Extended Abstract - Retention of Marginal Students: Effective First Year Interventions

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Abstract - **Time to graduation and persistence in major have always been an issue for many engineering and engineering technology students. It is not uncommon for students to take an extra semester or more beyond the standard 4 years to complete their degree. Further, many students change their major or leave college altogether because of challenges with specific classes. Students whose academic preparation is marginal make up the largest segment of this group. In this work, we addressed the question "Are there factors that if addressed in the first year could significantly influence student success in engineering particularly among marginally prepared students?" To gain an initial understanding of the most common barriers, we looked for systemic factors within our engineering technology programs that significantly affect students' persistence in the major. From a review of transcripts for a 7 year period for all engineering technology students at our school, the results showed, not surprisingly, mathematics and English to be the biggest academic factors in student retention and persistence in major. Our efforts, funded by NSF, focused on the *non-academic* areas of personal responsibility, interdependence, mentoring, and the effect of having a strong cohort. The premise here was that academic support in math and English is already widely available, e.g., peers, faculty, and learning resources centers. Further, our interest was to develop methods that did not incur significant additional resources on either faculty or the institution. As one indicator of success, we present the quantitative measure of a comparison of the students' predicted GPA and their actual cumulative GPA. Analysis showed statistically significant improvement in student gains. We briefly present the educational methodologies developed and early results achieved from this effort.**

Index Terms – Personal Responsibility, Interdependence, First Year Seminar, Student Success

INTRODUCTION

Most universities and colleges consider retention and persistence of its students an important issue. While most disciplines concern themselves with keeping students in their major and timely student progression towards graduation, engineering perhaps is unique in its need to keep students from leaving the discipline and having them progress appropriately. Despite recent understanding that engineering retention is similar to rates in other majors, unlike other majors, it does not attract new student into the major beyond the first year in any appreciable numbers.[1] This makes retention of students more critical than in other disciplines.

Most retention and persistence programs in engineering focus on traditional forms of improving student learning success. Common among these are study skills, time management, extended classroom time such as supplemental instruction, and, in some cases, mentoring.[2] Additionally, these programs do not differentiate among the types of students except perhaps based on gender or minority status.

In our work, our primary focus is on non-academic areas of personal responsibility, interdependence, cohort development, and mentoring. In addition to these areas, we do cover traditional academic success skills. However, they are covered in the context of our primary focus. We chose for this study students whose academic predictors placed them in the at risk category of success in our engineering program.

PARTICIPANTS AND SETTING

Students selected for this program are engineering technology students in a four-year bachelor of science, electromechanical discipline (EMET). The school acts as a small liberal arts college with strong engineering and engineering technology programs. In our selection process, the three most significant factors we included were their early academic performance indicator (pGPA), first-generation in college, and financial need.

The intention here is to provide support for the category of students who are often on the cusp of academic success/failure. From a review of transcripts for all EMET students over a 7 year period, we determined the range of pGPA of 2.5 to 3.0 to fit tour criteria of academically at-risk students.[1] Further, the risk factors of first generation in college and financial need were considered in the final selection of the students admitted to the S-STEM program.

METHODOLOGY

The Scholars in STEM (S-STEM) program has two distinct segments. The first year contains intensive training in our success techniques. Upon completion of the first year,

[1] We did accept students with lower pGPAs.

students progress to a more traditionally independent learning format. During this latter segment, students mentor the first year students.

The first year begins with a summer bridge program that focuses on cohort development and begins the process of converting the vague concepts of personal responsibility to concrete, pragmatic actions, behaviors, and beliefs. The first two semesters continue with student personal development as related to academic success. In each of these semesters, students take a 1 credit course specifically designed for S-STEM students. Further, students take an engineering design 1st year seminar (EDSGN 100) with the same faculty teaching the 1 credit specialized courses. EDSGN 100 meets 6 hours per week in the first semester. This high contact time with the students allows a unique opportunity to work with students on improving their chances for academic success.

Table 1 contrasts the two foundational components of our program—accepting personal responsibility and employing interdependence—with their alternative and counterproductive actions/behaviors/beliefs of struggling students.

TABLE 1
DIFFERENCES OF SUCCESSFUL STUDENTS AND STRUGGLING STUDENTS.[3]

Successful Students	Struggling Students
Accept Personal Responsibility: Believe that their actions, behaviors, and beliefs are the primary cause of what happens to them.	See themselves as victims. Believe that what happens to them is a result of external forces particularly other people who cause their problems.
Employ Interdependence: Understand when they need assistance and seek out and develop supportive relationships	Believe they can do it alone. Often see help as a weakness and resist it when offered.

The underlying component of these success characteristics is grounded in the social-emotional development of the student. While this can be challenging for students in any discipline, it is particularly difficult for most engineering students. Our primary learning techniques are reflective and reactive journaling. To increase student buy-in, the majority of the journal prompts are directly related to engineering topics.

RESULTS

The measure of success of this program will be students' academic performance and persistence towards graduation in the EMET program. Academic performance is measured through a comparison of the student current cumulative GPA (cum GPA) to their predicted GPA (pGPA). This pGPA performance indicator is our university's metric to predict student academic performance in their major—it differentiates between science majors and non-science majors. This indicator includes factors such as specific high school attended, high school performance, and SAT scores.

In the explanation of our results, we separate students who continued in S-STEM program from students who left. In order for students to continue in our program, they had to maintain a minimum of a 2.70 cum GPA out of a 4.0 maximum and fully participate in program activities. Figure 1 shows the results for all students currently in the S-STEM program. All have met the requirement of maintaining the minimum GPA. Their most recent cum GPAs range from 2.78 to 3.93 with a mean cum GPA = 3.38. The difference between their cum GPA and pGPA ranges from -0.01 to + 1.15. The mean difference is +0.69—greater than 2/3 of a letter grade higher than their predicted grade point average. (Note student A, a returning adult student, does not have a pGPA.)

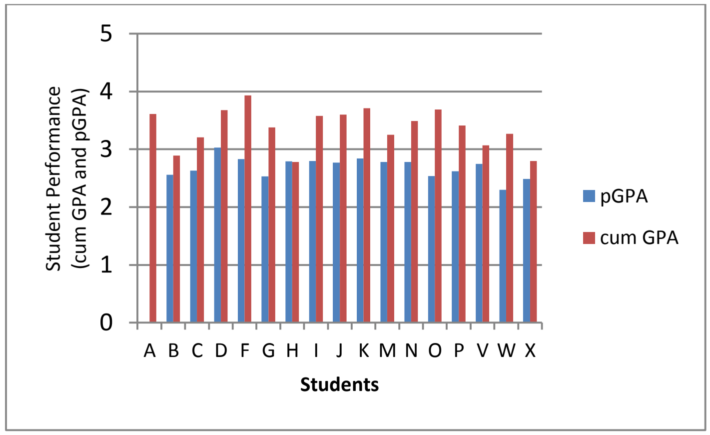

FIGURE 1
S-STEM STUDENT PERFORMANCE: PGPA (BLUE) COMPARED TO CUM GPA (RED).

We statistically analyzed the data to determine validity of the correlation between our program efforts and students' performance by cohort and semester. Analysis shows $p<0.05$ with a confidence level of 95%. Thus, our program efforts are statistically significant for all cohorts and all semesters with the exception of the most recent group of students (Cohort 11-12). None-the-less the 11/12 cohort maintains a GPA that is higher than their pGPA. (They are higher than predicted, but not high enough to be statistically significant.)

Table 2 details performance of students no longer in the program. Nearly all of these students left (8/10) within the first 2 semesters, 3/10 changed their major and 2 are enrolled in STEM majors.

TABLE 2
PERFORMANCE OF STUDENTS WHO LEFT THE S-STEM PROGRAM

ID	Cohort	Semester Left	Cum GPA	SC pGPA	Cum GPA-GPA
E	09-10	SP10-withdrew	1.38	2.43	-1.05
L	09-10	SP10—changed major	2.08	2.31	-0.23
R	10-11	SP11—withdrew	0.54	2.42	-1.88
S	10-11	SP11—changed major	3.46	2.65	0.81
T	10-11	Sp11—changed major	2.41	2.54	-0.31
U	10-11	FA11—withdrew	2.27*	N/A	N/A
Q	10-11	Sp12—withdrew	2.48	2.52	-0.04

Y	11-12	SP12—withdrew	2.83	2.77	-2.51
Z	11-12	FA11—withdrew	0.00**	2.51	N/A
ZZ	11-12	FA11—withdrew	0.00**	2.51	N/A

* Adult student—no pGPA calculated.

**Withdrew before the end of the first semester.

SUMMARY

We developed a success program whose principal focus is on the non-academic factors of cohort development, personal responsibility and interdependence. The target audience was students with a pGPA between 2.5 and 3.0. This group was considered to be on the cusp of being at-risk academically. The program began with high-intensity training during the first year. At this time our program success is measured quantitatively comparing predicted GPA to cumulative GPA. Excluding the students who left our program before the end of the first semester, approximately 70% of our students are on track to graduate or have graduated within four years. This is compared to the typical average time to graduation of 4.7 years. All except for one student exceeded their pGPA. The student was only 0.01 less than the pGPA. The average increase of cumulative GPA over pGPA was +0.69, nearly over 2/3 of a letter grade higher.

ACKNOWLEDGMENTS

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AUTHOR INFORMATION

PETER J. SHULL is Professor of Engineering at The Pennsylvania State University. After a successful career in the technical field of Nondestructive Evaluation (NDE), and having worked at the National Institute of Standards and Technology (the location of the atomic clock used as the United States time standard), Dr. Shull made the decision to return to academia and began his career in education. From the first day, Dr. Shull noted an apparent lack of sound educational practice at the higher educational level. This is reflected in a statement made by Dr. Shull's Ph.D. advisor regarding teaching—"If you know the material well, you'll be a great teacher!" Recognizing that one's degree of knowledge of a subject has no relationship to their understanding of pedagogy or their ability to apply it, over the past 15 years, Dr. Shull has maintained an active focus on sound pedagogy as related to engineering education. These efforts have been divided into understanding pedagogical theory and the pragmatic application into the classroom. His primary areas of focus are teaching functional and effective teamwork which is based in social-emotional development and personal responsibility (an inherently difficult area for most engineering students) and cognitive and metacognitive methods to improve student learning.

Dr. Shull has authored numerous publications in the field of pedagogy and the technical area of NDE including the popular textbook entitled *Nondestructive Evaluation: Theory, Technique, and Applications* (Marcel Dekker, 2001). He is a Fulbright Scholar (Argentina—2006).