
AC 2011-1742: "SUCCESS IS DIFFERENT TO DIFFERENT PEOPLE": A QUALITATIVE STUDY OF HOW AFRICAN AMERICAN ENGINEERING STUDENTS DEFINE SUCCESS

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“Success is Different to Different People”: A Qualitative Study of How African American Engineering Students Define Success

There have been many calls to build the Nation’s STEM workforce by attracting and educating more students in academic STEM programs.¹⁻⁴ Much of the emphasis has been placed on building more diversity in STEM (Science, Technology, Engineering, and Mathematics) fields by focusing attention and resources towards building equitable representation of STEM graduates among under-represented groups.^{2, 3, 5} One potential pitfall to establishing more diversity in STEM fields may be a lack of understanding of the differences among our under-represented and under-served groups. In particular, it may be important to understand whether or not there are differences in how under-represented minority (URM) engineering students define personal success as compared to majority engineering students. Understanding these potential differences may enable university administrators and faculty to educate and support these students in relevant ways that enhance their ability to succeed.

This analysis was drawn from a larger study that employed interdisciplinary, mixed-methods to identify factors contributing to the successful retention and graduation of under-represented and under-served minority engineering students at a predominately white research institution. URM engineering students participated in face-to-face interviews designed to engage them in reflection and discussion of their lived experiences as engineering students. From this larger data set, a demographically diverse set of 20 African American engineering students were sampled to address the research questions: How does self-defined success relate to academic performance of successful African American engineering students? What demographic factors contribute to how success is defined?

Responses were thematically categorized, numerically analyzed, and viewed through the lenses of social-cognitive and goal theories to more easily interpret the influence of differentiating factors in students’ definitions of personal success. The majority of engineering students’ definitions centered on graduating college, overall happiness, career, family, or money, and most definitions contained multiple themes. Though there was no apparent relationship between academic performance and the definitions of success, relationships related to gender, parental education, community size, and engineering discipline appeared to emerge.

Introduction and Background

It is no secret that global powers such as China and India are technologically advancing at a substantial rate, leaving the United States susceptible to being overtaken technologically.⁶ Many have suggested that a potential reason for the US’s technological demise is the shrinking of its STEM workforce.^{7, 8} However, in 2006 only 4.7% of the engineers in the US were African American or Hispanic Americans which is perplexing considering the fact that they also represented 28% of the US population that very same year. Research has long suggested that the inclusion of untapped resources such as women and underrepresented minorities in STEM may be the answer to this critical problem.^{1, 2, 6, 8, 9} President of the National Academy of Engineers (NAE), William A. Wulf, called for diversity in the STEM workforce, citing the creative potential brought on by what he called “individual diversity”.¹⁰ Armed with this revived attention on STEM diversity, many of the nations colleges and universities have focused on increasing their URM participation. However, are they really prepared for it? Unfortunately, statistics say otherwise. URM students enrolled in predominantly white colleges are among the lowest

academic performers, least persistent, and fewest graduated STEM majors.⁵ Seymour and Hewitt investigated reasons for low persistence among URM undergraduate students pursuing STEM majors. This ground breaking study employed a qualitative methodology involving face-to-face interviews that allowed an in-depth understanding of the struggles inhibiting the persistence of URM undergraduate STEM majors by allowing them to discuss their lived experiences on predominately white campuses.¹¹ This seminal study established that URM's experienced the hardships of majority student persistence as well as additional issues such as poor high school preparation, over confidence, feelings of isolation, poor student-faculty relationships, and internalizing blame for poor academic performance. With these common struggles established, newer studies began focusing on identifying factors of success (rather than failure) using more quantitative approaches.^{4, 12-15}

The Research Institute for STEM Education (RISE) combined the use of quantitative and qualitative methodologies to better understand the successful persistence of URM engineering students. Like Seymour and Hewitt, the methodology for this study also included face-to-face interviews to allow common struggles and strategies for success to emerge from the student's own lived experiences. While the study focused on successful URM engineering students, unlike the aforementioned study, it's participants were disaggregated into four URM and underserved-minority (USM) groups (American Indian, African American, Asian American, and Hispanic American). This approach was believed to promote both broad research identifying similarities across URM groups¹⁶ as well as more specific studies conducted within each individual ethnic group.¹⁷⁻²⁰ To this point, insight has been gleaned from the stories of successful American Indian, Asian American, and Hispanic American undergraduate engineering students at this particular institution, however African American experiences have yet to be captured.

African Americans have long been among the most vocal advocates for education amongst URM populations. Their visibility has allowed many black students to benefit from academic and financial opportunities within predominantly white engineering institutions in the US. However within these institutions, African American students have historically persisted poorly.⁵ Research pointed to the K-12 "achievement gap" that exists between Black students and their White and Asian counterparts which is spearheaded by a plethora of reasons including poor schools, poor preparation, lack of interest, and disidentification with academics.²¹⁻²⁵ While reasons for poor persistence among African American students are well documented, strategies for successful engineering persistence are somewhat less prevalent. Studies of successful African Americans are often quantitative, broader in terms of academic major, or related to the high school experience.^{13, 26, 27} Furthermore, these studies often define success for the student with quantifiable measures such as academic achievement, persistence, or graduation.

Merriam-Webster's online dictionary defines success as a "favorable or desired outcome"²⁸, and while educators and researchers may feel we understand what students view as "favorable or desired", the constructivist approach of qualitative research teaches us that the students construct their own meanings. "Outcomes" can be seen as synonymous with goals, which are central to how success is defined. The way goals are set is central to goal theory, and there are two types of settings: assigned, and self-set. Goal theory suggests that for assigned goals, there is a positive relationship between goal difficulty and task performance; it also suggest a positive relation ship between task specificity of goals (i.e. targeted goals vs. "do your best" goals) and task performance.³⁰ However, when compared to assigned goals, self-set goals were found produce

higher task performance outcomes.²⁹ Hollenbeck & Brief (1987), found individual differences play a role in the goal setting process³¹, while Dweck and Leggett (1988) utilized a social-cognitive approach and implied that individuals have implicit goal orientations, that govern their approaches toward goal setting. In their study, goal orientation are broken into two types, performance and learning (or mastery) goals. Performance goal orientation (or helpless goals) elicit competition, seek to prove competence and avoid showing incompetence, while mastery goals seek to increase competency, understanding, and appreciation.^{31, 32} The aforementioned studies suggest that individual differences may impact goal orientation of mastery vs. performance goal orientations, finding that mastery goal orientation is preferable to performance goal orientation due to its lack of reliance on high-perceived task competence. In other words, individuals with lower perceived task competence perform at lower levels with performance goals than they do at mastery goals, while individuals with higher perceived task competence perform well at performance goals.²⁹ In the researcher's experience, performance goal orientation is employed by many African American engineering students on predominately white campuses. This orientation is perhaps induced, as African American students are often confronted with stereotype threatening situations in which they feel that they must prove their competence to disprove commonly held negative stereotypes about students of color.³³ The sociocognitive theory suggests that humans develop implicit schema from observing others, which seem to imply that experiences that contribute to existing schema may contribute to the human goal orientations. This study intends to gain understanding of the meaning of the success as it relates to a group of African American undergraduate engineering students, how select demographic characteristics may provide insight to this meaning, and the relationship between meaning of success and academic achievement through the lens of goal and sociocognitive theories.

Subjectivity Statement

Before proceeding it is essential to communicate any subjectivities that my bias, unbalance, or limit this research. As an African American engineering alum who has amassed experience as a student, mentor, director, and teacher of students in the STEM fields, I have a keen interest in subject matter related to success among African American students in STEM. It is my personal belief that among other things, there is much to learn from the lived experiences of successful students. While I consider my ethnicity and experiences strengths due to the insight they bring to the interpretation of student lived experiences, those same strengths can also be seen as limitations. Inherently, with my ethnicity may come potential racial biases that could impact interpretations of the student lived experience. My experiences may limit my understanding of people with dissimilar backgrounds than I, potentially causing subtleties related to dissimilar experiences to be overlooked or wrongly interpreted.

Methodology

In the following sections we first provide detailed demographics of the 29 students to demonstrate the wide range of backgrounds and experiences these students bring with them to college.

This semi-longitudinal study is a largely qualitative. It utilizes interview, survey, and academic transcript data of 20 African American undergraduate engineering students. Students were invited to participate during their sophomore, junior, or senior years and were repeated annually

until graduation. Between the fall academic semester of 2005 and the to the spring semester of 2007, semi-structured interviews were conducted. Interviews ranged 60-120 minutes in length. To provide longitudinal perspectives, in several cases multiple interviews were completed a year apart. Each interview was transcribed and coded for analysis. Interview transcript data provides student responses to the question “what is success to you?” Due to the overwhelming amount of data, traditional manual methods of qualitative analysis were not practical. For this reason, QSR©’s NVivo 8 computer assisted qualitative data analysis software package was used to facilitate this analysis. NVivo 8 was used for data storage, content analysis, and thematic analysis. NVivo provides tools for coding and categorizing as well as frequency counting. Survey data is comprised of demographic information as well as results from an engineering attitudes survey that was collected from participants via a preliminary questionnaire taken from a broader ethnographic study of factors contributing to undergraduate persistence in engineering collected by RISE.¹⁶ The interview transcript data provides student responses to the question “what is success to you?” Survey and academic transcript, this data was used to provide demographic information used to identify potential relationships between their responses, their grades, and their background. Participants represented a demographically diverse sample well distributed across gender, discipline, parental education, community type, high school graduating class, and college GPA. Among this sample the distribution of parental education is vastly different from that of the US African American population. At least one parent in each household had college experience. Table 1 below represents the characteristics of the sample.

Table 1. Sample Characteristics of African American Engineering Students

Males	11
Females	9
College GPA	
<2.99	9
3.0-3.49	5
>3.5	5
Missing information	1
Parental Education Level	
4yr Degree or above	11
2yr Degree	2
Some College	4
Graduated High School	2
Missing information	1

Responses from eleven males and nine female African American undergraduate engineering students were analyzed. Forty-five percent of the sample earned a college GPA of 2.99 or below (9 students), 25% earned between 3.00 and 3.49, while another 25% earned between 3.5 and 4.0 GPA.

Using a qualitative software package (Nvivo 8), each transcript was analyzed for each student’s response to the question “what is success to you?” As responses were then analyzed, the

following nine categorical success definition themes emerged from the data: graduating, happiness, family-related, job/career related, money related, learning related, formal success definition, knowledge application, and other. These themes were organized in groups, then compared to select demographic data to identify potential relationships and described through the lens of goal theory and sociocognitive theory. Available demographic data tables were reduced to the select categories of gender, engineering discipline, parental education level, community type, and high school graduating class size as variables that may provide insight to individual differences among participants', implicit mental schema, and consequently their goal orientations.

Results & Analysis

Emergent themes from student self-defined success definitions are represented in the table below. Note that the majority of student responses contained multiple themes. This explains why the total number of themes is greater than the number of students participating.

Table 2. Self Defined Success Themes

Graduating	10
Happiness	9
Family Related	8
Job/Career Related	8
Money Related	7
Learning Related	6
Formal Success Definition	6
Knowledge Application	3
Other	8

The most frequent themes found were graduating (10), happiness (9), family-related (8) and career-related definitions (8). Once data was categorized into emergent themes, the themes were sorted vs. the select demographic categories to analyzed for potential alignment. Strong cases for alignment between select demographic factors and self-defined success definitions were not found, however an interpretation of a relationship between self-defined success themes and goal orientation appeared to emerge. Graduating, job/career related, and money related goals were related to performance goals, while learning related, and knowledge application themes were related to mastery goals. Remaining goals such as happiness and family related goals could not be categorized into the two goal orientation types, however they may provide insight to the individual differences that contribute to goal orientation. The following sections will further describe the researcher interpretation of these relationships through the lens of goal theory.

Performance Goal Oriented Responses

Dwek & Legget (1988) suggests that performance goal orientation for self-set goals is the more superficial of the two goal setting types. Performance goals are seen to be more superficial, and lack the desire to gain skill or competence that mastery orientation has. Response definitions with goals that implied performance rather than mastery were considered performance goal

oriented. Themes related to graduating, finding a job, and making money were interpreted as performance goal oriented because they did not imply increased competency or understanding.

Graduation related responses

Half of the students cited graduation in their definition for success with no reference to learning, gaining competence, or becoming an engineer. The following passages express the sentiment of several:

“In general I think it’s just as far as college probably just getting that degree. That’s a really big step. You know that you’ve accomplished something. There are a lot of people that don’t get that opportunity, and a lot of people that do get the opportunity and waste it.” (Male Civil Engineer)

“I don’t think I’m successful until I actually get the degree. Until then, I think I am still struggling by. Because at anytime I could change my major, I know I am not because that is what I want to do and that is what I want to be. I want to leave the University of Oklahoma with an electrical engineering degree. That is my goal. As soon as I get that, then I will believe I am successful at this college.” (Female Electrical Engineer)

In the passage above, the student is even more specific about her goal, yet she seems to think she could change majors at any time. This response seems to symbolize a potential lack in perception of competence within her major. In previous studies this trait has been recognized as one shared by performance-oriented individuals. For some, graduation was the primary and most prevalent objective, while for others it was simply the first goal before moving on to the next like for this student:

“Like I guess success with what you are asking is like yes graduating from college will be successful, but also I see success in your life after college” (Male Electrical Engineer)

In the passage above, the student sees graduation as success, but also seems to consider life after graduation. While his sentiments appear to hold a bit more long term outlook for success, one in which seems to imply a success independent of graduation, he doesn’t specify what else he defines success as. Given the difficulty of persisting in engineering relative to other fields, graduating may be considered a difficult and specific goal, which has been found to relate to higher task performance, however when graduation used as a self-set definition of success, it implies that success is based solely on the task of receiving a degree which proves competence rather than the gaining of competence.

Job/Career and Money

Responses related to job/career and money related themes were often intertwined with other more primary goals, for this reason these goals were seen as auxiliary. However, as with graduation-oriented definitions of success, they were also classified as performance orientation due to their more superficial task oriented implications. The following passage exemplifies how these types of goals were used in combination with more prominent goals:

“As soon as I step out of here [college] step right into the office [work], and start working, so now I can reap some of the benefits that have been passing me by as far as like seeing my friends doing all their stuff. That will be real nice Happiness” (Male Industrial Engineer)

Here this student is merely expressing a need to get a job, not necessarily to be an engineer, but to simply work to make good money. These goals, while a necessity to live, represent a simple performance task of getting a job that lacks the depth of meaning beyond simply making money.

Mastery Goals

Mastery goals are those that seek to enhance competency and build new knowledge. Those who exhibit mastery goal-orientation have higher task performance, focus more, and overcome obstacles better than performance oriented students due to their view of failure as a learning experience rather than a lack of competence.³⁴ Several students defined success for themselves in terms of mastery goals of either learning or applying knowledge. These student transcripts seemed to have maturity jumping from the pages. This type of maturity is embodied by the statement below in which the student realizes he could learn more from a course he earned a “C” in than he had in any course in which he earned an “A”:

“I would like to say that or just like getting an A in class, but I’ve sort of learned now it’s not about so much success, as I guess, it’s how the success relates to me. But about conventional success as how much you can take from an experience, how much you can learn in a class. Like, there’s one class I recently took, and I made a C in the class, but honestly I learned so much in that class I learn much more than any other class [I made an A in]. So I think success is how an experience changes you, how your outlook changes based on that” (Male Aerospace Engineer)

While the passage above provides a direct example of mastery goals from an academic performance perspective, the statement below provides a more general take, but still exemplifies mastery goal-orientation:

“Success means learning something, learning a lot of stuff that I didn’t know, like, coming into this, and being able to apply those concepts to everyday life situations.” (Female Computer Engineer)

All emergent themes weren’t characterized as either performance or mastery goals, some had to be placed in a separate category. The following themes had to be considered differently

Happiness & Family related responses

The next most frequent theme used by students to define success was happiness, which was described by nearly half the students in the sample. Here, a chemical engineer defines success as a real-time happiness:

“Success. Um, success is being happy where you are. Like, if you can reach a point where you don’t regret anything, or, if you do regret anything you have come to terms then that’s success.” (Female Chemical Engineer)

Here an interaction between the student and interviewer illustrates a more general expression of happiness as success:

“P: Hmm, success means being happy.

I: Being happy?

P: Being able to enjoy yourself. I guess, it doesn't necessarily mean money. Um, like-I don't know, the best thing for me is just being truly happy, I guess.” (Male Civil Engineer)

Students often defined success in terms of family as well. Students who defined success in terms of family seemed to keep it as more focal point, rather than auxiliary as evidenced by these responses:

“Um, well, I think that I'm successful because you know I have a happy, healthy family and then you know the degree and the job. Those would definitely be my top things.” (Female Chemical Engineer)

“I guess being able to provide for my family.” (Female Computer Engineer)

While happiness and family were prominent themes used by students when defining success for them selves it was unclear whether these types of goals could be considered performance goals or mastery goals. Perhaps these definitions inform the implicit schema of the participants, providing an understanding of what they hold most important, calling for a mechanism that helps us determine how these goals may contribute to the development of a specific goal orientation. With emergent themes now explored, the following section will attempt to construct meaning for these observations and provide implications.

Discussions & Conclusions

African American engineering students have historically persisted unfavorably at predominately white institutions (PWI's), however this group was able to overcome the odds. To understand their success, the students were interviewed about their lived experiences as undergraduate engineers at a PWI. This research sought to learn more about how these students became successful by understanding their definitions of success and viewing their responses through the lens of goal theory and sociocognitive theory. Analysis of their definitions of success revealed several themes, which were assigned as performance or mastery oriented goals. While mastery goals are considered by the research to be the optimal goal type, several of these successful students responses indicated a lean toward performance goal-orientation. Though performance goals are not seen to be as inclusive as mastery goals, the presence of performance goal orientation along with academic success may indicate higher perceptions of task specific competence. These students were largely from households where at least one parent had some college experience, which may have been a strong contributing factor in their success. A perception of high task specific competence may come from the capitol acquired from being raised in households with college experience and/or high school performance and preparation. However, given the understood K-12 achievement gap, as well as the tendency for minority students to arrive at PWI's over confident and under-prepared, perhaps performance goals are fools gold for these students and mastery goals should be more pronounced as a goal orientation style and in undergraduate engineering curriculum. While some understanding was gleaned from

how these students defined success for themselves, more knowledge of upbringing, classroom environment, and peer interaction could lead to a greater understanding of goal orientation, goal types, and socio-cognitive influences on success of African American engineering students.

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