

QUEST: A Program to Attract and Recruit Highly Qualified Engineering Students through a Summer Program Focused on the Needs of the Students

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Abstract

The James Worth Bagley College of Engineering at Mississippi State University has been experimenting with a program aimed at recruiting highly qualified students to study engineering. The premise of the program is the belief that once high school students experience engineering college life on campus, their interest in both engineering and the University will be piqued and new freshmen will be gained.

Initially the program involved bringing students to campus during a regular summer term, registering them in two college classes which would either apply to engineering or serve as a foundation for engineering studies, and offering them a series of enrichment seminars that explained the various fields of engineering and offered insight on how to become a successful college student. After meeting with limited success, the program moved away from college courses and toward engineering research while maintaining the enrichment seminars. We also found that the length of the program needed to be reduced in order to be more attractive to students.

The program has been successful in attracting students and developing relationships between the high school students and the faculty members. The evolution of the program is described and the reasons for why changes were made are discussed.

Introduction

A challenge which faces most colleges of engineering is how to attract and recruit highly qualified students. Those students who are most qualified to pursue an engineering career are often the most difficult to attract for a variety of reasons. These students are recruited by the best colleges and universities in the nation and it can often be difficult to keep the local students in a nearby university. Given their drive and ambition, the prospect to explore schools out of state or even out of the region can be difficult to overcome. These students are also well-qualified to pursue most any career of their choosing often making it difficult to interest them in engineering. Having little exposure to engineering in high school, science majors are enticing to these students.

In an effort to turn this situation around, five years ago, the James Worth Bagley College of Engineering at Mississippi State University developed the Quest program. The original intent of this program was to get highly qualified students exposed to college and enrolled in college courses. While a success, the program was not fully meeting all of our expectations so changes were made over the years resulting in the current program. Self-evaluation is on-going and future changes are certain to happen, but currently we believe we have hit on the right program for students of this caliber.

Program Evolution

When started in the summer of 2000, Quest was an in-residence summer program for rising high school seniors. Selection was competitive and based on ACT scores, high school grades, teacher recommendations, and an essay in which the students discussed presented their reasons for being interested in engineering as a career and why they wanted to be part of the program. To keep the numbers manageable and to ensure each student received individual attention, the program was capped with an enrollment of 20. This enrollment continues to this day.

College Coursework

To achieve the goals of the program, students in the first three programs were required to enroll in two regular college-level courses in a summer term and live on-campus in student housing. The purpose in this was to get students exposed to student life on campus and have them experience college courses. It was also hoped that once students had earned college credit with us, they would return as freshmen to continue in the program. Of course the classes they took were also transferable to another institution. In addition to taking classes and living on campus, students were required to attend enrichment seminars and participate in tours of engineering departments and facilities.

We determined early on that we needed to limit the courses students could take during the summer term based on our belief that even these highly qualified high school students were not prepared for the rigors of two difficult college level courses. We therefore allowed the students take one difficult course, typically College Algebra, Trigonometry, or Calculus, depending on their ACT math subscore, and an easier engineering graphics class. The engineering graphics class was offered a special class only for these students but was taught using the same syllabus as the regular class. This class was an opportunity for all the students to share a common course, be in one class where we could easily find them when needed, and they could learn to study as a group. This class was also offered in the afternoons which allowed us to cancel the class when needed to accommodate an out-of-town tour.

As a result of grades earned in the first year of the program, we realized that even these highly qualified students were often not ready for some of the more difficult college level classes. We had instances where students did poorly in an introductory sociology or psychology course but found these grades were more the result of a lack of class attendance than students not being able to handle the material.

Calculus was a different situation however. Some students did fairly well in Calculus and others did poorly. Even those who did well in the class commented that they had to work very hard to earn their grades and, in the end, wish they had taken another class. Given that Calculus is often a difficult class for first semester freshmen, we were not surprised to find it difficult for rising high school seniors. Summer classes are taught in five-week terms with each class meeting five days a week for two hours each day. After the first summer we reached the conclusion that math courses were too difficult for most of these students and we essentially prohibited students from taking them in future summers.

During the following years we continued to offer the engineering graphics class but forced the students to take classes that were hopefully not as challenging as Calculus. Most students found that taking introductory psychology or sociology courses or lower level history courses provided rewarding college class experiences, required some study time each day, but were not over-bearing or impossible. The engineering graphics class was rewarding but did not require extensive amounts of time outside of class.

Enhancements and Tours

In addition to the classes students were required to take, three to four afternoons of each week were consumed with either an enrichment seminar or a tour. These were designed to improve the students' chances of success in college and expose them to engineering. These afternoon sessions were not difficult but did require the investment of time, especially if an out of town tour was scheduled.

Enrichment seminars were presented to improve the students' life skills and to establish good work and study habits. A very popular seminar was on the Myers-Briggs Personality Type Indicators. To facilitate this seminar, each student was given the MBTI during the orientation session and the instrument was forwarded to the psychology professor who offered the seminar. When the seminar was presented, students not only learned about the MBTI and traits of the various personality types, they also learned what their type was as well.

Other seminars focused on how to develop good study habits, applying for financial aid and scholarships, and time and stress management. Comments received from the students were in general positive for the seminars. The MBTI seminar has consistently been a favorite of the students due in part to the material covered but perhaps more due to the personality of the professor presenting the seminar for evaluation. Time and stress management are also popular, with students commenting on the immediate application of the techniques they learned to high school.

One of the most valuable aspects of the Quest program has been the tours of engineering departments and facilities. An afternoon is set aside for each engineering program we offer to allow students to meet with the faculty and staff in the department, tour the departmental facilities, see some of the research being conducted, and learn more about

the discipline. An additional afternoon has also been set aside for a tour of some of our larger research centers in the college.

Students enjoy the tours of the academic departments and admit they learn more about the profession through the tours. One recommendation the students consistently make is that they would prefer the departmental tours focus more on what jobs an engineer would do after graduation rather than what courses students take while in the program of study. We continue to work on presenting more of that type of information to the students but most departments still include a fair amount of what courses are included in the program of study.

Tours of industrial facilities have also been well received by both the students and the engineers at the industrial facilities. Through the tours the students have the opportunity to meet with practicing engineers and see the kinds of work they do. They also get to see that, for example, an industrial engineer at one plant does work that is different from what an industrial engineer does at another plant. An added benefit is that the students get to see some of the world-class facilities in their own region.

Although tours are popular, they are time consuming when travel time is considered. They were dropped from the most recent Quest program strictly due to time constraints and the students asked that they be added to future programs. Every effort will be made to add tours but there are always trade-offs to be made when dealing with a limited amount of time.

A Change of Focus

After three years of Quest experience, we still thought that we were not getting what we wanted from the program. The students were all high quality but grades were suffering more than we desired. The last thing we wanted to do was to bring in exceptional students and then give average, or even below average, grades to start their college careers. Engineering graphics had been eliminated from many of the engineering programs of study meaning that although students took the class, it no longer applied to many engineering majors.

Beginning with the fourth year of the Quest program, we decided that giving the program a different focus might work in our favor. After some discussion we decided to eliminate the course requirement and replace it with a research experience. We kept the other aspects of the program constant so students still lived on campus and participated in departmental and industrial tours. Each student was asked to identify their preferred area of study which we used in conjunction with their essay to match them with an engineering faculty member conducting research.

Research performed by students varied across departments but was beneficial for the students and faculty involved. Several students worked at the Center for Advanced Vehicular Systems where they learned to use specialized computer software and helped plan experiments. Others worked on the development of instrumentation in biomedical

engineering and still others conducted aerodynamic testing on models. All students interacted with faculty, technicians, and particularly graduate students in the laboratories.

With the switch to a research-focused rather than a classroom-focused program, we opted to limit the first summer of the new program to students from the state math and science school which is located in a nearby city. These students are all top-performers and many had some relationships with the college already established. Competition was still competitive and we found that even students who had relationships with faculty were often interested in exploring research in a different area which we were generally able to accommodate.

Conducting a program focused on research in the summer presented several challenges. The primary challenge being finding faculty on campus the students could work with. The Bagley College of Engineering is ranked in the top 40 schools by the National Science Foundation in terms of research expenditures so available research was not a problem. The problem was that many of the faculty spent the summer working in government labs or with colleagues at other institutions. As a result, not every student got their first choice of research assignment but they were assigned to a closely related area.

Expectations of the students were and remain high. Each student was scheduled to work at least 20 hours per week in the lab and most afternoons were filled with tours or seminars. Students were told up front that they were working on real projects and their faculty mentors had deliverables that had to be produced. As a result they had to perform in the lab and there was not much time for them to make mistakes. If they were not comfortable performing a task they were told to let their mentor know beforehand. Students were also exposed to some of the more mundane aspects of research such as collecting references from the library or tracking down pieces of equipment which were needed. This was valuable in showing students that research was not as straight forward as depicted in television shows.

For the summer of 2004, Quest was offered again with a research focus but was reduced from five weeks to three weeks. Having a five week term was required for the earlier programs due to the summer school class schedule. It was retained for the first research program simply because the program had always been five weeks long. However, based on student feedback and discussions with other high school students, we decided that five weeks was perhaps too long. We had also talked with many students who mentioned they were interested in the Quest program but could not attend because of summer jobs or family vacations. By reducing the program to three weeks we saw an increase in the number of applicants and the experience of the students who attended was seemingly better.

Reducing the length of the program did not come without costs. To get the tours and seminars we thought were needed worked into the schedule, every afternoon of the three weeks was filled with an activity. This did not allow the students time to rest and enjoy the other aspects of campus life, although most did manage to squeeze in some activities. We also had to drop the tours of industrial facilities due to time constraints which

prevented the students from seeing practicing engineers working somewhere other than the research lab. At the conclusion of the first three-week session, the students unanimously agreed that it needed to be longer. However, when asked how many of them would have applied in mid-March if they had known the program was going to be five weeks long, most said they likely would not have applied. Their suggestion was that we advertise the program as being three weeks long and then at the end of the second week, once they had realized how much fun they were having, to extend the program to five or six weeks.

Program Costs

In general, the costs of the Quest program have been fairly low and have ranged from just over \$1900 per student to just under \$600 per student. The major costs of the program were food and housing. Housing was provided in a resident hall used for summer camps with two students placed in each room. As an added incentive to recruit counselors, they were given single-occupancy rooms near the students. In addition, each counselor was provided with an \$800 stipend.

During the first several years of the program, tuition costs were a major part of the budget. Students registered for two classes and were charged the going rate for tuition and fees. Each student was then awarded a scholarship to cover these costs. Books for the engineering graphics class, initially required of all Quest students, were purchased by the college and used in the following years. Students were required to purchase the other text books they needed depending on the course requirements and additional scholarship funds were awarded to cover those costs.

The other major budget item for the program was the cost of food, both subsistence for the students and a banquet at the end of the program. We had two options from which to choose for subsistence: a pre-paid food plan in which purchases were subtracted and no refunds were given for remaining balances; or a charge card which required us to pay for what we used at the end of the summer. As a demonstration of trust to the students, and to prevent from over-paying for food, we opted to use the charge card. These cards were valid in any on-campus dining facility, including the library, and were rated highly by the Quest students. With the exception of one or two students, everyone was very responsible in using the cards and parents had the assurance that their children would not go hungry. Several cards were lost but detailed record keeping allowed the lost cards to be cancelled and new ones issued before any unauthorized charges could be made.

The costs of operating the program decreased by a factor of three to four when the program was converted from a course-based program to a research-focused program which provided an added incentive to implement the change. This cost reduction was due primarily to not having to pay tuition and fees or buy books. Additional savings in housing and food costs were realized when the program was reduced from five to three weeks.

There were other miscellaneous costs in the program that varied from summer to summer. Each group was given t-shirts of their own design to wear when they returned to their high schools. We made sure the web address of the program was printed on the shirt in an effort to recruit students for the following years. Several day trips were also made for tours which required vans be rented from the campus motor pool. Most of the seminars given during the program were provided at no cost by University staff and faculty members. A few speakers were paid minimal honoraria which ranged from \$200 to \$300.

Results

The Quest program has been successful and will be continued. During the first three years of the program, 81% of the students who attended Quest ultimately enrolled at Mississippi State and 73% enrolled in the Bagley College. Overall the results are a little less encouraging with only 56% of the students who attended Quest enrolling at the university. These overall numbers are however skewed by the first research-oriented Quest program. The students comprising this class were all from the state sponsored school for math and science and were all highly sought after by the best colleges in the nation. These students were also experienced at living away from home on a college campus and tended to be more adventurous than other students. As a result they were more likely to select colleges that are further away from home than were students from conventional high schools. It is too early to tell what will happen with the most recent Quest class because they will not enroll in college until the Fall of 2005.

As a result of the Quest program all participants gained a better understanding of engineering and engineers. Many who had been considering pursuing careers in science fields decided that engineering was more fun and exciting and they changed their intended majors. There were a few students who, through this program, realized that engineering was not what they wanted to do and chose to major in other fields. While it was disappointing to lose these students, we would have lost them eventually anyway and by helping them reach this decision earlier they will likely have more rewarding college experiences.

Decreasing the length of the program from five to three weeks increased the number of applications received and generated more interest in the high schools. Although participants in the first three week program agreed that they would have liked for it to have lasted longer, none said that it was too short. They in fact confirmed our suspicion that the five week program was discouraging students from applying. The three week program allows students to participate in Quest and still work before or after the session and go on family vacations.

We have benefited from the program by gaining some outstanding students. Even those students who chose to not attend school with us commented at the end of the program that they were impressed with what was available and had a positive impression of the college. They also said they would recommend friends consider us as a college for engineering.

Future Plans

Given the success of the program, Quest will be offered again in the future. The three-week research format will be maintained for at least another year and applications will be accepted, like last year, from any qualified student regardless of the high school they attend. In spite of student concerns, we do not plan to eliminate any of the tours or seminars; we find them too valuable to not offer them to the participants. We would like to include more tours, especially of industrial facilities and may accomplish this by extending the program by two or three days. The extra days would be spent solely on tours, covering two or three facilities a day and perhaps staying in hotels at night to cut down on the travel time. This would give the students needed exposure to engineering outside of the research lab.

A cost/benefit analysis is also planned in the next year or two. Student involved in Quest are provided with free on-campus housing and a campus dining card. As a result the only costs to the student to participate in the program are transportation to the campus and money they wish to spend incidental items and entertainment. The first few years of the program were funded by a grant from the Tennessee Valley Authority Economic Development Program but the last several years have been funded from college gifts and endowments. Once a sufficient number of students have completed the program, we will review it to see if this is the best use of the money or if we could better use the funds for scholarships.

Conclusions

Quest has achieved its stated goals of exposing high-quality high school students to engineering and recruiting them to the college. A reduction of the program from three weeks to five weeks increased interest and participation but did result in the necessary elimination of some industrial tours. Faculty interest has increased as a result of the caliber of student research they can gain in the summer at no cost to them other than their time to teach and mentor the students. With minor modifications, this program could be adapted to most any college of engineering.

Biographical Information

ROBERT A. GREEN

Robert Green is the Undergraduate Coordinator for the Bagley College of Engineering at Mississippi State. He works with undergraduate students throughout their college careers and manages the college's Computer Initiative which mandates all students have a computer. Mr. Green is a Lieutenant Commander in the Naval Reserve and frequently presents seminars on ethics and leadership.

ROBERT P. TAYLOR

Bob Taylor recently retired as the Interim Dean of the Bagley College of Engineering at Mississippi State where he was also a professor of Mechanical Engineering with many years of experience as both a teacher and researcher. He is currently a professor of Mechanical Engineering at the University of Alabama.