

AC 2007-2723: IDENTIFYING FACTORS AFFECTING PERSISTENCE RATES AMONG UNDERGRADUATE ENGINEERING STUDENTS FROM UNDERREPRESENTED POPULATIONS AT THE UNIVERSITY OF VIRGINIA

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Identifying Factors Affecting Persistence Rates Among Undergraduate Engineering Students from Underrepresented Populations

Abstract

The literature abounds with descriptions of factors affecting persistence rates both positively and negatively among undergraduate engineering students from underrepresented populations. For the purposes of this study, the relevant underrepresented populations are African American, Hispanic American, and Native American. Some of these factors universally affect all students, and others are specific to a school of engineering's culture. We propose a survey to identify the factors most significantly affecting persistence rates at the School of Engineering at the University of Virginia (U.Va. SEAS), the developmental form of which is presented in this paper, as the first step in creating retention programs that will work effectively in our institutional culture.

Keywords: Persistence, retention, underrepresented populations in engineering

Introduction

Research into the factors affecting persistence among undergraduate engineering students from underrepresented populations addresses a critical need. There is a well documented gap between the demand for technically educated professionals needed to maintain the United States' competitiveness in science and engineering and the supply graduating from U.S. schools and colleges of engineering.¹ Overall, domestic demand for engineers and computer scientists is predicted to rise by 36% by 2010, yet the number of engineering baccalaureate degrees granted by colleges and universities in the U.S. was off in 2004 by 20% from the peak number in 1985. And the national retention rate in engineering, as of 2006, is 48%, a rate that has remained relatively flat for over a decade.² No student population demographic can be neglected in the effort to close the supply-demand gap. Historically, certain populations – African American, Hispanic American, and Native American – are underrepresented in engineering in proportion to their numbers in the general population due to many cultural, social, and academic factors. (see, for example,³) These populations also represent “the largest untapped resources available to help maintain and/or increase engineering enrollments”⁴ although they, regrettably, enroll in engineering studies in smaller numbers and leave in larger numbers than students from other populations.⁵ Consider, too, the fact that it is more cost effective to retain undergraduate engineering students than to recruit them.⁶ It is therefore imperative to identify and incorporate the factors most affecting persistence – both “leaving” and “staying” factors – among students from underrepresented populations into retention initiatives in order to increase the probability of the initiatives' success.

There are several ways to elicit information regarding the factors most significantly affecting persistence rates: observation, interviews, focus groups, and surveys. We choose to start with a survey for several reasons. First, a survey is the most efficient means for quickly collecting a standardized set of data that can be used to structure future research efforts. Second, the survey will purposefully support a mixed methods (a combination of quantitative and qualitative

methods) research design. The quantitative data will help us develop generalizable conclusions, and the qualitative data will help us to identify factors influencing persistence at the individual level. Finally, we would like to build on the results of a survey conducted by the Engineering Student Council (E-Stud) in Fall, 2006, at the request of the School of Engineering and Applied Science (SEAS) Dean's office, to determine why respondents left SEAS. We are interested in determining how the persistence factors cited by the literature play out at the University of Virginia (U.Va.) as well as identifying the persistence factors unique to our institution's culture so we may make the most effective recommendations regarding retention initiatives.

First, a clarification of terms. A student persists in a course of study; a program retains a student. The focus of the literature on retention presents research and findings from the programmatic point of view; the focus of the literature on persistence studies the factors influencing a student to remain in a chosen discipline. Regardless of the point of view, there are basic factors affecting student persistence/retention in undergraduate engineering studies: self confidence,^{7,8,9} attitudes towards engineering,^{9,10} quality of instruction,^{11,12} and the quality of the college experience.¹⁰ Additional factors influencing the persistence of students from underrepresented populations include feelings of isolation and perception of a hostile environment.⁵ The main predictors of success in engineering studies, grades (high school, for first year students and core courses, for first and second year students) and SAT scores, are not to be confused with predictors for persistence, for a student does not need a high GPA to remain in engineering studies.^{7,11,13} For that reason, studies that conclude that predictors of academic success are important predictors of persistence (see, for example, ⁶) should be viewed critically to ensure that confounding variables are not considered in analysis.

Survey Development

The proposed survey's development is guided primarily by two sources. The first source is the findings from the aforementioned SEAS E-Stud "leavers" survey, which provide partial confirmation of "leaver" factors cited in the literature. The E-Stud survey will also help us to identify "specific to U.Va." factors. The second source is results from a review of the pertinent literature. Citations such as ⁹ which provide sample validated survey questions are very helpful in the development process.

There are two intended audiences for the proposed survey. The first audience is current SEAS undergraduate engineering students from underrepresented populations; we would like to identify factors supporting their persistence (i.e., why are they "stayers"). The second is former SEAS undergraduate engineering students from underrepresented populations; we would like to identify the factors that led to their leaving the study of engineering (i.e., why are they "leavers").

E-Stud Survey Results

The majority of respondents to the E-Stud survey (*n* not specified but is assumed to be a minimum of 49, based on the number of responses to a question eliciting "other reasons not mentioned") cited lack of flexibility in the curriculum (73.6%) as the main reason they left SEAS. An analysis of responses on this topic indicated that the respondents may have been

likely to stay in engineering if the curriculum had been flexible enough to allow them more opportunities to take courses in the humanities and social sciences. Other significant responses are:

- the type of work or concentrations offered were not a good fit
- the school was different from what was expected
- the school did not meet expectations
- lack of personal attention
- required courses irrelevant to ultimate goal
- lack of support for ANY (emphasis students’) creativity

No demographic information about the respondents was provided, so we cannot determine “leaving” factors specific to students from underrepresented populations from the survey responses.

Survey Questions

The demographic data will help us stratify and analyze responses by race, gender, economic, and academic class.

Tell us about yourself. While we would appreciate answers to all of the questions, answering them is optional.	
I am a	_____ 1 st _____ 2 nd _____ 3 rd _____ 4 th _____ 5 th year student
I gender identify as	_____ female _____ male _____ other
My main ethnic identification is	_____ African American _____ Hispanic American _____ Native American _____ other
My education is funded by	_____ % me _____ % parent/guardian
I self identify my family as	_____ “blue collar” _____ “white collar” but not executive _____ executive level _____ other
If you left SEAS, please indicate when:	_____ class year _____ semester

A Likert scale of 1 = strongly disagree to 5 = strongly agree will be used to elicit answers to the following questions.

Self Confidence

1 st years:	I am prepared to complete my basic math and science courses successfully. I am confident in my ability to complete my coursework in my basic science courses successfully.
2 nd /3 rd years:	I am prepared to complete my major courses successfully. I am confident in my ability to complete my coursework in my major courses successfully.
4 th /5 th years:	I am prepared for the professional practice of engineering. I am confident in my ability to be a successful practicing engineer.
All:	I am secure in my abilities to succeed academically. I am secure in my abilities to succeed personally.

Attitudes Towards Engineering

I enjoy the study of engineering.
I study engineering only because I want a good job when I graduate.
I have a positive awareness of the general practice of engineering.
I have a positive awareness of the practice of engineering in my (intended) major.

Quality of Instruction

My professors in the following courses were competent: in my core courses, overall in my major courses, overall in my electives, overall in my Science, Technology, and Society (STS) courses; repeat for teaching assistants

My professors in the following courses were caring: in my core courses, overall in my major courses, overall in my electives, overall in my STS courses; repeat for teaching assistants

I basically had to teach myself in the following courses: in my core courses, overall in my major courses, overall in my electives, overall in my STS courses

Quality of College Experience

I received the faculty mentoring I needed to succeed.
I received the peer mentoring I needed to succeed.
I received the academic advising I needed to succeed.
I received the career advising I needed to succeed.
I received the tutoring I needed to succeed.
I believe the faculty is dedicated to my success.
I believe the administration is dedicated to my success.
I believe my major department is dedicated to my success.
I am happy with the opportunities provided by the Career Office.
I'm personally happy to be in SEAS.
I'm personally happy to be at U.Va.
I'm happy with the quality of academics in SEAS.
I'm happy with the quality of academics at U.Va.
I'm happy with my extracurricular activities.
I have the flexibility in my schedule to take the electives I want to take.
My instructors support my need to be creative.
My curriculum supports my need to be creative.
I have a strong peer group that supports me personally.
I have a strong peer group that supports me academically.

Finally, we will provide respondents the opportunity to add structured and free-form comments and observations. These qualitative data will be analyzed to determine additional factors affecting persistence among our target populations. The results will also be used to formulate questions for follow-up through interviews and focus groups. The questions are listed on the following page.

Initial Survey Validation

This version of the survey was subjected to both face and content validation by its developers. “Face validation,” or the physical appearance of validity, is assessed by evaluating whether the instrument in question is believed to capture the intended information.¹⁴ “Content validation” refers to the instrument’s ability to provide a representative sample of the subject matter under study.¹⁴ Based on our experience and familiarity with similar surveys, we believe that the survey questions will elicit the expected data.

For those who stayed in engineering: what are the major influences or factors keeping you in engineering? What, if anything, would make you leave the study of engineering?

If you stayed at U.Va., what were the major influences or factors keeping you here? If you transferred to study engineering another university, why did you transfer?

For those who left engineering: what were the major influences or factors in your decision to leave engineering? What, if anything, would have made you stay in engineering?

If you stayed at U.Va., what were the major influences or factors keeping you here? If you transferred to another university, why did you transfer?

For all: would the opportunity to participate in research as an undergraduate have any influence on your decision?

Do you anticipate working in engineering or a related profession after graduation?

If so, for how long? If you plan a short career (> 5 years), to which career path do you plan to switch?

If not, in what field do you plan to work? Will you need graduate education to accomplish your career goal?

Any other comments? Thank you so much for your honest responses!

Future Work

Future work includes the piloting, modification, and further validation of this survey; administration and analysis of this survey, including obtaining IRB approval; the extension of the survey to identify factors influencing persistence among graduate engineering students from underrepresented populations; and performing principal components analysis (PCA), as the data warrant, to determine the most influential factors to evaluate. The ultimate outcome is the development and implementation of initiatives to support the influence of positive factors and ameliorate the effects of negative factors. With the information provided by the survey, we will be able to build institution-specific programs based on proven retention strategies such as cooperative learning^{15,16,17} and learning communities,¹⁸ but tweaked to our institutional culture and the needs of our students from underrepresented populations. We will also use the

information to strengthen and expand our popular high school to 1st year bridge, or transition, program in both numbers and in years covered (i.e., 1st to 2nd year and 2nd to 3rd year BRIDGEs).

We will enlist the help of the local chapters of the National Society of Black Engineers (NSBE) and the Society of Hispanic Professional Engineers (SHPE) in survey administration.

Acknowledgments

We thank the reviewer for his/her comments, the SEAS Dean's Office for permission to use the referenced survey results, and the students and staff of the Center for Diversity in Engineering for their dedication.

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