

Assessment of an Engineering Outreach Program: Hands on Engineering

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The College of Engineering at North Carolina State University (NC State) has developed an outreach program using a unique presentation of interactive demonstrations. The program is used at school visits at levels K-12 across the state of North Carolina. How effective are such short-term visits to schools or by groups of students to campus? This paper presents a brief description of the program and summarizes assessment results collected from students, teachers and administrators at schools visited over the past three years. Over 3000 students and 100 teachers/administrators have been involved to date.

Assessment of program goals is essential to the ability of a university program team to obtain and maintain funding, whether from external or internal sources. Not all types of programs are easy to assess, however. Outreach is one type of program that presents some unique challenges in assessment. This paper describes the framework of assessment that has been put together for the engineering outreach program at NC State University. Sufficient motivation for assessment of any program is provided by the need to justify the continued funding of that program.

The first challenge in assessing an outreach program is to define what is meant by outreach. For the purposes of this paper, we contrast outreach with recruitment by distinguishing between the goals and expected outcomes of a particular program. Some programs have elements that contain both outreach and recruitment goals. These definitions will naturally vary among institutions somewhat. Outreach programs might have goals that include encouraging underrepresented groups to consider science, technology, engineering and math (STEM) careers, informing students and teachers about the fields of engineering, helping enhance K-12 science education, etc. Recruitment programs typically have very focused goals of encouraging students to apply to a particular university and/or a particular degree program.

The second challenge in assessing outreach programs is to enumerate expected outcomes that are measurable. A goal such as encouraging underrepresented students to consider STEM careers can be difficult to assess in terms of outcome. A focused longitudinal study of career choices made by students who have attended an outreach event at the K-5, or even the 6-12 level, is difficult. So how can one determine whether an outreach program is having a desired impact?

To establish a comprehensive plan for assessing outreach, the College of Engineering outreach office at NC State analyzed the goals of their outreach activities. The following table summarizes some of the various types of programs and the outreach goals established for each. Some of these programs may also have implied recruiting goals, which are not noted.

Type of Program	Contents	Outreach Program Goals
GK-12 Engineering Fellow in classroom once per week for 10 weeks	Engineering students in classrooms working with teachers and K-8 students ¹	1-Long-term teacher/school impact on science attitudes 2-Long-term impact on student science attitudes 3-Special emphasis on underrepresented groups
Visit to K-12 classroom	Hands-on engineering program ²	1-Encourage students to consider engineering fields 2-Role modeling
Expanding Your Horizons	Workshops and programs for seventh and eighth grade girls	1-Encourage girls to consider STEM careers 2-Increase self-confidence of girls
Campus visits, Spend a day in engineering	Hands-on engineering program and tours; spend a day with a student	1-Encourage students to consider engineering fields 2-Role modeling
Visit to K-12 school	Hands-on engineering assembly and/or career fair display	1-Encourage students to consider engineering fields 2-Role modeling
Middle school engineering camp	Week long teacher camp and week long student camp ³	1-Encourage students to consider engineering fields 2-Impact teacher attitudes and pedagogy 3-Role modeling
High school engineering camps	Several week long residential student camps	Encourage students to consider engineering fields

Once the goals had been established, it became possible to plan ways of measuring the success of each program at achieving its goals. Traditionally, only anecdotal data in the form of letters and emails had been collected. While these provide valuable information about the program impact, they are not sufficient to consistently assess long-term affects. Immediate surveys can assess whether the program was well received, but, again, cannot give long-term data.

Most of the outreach programs at NC State have as a goal informing about and encouraging students to study engineering. Every program has as an underlying goal the encouragement of underrepresented groups and role modeling. Role modeling is done by carefully selecting the presenters. Most presenters have received training in presenting to diverse audiences, but gender and ethnicity issues are never discussed unless a student asks a question. Most presenters are female or belong to an underrepresented ethnic group. In addition, presenters are careful to choose a diversity of examples that will appeal to a wide variety of students. (For example, consumer items like CD players are used as examples of engineering design rather than racecars.)*

The outreach assessment plan for the College of Engineering presently consists of several companion elements. What can be measured is measured, but anecdotal data is also collected. The following table summarizes the types of assessment used with each event. An X indicates that the assessment is currently used and an O indicates that this type of assessment will be instituted in Spring 2002.

	End survey of students	End survey of teachers	End survey of parents	Four month survey of teachers	Collect letters/ emails	Collect school data	Freshman student survey
GK-12 Fellow in classroom	X	X	X	X	X	X	
Single visit to K-12 school	O	X		O	X		X
EYH	X						X
Spend-a-day	O	X		O	X		X
Middle school engineering camp	X	X	X	X	X		
High school engineering camps	X				X		X

* One program was inadvertently so successful at role modeling (each of three presenters was female) that one of the questions at the end of the session was whether boys could be engineers too.

One of the most comprehensive sets of data collected so far is from a survey given to entering freshmen students asking them to rate the effect various recruiting and outreach programs had on their decision to come to the College of Engineering at NC State. The results of questions concerning programs whose primary focus was outreach are enumerated in the table below. Students were asked to first indicate whether a program had an influence on their decision to study engineering (at NC State) and then to rate the influence each program had on their decision on a scale of 1 (some impact) through 5 (large amount of impact). This means that the group is (obviously) composed of students who have already made the decision to come to NC State. No data were available for students who did not come to NC State. The table lists the average “influence score” of those who indicated that a particular program had an impact on them. The numbers responding that the program impacted their decisions are in parentheses. The total number of surveys returned was approximately 600.

	“Influence score”	Number Noting Influence
Fellows in classroom	N/A	N/A
Single visit to K-12 school (combined classroom and school-wide visits)	2.7	155
EYH	2.75	4
Campus visit/Spend a day	3.58	97
Middle school engineering camp	N/A	N/A
High school engineering camps	4.2	66

The middle school camp and GK-12 Fellows program are too new for any attendees to have come to NC State as freshmen. Note that the Expanding Your Horizons (EYH) conference is for middle school girls, so the respondents that said it influenced them were recalling influence from seventh grade to college.

For the GK-12 Fellows program the goals are much more stringent and include long-term effects on students and teachers. Student, teacher and parent surveys have shown that this multi-hour contact program has indeed had significant long-term affect on all constituencies. This program assessment is summarized in reference [1]. The assessment measures include tracking numbers at schools like test performance, science fair participation, teacher enrollment in science training, use of content by teachers in classroom, the numbers of science-related questions asked by children, etc.

Some of the programs have comprehensive assessments associated with them. In particular, the middle school camp is addressed in reference number [3]. One additional assessment has been to ask the six teachers in the middle school camp if their experience has affected the way they teach this year; all six teachers noted a significant influence. One teacher has used several of the projects developed for the camp in her classroom this year.

For outreach events that consist of one or two visits to a K-12 school in a year, statistics are collected on how frequently the school asks for repeat visits. In addition, anecdotal data are collected from teachers and counselors. Of the schools where single visits are made in a year's time, data has indicated that these visits are most successful in long-term impact when teachers/counselors follow-up. One school in particular has a counselor that meets with students on a regular basis and even videotaped the presentation for repeated use. At this high school, the counselor reported that from the first year of presentations, four students that were not previously considering engineering (of the forty students who attended) have decided to consider an engineering degree program. Of the second year of presentations, eight students have enrolled at NC State. Of these, two had never heard of engineering before the presentations, and two were not considering engineering as a career.

In summary outreach programs can be very difficult to assess in a meaningful way. NC State College of Engineering has put together an outreach assessment plan that has started to produce results. Data showing that outreach can have long-term affect on students and teachers are much needed for every program. Preliminary results indicate that outreach can have an effect. More data will continue to be collected from the large numbers of students and teachers that the outreach program touches each year.

References

[1] Bottomley, Laura J. and Elizabeth Parry, et al., " Lessons Learned from the Implementation of a GK-12 Grant Outreach Program," Proceedings, 2001 ASEE Annual Conference, Albuquerque, NM.

[2] Bottomley, Laura J. and Elizabeth Parry, " Illuminating Engineering," Proceedings, 2000 ASEE Annual Conference, St. Louis, MO.

[3] Bottomley, Laura J. and Elizabeth Parry, "A Summer Engineering Camp for Middle School Students," Proceedings, 2002 ASEE Annual Conference, Toronto, Canada.

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