Recruitment and retention challenges at a midsize engineering college

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Abstract *– Southern Illinois University Carbondale (SIUC) being a state university with limited scholarship funds, and as a rural university away from major industries, faces great challenges in recruiting well-prepared students for engineering education. Retention of students who are not well prepared during high school education represents yet another set of challenges. The retention problem becomes more complicated when students who are well-prepared experience difficulties in making the transition from high school to college. In this paper, programs developed in the College of Engineering (COE) during the last few years to overcome these recruitment and retention challenges are presented. For each program, statistics compiled and lessons learned are introduced. Evolution of the programs and future improvements are discussed. In addition, a comparative study of freshmen versus transfer students' recruitment and retention issues are presented.*

Index terms *– engineering residence halls, freshmen and sophomore retention programs, freshmen recruitment programs, supplemental instruction*

BACKGROUND

The College of Engineering (COE) at Southern Illinois University Carbondale (SIUC) can be classified as a mid-size engineering college with four engineering and one technology departments, sixty three faculty members, slightly over one thousand undergraduate, and about 450 graduate students. New, continuing, and graduated student statistics since 2000 are shown in Table 1.

	2000	**2001**	**2002**	**2003**
New Freshmen	129 (3)	152 (9)	158 (15)	194 (9)
New Transfer	121 (31)	124 (18)	119 (24)	121 (35)
Continuing	782 (168)	742 (144)	740 (134)	728 (146)
Total	1032 (202)	1018 (171)	1017 (173)	1043 (190)
Graduated	230 (76)	214 (75)	208 (59)	210 (53)

* Numbers in parentheses represent technology students' statistics.

TABLE 1
UNDERGRADUATE STUDENT STATISTICS AT THE COLLEGE OF ENGINEERING SINCE 2000

The average ACT math and composite scores of the fall 2003 freshmen class were 25.64 and 24.18, respectively. The COE follows the University admission standards for both the freshmen and transfer students, which is an ACT composite score of 20 for freshmen (with some exceptions) and a GPA of 2.0 for transfers. It is noted that the University increased ACT composite score to 21 for incoming freshmen for fall 2004.

RECRUITMENT

The COE's undergraduate enrollment has stabilized at slightly over 1000 students since 1996. The assessments in recent years indicated that we should increase enrollment by about 10 to 15%. We also decided to attract more well-prepared students to the programs. As a result, the COE has intensified its recruitment efforts since 2000 by initiating new programs such as scholarship, high school outreach, and engineering emphasis floors programs and by improving the existing programs such as women introduction to engineering and summer bridge programs. These programs will be briefly presented below.

Scholarship Program

With ever increasing costs of higher education, scholarships play an important role in college selection. Engineering colleges must not only have funds available for scholarships to recruit students to their programs; but must also have scholarships set at meaningful amounts to attract academically talented students to improve quality, and therefore, retention. Realizing this undeniable fact, the COE hired a development officer in 2001 to improve its fund raising capacity. Following the same logic, the University decided to allocate about one million dollars to new freshmen and transfer student scholarships starting fall 2003. The effect of revitalized scholarship program on engineering student recruitment can be observed from Figure 1 since 2000.

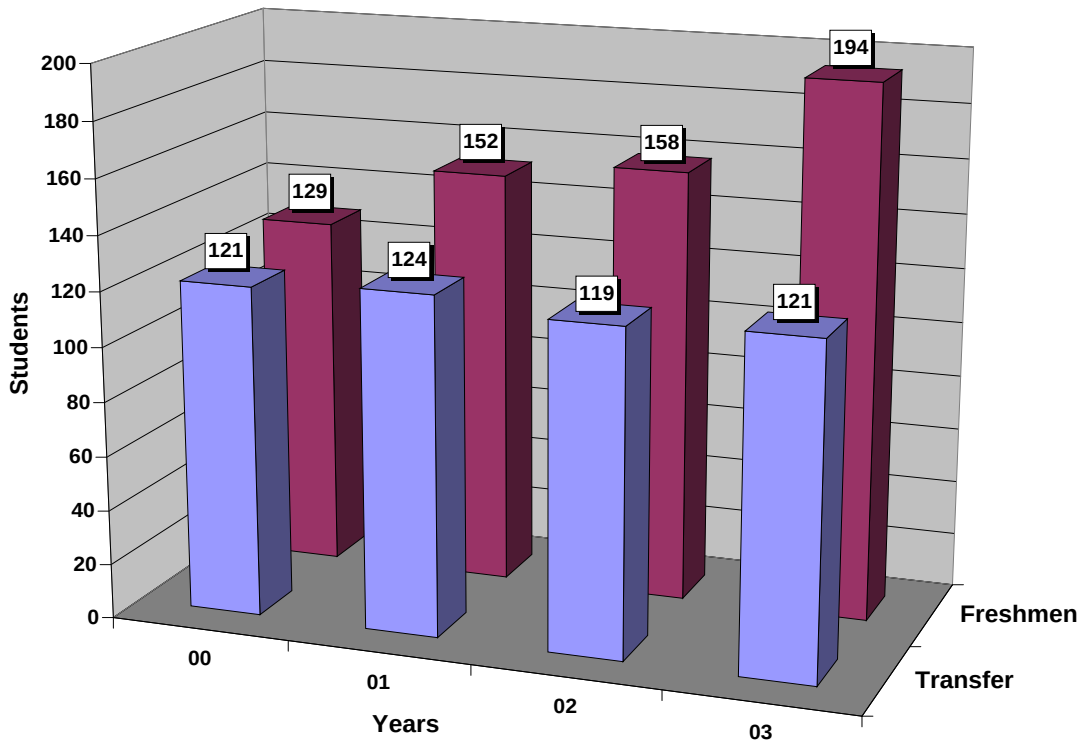

FIGURE 1
NEW FRESHMEN AND TRANSFER ENROLLMENT IN THE COLLEGE OF ENGINEERING SIINCE 2000

The full impact of the joint campaign, however, was seen in the fall 2003 recruitment when a record high 194 new freshmen enrolled. The distribution of the COE scholarship funds for fall 2003 is given in Table 2. As shown, 95 freshmen benefited from the program for a total of $168, 875; and altogether 207 students received a total of $320,650.

Over and above the COE scholarships, the academically talented freshmen and transfer students received substantial scholarships from the University. Based on an index score system, the University scholarships were awarded as: 1) Dean's scholarship: $3,000/year for 2 years, 2) Provost scholarship: $4,000/year for 2 years, 3) Chancellor scholarship: $5,500/year

for 4 years, 4) Presidential scholarship: $10,500/year for 4 years, 5) Merit Finalist scholarship: $3,000/year for 4 years, and 6) Transfer student scholarship: $1,000 for 1 year.

	Freshmen	Transfer	Continuing	Total
Number	95	8	104	207
Average	$1,778	$938	$1,387	$1,549
Total	$168,875	$7,500	$144,275	$320,650

TABLE 2
DISTRIBUTION OF THE COLLEGE OF ENGINEERING SCHOLARSHIP FUNDS IN 2003

In fall 2003, the COE students received 5 of the 19 presidential, 3 of the 10 chancellor, 2 of the 4 merit finalist, 13 of the 61 provost, 20 of the 90 dean, and 2 of the 47 transfer scholarships. The total dollar value of these scholarships for one academic year was about $200,000. Although the COE undergraduate student body represents only about 7% of the university undergraduate body, the share of scholarships for COE was about 20%. This is an indication that with the improved scholarship funds COE was able to attract more academically talented students in its programs. This fact has also been proven by the math placement test the COE administers to its freshmen class: when only 39% of the freshmen class tested for Calculus I and above in fall 2000, the percentage gradually increased to 41% in 2001, 50% in 2002, and 56% in 2003.

It is clear from the above statistics that the transfer student scholarship funding is not at the desired level. The university kept the minimum GPA requirement at 3.75 for fall 2004 and increased it to 3.85 for fall 2005 for transfer student scholarship. Since most community college students who want to pursue engineering degree do not meet the 3.85 GPA requirement, the number of engineering transfer students receiving scholarships from the University is very low. To remedy this situation, we submitted a proposal to NSF – Computer Science, Engineering, and Mathematics Scholarship Program (CSEMS) in spring 2004, but we were not successful. Therefore, special attention needs to be given to funding additional transfer student scholarships in the future.

Our assessment of scholarships indicates that to attract and retain academically talented students in our programs we will need to increase College's scholarship funding to $500,000 from the current level of $320,000 and maintain the University funding at $200,000 annually ($400,000 for two year commitment).

High School Outreach Program

In fall 2000, COE launched a new program to introduce the engineering profession to area high school students. These high schools are located within 80 miles of SIUC. The program grew from 11 high schools in the first year to 50 at the end of 2003. Every fall we invite counselors, math and science teachers from these high schools to introduce the programs, show the facilities, and update scholarship information. The benefits to high schools are: 1) a scholarship of at least $1,000 is dedicated to each high school to be given every year to a deserving student who would enroll in COE, 2) students from outreach high schools can participate in to a two-day "Introduction to Engineering" summer program at no charge, 3) bring up to 30 students interested in engineering to visit COE to do hands-on experiments and participate in student design project demonstrations, 4) receive speaker from the COE for career days and seminars. Every summer, we bring about 20 students from these high schools to attend our "Introduction to Engineering Program". Due to these activities, the COE receives significantly more academically talented students from the member high schools. In the future, we should be able to bring about 40 students to this summer program.

Women's Introduction to Engineering

This program provides the opportunity to explore the various disciplines of engineering and related career tracks to academically qualified sophomores from across the State of Illinois. We target sophomores because they are just thinking about career and college choices, particularly the summer prior to their junior year.

Each year, the College reaches over 1000 well-qualified female students by mail and invites them to a 4-day summer program. Every summer, about 75 students attend the program. The College has not been as successful in recruiting from this program as it has from the High School Outreach Program. We believe this is due to the fact that there is a two-year lag between the exposure to the College of Engineering and their decision time for college. In the past, these students were not closely tracked. Under new administration of the program, we will closely follow these students and update them on the scholarships, undergraduate research opportunities and other developments at the COE and at the University.

Freshmen Orientation Program

Since 1997, the COE has offered an expanded orientation program for new freshmen students. This is a two-day program right before the fall semester starts. Meeting other engineering students and faculty, team building, and developing commitment to the engineering major/career are the program's primary goals. This voluntary-attendance program attracts about 75 % of the incoming freshmen class. Surveys indicate that the participants are very appreciative of the program as an excellent way of starting the semester. More importantly, this program reinforces the formation of study groups in both the engineering emphasis housing and the engineering designated math classes.

Summer Bridge Program

The Minority Engineering Program (MEP) of the COE has provided a Summer Bridge Program for entering students since 1987. Freshmen students enroll in two summer term courses (for credit) and are required to attend two MEP workshops (supplemental math and engineering science). Students generally do well academically, gain confidence, and are better prepared to face the academic rigors of the engineering curriculum in the fall. In 2003, there were ten participants in the Summer Bridge Program. Of the ten Summer Bridge participants, all improved their math placement test scores significantly. Six placed into Calculus I or higher and the remaining four placed into the next highest math course from their initial placement. One student placed into Calculus III. The same student also completed a research project under the direction of a Civil and Environmental Engineering professor. Although expensive to conduct, Summer Bridge consistently proves to be one of the most effective retention programs.

Traditionally, SIUC is well known for its commitment to the education of minority and underrepresented groups. In fall 2003, 2,630 of the 16,366 undergraduates were minority students, constituting 16% of the student population. The SIUC's tradition towards minority groups has also been reflected in the COE with MEP established in 1985. MEP is an academic support program designed to increase the enrollment, retention, and graduation of ethnic minorities in engineering. Over the last four years, about 18% of the College's undergraduates have been ethnic minority students. The student chapters of National Society of Black Engineers (NSBE) and Society of Hispanic Professional Engineers (SHPE), nurtured by the MEP, have been very active. Both chapters play an important role in the College's recruitment through activities such as visiting their high schools to introduce our engineering programs to prospective students, by participating in Open Houses, and by increasing the visibility of SIUC and the COE in local and national conferences.

Engineering Emphasis Floors in University Housing

University Housing reserves one entire residence hall and two floors of another hall for engineering students only. The College assigns mostly freshmen and sophomores to these residence halls. The objective is to provide an environment conducive to develop community, tradition, and enhance the academic performance of students. Each year, freshmen engineering students are clustered in these two halls. These students are also block scheduled in common course sections to encourage more cohesive study groups. Popularity of engineering housing has surged among new students and their parents. For fall 2004, over 100 freshmen, or more than half the freshmen class, requested and were placed in engineering designated housing. COE has requested more housing space for fall 2005 to meet the increased demand.

Student Design Projects

Another important recruitment tool for the COE has been the student design projects. The exhibition and demonstration of these projects by student groups receive the attention and appreciation of the visiting prospective students and parents during open houses and individual visits. The most attractive student projects have been steel bridge, concrete canoe, Formula race car, moonbuggy, battlebots, and hovercraft. The COE and the departments provide unequivocal support to design groups.

RETENTION

From fall 1998 to fall 2003, the freshmen retention in the COE has been about 66 %. This percentage drops to about 47 % by the end of the sophomore year. Over the last 10 years the graduation rate of freshmen class has been around 33% at the end of sixth year. The transfer student graduation on the other hand has been around 65 % in four years after entry. We estimate

that freshmen and sophomore retention rates should be improved by 5 to 10% with the programs we started during the last few years, which will also improve the graduation rate. There is a limit on how much remedial help can be given to a student who enters an engineering program with a deficient math and science background from high school. After improving the scholarship funds of the COE, the administration will seriously consider increasing the entry ACT score for freshmen and GPA for transfer students. Only then, we will see the full impact of the retention programs. The most prominent retention programs in the COE are briefly presented below.

Supplemental Instruction in Mathematics

Passing math classes has been an uphill battle for many engineering students. The statistics indicate that on the average about 50 % of the students were passing math classes, which was significantly affecting retention in the College. In spring 2001, to radically address the concern, COE, in cooperation with Department of Mathematics, started a full scale Supplemental Instruction Program (SIP) in various preparatory math classes and in Calculus I after a huge success in a pilot program in Pre-calculus class. The outcomes have been beyond anybody's expectations. The passing rates improved from a low 50-55 % to 75-80 %. Subsequently, the program was extended to cover Calculus II and Introduction to Differential Equations after repeated requests from the students who had benefited from the program in lower level classes.

In this program, students stay in class for an additional hour three days a week. This additional hour immediately follows the lecture and is used to solve problems related to the topics covered in the lecture. Some instructors give worksheets, others have students start homework, and still others give quizzes during this time. Students form study groups composed of three to four students. The instructor usually stays in class for the first few minutes to answer questions. Students are then guided by two to four undergraduate teaching assistants. The number of teaching assistants depends upon the size of the class. These assistants promote discussion among the group members to tackle the problems. The work that students complete during this time is always graded to encourage participation.

The undergraduate teaching assistants guiding these sessions are selected based on the recommendation of the mathematics professors, their grades in mathematics courses, and their overall GPA. They must possess excellent oral communication skills and they must have strong social skills.

COE tracked passing rates of students in various math courses with SIP and the passing rates of the students who could not enroll in math courses with supplemental instructions due to scheduling conflicts. Figure 2 summarizes the outcomes since spring 2001 when the program was established. The passing rate is defined as grades of "A, B, and C" in a grading system of A, B, C, D, and F (students are not allowed to take the next mathematics class with a grade of D or F).

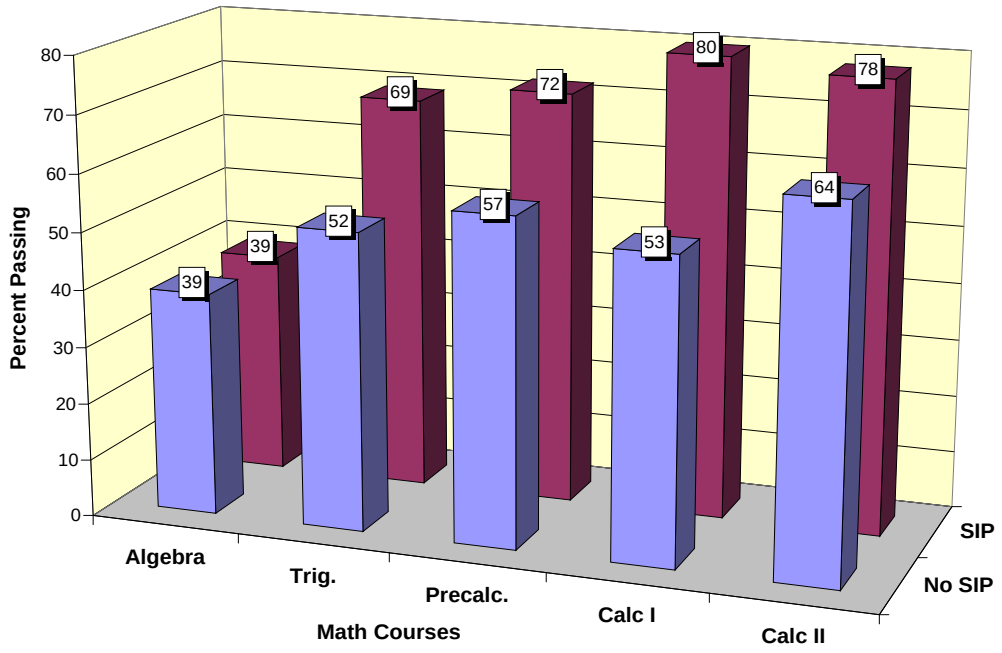

FIGURE 2
PASSING RATES IN VARIOUS MATH COURSES WITH AND WITHOUT SUPPLEMENTAL INSTRUCTION PROGRAM SINCE SPRING 2001

It is clear that there is statistically significant improvement in passing rates in all courses, except MATH 108 – College Algebra. The failure in MATH 108 can be explained by three major factors:

1. Students have weak math aptitude. It must be mentioned here that those students who have high math aptitude but come from high schools with weak math programs do very well in MATH 108. As a matter of fact, some of these students become the best students in the COE.
2. Students placing in MATH 108 are not sufficiently focused to go through the rigors of math and science required for engineering. They are not sure if engineering is for them.
3. They lack discipline, and therefore, attendance for both regular lectures and supplemental instruction sessions is critically low.

With the exception of College Algebra (MATH 108), the program is remarkably successful. The improvement is not only in passing rates but also in good grades, A's and B's, as seen in Figure 3. It is particularly impressive that one half of the students in Calculus I and Calculus II are passing the course with grades A and B.

Currently, we need 10 undergraduate assistants to run the program. For the last two fiscal years, we were able to finance the program through the University's Undergraduate Assistantship Program that allocates funds based on competitive proposals. For the upcoming fiscal year (FY05) the Undergraduate Committee decided to fund only six students for SIP. For continued success of the program the support of the upper administration is essential if the Assistantship Committee decides not to grant funds anymore.

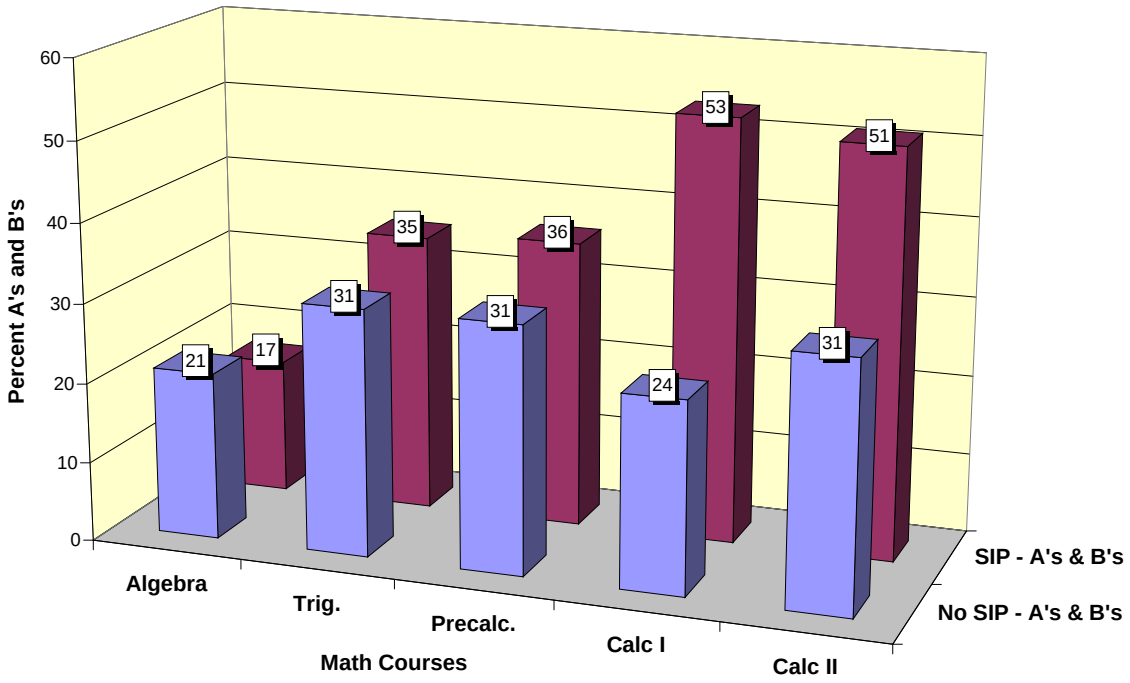

FIGURE 3
PASSING RATES WITH GRADES A AND B IN MATH COURSES WITH AND WITHOUT SUPPLEMENTAL INSTRUCTION SINCE SPRING 2001

Residence Hall Tutoring Program

The Engineering residence hall and the two engineering floors in a separate facility play an important role in marketing the College to freshmen. To enhance the effectiveness of the engineering housing program the College assigns tutors to the common study areas in the two main residential housing locations on campus. The tutors are outstanding undergraduate students with excellent math, science, and engineering background. They tutor from 7 to 10 pm Monday through Thursday.

The demand for these tutors is very high and the feedback from the students is very positive for their knowledge and interpersonal skills.

Early Intervention Program

The COE Advisement Office contacts all instructors of engineering sections of math, physics, and chemistry classes on the 4th week of a semester to request a report on the performance, as well as the attendance, of our students. Students experiencing difficulties are sent letters offering help, pointing out the free tutoring programs at the engineering dorms, Minority Engineering lab and the Department of Mathematics. In the past, however, very few students responded to our offers and recommendations.

Starting fall 2004, we will pilot a program where we assign faculty members from each department to directly contact and work with students experiencing difficulties. We will target freshmen and sophomores. These volunteer faculty members will track student progress all semester long. The Associate Dean of the College will coordinate the activities of the faculty group. The pilot program will be reviewed at the end of the first year. The very obvious assessment tool will be the retention rates of the students as compared to previous years. We will consider a 5 to 10% increase in retention as a successful outcome, and as a consequence we will continue the program and try to improve it with lessons learned from the first year. Otherwise, the faculty group will come up with alternative recommendations.

CONCLUSIONS

The College of Engineering at Southern Illinois University Carbondale developed a number of programs to overcome the challenges of recruitment and retention of a midsize engineering college as part of a state university with financial constraints and being in a rural location away from the major industries. Some of these programs such as High School Outreach, Engineering Residence Hall, and Supplemental Instruction had very positive impact on the challenges. However, some of the other programs such as Women Introduction to Engineering and Early Intervention could not be used to their fullest potential. We have made our highest priority to improve the implementation of these programs that have so much to offer in making the recruitment and retention a huge success in the College of Engineering.