AC 2011-2141: GOLDSHIRT TRANSITIONAL PROGRAM: FIRST-YEAR RESULTS AND LESSONS LEARNED ON CREATING ENGINEERING CAPACITY AND EXPANDING DIVERSITY

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GoldShirt Transitional Program: First-Year Results and Lessons Learned on Creating Engineering Capacity and Expanding Diversity

Introduction

Women and underrepresented minority students pursue engineering degrees at disproportionately lower rates as compared to the majority male population. One reason for the low participation rate among underrepresented minorities is that many of them lack adequate preparation coming out of high school to enter university-level engineering programs. To address this preparation gap, the Engineering GoldShirt Program at the University of Colorado Boulder seeks to provide students the opportunity to academically prepare to enter engineering and to persist to graduation.

The University of Colorado Boulder has established aggressive goals to increase the number and percentage of underrepresented and women students enrolling in, and graduating from, the College of Engineering and Applied Science. The GoldShirt Program is a key strategy for achieving these bold goals. Supported in part by the National Science Foundation, the GoldShirt Program provides a performance-enhancing preparatory year for under-prepared students directly admitted to the engineering college. This GoldShirt year includes coursework in mathematics, physics, chemistry, project-based engineering design and the humanities to prepare students to enter the regular engineering curriculum in their second year of college. Most GoldShirt students live together in a living and learning environment focused on engineering excellence.

The pilot cohort (cohort 1) entered the program in fall 2009 with 16 students—15 of whom returned for the fall 2010 semester. This cohort achieved strong academic success in their first year. Based on the academic success of cohort 1, the university doubled the GoldShirt Program's capacity to 32 students in fall 2010 (cohort 2), digging even deeper into the preparation pool of students. Cohort 2 consists of 32 students of which there are 24 underrepresented minority students, 6 females, 20 first-generation college-bound students and 8 English language learners. Students in cohort 1 serve as mentors for the entering first-year students in cohort 2.

The program is assessed based on the students' academic performance, retention and their feedback on a variety of topics including their perceived preparedness in key courses (math, science, engineering, humanities and writing), sense of community within the program and college, and their intention to graduate and pursue a future in engineering.

Ennis et al.[1] described the motivation for the GoldShirt Program and key elements of its design, and also reviewed performance and assessment results for the first year. This paper further delves into the strengths and weaknesses of the GoldShirt Program by examining how the students performed academically both in the GoldShirt year and beyond into the first year of the regular engineering curriculum. The paper provides a brief overview of the program, followed by an examination of the key challenges and outcomes in selected program elements, including recruiting, Summer Bridge, the residential life program, and a new peer-mentoring program

instituted this past year. The paper examines students' performance to date in mathematics and physics courses along with their overall records and describes the GoldShirt Program's broader impact on the engineering college.

GoldShirt Program Overview

The Engineering GoldShirt Program is designed to provide a performance-enhancing preparatory year for highly motivated students who lack adequate preparation for engineering as they complete high school. The program includes a focused selection process that culminates in on-campus interviews for candidates identified from their college applications. GoldShirt students are required to participate in a GoldShirt Summer Bridge experience prior to beginning college, and to complete a common GoldShirt year curriculum. They expect to take five years to complete their engineering bachelor degrees. Most first-year GoldShirt students live together in a living and learning environment focused on engineering excellence. GoldShirt students are eligible for a $2500 participation scholarship each year they remain actively engaged in the program and meet the scholastic requirements for scholarship renewal.

Student Selection Process

The Engineering GoldShirt Program targets participation from students who are underrepresented in engineering, including women, underrepresented minorities, and first-generation college-bound students. Candidates are chosen from students who apply to the College of Engineering and Applied Science but are not directly admissible due to test scores or high school grade point average.

Cohort 1 was equally divided between women and men, but cohort 2 has only six women out of the 32 students. One of the challenges faced in trying to achieve an approximate gender balance within the cohorts is that we have difficulty finding female students who apply to the college who fall *below* our direct admission criteria, and thus would be considered for the GoldShirt Program. Since we do not recruit directly into the Engineering GoldShirt Program, the dearth of women applicants at the lower end of the preparation scale came as a surprise to our college. We hypothesize that females do not have high enough self-efficacy to apply to engineering if they do not think they will be admitted.

To better understand where the population of young women who apply to our college come from, we analyzed which high schools had the most women apply to our college and ultimately enroll. We found that the schools that sent the most women were the top-performing local high schools. We did the same for minority students and found that in addition to one top-ranked school about an hour from our campus, our partner schools where we have active K-12 engineering education programs matriculated the most minority students. This highlights the need to continue our partnerships with minority-serving high schools and recruit more effectively locally.

We have taken steps to increase the number of local women that apply to our college; we describe to prospective students that there are multiple pathways into the college and encourage everyone who is interested to apply, even if they do not think they would be accepted. We hope

that making women students more aware of the different pathways and options, including GoldShirt, will encourage them to pursue engineering in larger numbers. We also highlighted the Engineering GoldShirt Program during a fall 2010 engineering event which attracted 96 high school girls.

We also see the need for increased visibility of engineering with local community organizations. This year the Engineering GoldShirt Program Director made contact with many local community organizations that serve diverse youth in our local communities, and we hope to expand these into full partnerships over the next two years.

GoldShirt Summer Bridge Experience

To jump-start their academic careers, GoldShirt students participate in a two-week residential Summer Bridge experience. The goals were twofold: 1) to prepare students both academically and mentally for the fall term, and 2) to build a strong, interdependent scholarly community. To achieve these goals, the summer experience included courses in engineering design, math, and humanities, coupled with team-building activities and student life seminars. Summer Bridge outcomes with cohort 2 included:

- *Fall math course placement:* The goal for math was to accurately place students into the appropriate math course for the fall semester, based in part on the results from their required freshmen engineering placement exam. These results, combined with the student's high school math courses, grades and ACT/SAT scores were used initially to estimate the students' placement into Math 1005 (College Algebra), Math 1011 (PreCalculus), Math 1021 (Trigonometry), and Calculus 1 (either 1 or 2 semester). From these levels students were grouped into two sections for summer bridge math classes. For four days, students in both sections attended class and completed math assignments individually and in study groups. The goal was to strengthen students' current skills so that they could demonstrate their peak performance on the final Summer Bridge math assessment, which determined their fall course placement.

  The students' math placement also determined their cluster schedule, which included math, humanities, physics and engineering projects courses. Students were placed in the same humanities and physics sections but different sections of their engineering projects course.

- *Technical skills:* The students gained experience using engineering software (Excel, SolidWorks, CorelDraw), and were introduced to the iterative, hands-on design process. Students were required to work in teams to create solar ovens and to present their team projects at a Design Expo on the final day of the summer program.

- *Orientation to college life:* For most of the students, the two-week Summer Bridge was their first university experience. They learned valuable skills in time management, studying, and living with others. Becoming familiar with the campus and its resources reduced student anxiety about starting college in August.

- *Bonding/Teamwork:* As a group, the GoldShirt students participated in a challenge course in which facilitators presented several challenge activities to the students both in large (32) and small groups (16). Their feedback on these experiences is documented in the "Student Feedback" section of this paper. Most students began forming friendships during Summer Bridge; during the fall semester, it became evident that these friendships were especially close. Although cohort 2 only has six women, they liken their friendships with the men in the cohort to sibling relationships.

- *Student mentors:* Current engineering students served as residence advisors (RA) and teaching assistants (TA) and helped lead the Summer Bridge participants as student mentors. Summer Bridge allowed participants to form relationships with current engineering students before the fall semester. Two students from cohort 1 served as mentors during the second summer: one as a TA in the engineering projects class and one as a RA and TA in the math class. The RA continued as a student mentor in the GoldShirt residence hall for the entire second year.

- *Creating shared core values:* Together, students defined a set of core values to which they hold themselves accountable. There is a new set of values that each cohort develops through an iterative process during the Summer Bridge seminar class. For cohort 2, their core values include commitment, leadership, humility, creativity, family and community, diligence, respect and perseverance.

- *Community Service:* Community service is a new component of the cohort 2 Summer Bridge experience. GoldShirt partnered with Habitat for Humanity on a community service project which included deconstruction of a home. This component will continue to be a part of the GoldShirt Summer Bridge experience. Students worked very hard on the hottest day of the year on this project; they expressed that this was a rewarding experience and that they look forward to future community service projects.

Residential Life

Living and learning together is a key strategy employed to foster both academic excellence and a strong sense of community in the GoldShirt Program. Andrews Hall is a newly renovated residence hall which houses the Engineering Honors Program (EHP), some BOLD engineering students and most first year GoldShirt students. The co-housing of students from these particular programs is intentional to foster a culture of scholarship and inclusion.

Both the opening of the newly renovated Andrews Hall and the pioneer class of the GoldShirt Program kicked off in the fall 2009 semester. With a new residence hall, a new engineering preparatory program and a new faculty-in-resident, it was inevitable that issues would occur. Underrepresented minority students in Andrews Hall were the minority in this environment, and GoldShirt students often expressed feelings of isolation and exclusion from the majority population in Andrews Hall—mostly students in the EHP—while comments from EHP students oftentimes offended the GoldShirt students and inferred mediocrity. Due to these struggles, many GoldShirt students were not comfortable living in Andrews Hall and made arrangements to live elsewhere the next year.

After collaboration with the faculty-in-resident regarding these concerns, several adjustments were made the second year. The GoldShirt students met the faculty-in-resident during Summer Bridge, and he taught their humanities class. He also hosted an open house during the event to welcome the GoldShirt students along with faculty and industry partners. This icebreaking event was pivotal in moving the residential experience in Andrews Hall to a more inclusive environment.

As a result of the Engineering GoldShirt Program students' demographics, the multicultural presence has increased in Andrews Hall, which is considered a positive outcome by all. The BOLD Center has supported three student mentors who live and lead BOLD/GoldShirt students in Andrews Hall. These mentors have collaborated with other student leaders in the hall as well as BOLD team leaders to introduce new culturally diverse activities. The cultural relevance of the artwork in of Andrews Hall became an issue on the radar to address. Student mentors selected artwork for study lounges and common areas which reflect the cultures of students who reside there. Other activities, such as a Mardi Gras celebration, are planned for the spring semester. These enhancements to the appearance of and activities in Andrews Hall will create a more welcoming environment for diverse students and an opportunity to share diverse cultures with all students in Andrews Hall.

Peer Mentoring Program

A new peer mentoring program was instituted for GoldShirt students in fall 2010, to help build and support connections between the first and second cohorts. Peer mentoring has been a proven approach in supporting retention among students for both the mentor and protégé [2]. Also, as the number of GoldShirt students increases over the years, the mentoring program can serve as a structure to manage and support the success of students enrolled in the program. During Summer Bridge, mentorship began with two GoldShirt student mentors from cohort 1. The mentoring program was expanded during fall semester to include all students in cohort 1 matched to 2-3 students in cohort 2. The structure is as follows:

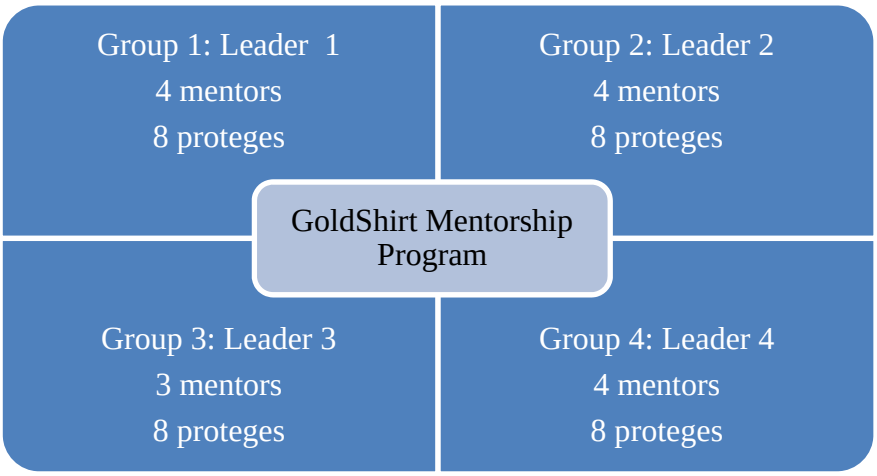

Figure 1. GoldShirt Mentorship Program Structure

Structure — The 32 new GoldShirt students were each assigned to a mentor from cohort 1. Four cohort 1 students were identified as group leaders for the program based on academic performance and leadership abilities demonstrated during their GoldShirt year. These students lead 2-3 other mentors also serve as mentors for 2-3 new GoldShirt students. All mentors were required to meet weekly with mentors for 20 minutes to check in on academics, residential life, social life, and other concerns.

Updates — Mentors updated a weekly survey to report weekly meeting updates. Several mentors reported concerns and the program director held intervention meetings to address student concerns and issues.

Results and Adjustments — Students who participated regularly have established a great mentor/protégé relationship. Those who didn't regularly participate are not as successful; some students commented that generally the meetings became redundant (same questions). Mentors need a better understanding of how to mentor, mentoring ideas, more direct questions, and ideas for informal activities outside of the required sessions. Moving forward, the program director plans to meet with each mentor group throughout the semester and add additional fun and social activities to foster expanded involvement and participation. Including motivational speakers, fun activities and competition are planned to appeal to students.

Academic Placement, Performance and Adjustments

GoldShirt Curriculum — The first-year GoldShirt curriculum is designed to prepare students academically in mathematics and science before they enter engineering calculus, physics and chemistry courses. The GoldShirt first-year curriculum consists of the courses listed in Table 1. Results and performance are discussed here for the mathematics and physics courses the GoldShirt students have completed to date.

Table 1. Engineering GoldShirt Program first-year curriculum.

GoldShirt Year — Fall Semester	GoldShirt Year — Spring Semester
Mathematics (4-5 credits) • Algebra, trigonometry or calculus • Determined by math placement exam • Concurrent Academic Excellence Workshops*	**Mathematics (4-5 credits)** • Next level math class • Concurrent Academic Excellence Workshops*
Preparatory Physics (3 credits) • Small section course	**Introduction to Chemistry (3 credits)** • Open to all students
First-Year Engineering Projects (3 credits) • Hands-on, team-based design course • Integrated with first-year engineering students throughout the college	**Free elective (3 credits)** • GoldShirt student choice • Encouraged to select outside of engineering
Engineering for Society (3 credits) • Writing and critical thinking course • Small section GoldShirt-only course	**The Meaning of Information Technology (3 credits)** • Writing and critical thinking course • Small section course open to all students

Leadership and Self-Management I (1 credit) • Small section GoldShirt-only course	**Leadership and Self-Management II (1 credit)** • Small section GoldShirt-only course
*Academic Excellence Workshops — Conducted concurrently with many mathematics and science courses, these workshops, taught by teaching assistants, guide students in practice problems and further course review.	

GoldShirt Student Placement and Performance in Mathematics — Students are placed into their first semester mathematics classes based on analysis of their high school transcript and placement exams administered before and during Summer Bridge. Table 2 shows the highest mathematics courses that GoldShirt students in our first and second cohorts completed in high school. Table 3 shows the results of the math placement exams taken during Summer Bridge, which correspond to the students' final fall placements.

Table 2. GoldShirt students' highest high school math course, by cohort.

Cohort	No. of students	Most Advanced High School Math Course (# students)
1	16	AP Calculus (6), Calculus 2 (1), IB Math Studies II (1), Pre-Calculus (4), Discrete Math (1), AP Statistics (1), AP Calculus and AP Statistics (1), College Trigonometry (1)
2	32	AP Calculus (5), IB Math Methods (1), Pre-Calculus (18), Trigonometry (2), IMP Math 3 (1), College Algebra (2), CU Algebra 1 (1), Algebra 2 (1), Survey of Algebra (1)

Table 3. GoldShirt student Summer Bridge math placement results.

Cohort (Size)	Intro to College Algebra	Calculus-Bound College Algebra	Trigonometry	Calculus 1A/1B (two semester Calculus 1)	Calculus 1 (one semester)	Calculus 2 (one semester)
1 (16)	4	6	0	3	2	*1
2 (32)	5	19	2	1	5	0
*One student placed into Calculus 2, but chose to enroll into Calculus 1 to better master the concepts.						

We learned from the placement exam results that even though students had completed upper-level math classes in high school (e.g., calculus, pre-calculus, etc.), they sometimes did not demonstrate readiness for the college-level math class that would come next in the sequence. Some students initially expressed frustration that they did not place into the course they had anticipated. Subsequent actual performance has supported taking a conservative approach to math placement. For example, some students who placed into college algebra initially said they thought the course was too easy, but as the semester progressed, they realized that they were "familiar" with the material but had not "mastered" the concepts.

GoldShirt students from the first cohort have now completed three semesters of college mathematics classes. The three most advanced students have completed Calculus 3 or Linear Algebra (as required for Computer Science Majors). Five more students have successfully

completed Calculus 2. The remaining students either have not yet entered the engineering calculus sequence (two students) or have been unsuccessful in engineering calculus courses (five students). Overall, the group's average grade in mathematics classes declined from 3.3 in their first semester to 3.0 in their second semester to 2.0 in their third. This average performance in math in the third semester was impacted by two students who decided during the semester they would leave engineering, and significantly reduced their efforts as a consequence of that decision. Other second-year GoldShirt students who are struggling with engineering math courses appear to need additional academic support and more accountability to the program.

GoldShirt Student Placement and Performance in Physics — The GoldShirt first-year curriculum includes Preparatory Physics, a small section course that aims to provide a strong foundational understanding of physics concepts through a combination of lectures, experiments, online simulations, and a hands-on project. The concepts taught in the course include kinematics, Newton's laws, work, and energy—all concepts for which the Colorado high school educational science standards require students to be able to demonstrate mastery. In high school, 13 of the 16 students in the first cohort, and 24 of 32 students in the second cohort, had completed either regular Physics or AP Physics. All of the students in the first cohort and 31 (97%) of the students in the second cohort enrolled in the preparatory physics course their first semester. Of the first cohort, six students have now completed the first semester of engineering physics. Among those six, one student achieved an A in engineering physics, one a C, and the other four received grades of D or below—so physics achievement appears to be a major barrier for student success in the Engineering GoldShirt Program.

The results from the first group of students who passed preparatory physics and then performed poorly in engineering physics showed that their preparation was clearly insufficient. Thus, we redesigned the preparatory physics curriculum for the second cohort by consulting with two professors from the physics department, reviewing course content with the GoldShirt team, obtaining feedback from students and integrating more learning technology into the curriculum. The changes added depth in fundamental content such as kinematics and Newton's laws, and added breadth of content in areas such as momentum, orbits and energy. Clicker questions were used in most lecture sessions to evaluate student understanding of concepts real time. PhET simulations, other online video simulations and videos were used throughout the course to explain key concepts. At the end of the semester, students were required to work in groups to prepare a lesson of new content and a lesson of spiral content to prepare their peers for the final exam.

With the preparatory physics course being one semester and some students not having any prior physics coursework, this redesign should provide a stronger foundation for students while also exposing them to more breadth of physics content. As students subsequently enroll in the engineering physics course, future adjustments to the preparatory course will be based on student performance.

Overall Academic Performance of GoldShirt Students — The second cohort of GoldShirt students has completed one semester of courses, for which overall performance results are shown in Table 4. After midterm grades were reported and analyzed, the GoldShirt Program director conferred with students with one or more Cs. The goal of these conferences was to develop

strategies for making academic improvements in courses in which students struggled. A similar midterm intervention strategy had been used the year before with cohort 1. In both years, the data suggest that the interventions made a difference. The results of final first-semester grades for the cohort showed good improvement from the estimated midterm grades. Thirteen of the 32 members of cohort 2 finished the first semester with GPAs of 3.0 or higher, and all but three students completed their first semester in good academic standing.

Table 5 shows the overall academic progress of GoldShirt students in the first cohort through three semesters of college, with the third semester essentially representing their first semester in the standard engineering curriculum. Several of the GoldShirt students are continuing to do very well. However, we are concerned about the sharp drop in performance of several individual students in their third semester. In some cases, we know that students reduced their effort after deciding to leave engineering. It also appears, , that some students need more academic support in their second year than they are receiving. We are addressing this by instituting Academic Excellence Workshops for the fourth semester, and requiring students to participate in a weekly advisory meeting in which they will check-in with the program director about academic progress and any issues that may be impeding their progress. Going forward, we are also investigating the possibility of requiring (or strongly encouraging) second year GoldShirt students to live on campus to help them maintain a community of academic excellence.

Table 4. Engineering GoldShirt Program GPA results for cohort 2 (on a 4 point scale).

	Estimated GPA at Mid-semester	**Final GPA**	**Difference**
Number of Students	31*	32	
Average GPA	2.75	2.94	0.19
Maximum GPA	3.37	3.85	0.79
Minimum GPA	1.84	1.24	-0.69

*Omitting one student who did not report grades at mid-semester

Table 5. Engineering GoldShirt Program GPA results for cohort 1 (on a 4 point scale).

	1st Semester	**2nd Semester**	**3rd Semester**	**Cumulative**
Number of Students	16	16*	15**	15**
Average GPA	3.43	2.90	2.13	2.88
Median GPA	3.44	2.97	2.05	2.93
Minimum GPA	2.61	1.26	0.63	1.96
Maximum GPA	4.00	4.00	3.79	3.89

* Includes one student who left the university at the end of the second semester

** Includes one student who lost their GoldShirt scholarship after the second semester, but continued to participate in the program.

Effects of Doubling Cohort Size

While doubling the cohort size from 16 to 32 from cohort 1 to cohort 2 is encouraging for impacting diversity in the college, the scaling is fraught with challenges. One-on-one time with

the program director has been significantly reduced; this is not necessarily a bad thing since the cohort 1 students expressed the need to "breathe" a little more and have more independence. However, the significant increase in the number of GoldShirt Program participants has limited the director's pulse on the progress of individual students— thus the creation of the GoldShirt Mentorship Program.

In light of the scaling realities, the program director maximized face-to-face time in classes, encouraged students to attend office hours and AEWs, and conducted brief conferences with each GoldShirt student. These strategies were beneficial in identifying students who needed interventions and support in their academics.

Student Feedback

GoldShirt Program assessment data were gathered as part of a formal assessment plan through the administration of five surveys along a specified timeline: pre-program, post-Summer Bridge, mid-semester of the first year, mid-year, and end-of-year. Data were collected on all five surveys from 16 students (cohort 1) during the 2009-2010 academic year, and on the first three surveys from 32 students (cohort 2) during the 2010-2011 academic year. Assessment methods target the following GoldShirt Program goals:

Goal 1 Increase engineering student interest and knowledge of an engineering career,
Goal 2 Build a sense of community among GoldShirt students and the larger college population,
Goal 3 Prepare students to succeed in a traditional engineering program the following year,
Goal 4 Attract a more diverse student body to engineering,
Goal 5 Increase the retention of students historically underrepresented in engineering,
Goal 6 Serve as a national model for successful recruitment and retention of underrepresented students.

Regarding Goal 1, *increase engineering student interest and knowledge of an engineering career*, knowledge of engineering as a career was measured on the pre-program survey, mid-year survey, and end-of year survey. Student responses to the pre-program survey question, "How clear was your understanding of engineering as a career before you enrolled at CU?" indicated that 29% of cohort 1 and 38% of cohort 2 GoldShirt students were clear or very clear from the beginning on their knowledge of engineering as a career. Mid-year and end-of-year survey responses to the question, "How clear is your understanding of engineering as a career now?" indicated that 100% of cohort 1 students were clear or very clear regarding their knowledge on both assessments, a +245% gain in knowledge of engineering as a career.

Student interest was also measured at the pre-program, post-Summer Bridge, mid-year survey, and end-of-year survey with the question, "Do you intend to complete a major in engineering?" Results from all three assessment points found that 100% of students from cohort 1 answered either probably or definitely yes to the question, indicating a strong commitment to graduating in engineering had been maintained throughout the year. On the other hand, we recognize this feedback does not tell the whole story, as one student left the university at the end of the first year, and two other students have since decided to leave engineering.

For Goal 2, *build a sense of community among GoldShirt students and the larger college population,* A sense of community was measured against GoldShirt students' experiences working in teams. Students were assessed on their team experiences on the pre-program, post-Summer Bridge, and mid-year survey with the question, "To what extent have you found it beneficial to work in teams?" Results from cohort 1 on the pre-program and post-bridge survey found that 82% of students found team experiences often or always beneficial, while 100% of students found benefit in teamwork on the mid-year survey, a 22% gain. For cohort 2, 88% found teams beneficial on the pre-assessment while 94% found their teamwork beneficial on the post-assessment, for a 6% gain during Summer Bridge. One student commented on their Summer Bridge team experience, "At first we came into the program not knowing anyone, but now we're like a family. By working together, we get to know others strengths and weaknesses, which holds us so close to each other."

An additional indicator of the development of a sense of community within the GoldShirt Program came in response to an open-ended question on the mid-semester survey, "What has been the highlight of the GoldShirt Program for you?" Here, 77% of cohort 1 and 71% of cohort 2 respondents focused on the community aspect as the highlight of the program. One student commented on the highlight of the GoldShirt Program as, "having a group of students that I know I can call friends, having such friends that are going through many of the same tasks and challenges as I am, and being able to support each other along the way."

While our goal of building community within the program is judged a success, it has been more of a challenge to integrate GoldShirt students into the larger population in the College of Engineering and Applied Science. On the mid-year survey for cohort 1, student responses to the question, "What might best improve the GoldShirt Program?" resulted in 31% of respondents indicating some difficulties finding equal footing with students outside of the GoldShirt Program. One student suggested, "There is a perception by other students that GoldShirt students aren't as smart as other engineering students so dealing with what some people say about us has been a little difficult."

With respect to Goal 3, *prepare students to succeed in a traditional engineering program the following year,* students from cohort 1 were asked the following question on the pre-survey, the mid-year survey, and end-of-year survey, "How prepared do you think you are to study the following subjects in the CU-College of Engineering and Applied Science?" Table 6 presents the percentages of students who responded "somewhat prepared" or "highly prepared."

Table 6. Student self-ratings of preparation to study engineering subjects.

Courses	Pre-Survey	Mid-Year Survey	End-of Year Survey
Physics	65%	75%	50%
Engineering Design	59%	63%	60%
Calculus	71%	75%	60%
Technical Writing	41%	38%	40%

Results show students' perceptions of preparation gains in three of the four subject areas through mid-year, but then deterioration by the end of the year in perception of their preparation in both physics and calculus. This suggests that confidence gains attained through mid-year need to be shored up as students encounter the increasing challenges of the second semester. Academic performance results from their third semester indicate some of the students' concerns about their preparation were justified; additional academic support appears to be needed for some well into their second year.

For Goal 4, *attract a more diverse student body to engineering*, the self reported demographic characteristics for GoldShirt students in cohorts 1 and 2 were compared against those of a large, first year engineering projects design course (FYEP; N=286) on gender, underrepresented ethnicity, English as a second language (ESL), and low socioeconomic status (SES). The self reported results, depicted in Table 7 indicate substantial increases in diversity among the GoldShirt students over our traditional College demographics.

Table 7. GoldShirt Program vs. First Year Course Student Demographics

Demographics	GoldShirt	FYEP	GoldShirt Difference
Female	31%	25%	24%
Underrepresented	57%	13%	338%
ESL	29%	8%	262%
Low SES	41%	24%	71%

For Goal 5, *increase the retention of students historically underrepresented in engineering*, retention was assessed by comparing the number of students initially enrolled in the program to the number who were retained after the first semester for cohort 1 and after the third semester for cohort 2. It was expected that at least 80% would be retained across both cohorts.

Results revealed that 14 of 17 (82%) cohort 1 students remain enrolled in engineering after the third semester and 30 of 32 (94%) of cohort 2 GoldShirt students remained after the first semester. Thus, retention goals have been achieved so far, but program administrators are nervous on this front.

Goal 6 was to *serve as a national model for successful recruitment and retention of Under-represented students.* To this end, we are working to disseminate lessons learned from our experience as it proceeds, including a paper presented by Ennis et al.[1] at the 2010 American Society for Engineering Education conference, and awareness of the program by Sullivan at several National Academy of Engineering meeting and conference presentations.

In summary, assessment results from the six program goals indicated all goals are being partially or completely met. Suggestions for improvement arising from student feedback include providing greater support for integrating GoldShirt students into the larger college population and preparing them for the rigors of traditional engineering courses, particularly physics and calculus.

Impact on Culture throughout the College

The GoldShirt Program is emerging as a major strategy among the College's leadership team to *broaden participation* throughout the college by students traditionally under-represented in engineering colleges. Investment in the GoldShirt Program is high—both financial and cultural. And, taking such a chance on a highly visible program for under-prepared students could pose risk to the college's reputation for excellence. That is a chance the leadership team is willing to take as we work through how to better achieve excellence through the GoldShirt Program. In many ways, the GoldShirt Program is a "game changer" in helping redefine our college's definition of excellence to be one that includes *achieving excellence through inclusion* and better serving all students from our state, recognizing that relatively few minority students graduate from our high schools prepared to jump into a traditional engineering education.

The essential questions we ask are "can providing a performance-enhancing GoldShirt year significantly change what is possible in terms of who can graduate from engineering college prepared to contribute to the engineering profession?" And, how can the GoldShirt Program significantly change who comes—and who succeeds—in our engineering college to reflect the rich diversity of our state's youth?

Engagement with the GoldShirt students has broadened awareness of the college's need to create *multiple pathways* for access to an engineering future, and the importance of the College creating a bridging experience for highly motivated students who are not yet prepared for the traditional engineering experience. Our vision is that the GoldShirt Program be synonymous with scholarship, and becomes a beacon for excellence. We must continue to measure everything we do, be data driven and adjust program design and delivery so that the performance and retention of GoldShirt students is at least on par with our college's population at large. We expect that it will take four to five years to achieve this level of excellence, and we intend to stay the course until we do. We are very fortunate to have the support of our college's various advisory boards in this GoldShirt endeavor, and their financial support helps us embark on this risky—and strategically important—endeavor.

Conclusion

Continuous improvements will be made to increase the effectiveness of all elements of the Engineering GoldShirt Program. Partnerships with the Applied Math and Science departments have begun to address the problem of academic difficulty beyond the GoldShirt year in Calculus, Physics and Chemistry courses. Ongoing support for students after their GoldShirt year must be further developed. Academic Excellence Workshops (AEW's) are being planned and required for all students for Math, Physics and Chemistry courses during their GoldShirt year and beyond.

Other program tuning is underway: adjustments will be made in the year three Summer Bridge program to increase students' skills in group study and collaborative learning; the Guaranteed 4.0 strategy, already shared with students in the GoldShirt Leadership and Self-Management courses, will be introduced sooner during Summer Bridge.

In general, the GoldShirt Program needs to develop a more purposeful plan to further the community building and sense of interdependence for success that is developed during the GoldShirt year. More support and direction for the mentorship program will be developed and implemented in year three, as the benefits of the mentorship program are apparent when both mentor and protégé engage in the process. And, student accountability to a community that they trust and value may be key in retaining these students through graduation and encouraging them to pursue engineering postgraduate work and professional careers.

Selecting students for cohort 3 is underway, with a goal of enrolling up to 32 students—at least 24 of which we hope are underrepresented minority students and 15 of which are women. The academic results of our first two GoldShirt cohorts suggest we may need to be more selective about who is invited to the Engineering GoldShirt Program, with a huge focus on finding better ways to assess student motivation to succeed (no easy task!).

Acknowledgments

The Engineering GoldShirt Program is supported by alumni and friends of the College of Engineering and Applied Science, and by the National Science Foundation through grant no. EEC 0835907.

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