Recruitment and Retention: Summer Transportation Institute for Secondary School Students

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Abstract

Devising techniques to recruit, retain, educate and graduate students in not widely known disciplines that demand continuous supplies of workforce has become essential for academic institutions. Recruitment and retention always call for novel approaches that are specific to target audiences and that fit for the host institution. In this aspect, engineering program recruiters reach out to potential candidates, ahead of time, for their respective programs with the support of industry partners who show willingness to fund recruitment programs for their future workforce.

Summer Transportation Institute (STI) at the authors' institution is such a program which has been conducted for the past 18 years to create awareness and interest among secondary school students about the transportation industry with support of Federal Highway Administration (FHWA) and the Ohio Department of Transportation (ODOT). This four week residential program that is designed with the introductory technical coursework, laboratory experiments, hands on activities, field trips and training in communication skills. In addition to the instructional activities, the financial support is also used for the food, accommodation and after class activities for the student participants and also for their mentors, who are undergraduate counselors.

The program curriculum introduces the topics of transportation in land, water, air, space travel, renewable energy in transportation, pollution due to transportation and applications of geospatial technologies in transportation. In addition, considerable time is also allocated for developing communication skills. The students in groups of five to six people are expected to present their experiences in one of these topics at the end of the program in an award ceremony attended by their parents|guardians, faculty and the program sponsors.

As a bridge between the basic mathematics and science and applied engineering, engineering physics plays a vital role in the instructions of this institute. The physics topics that are touched and explored include forces on trusses, physics of flotation and motion of floating objects, theories of flight and physics of energy. The instructions are followed with hands on activities or field trips that can enhance the student experiences.

Every year, while this institute helps to recruit 1-2 students from the pool of 25-30 participants for the engineering and science programs, it also helps to support the few undergraduate students as mentoring counselors in summer as a form of retention. The impact of instructing engineering physics at early stages on performance in the college is strong and could be systematized with expanding such instruction to include additional engineering physics.

Introduction

Devising techniques to recruit, retain, educate and graduate students in less established or less known disciplines that demand continuous supplies of workforce has become essential for academic institutions. This situation leads to the involvement of program faculty in recruitment

and retention of capable students for their respective programs as a part of their jobs beyond teaching, researching and mentoring. Recruitment and retention always call for novel approaches that are specific to the target audiences and that fit for the host institution. In this aspect, engineering programs identify and reach out to potential candidates, ahead of time, for their programs with the support of industry partners who show willingness to fund recruitment programs for their future workforce. The recruiting faculty often take advantage of this opportunity and develop outreach programs to:

a. identify potential future students and to guide and mentor them in exploring their career options and opportunities,
b. elevate the educational gaps between the high school and the first year university for a potential candidate by introducing intermediate topics that can bridge the gaps, and
c. provide a campus environment in which the middle school students and high school students can experience their independence and learn responsible decision making as growing adults

The recruitment avenues include summer or weekend camps for the targeted students and area science fairs, and feeder school visits (Barger et. al, 2104). Among them, summer camps with specific themes for the middle and high school students are one of the successful recruit tools that has broader impacts and holds significant indirect intellectual merits.

Summer Transportation Institute:

Central State University (CSU), an 1890 Land Grant University is one of the Historically Black Colleges and Universities (HBCU) in the Midwest US. Over the years, CSU has run a number of summer programs relevant to STEM disciplines and careers sponsored by various agencies including

a. Summer Transportation Institute (STI) for middle and high schoolers for transportation careers,
b. ExxonMobil Bernard Harris Summer Science Camps (BHSSC) for middle school students to learn about STEM,
c. Upward Bound (CSU-UB) for high school students with an opportunity to enhance the academic skills necessary to successfully complete high school and enroll in and graduate from college,
d. CSU-ATK Pre Engineering Program for to introduce high school upperclassmen to various engineering disciplines and careers,
e. AG-STEM Institute for agricultural-STEM education oriented middle school students (Youth Development and Leadership) and graduating high school students (Bridge),
f. Verizon Minority Male Makers for middle school students, and
g. Seed to Bloom sponsored by USDA for the middle scholars for studying about agriculture, water conservation, soil protection and overall plant management.
h. STEM-X-ED Middle School Program sponsored by the Department of Defense (DoD)

Most of these programs intend to serve the mission of an HBCU, and target to identify, develop, recruit, support, retain and graduate minority students in careers where they are the

underrepresented. This paper presents one of the longest summer programs at CSU, Summer Transportation Institute (STEM) in which the authors are involved.

The Summer Transportation Institute (STI) was first initiated at CSU in 1999 by the second author with fifteen students. It is designed to assist the Federal Highway Administration (FHWA), the Ohio Department of Transportation (ODOT) and other stakeholders in creating an awareness and in stimulating the interest in secondary school students to take advantage of the opportunities that exist in the transportation industry. The program targets students in grades 9-11 and provides an excellent opportunity for CSU to utilize the talents and experience of its faculty and in cultivating a secondary school population, mainly from Ohio, that has the potential to become future undergraduates, especially in the Science Technology, Engineering and Mathematics (STEM) areas.

The STI consists of an academic program, a learning skills enhancement program, an evening program and a sports/recreation program. Participants in the STI are exposed to all forms of transportation and introduced to the transportation related mathematics, physics and engineering. Academic activities include building and testing of model scale bridges, airplanes and boats. The academic curriculum includes mathematical and physical concepts related to stresses in bridges, mechanics of flight of planes and rockets, buoyancy in water, energy and power. The annual 4 week STI program at CSU has typically attracted about 25 students per year and is conducted in collaboration with the U.S. Department of Transportation, Federal Highway Administration (FHWA) and the State of Ohio Department of Transportation, Transportation Research Center (East Liberty, Ohio), US Coast Guard, Central Ohio Transit Authority (COTA), BOEING Corporation, Honda of America, Ohio Ready Mix concrete, Toyota, Central Ohio Transit Authority (COTA, Columbus), ARTIMIS (Cincinnati), Ohio State University Airport, CSX Intermodal Terminals and other transportation related agencies.

Central State University has developed a living and learning program for high school students interested in investigating careers in the transportation industry through the STI. In addition to the instructional activities, the financial support is also used for the food, accommodation and after class activities for the student participants and their mentor undergraduate counselors. This program has so far graduated around 450 middle and high school students and by average got one student per year for matriculating in a STEM program at CSU, in return.

Curriculum

Day program

It is very important to have the right tool of recruitment that is not only attractive to the parents and teachers, but also to the subject at the center, the students (Lachney and Nieusma, 2015). Hence, the design of the curriculum should be designed in the view how it can make the student interested and engaged.

STI is a four week program that is designed with the introductory technical coursework, laboratory experiments, hands on activities, field trips and communication skills. The program introduces the topics of land transportation (first week), water transportation (second week), air

transportation and space travel (third week), renewable energy in transportation, transportation related pollution and GIS and GPS systems (fourth week). In addition, considerable time is also allocated for developing communication skills. The students as a group of five to six people under the mentorships of the academic coordinator, the communication professor and the CSU student counselors, are expected to develop and present their experiences in one of these topics at the end of the program before the award ceremony.

As a bridge between the basic mathematics and science and applied engineering, engineering physics plays a vital role in the instructions of this institute. The physics topics that are touched and explored include forces on trusses, physics of flotation and motion of floating objects, theories of flight and physics of energy. The instructions are followed with hands on activities or filed trips that can enhance the student experiences.

Although the field trips and the presentation topics from guest speakers change year to year with the availability of the sponsors and the logistics, Appendix-A provides a typical four week educational curriculum for the STI program.

Evening and weekend programs

A residential summer program for a month merely with the educational components can only exhaust the middle school students, and can also indirectly trigger the negative feeling about the programs and the course materials. Hence, it should be certainly encouraged to have relaxing evening and weekend programs to revitalize the students after their daily assignments. In STI, students are provided with enough after school activities with the help of the student counselors under the guidance of a evening faculty coordinator. These activities include various sport activities in the university gymnasium, movies and weekend trips to outdoor activities.

Recruitment process

The recruitment is mainly done through the STI program director's annual letter on announcing STI Program to the guidance counselors of the feeder high schools. This is done in the first week of March. Additionally, it is also informed through the local science fairs such as *Miami Valley Science and Engineering Fair-West District Science Day* and *Dayton TechFest*, and through the CSU students and the STI alumni who may know suitable applicants among their peers and juniors in their high schools.

The letter to the high school counselors summarizes the requirements and the details of the scholarships. The typical scholarship package includes tuition, workshops and handouts, room and board, facility usage, equipment and supplies, travel (field trips) and lab fees. As per requirements, Students must:

- Be in the 10th, 11th or 12th grade for the school year the student attends the STI,
- Have completed or be qualified to enroll in Pre-Algebra for that particular school year,
- Have cumulative minimum grade point average of 2.5 on a 4.0 scale,
- Have an interest in Engineering, Science, Transportation or Technology related career,
- Have at least 2 letters of recommendation,

- Provide an essay (Why the student wants to participate in the STI and how it can assist in meeting individual career goals), and
- Provide transcripts.

The STI program director, the academic coordinator and the staff review the applications and select the STI participants in May.

Recruitment and Retention

Every year, while this institute helps to recruit 1-2 students from the pool of 25-30 participants for the engineering and science programs, it also helps to support the few undergraduate students as mentoring counselors in summer as a form of retention and to improve their leadership, management and communication skills, and work ethics. The impact of instructing engineering physics at early stages on performance in the college is strong and could be systematized with expanding such instruction to include additional engineering physics.

Available details on the demographic statistics of STI from 2008 to 2016 are given below (except for 2010 for which year data is unavailable) in Table 1.

Table 1: Demographic statistics of STI from 2008 to 2016

	Participants					From this year STI to CSU Freshman		
Year	*Total*	*Male*	*Female*	*Ohio*	*Other States*	*Enrollment*	*Program*	*Status*
2008	28	16	12	NA	NA	NA	NA	
2009	30	17	13	24	6	3	MFE, BIO, CHM	Graduated
2010	NA	NA	NA	NA	NA	NA	NA	
2011	33	18	15	27	6	5	COM,WRM, MFE, 2 BIO	Seniors
2012	30	13	17	26	4	1	MFE	
2013	30	15	15	28	2	1	ENE	Junior
2014	26	11	15	25	1	0		
2015	19	10	9	19	0	2	ENE, MFE	1 NSF S-STEM Scholar
2016	24	16	8	22	2	N/A	N/A	

Notations: BIO- Biology; CHM – Chemistry; COM- Computer Science; ENE – Environmental Engineering; MFE- Manufacturing Engineering; WRM – Water Resources Management
NA – Not Available; N/A – Not Applicable

Conclusions and Acknowledgement

The authors want to thank the sponsors, especially ODOT and FHWA for their continuing support for the STI program that tremendously make all parties -the transportation industry, government, students and the university- win at the end. This is a very helpful tool for attracting the communities to improve the diversity in a field in which they are underrepresented. This helped the university faculty to continuously engage in transportation related research and also motivated CSU to apply for external funding for a minor in transportation related infrastructure track in its Environmental Engineering program. More than anything, this program helps the students to be recruited in a program where they are continuously supported academically, morally and most of the time, financially. The first author wants to thank the Department of Transportation sponsored UTC, *NEXTRANS* for the partial financial support to the STI program, the summer internships to the environmental engineering students that helped in retention and research. The first author also wants to thank National Science Foundation - Division Of Undergraduate Education (S-STEM Award#1565049) for fully supporting an environmental engineering undergraduate, who first came to CSU as a high school STI participant in 2015 with another three environmental engineering undergraduates.

References

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2. Lachney, M. and D. Nieusma. 2015. Engineering Bait-and-Switch: K-12 Recruitment Strategies Meet University Curricula and Culture. *12snt ASEE Annual Conference & Exposition*, Seattle, WA. June 14-17, 2015.

Appendix A

PROGRAM SCHEDULE

DAY	ACTIVITIES
WEEK 1 - Surface Transportation	
Sunday	Arrival, Registration, Check In/Room assignments Introduction of Faculty and Staff; Code of Conduct University Tour/Social Hour
Monday	*Orientation to the Summer Institute:* What we will learn; Rules of behavior; Group Work; Formation of Groups; Pretest Career Opportunities in the Transportation Industry Map Reading Questions & Answers COTA Field Trip

Tuesday	Greene County Dept. of Motor Vehicles Introduction to Bridges and Bridge Construction using kits
Wednesday	Review of previous day activities Honda Research and Development Presentation
Thursday	Ohio Department of Transportation - Columbus Building Highways: Materials lab, sign design shop, surveying, ODOT mapping and GIS, Geometric design section, etc. ODOT Materials Labs continued
Friday	Review of Previous Day activities and Writing Assignment **ACT Practice** Bridge Testing Ready Mix – Concrete Demo Weekly Assessment
WEEK 2 – WATER TRANSPORTATION	
Monday	Overview of previous week activities Physics of Floatation, Introduction to Boat Design and Boat Construction Xenia Water Treatment Plant
Tuesday	Alum Creek State Park
Wednesday	Overview of previous activities and feedback from students Boat construction and testing **ACT Practice** Power Point Internet Research Assign. Teamwork
Thursday	Open Discussion **ACT Practice** Wright Paterson Air Force Museum
Friday	Open Discussion **ACT Practice** **How to Prepare for College** Study Habits Weekly Assessment
WEEK 3 - AIR TRANSPORTATION	
Monday	Introduction to Global Positioning Systems (GPS) & GPS Lab Activities Theory of Flight Airplane design and construction Measure Air /Noise Pollutants
Tuesday	Don Scott Air Field/Ohio State University Airport
Wed.	Final Presentation Requirements **ACT Practice** Airplane test and Contest Xenia Wastewater Treatment Plant Presentation skills
Thursday	Rocket Design and Construction **How to Prepare for College**

Friday	Review of Final Presentations Work on Final Presentations Weekly Assessment
WEEK 4 – Safety, Introduction to GIS & Renewable Energy in Transportation	
Monday	Introduction to Renewable Energy Physics of Energy **ACT Practice** Introduction to GIS & GIS Lab Work on Final Presentations
Tuesday	**ACT Final Exam** Work on Final Presentations
Wednesday	Work on Final Presentations Computer Lab/Final Presentations
Thursday	Work on Final Presentations Presentation Rehearsal
Friday **Closing** **Awards** **Luncheon**	Participant Final Presentations - Smith Auditorium Awards Luncheon –National Afro-American Museum Checkout-Dormitory