Introducing Students from the Academy for Mathematics and Sciences to Engineering

Stephan A. Durham[1], Mark L. Kuss[2], Ernest Heymsfield[2], Hanna Sheppard[3]
University of Colorado at Denver[1] / University of Arkansas[2] /
Rogers School District[3]

Abstract

In recent years, the Department of Civil Engineering at the University of Arkansas has been involved with the Academy for Mathematics and Sciences Program. The Academy for Mathematics and Sciences Program provides opportunities for high school students to be successful in the pre-college setting and ultimately higher education. Eligible students include high school students from low-income families or families in which neither parent holds a college degree. The overall objective of this program is to increase enrollment for students in higher education institutions. This program involves a six week summer program in which the students are engaged in "hands on" activities in the areas of math, laboratory sciences, composition and literature. The Department of Civil Engineering assists in the laboratory science portion of the program. Since the Department's involvement, students have become involved in innovative ongoing research. Research the students perform is practical and experimental and includes topics such as field permeability of asphalt, in situ permeability of concrete, and theoretical specific gravity of asphalt mixtures. At the end of the six week program, the group of students are required to present there research to parents, teachers, and friends. This program is useful in recruiting students into the engineering field. One student currently at the sophomore level in civil engineering is a former academy student and encourages others to participate. Upon speaking to several students during the summers of 2004 and 2005, they were enthusiastic to become involved as an engineering student at the University of Arkansas. This program helps students that are not financially able and are eager to succeed become interested in engineering.

Introduction

The University of Arkansas Academy for Mathematics and Sciences allows over fifty students in grades 9 through 12 from Northwest Arkansas to participate in a college preparation program.[1] The federally funded program is aimed at preparing students that excel in math and science for college upon graduating high school. The program includes a six week summer session as well as continual involvement during the academic year.

The program not only focuses on math and science, but includes classes in English, foreign language, literature, and computers. The primary focus is math and science and is reinforced through faculty involvement with group and individual research projects. The projects examined in recent years in the civil engineering portion includes evaluating a field asphalt permeability device, concrete permeability device, and a new innovative testing device to determine the

theoretical specific gravity of asphalt mixtures. In the summer of 2005 a group of students shown in Figure 1, plan to evaluate a new non-destructive testing device used for determining

concrete compressive strength. This research is state-of-the art and introduces students to the numerous steps involved in research programs. Students are required to develop outlines for the testing program, design and create material to be tested, and present their findings through a paper and presentation.

Figure 1:Students Participating in the Academy Program (Summer 2005)

Program Objective

The academy program was originally developed to provide participants opportunities to succeed in the pre-college setting and ultimately higher education. The primary goal of the program is to increase enrollment rates of students in institutions of higher learning. In addition, it is the programs desire to encourage participants to ultimately graduate from a postsecondary institute. Other services that the program provides include[2]:

- Assistance in reading, writing, study skills, and other subjects needed to succeed beyond high school.
- Counseling in the areas of academics and finance.
- Tutoring services and mentoring programs.
- Information on opportunities in higher education.

- Assistance in completing college entrance and financial aid applications
- Preparation for college entrance exams.
- Work study programs.

Eligibility Requirements
Students must have completed the 8th grade and be between the ages of 13 and 19 to participate in the Academy of Mathematics and Sciences Program[2]. In addition, the students must exhibit need for academic support and demonstrate willingness to pursue a postsecondary education. Eligibility requirements include:

- Student must be from a low-income family, or
- Is a potential first-generation college student

The program requires that two-thirds of the academy participants be both low-income and potential first-generation college students. The remaining one-third must be either of the two stated above.

Students are selected to participate in the program based on recommendations from local educators, social workers, or other individuals that possesses knowledge of the student's potential.

Summer Program
This program includes a six week summer program in which the students are engaged in "hands on" activities in the areas of math, laboratory sciences, composition and literature. The Department of Civil Engineering assists in the laboratory science portion of the program. Since the department's involvement, students have become involved in innovative ongoing research. Research the students perform is practical and experimental and includes topics such as field permeability of asphalt, field determination of concrete permeability, and theoretical specific gravity of asphalt mixtures.

Students participating in the program during the summer of 2005 are evaluating a non-destructive device for determining concrete compressive strength. Their research program includes developing a testing procedure for the newly designed device, performing a comprehensive literature review, creating a testing program, and presenting their findings in a paper and presentation. Students batching and mixing concrete to be used in the testing program are shown in Figures 2 and 3, respectively.

At the end of the six week program, the group of students are required to present there research findings to parents, teachers, and friends. This program has been useful in recruiting students into the engineering field. In addition, it has been recognized that students learn to work in groups effectively.

Student Feedback
The program has been very effective in providing students with the opportunity to succeed in college. In addition, the research projects performed by these students have encouraged many of them to pursue careers in Engineering. Success stories and student feed back are found below.

Figure 2:Students Prepare to Make Concrete

Figure 3:Students Mix Concrete

Jonathan Ball is currently a sophomore at the University of Arkansas in the Department of Civil Engineering. He is a former participant in the Academy for Mathematics and Sciences and is still heavily involved in helping the program during its events. Upon completing high school, Jonathan received two distinguished scholarships from the University of Arkansas. He was awarded the Honors College Scholarship and the College of Engineering Scholarship. These scholarships are worth $9,500 per academic year.

Heather Winningham is a two year academy program participant. She commented on her experiences and how the program has helped her prepare for college.

> *"It has helped me a lot in school. The program helps me get a head start on what I'll be doing the next year and it helps me understand what we are learning. It has also helped me socially, by helping me talk more openly and more confidently."*

The program has also benefited Tonya Welch in several ways. Tonya is a two year participant. Her comment is presented below:

> *"I've learned math that I had tried to do before, but struggled with. I've met people that have now become some of my very best friends. I've learned new ways to solve old problems."*

It has also encouraged several students to examine possible careers in engineering.

Chase Barnett, a two year academy student, has found the science portion of the program to be very interesting. He plans to attend college and purse a mechanical engineering degree. Ruanda McFerren is not sure of her plans but states:

> *"At this time, I don't think that I will pursue engineering. Learning about engineering through the program has been interesting and I would like to learn more about it."*

Conclusion

The Academy for Mathematics and Sciences Program at the University of Arkansas has been effective in providing students with opportunities to pursue education beyond graduating from high school. The program encourages students from low-income families and/or families in which neither parents hold a college degree to attend institutions of higher education. The program emphasizes the math and science as well as assistance in other subject areas. Students have found interest in the engineering portion of the program resulting in increased enrollment in the engineering curriculum. This program not only introduces students to engineering, but challenges them to succeed in their future education.

Bibliography

1. University of Arkansas Pre-College Programs Instructor Handbook.

2. http://www.ed.gov/programs/trioupbound/index.html., U.S. Department of Education., June 2005.

Biography

STEPHAN DURHAM is an assistant professor at the University of Colorado at Denver in the Department of Civil Engineering. He obtained his MSCE and Ph.D. degrees from the University of Arkansas in the area of repair and strengthening of concrete bridge superstructures. His interests include concrete materials and repair.

MARK KUSS is the master scientific research technologist in the Department of Civil Engineering at the University of Arkansas. He provides assistance to the academy in the research aspect of the program. He has developed numerous devices that have been tested by these students.

ERNEST HEYMSFIELD is an assistant professor at the University of Arkansas in the Department of Civil Engineering. His interests include bridge evaluation and numerical modeling.

HANNAH SHEPPARD is a special education teacher for the Rogers School District in Northwest Arkansas. She has several certifications in teaching. She is responsible developing and overseeing the scientific portion of the academy program.