Results of Summer Enrichment Program to Promote High School Students' Interest in Engineering

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Abstract

For more than thirty years, personnel from the University of Louisville J.B. Speed School of Engineering have presented a summer program targeting high school students historically underrepresented in engineering fields. INSPIRE provides these students with an introduction to careers in engineering and assists the students in planning their futures, even if they choose not to pursue engineering after high school graduation. This article provides an overview of the INSPIRE program, selected activities, costs, and outcomes.

According to a recent report by the National Center for Education Statistics (NCES), located within the U.S. Department of Education and the Institute of Education Sciences, the U.S. population has become more diverse over the past two decades as minority groups, including African Americans, Hispanics, American Indians/Alaskan Natives, and Asians/ Pacific Islanders, have increased more rapidly than the White population. In 2005, minorities made up approximately 33 percent of the U.S. population. These same minority groups are expected to represent nearly 39 percent of the total population by the year 2020. Additionally, just about a quarter century ago, the National Science Board's (1983) Commission on Precollege Education in Mathematics, Science, and Technology (MST) assessed the state of U.S. precollege education in the science fields and found it seriously lacking to meet the projected demand.

Ethnic minorities, including African Americans/Black and Hispanic students are attending college and earning degrees in greater numbers than they have historically (Nettles, Perna, and Freeman 1999); however, they are not pursuing certain disciplines, including engineering, at a consistent rate (Perna 2000). Groups that have been historically underrepresented, particularly females and ethnic minorities, are also not obtaining engineering degrees in proportion to their representation in the general public (Davis and Finelli 2007). In the late 1980s, the Task Force of Women, Minorities, and Persons with Disabilities in Science and Technology called for cooperation among schools, colleges, industry, and federal and state governments to increase the pool of science and engineering talent, particularly for underrepresented minority groups, through programs similar to those instituted following the Soviet launch of Sputnik in 1957, which ushered in new political, military, technological, and scientific developments (DeLougry 1988). Two decades later, the pipeline statistics are not as promising given the seriousness of the need for such technical skills.

According to data provided by the U.S. Department of Education, National Center for Education Statistics, in 2010 Whites earned nearly 70 percent of the bachelor's degrees awarded in the various engineering disciplines while African American only earned 4.5 percent. Hispanic recipients were higher than that of African Americans at 6.9 percent and Native Americans/American Indians were less than one-half of a percent. Table 1 shows Whites earned 62,314 bachelor's degrees in engineering in 2010, compared to African Americans who earned 4,688 bachelor's degrees in engineering that same year. Table 1 also displays the discrepancies between ethnicities of earned master's and PhD's in engineering in 2010.

Table 1. Engineering Degrees Attained by Group, 2010

Ethnicity	Bachelor's	Master's	PhD's
White	62,314	15,424	2,505
Asian	9,667	4,301	569
Latino	6,105	1,573	210
African American	4,688	1,385	163
American Indian/Alaskan Native	525	114	10
Non-Resident Alien	4,951	16,549	4,314

Source: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education System (IPEDS), Completions Component, 2009–2010 (persons of two or more races excluded).

Table 2 shows a lack of significant change between 2009 and 2010 for engineering degrees earned by ethnically diverse populations, including Latinos, African Americans, and American Indians/Alaskan Natives. The small proportion of ethnic minorities (and women) with degrees in engineering and other STEM disciplines contribute to the discrepancies in workforce and employee demographics in these fields.

Table 2. Percentage of Engineering and Engineering-Related Degree Attainment by Group and Level, 2009 and 2010

Ethnicity	Degree	2008–2009	2009–2010
Latino	Bachelor's	6.8%	6.9%
	Master's	3.4%	3.7%
	Doctoral	2.1%	2.7%
African American	Bachelor's	4.7%	4.5%
	Master's	2.9%	3.0%
	Doctoral	2.0%	2.1%
American Indian/Alaskan Native	Bachelor's	.5%	.5%
	Master's	.3%	.2%
	Doctoral	.3%	.1%

Source: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education System (IPEDS), Completions Component, 2006–2010, released Nov 2011.

The *Science and Engineering Indicators* of 2006 reported that, with the exception of Asians/Pacific Islanders, underrepresented minorities represented only a small proportion of those persons employed in science and engineering (S&E) occupations in the United States. These statistics have not improved. Collectively, underrepresented minorities constitute 24 percent of the total U.S. population, 13 percent of college graduates, and a mere 10 percent of the college educated in S&E occupations. Although Asians/Pacific Islanders constitute only 5 percent of the U.S. population, they accounted for 7 percent of the college graduates and 14 percent of those employed in S&E occupations in 2003, according to a 2006 Report of the National Science Board, "A Companion to Science and Engineering Indicators 2006." Women, on the other hand, constituted slightly more than a quarter (26 percent) of the college-educated workforce in S&E occupations (and nearly 40 percent of those with S&E degrees) but close to half (46 percent) of the total U.S. workforce during that same time.

Representation of racial and ethnic minority engineering students across the United States has not increased significantly between 1990 and 2010. Attracting and retaining underrepresented minority and female students continues to be a major concern for most engineering schools in this country. With the "critical shortage" of technically skilled workers, such as engineers, many scholars in academe believe continuous targeted strategies, such as pre-college programs focused on science, technology, engineering, and/or mathematics (STEM), provide a viable pipeline for many universities, particularly at the undergraduate level.

Pre-college engineering programs targeting underrepresented minorities and females have been in existence at various colleges and universities in the United States for over thirty years. However, many have yielded varying degrees of success relative to meeting the goal of attracting, enrolling, and retaining these underrepresented minorities and female students to their respective colleges and universities. Until recently, few program directors focused on the need for validated assessment methodologies and participant tracking methods that could be used to further corroborate the value of such pre-college initiative and programs (Marra and Bogue 2004). The remainder of this paper details a pre-college engineering program as a low-cost model for other engineering schools.

Program Background

In 1980, personnel from the University of Louisville's J. B. Speed School of Engineering and the Jefferson County (Kentucky) Public Schools met to discuss the need to heighten the awareness of the opportunities within engineering to underrepresented minorities in the Louisville area. One outcome of these discussions was to design and implement a summer enrichment program on the university's main campus to address this need. Since the summer of 1981, the University of Louisville

has provided an avenue for a group of female and underrepresented minority students to be introduced to engineering by participation in the INSPIRE program.

The INSPIRE Program Model

INSPIRE is an acronym for Increasing Student Preparedness and Interest in the Requisites for Engineering. It is a three-week, five days a week, non-residential summer enrichment program designed to provide an introduction to engineering to students who have been historically underrepresented in the engineering field. Those targeted for the program include African American, Hispanic/Latino, Native American, and female students who attend Louisville-area public or private high schools. Although the program focuses on attracting students who are often underrepresented in engineering, enrollment for INSPIRE is open to all.

Within eight weeks of the start of INSPIRE, brochures and applications are sent to the area high school counselors and math/science department chairs, local youth groups, and churches with large African American congregations. The program director puts additional efforts towards targeting African American youth who may currently participate in other local academic enrichment programs such as the YMCA Black Achievers Program and the Lincoln Foundation. Efforts are made to recruit Hispanic/Latino students by reaching out to colleagues at Adelante Hispanic Achievers, Inc., a community-based organization focusing on middle and high school Hispanic youth. Special efforts are made to target minority students who may have the aptitude for advanced study in engineering fields but who may not have performed up to their abilities in the early years of high school. Guidance counselors are asked to identify the "show promise" students. Most students in the program are female and/or an underrepresented minority who has completed the ninth, tenth or eleventh grades by the start of INSPIRE. While most students are attending public schools, the program does accept students from private or parochial schools as well. On occasion, students from out-of-state schools are accepted if they are residing in Louisville for the summer.

Program participants are selected by the director of the INSPIRE program from a pool of applicants. The student's high school counselor must submit a recommendation letter supporting the student's participation. In addition, applicants must provide a written and signed evaluation from their current math or science teacher. Current transcripts are submitted as part of the application process. The student applicants also have to submit an essay indicating why they would like to participate in the program. Lastly, the applicant must commit to participating in the entire program. Exceptions are rare but are accepted on a case-by-case basis.

Each summer the program director accepts between twenty and thirty students. The enrollment is kept at this small number so there can be close interaction between the students and also between faculty and program participants. Another reason enrollment is capped at thirty is because field trips are an important part of the program and large numbers would make such off-campus activities less manageable.

In 2009, Brown-Forman agreed to become corporate sponsor of the INSPIRE program and their support continues to this day. Because of funding from Brown-Forman, participants are able to attend the program without any out-of-pocket costs. However, arrangements to get to and from the campus each day are the responsibility of each program participant.

INSPIRE Program Curriculum

The Brown-Forman INSPIRE program is conducted Mondays through Fridays from 9:30 a.m. to 12:30 p.m. during the month of June. The 2013 INSPIRE schedule is shown in Table 3. This particular schedule exposes each program participant to fifteen sessions consisting of two plant trips, seven introductions to engineering disciplines, and six non-engineering related sessions. Field trips to local industries are key elements of the program. The trips enable the high school students to see engineers and technicians on the job. The program participants often meet with students serving as engineering cooperative interns and interact with engineers who were once in INSPIRE themselves.

Table 3. Sample INSPIRE Schedule

Week 1	
Day 1	Orientation and the True Colors® Exercise
Day 2	Goal Setting and "Perfect Student" Workshop
Day 3	Road Map to a Successful College Experience
Day 4	Intro to "Green Engineering"
Day 5	Field Trip to GE Appliance Park
Week 2	
Day 1	Order Your Educational Steps (OYES)
Day 2	Structures Reaching Over Water/KY Department of Transportation
Day 3	Introduction to University of Louisville's Library Services and Introduction to Rapid Prototyping
Day 4	Intro to Electrical Engineering
Day 5	Field Trip to Brown-Forman
Week 3	
Day 1	Intro to Bioengineering
Day 2	Intro to Mechanical Engineering
Day 3	Intro to Computer Engineering and Computer Science
Day 4	Intro to Chemical Engineering
Day 5	Engineering Panel and Assessment/Wrap-up

The program participants utilize the classroom and laboratory facilities at the university's J. B. Speed School of Engineering for both engineering as well as non-engineering sessions. Table 4 provides a succinct synopsis of sessions. Over the last decade, several engineering modules have been developed across the engineering

discipline that can be used for pre-college students in ninth through twelfth grades. Each disciplinary faculty chooses the session to be used and notifies the INSPIRE director accordingly.

Non-engineering related sessions are conducted by a combination of the program director, graduate students, and university faculty or staff, depending on the session objectives, resource availability, and expertise. These sessions provide the participants with information on what it really takes to be prepared to major in engineering, exposure to various work environments of practicing engineers as well as success tips for college, no matter which academic major is pursued.

Minimum course taking guidelines for graduation requirements have been enacted by many states in the U.S. since the early 1980s. These minimum standards for high school graduation are usually consistent with the *New Basics* criterions recommended by the National Commission on Excellence in Education through "A Nation at Risk," a 1983 report that critically examined the American school system. Kentucky high school (pre-college) curriculum requirements include four units of English/language arts, three units social studies, three units mathematics, three units science, one unit health/physical education, and one unit arts/vocation. The pre-college curriculum (PCC) required for admission into the University of Louisville is in alignment with the NCEC requirements. Although most high school students are told by their high school counselor the coursework requirements for graduation, this information is revisited during one of the INSPIRE non-engineering related sessions. Emphasis is placed on taking advanced math (preferably calculus, if available) as well as chemistry and physics.

Each engineering session at INSPIRE consists of a combination of brief introductory lecture/discussion, followed by a hands-on activity, often in teams. The session ends with a brief discussion and reflection on the experience relative to its respective engineering discipline and concepts taught at the beginning of the period.

Since one of the programmatic goals of the INSPIRE program is to introduce the students to various aspects of engineering, faculty members and graduate students from their respective department conduct the engineering related sessions. Although some topics may vary slightly from year to year, recent sessions provide the students with information on the following engineering disciplines: electrical, chemical, industrial, mechanical, computer, civil, and bio-engineering. Furthermore, undergraduate African American and female engineering students who are members of the National Society of Black Engineers (NSBE) and/or the Society of Women Engineers (SWE) also interact with the high school students and serve as role models during the program.

Table 4. INSPIRE Program Descriptions

Chemical Engineers as "Universal" Engineers	Chemistry is an important part of a wide variety of industries, from petroleum and pharmaceuticals to microelectronics and foods. The additional training that

	chemical engineers receive in chemistry has led some to propose calling them "universal" engineers. During this session, students will be introduced to the field of chemical engineering - where ChE's work, what ChE's do, etc. Students will divide into small groups to see various demonstrations of traditional chemical engineering operations. Finally, students will learn about what the future holds for chemical engineers and what exciting, new areas are emerging in which chemical engineers can participate.
Introduction to Bioengineering	Bioengineering is a relatively new engineering discipline when compared to the long-standing traditions of other engineering fields. A bioengineer uses traditional engineering skills and tools to analyze and solve problems in biology and medicine. This session will introduce the students to various aspects of this exciting field.
Introduction to Civil Engineering	Following a general introduction to mixture design and field control of Portland cement concrete, a hands-on concrete mixing session is held in the construction materials lab. A second Civil Engineering session is on "roadway and bridge construction," and the students build bridges and test them for strength and endurance.
Introduction to Computer Engineering and Computer Science	Computer Engineering and Computer Science have become fundamental components of all science and engineering disciplines and most other fields of inquiry. In this session, students will be introduced to some of the most promising areas of CECS such as cyber security and artificial intelligence. Short-term and long-term prospects for computer scientists and computer engineers will be discussed, as well as the impact of CECS majors on society in the next few decades.
Introduction to Electrical Engineering	Machines are becoming more and more integrated into our daily lives. One focus of this session is to cover how to improve interactions between humans and technology by collecting body signals from a person as a measure of a person's mood. Students will also have the opportunity to work with an ER-1 robot. The session will conclude with an overview of the electrical and computer engineering discipline, including the description of freshman enrichment courses taught at the University of Louisville.
Introduction to "Green Engineering"	This session will be a presentation on "green engineering" —more and more Americans are interested in sustainability to a sampling of the many ways engineers can help society reduce environmental footprints. The

	format will include a slide presentation, group discussion and hands-on activities.
Order Your Educational Steps (OYES)	This session will allow the INSPIRE students to take a brief tour of the campus and then meet with a panel of currently-enrolled University of Louisville students to get "the real story" of what college life is like. The students will share their experiences and will let the INSPIRE students know how college life differs from high school and how it provides great experiences as well as challenges.
Introduction to Mechanical Engineering	This session will open with an introduction to the mechanical engineering profession. They will introduce aspects of mechanical drawings, electric motors, and gear systems. Then the class will assemble a device that involves gears and an electric motor. A second activity will introduce design and will require students to develop and test a zip-line carrier.
Introduction to Rapid Prototyping	In this session, students will be introduced to the Rapid Prototyping Center. They'll learn why rapid prototyping is used, and they'll learn about the SLS (selective laser sintering) process and its applications and view numerical controlled machines (CNC). The students also will be shown solid modeling and view the model of Patrick Hughes' home from the "Extreme Home Makeover" show. They'll visit the Haas Technical Center and will learn how all this fits into the curriculum here at the Speed school.
Introduction to University of Louisville's Library Services	Who or what is the RRS?? The RRS (Robotic retrieval system) is the newest tool to aid in the storage and retrieval of many of the materials in the library. This session will introduce students to the RRS. They will also be treated to an instructional session on the benefits of using an electronic thesaurus and will be introduced to media resources and visit the new Digital Media Suite.
Operations Research	This session provides a general introduction to operations research (OR) and describe, in detail, how to formulate a few standard OR problems. The discussion continues with emphasis on engaging the students. The students then are taken to the IE computer lab and allowed to use the optimization software for a problem solving exercise.
Production and Manufacturing "Just in Time"	This module introduces the students to two principal methods of controlling production systems: (1) a "push" system and (2) a "pull" or "just in time" system. Through hands-on simulations, students experience the advantages and disadvantages of both control schemes for assembly

	line production. Students are divided into teams of three which physically simulate the production of the product (a book). Using different production control methodologies, the teams compete against one another to see which team can meet the customer requirements of (1) orders on time, (2) maximize quality, and (3) reduce (or minimize) scrap.
Road Map to a Successful College Experience and Career	This session will build on the True Colors exercises from the previous day and will provide opportunities for students to map out ways to be successful as you complete high school, enroll in college, and look forward to a rewarding career.
Structures—Reaching over Water and into the Sky	This session will be an introduction to the laws of physics through the eyes of a civil engineer. Ever wonder what holds up a bridge or why it has the shape it does? Ever wonder what goes into the design and construction of the world's tallest buildings? Student will study the effects of gravity, friction, compression and tension, all while working to design their own unique structures and sees whose design is the most effective.

The True Colors® Exercise

Along with introducing the high school students to various aspects of fields of engineering and technology, the INSPIRE program's non-engineering related sessions assist the students in identifying vocational interests and personality profiles. These outcomes may impact their learning style as well as the effectiveness of any interpersonal relationships, particularly for underrepresented minorities. Latham (1997) noted that as the face of America's classrooms changes, teachers and administrators are being called on not only to respect their students' diversity but also to capitalize on the possibilities that diversity presents for teaching and learning.

In the late 1990s, the INSPIRE director began the program with an activity entitled True Colors. True Colors® was founded in 1978 by Don Lowry. Based on the work of clinical psychologist David Keirsey, who studied the work of psychologists Carl Jung, Katherine Briggs, and Isabel Myers, Lowry theorized that all people fit into one of four broad categories of personality (Keirsey and Bates 1984). Lowry's True Colors® program asks participants to identify their "color spectrum" using four cards that represent key personality types: Blue, Gold, Green, or Orange. Each color has particular strengths and each analyzes, conceptualizes, understands, interacts, and learns differently. But these differences, if not acknowledged and understood, can become barriers to interpersonal communication, making understanding between people of different types difficult.

True Colors®, which expands upon Keirsey's four temperament types, translates complicated personality and learning theory into *"one of the easiest, most convenient*

ways of understanding and appreciating human behavior." However, True Colors® can be administered only by a True Colors® certified trainer. The director of INSPIRE has such certification, thus, she conducts this particular session. The program participants receive instruction and background information on True Colors® and are given the True Colors® printed materials. The content expands upon Keirsey's four temperament types while it translates complicated personality and learning theory into an easy and convenient way of understanding and appreciating human behavior. Students respond very favorably to the True Colors® session.

Other Program Features

INSPIRE students are provided with information on the college application process as well as the financial aid process. The students are instructed on the critical requirements of completing the FAFSA (free application for federal student aid) form. They also are instructed on the importance of high school course curricula, high school grades, and the impact of their performance on the ACT/SAT. In addition, the program participants receive guidance on building a personal portfolio, including such components as community service, extracurricular activities, arts and writing portfolios, transcripts, and letters of recommendation.

Over the years, the program has included field trips to selected area industries such as General Electric Appliance Park, the Louisville Water Company, North American Stainless, Toyota Manufacturing, the Metropolitan Sewer District's Floyds Fork Wastewater Treatment Plant, and Brown-Forman. Oftentimes the leaders of these industrial sessions are University of Louisville and J. B. Speed School of Engineering alumni. During these sessions INSPIRE students get to learn about the host company and how/where they use engineers. This component of the program provides students an opportunity to expand their understanding of what engineers do.

In discussions with the students after these field trips it has been revealed that, in many cases, these students had never before visited an engineering site and thus had never seen the types of projects that engineers are engaged in. By incorporating these off-campus field trips in the program, INSPIRE personnel are able to let these high school students actually see engineers at work. It is especially important for them to see females and minorities engaged in such important technical occupations.

INSPIRE Program Budget

INSPIRE is a low-cost, non-residential model. It is offered daily for half days and lasts three weeks in the summer. Significant costs are spared as a direct result of not having to house the program participants, and food expenses are at a minimum since major meals are not offered. In addition, the targeted cohort each year is capped at thirty participants. Faculty x-pay is typically the largest expense (~$2,500–3,500), followed by materials/supplies (~$2,000), refreshments (~$800), and transportation (~$400). Costs have risen in the thirty-year history of the program, but a low-cost program was always central to the mission. The approximate cost of the 2013 summer INSPIRE program was $7,500.

In early years of the program, the most expensive items were the refreshments and field trips. On the days where a field trip is scheduled, the transportation and refreshments are provided by the INSPIRE program. Other items in the budget were prizes for the students, t-shirts, and program materials. Each program participant is provided a notebook of various materials needed throughout the program (i.e., schedule, copies of session instructional materials, program surveys, etc.). Also, program brochures and applications are budgeted items.

Since 2009, thanks to the sponsorship of corporate donors, instructional faculty each receives a stipend of $400. These funds are often used by faculty for conference registration or professional travel. In earlier years of the program, such funds were not available for the faculty.

The faculty develops all instructional materials for their session as well as provides any needed lab items. Although some faculty choose to assign their respective graduate students as helpers in the laboratory portion of the session, these sessions also could be conducted entirely by graduate students or senior-year undergraduates.

This program model could be expanded easily to full-day sessions with or without it being a residential program. However, those decisions would have an immediate direct cost impact as well as increase the potential liability to the hosting university or college. Since a large proportion of the students who apply and attend INSPIRE are from the metropolitan Louisville area, there has not been a desire for such program expansions.

Impact of INSPIRE and Future Opportunities

An ultimate goal of the program is to increase the number of underrepresented minorities who pursue higher education for engineering. A secondary goal was enrollment at the University of Louisville. The Office of Institutional Research and Planning assists in tracking the students who subsequently enroll at the University of Louisville. Based on the most current records, which include fall 2012 enrollments, 854 students participated in the INSPIRE program between the years of 1981 and 2013.

Over the years the program has been adapted. Initially, INSPIRE enrolled forty students and the program lasted six weeks. After a few years it was noted that attendance decreased dramatically (due to family vacations, part-time jobs, and other summer commitments) typically after the fourth week, so the program dates were adjusted, and the three-week structure was implemented. Enrollment was also capped at thirty students, which reduced costs and simplified logistics such as transportation for field trips.

Table 5 summarizes the outcome and matriculation of the INSPIRE students from 1981 through 2013 by race/ethnicity. There were 522 students identified who enrolled in the university at some point, including forty-nine program participants who enrolled while still in high school as part of the university's high school visitor program. These 522 students represent 61 percent of our cohort. Of those 522 INSPIRE participants

who enrolled, 228 (43.67 percent) persisted and were awarded a degree from the University of Louisville.

The director has anecdotal evidence of students who participated in INSPIRE and later earned degrees from other institutions (in engineering fields), but the numbers were small, and it proved very difficult to track students who did not enroll at the University of Louisville. Also, as admission requirements continue to increase at the Speed School of Engineering, especially with regard to standardized test scores, the director has noticed the impact on former INSPIRE participants who have been denied enrollment to the engineering program. These students often enroll in the College of Arts and Sciences for pre-engineering or elect to pursue other college majors.

Table 5. Former INSPIRE Students who Enrolled at the University of Louisville by Race/Ethnicity from 1981–2013

Race/Ethnicity	Number of Participants Enrolled at the University of Louisville
African American/Black	248
Caucasian/White	207
Asian	47
Hispanic/Latino	12
Non-resident alien	4
Native American/Indian	1
2 or more races	1
Unknown	2
Total	522

There were eighty-seven (out of the 228) students awarded the bachelor's or master's degrees in engineering (38 percent) as seen in Table 6. In the early years of the INSPIRE program, students who enrolled at the University of Louisville also had the option of pursuing associate degrees in engineering. There were five INSPIRE participants who acquired an associate degree. Including these students, the percentage would increase to 40 percent. There were also other math/science based degrees granted among INSPIRE participants; namely, six medical degrees, six degrees in nursing, eleven degrees awarded in biology, seven in math, two in physical therapy, one in chemistry, one in Information Science/Data Processing and one in Computer and Information Systems.

Table 6. Selected STEM Degree Distribution of former INSPIRE students who enrolled at the University of Louisville from 1981–2013

Degree Program	STEM Degrees (from the University of Louisville) of INSPIRE Participants
Electrical Engineering	30
Mechanical Engineering	15
Engineering Math/Computer Science	13
Chemical Engineering	13
Industrial Engineering	9
Civil Engineering	6
Engineering Science	1
Biology	11
Medicine	6
Nursing	6
Mathematics	7

It is believed that the INSPIRE program has led to increased interest in engineering for many minority students and subsequent enrollment at the University of Louisville for many past participants. What is less certain is whether or not the students who participated in INSPIRE would have either chosen engineering or the University of Louisville had they not taken part in the program. Further research and analysis needs to be completed to ascertain a more definitive response from prior program participants. However, with respect to the goals of the program, it is successful at what it does—*enabling participants to acquire a degree of interest, proficiency, and understanding of the requisites for engineering*. Therefore, the student returns to high school with a much better understanding of what is offered at the university with respect to engineering and what they need to do to be ready to pursue such a career field.

Other opportunities for further research include the outcomes data analysis of the program pre- and post- survey information. Although post program surveys were always an integral part of INSPIRE, it was not until recently that a validated assessment tool for pre-engineering program in the form of a pre- and post-survey instrument was used.

Evaluation and Assessment

In evaluating the INSPIRE program, it was realized that while it does provide a solid, broad overview of engineering for students considering that career, it does not provide academic skills to help these students gain entrance into an engineering program nor

does it help ensure academic success. The INSPIRE program could be strengthened by incorporating a "second summer experience" for students truly focused on pursuing an engineering degree. These students would be invited back to the University of Louisville the summer before college enrollment and they would participate in RE-INSPIRE for six weeks. The program would focus on strengthening the students' math backgrounds (with pre- and post-tests) and study skills, and would allow the students to establish a sense of community. In addition to the attention placed on advanced math, these students would enroll in a section of College Writing (English 101), earning three hours of college credit. Such collaborative learning and community building would better prepare the students for the rigors of the engineering curriculum.

The basic INSPIRE program could continue, but it, too, should incorporate more academic preparation and perhaps focus on three engineering disciplines in more depth versus giving broad overviews of six areas of study. Civil, mechanical, and bio engineering would be three areas that could be focused on to provide the high school students with introductions to a variety of engineering possibilities.

Program evaluations, given on the last day of the program to each participant, indicate the INSPIRE program has been a success, particularly in increasing the knowledge about engineers, career opportunities within the field, and degree options within engineering at the university. The majority of the students rated the program as "very successful" in the post-program survey. Here is a sampling of participants' remarks when asked for other comments at the end of the questionnaire:

> "It was a new experience and I was allowed to meet new people and also see what engineers do. It gave me a motivating force to pursue engineering."
>
> "I really enjoyed this program. [I'm] still not sure if I want to be an engineer, but it [INSPIRE program] opened my eyes to new options."
>
> "This was a great program and I really enjoyed taking this class. I got to see the U of L campus so I'm going to apply to the Speed school in the fall."

When asked *"Would you recommend that your friends participate in this program?"* on the post-survey instrument, nearly 100 percent of the participants responded with *Yes*. When asked to explain why (or why not), the *Yes* responses included comments such as:

> ". . . because it is helpful for any student planning on going to college."
>
> ". . . I think it is a great learning experience, and it will help if you want to go into engineering."

The University of Louisville plans to continue conducting the INSPIRE program. Private corporations are committed to providing funding, at least through 2015, which ensures the continuation of the program at least through that year.

Conclusion

The number of professionals in engineering fields who represent minority populations (ethnic minorities and women) is increasing but not at an appropriate rate, as the engineering workforce is not reflective of the population. Continued early exposure to engineering as a discipline and conversations about the various paths to successful engineering careers are encouraged.

A low-cost, summer enrichment program for underrepresented minority students interested in the engineering profession has been discussed in this paper. With respect to its impact on minority engineering recruitment, the program has been one of the intervention strategies used at the University of Louisville to introduce underrepresented minorities to various fields of engineering. An overview of the Brown-Forman INSPIRE program, selected activities, costs, and outcomes were presented. Critical success factors, anecdotal observations, and challenges faced by program administrators were also noted. This model, or certain aspects, could be adapted to any university and used by other engineering schools to address the need to bring more underrepresented minorities into the pipeline for engineering-related career fields. The Brown-Forman INSPIRE program has introduced hundreds of young people to various fields of engineering and exposed them to a college environment. Future research could examine the impact of INSPIRE and other "pipeline" programs on college enrollment, degree selection/attainment, and workforce/career development.

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