

Evaluating the Impact of ECS Academic Catalyst for Excellence (ACE) Scholarship Program

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Abstract

Recent research strongly suggests that engineering education loses about 53% of undergraduate students of which roughly 40% switch to non-science fields. Similarly, the out migration from the College of Engineering and Computer Science (ECS) at California State University, Fullerton (CSUF) has been profound. In 2010 with funding availed from the NSF, ECS at CSUF established the ECS Academic Catalyst for Excellence (ACE) Scholarship Program designed to reverse its historical legacy of high student attrition. This program awards scholarships to ECS students over the 5-year period of the project and leverages a well-established network of ECS and University student services to support cohorts of ACE scholars (recipients of the ACE scholarship) majoring in ECS majors. The ECS ACE scholarship program provides tuition scholarships and a myriad of support services ranging from peer mentoring to priority registration. The paper presents detailed evaluation and assessment of the scholarship program using the following measures: a) Attitude and enthusiasm of students towards the ECS ACE scholarship program activities; b) Academic self-efficacy, and STEM interest and motivation based on the assessments of ACE scholars; c) Qualitative measure of program effectiveness based on: GPA of ACE scholars when compared to traditional students of similar background not supported by the ACE program; d) Impact of working hours on the ACE scholars' academic performance; e) Correlation between the scholarship amount and ACE scholars' academic performance.

I. Introduction

Students planning to major in science or engineering make up approximately 30% of all incoming college students, however, the attrition rate is the highest among all undergraduate disciplines¹. In a broad national study of attrition, it was reported that engineering education loses about 53% of undergraduate students of which roughly 40% switch to non-science fields². The most attrition occurs during the first two years³ and therefore institutional retention efforts must be focused on the needs of freshmen and sophomores to achieve more equitable attainment rates. The attrition rate in the College of Engineering and Computer Science (ECS) at California State University, Fullerton (CSUF) is profound and similar to the national trend. In Spring 2010 with the funding availed from the NSF, ECS at CSUF established the ECS Academic Catalyst for Excellence (ACE) Scholarship Program designed to reverse its historical legacy of high student attrition. This program that awards scholarships to ECS students over the 5 year period of the project and leverages a well-established network of ECS and University student services to

support ACE scholars (recipients of the ACE scholarship) majoring in ECS majors. Currently there are 23 participants in the ACE scholarship program.

Section II briefly describes the guiding principle and program implementation. Detailed evaluation and assessment of the scholarship provided in section III and conclusion in section IV.

II. ECS Academic Catalyst for Excellence (ACE) Scholarship Program

(a) Guiding Principle of the ECS ACE Program: The guiding principle for the ACE scholarship distribution plan is to provide 4 years of continuous financial support to a maximum number of incoming freshmen and sophomores as research suggests that the most attrition occurs during the first two years of college.

(b) Program Implementation: ECS ACE program is a comprehensive educational support system designed to increase student retention. The scholarship serves as a catalyst that allows students to focus diligently on their academics. The ECS ACE scholarship program targets academically promising but economically disadvantaged ECS students with special emphasis on first generation college students and students underrepresented in the STEM fields. The program leverages a well-established network of ECS and University student services to ACE scholars to provide a myriad of support services ranging from peer mentoring to priority registration. Scholars are selected on the basis of their academic potential and financial need. Based on the class level, an ACE Scholar receives tuition scholarship for a maximum of seven consecutive semesters (up to \$2000 per semester). The academic standing of ACE scholars is evaluated every semester and necessary remedial steps are taken if their academic performance is not up to par.

(c) ECS and University Support Systems Utilized for the ACE Program: Instead of creating new support systems for the program, existing and well-established network of ECS and University support systems such as Center for Academic Support in Engineering and Computer Science (CASECS), University Learning Center (ULC), Center for Internships and Service-Learning (CISL), and CSUF Career Center were leveraged to ensure the success of the ACE program.

(d) ACE Scholar Support Services: In order to improve educational opportunities and increase retention of ECS students following support services were incorporated into the ACE program:

- ***One-on-One Peer Mentoring/Tutoring*** – Three peer mentors/tutors were hired to provide mentoring and tutoring services to the ACE scholars as and when they need it. However, scholars were stipulated to meet with the peer mentors/tutors once in three weeks to update the program on their academic performance, participation in various program activities and career goals. The ACE mentors/tutors report back to the ACE program director on a weekly basis. This feedback gives the ACE program a first-hand analysis of the ACE scholars, their performance and standing in the program.
- ***Professional Development Workshops*** - In collaboration with the *Career Center*, ACE program provides exclusive resume writing exercises, interview practice sessions, career exploration guidance, information on graduate school transfers, job fairs, etc.

- **Academic Internships and Job Fairs** - CASECS in collaboration with the CISL, Career Center, ECS Dean's Affiliates and departmental industry advisory boards is expanding the summer internship opportunities for engineering and computer science juniors and seniors; it also assists with career placement through on-campus job fairs.
- **Speaker Series** - The ACE program has been organizing speaker series for ACE scholars several times a year with speakers who provide insight and information on careers in engineering and computer science.
- **Academic Counseling** - ACE scholars automatically become CASECS members. Academic counselors in CASECS work with the ACE scholars to guide them from acceptance to graduation and career placement.
- **Priority Registration** – Through CASECS, ACE scholars' are given priority to register for classes.

(e) Scholarship Remedial Process: The academic standing of ACE scholars is evaluated on their semester grades, and feedback from their mentors and academic counselors who gauge the scholars for motivation and ability to manage time and resources. If scholars do not meet the minimum retention criteria due to a deficiency in GPA, the scholar is placed on scholarship probation for a semester with mandatory peer tutoring/mentoring. The scholarship is withdrawn the next semester following the probationary period if the student still does not meet the retention criteria.

III. Program Assessment and Evaluation

The program is currently employing the following assessment techniques to measure its effectiveness: a) Attitude and enthusiasm of students towards the ECS ACE scholarship program activities; b) Academic self-efficacy, STEM interest and motivation based on the assessments of ACE scholars; c) Qualitative measure of program effectiveness based on GPA of ACE scholars when compared to traditional students of similar background not supported by the ACE program; d) Impact of working hours on the ACE scholars' academic performance; e) Correlation between the scholarship amount and ACE scholars' academic performance.

(a) Attitude and enthusiasm of students towards the ECS ACE scholarship program activities

The attitude and enthusiasm of ACE scholars towards the ECS ACE scholarship program was used as the principal operational measure of effectiveness. In Fall 2012, all 23 ACE scholars in the program were asked to complete a survey during their meeting with the tutors/mentors. The survey included two questions with responses: strongly disagree, disagree, neutral, agree, strongly agree along with one question with free-response answer.

Figure 1(a) summarizes the student response to the first question in survey, "*The scholarship from the ACE program helps me cover my "unmet" financial need and allows me to focus diligently on academics.*" Only 70% of the scholarship recipients agree that the program helps them cover their "unmet" financial need. One of the primary contributing factors for this is the difference in the scholarship amounts according to the recipient's grade level at the time of the award (freshmen and sophomores are awarded \$4000/year, whereas juniors and seniors are

awarded \$2000/year). The motivation to structure the awards in two tiers was based on facts that: a) most attrition occurs during the first two years in college; and b) good number of ECS are able to attain academic internship/job in their junior and senior year, which in turn reduces their financial need. In Fall 2012, only 10 freshmen/sophomores level scholarships were awarded. The program plans to analyze this data in detail and take necessary steps to address the need to provide adequate funds to meet the unmet financial need of juniors and seniors in the program.

The scholarship from the ACE program helps me cover my “unmet” financial need and allows me to focus diligently on academics.

The activities and support systems associated with the ACE program complement the instruction received through classroom lectures and will help me secure employment or transfer to a graduate program.

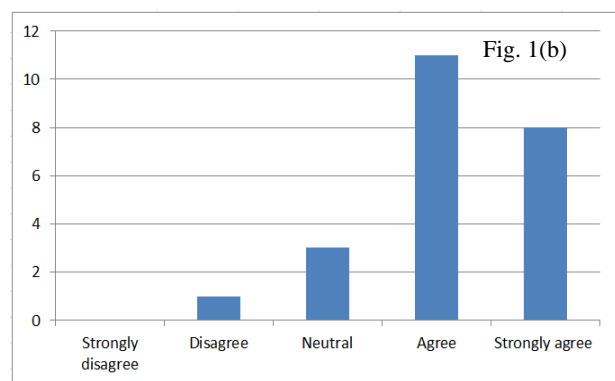
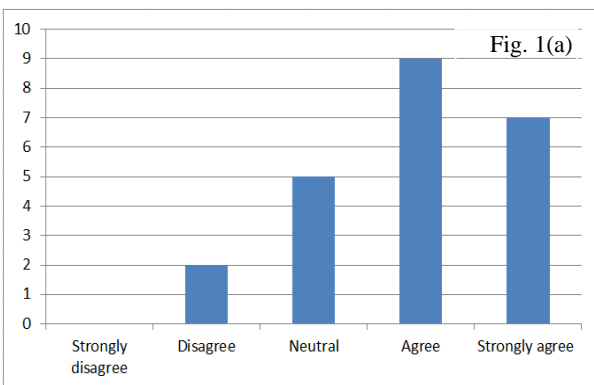


Figure 1: Student survey questions and feedback to measure attitude and enthusiasm of ACE scholars towards the ECS ACE scholarship program

Figure 1(b) summarizes the student response to the second question in survey, “*The activities and support systems associated with the ACE program complement the instruction received through classroom lectures and will help me secure employment or transfer to a graduate program.*” 83% of the scholarship recipients agree that the activities and support systems do have the intended impact.

(b) Academic self-efficacy, STEM interest and motivation based on the assessments of ACE scholars

Research has found that self-efficacy is positively related to grades in STEM courses along with intent to persist given that students enter courses with varying levels of fear and anxiety. The Baldwin Confidence Survey Form⁴, created to measure self-efficacy in STEM, was used for this study. Participants respond to statements on a five-point scale, ranging from strongly disagree to strongly agree. Statements are phrased both positively and negatively to increase reliability and reduce apathetic answers. Table 1 shows the pre and post STEM self-efficacy survey conducted to study the impact of ACE program and associated activities. It was observed from the data that there is a slight shift in the average score for most of the questions indicating the positive impact of the ACE program on the STEM self-efficacy of ACE scholars. This impact has to be

continuously tracked on a yearly basis to draw concrete conclusions and take remedial steps. The weekly reports from ACE mentors/tutors give a first-hand analysis of the ACE scholars, their performance and standing in the program. The reports reveal good indicators of STEM interest and motivation among ACE scholars, most of whom want to further pursue their master's degree in their respective disciplines.

Table 1. Pre and post STEM self-efficacy survey conducted to study the impact of ACE program and associated activities. The survey used a five-point scale, with responses ranging from strongly disagree (5 pts) to strongly agree (1 pt).

<i>Survey Question</i>	<i>Average score for the question during the first semester in the ACE program (pre STEM self-efficacy)</i>	<i>Average score for the question in Fall 2012 (post STEM self-efficacy)</i>
1. I am confident I have the ability to learn the material taught in STEM.	2.7	2.4
2. I am confident I can do well in STEM	2.6	2.2
3. I think I will do as well or better than other students in STEM	3.1	3.2
4. I don't think I will be successful in STEM	3.7	3.8
5. I am confident that I can understand the topics taught in STEM.	3.5	3.0
6. I believe that if I exert enough effort, I will be successful in STEM.	3.7	3.4
7. I feel like I don't know a lot about STEM compared to other students in this class.	3.5	3.9
8. Compared with other students in this class, I think I have good study skills.	2.8	2.7
9. Compared with other students in this class, I don't feel like I'm a good student.	3.4	3.8
10. I am confident I can do well on the lecture exams in STEM.	3.1	2.6
11. I am confident I can do well on labs in STEM.	2.9	2.6
12. I am confident I can do well in projects in STEM.	3.3	3.0
13. I think I will receive a C or better in STEM.	2.3	1.7
14. I don't think I will get a good grade in STEM.	3.6	3.9
15. I am confident that I could explain something learned in a class to another person.	2.5	2.4

(c) Qualitative measure of program effectiveness

Qualitative measure of program effectiveness based on the grade point average (GPA) of ACE scholars when compared to average GPA of students of similar background not supported by the ACE program in Table 2.

It can be observed from Table 2 that the average GPA's of ACE scholars in all the five majors are better than the average GPAs in their respective departments. However, the sample sizes for Computer engineering and Electrical engineering majors are too low to draw any meaningful conclusions.

Table 2: Qualitative measure of program effectiveness based on GPA

ECS Major	Fall 2012 Average GPA of ECS majors*	Fall 2012 Average GPA of ACE Scholars (number of ACE scholars)
Civil	2.78	2.96 ($N = 11$)
Computer	2.59	2.72 ($N = 2$)
Computer Science	2.93	3.51 ($N = 4$)
Electrical	2.79	2.91 ($N = 1$)
Mechanical	2.96	3.15 ($N = 5$)

*Data source: Office of Institutional Research and Analytical Studies, CSUF

(d) Impact of working hours on ACE scholars' academic performance

Impact of working hours on the ACE scholars' academic performance was studied. Following is the summary of the study:

- Modest negative *correlation* (r) (-0.37) was observed between number of working hours and the academic performance (GPA) of the scholars; *coefficient of determination* (r^2) indicates that 14% of variation in academic performance can be explained by the variation in the number of working hours.
- Average GPA of scholars with work commitments (off-campus and/or on-campus) was 3.04 and that of scholars without workout commitments was 3.12.
- Only two out of the 23 ACE scholars were engaged in a technical internship/job, therefore comparison of average GPA's of the scholars with and without technical internship/job commitment was statistically insignificant.

(e) Correlation between the scholarship amount and ACE scholars' academic performance

The ACE scholarship amount was structured in two tiers based on the recipient's grade level at the time of the award or renewal. Freshmen and sophomores are awarded \$4000/year, whereas juniors and seniors are awarded \$2000/year. Correlation between the scholarship amount and ACE scholars' academic performance (GPA) was studied and the following was the summary:

- Weak negative *correlation* (r) (-0.08) was observed between scholarship amount (\$2000 vs. \$1000) and the academic performance (GPA) of the scholars; *coefficient of determination* (r^2) indicates that only 1% of variation in academic performance can be explained by the variation amount of scholarship awarded.

- Average GPA of scholars with junior/senior level scholarship (\$1000) was 3.12 and that average GPA of scholars with freshmen/sophomores level scholarship (\$2000) was 3.05.

IV. Conclusion:

The paper describes the motivation, program implementation, and detailed program evaluation and assessment of ECS ACE scholarship program, designed to reverse its historical legacy of high student attrition at the College of Engineering and Computer Science (ECS) at California State University, Fullerton (CSUF). The program awards scholarships to ECS students over the 5 year period of the project and leverages a well-established network of ECS and University student services to support ACE scholars. The attitude and enthusiasm of ACE scholars towards the ECS ACE scholarship program was used as the principal operational measure of effectiveness. It was observed that only 70% of the scholarship recipients agree that the program helps them cover their “unmet” financial need; the two tier structure of the scholarship is considered as a primary contributing factor. Majority of the scholarship recipients agree that the activities and support systems do have the intended impact. Pre and post STEM self-efficacy surveys conducted to study the impact of ACE program and associated activities indicates a positive impact. The weekly reports from ACE mentors/tutors reveal good indicators of STEM interest and motivation among ACE scholars. Even though it was observed that the average GPA’s of ACE scholars in all the five majors are better than the average GPAs in their respective departments, the sample sizes for Computer engineering and Electrical engineering major are too low to draw any meaningful conclusions. Unlike expected, the off-campus and/or on-campus working hours and the scholarship amount was observed to have a minimal impact on the ACE scholars’ academic performance.

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Acknowledgments

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