’ academic achievement is paramount when considering the success of an academic support program. However, that the students’ often expressed appreciation for the College’s care and concern should not go unnoticed. The reputation and rigor of Engineering at Illinois made the college’s demonstration of “compassion” all the more impressive for the students and mentors. This should be recognized and built upon.

**Conclusion**

The College of Engineering at the University of Illinois at Urbana-Champaign is deeply concerned about the retention of students on probation, particularly minorities and females after the first year and going into the second year. Minorities make up only four percent of total engineering population (N = 5600). The percentage for women is approximately 15 percent. These numbers are both lower than the figures of entering freshmen to the college. Academic probation is one issue that seems to affect underrepresented minorities more pervasively than the student body at large. While the College of Engineering has had a minority engineering program for 34 years, a women in engineering program for 11 years and numerous tutoring programs, there is a distinct need for more intensive and proactive retention programming. The program initiated was modeled after best practices found at other top engineering programs in the nation and also our own mentoring program for women. While the retention program demonstrated positive effects (especially based upon the qualitative results), we realize that modifications need to be made such as the implementation of a summer program preceding freshman year and a program that continues into the sophomore year.

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**References**


12 Merisotis, ibid.


20 Gandara, ibid.


26 Habrowski, ibid.


