

“Out of the Classroom Experiences”: The Importance of Qualitative Experiences in Student Academic Success

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Abstract

Over the past decade the total enrollments for engineering students at the Nation’s colleges and universities has declined significantly. Although there are many reasons expressed why this decline has occurred, few focus on the qualitative and “out of the classroom” challenges college and university students face while pursuing engineering degrees at our nation’s institutions. Many of these challenges mirror issues of society-at-large but are sometimes overlooked by professionals who deal with these students.

To facilitate a student’s personal journey toward enhanced development and transformation, engineering professionals must keep in mind that many of the experiences encountered by students create some cognitive dissonance and challenge thought patterns, behaviors, and self-identity. To respond more effectively to their needs, the professional focus must support a student’s need for a sound identity and awareness of issues that might impact their academic performance. Some of their issues might include academic, economic, motivational, family background, societal, diversity, and values challenges. Although these challenges are very complex, maintaining a comprehensive and developmental approach is extremely important. It is important because a student’s future and retention in engineering will depend on how they handle academic/personal issues that impact their performance as well as mastering the academic challenges encountered in the classroom.

In an effort to deal with some of these issues more effectively, Minority Engineering Program administrators at the University of Illinois at Chicago developed an academic tool titled “Roadmap to Academic Success”. This roadmap can be used by professionals and students to identify appropriate academic solutions. The goal of this tool is to outline and illustrate other factors and approaches that might be considered useful while working with engineering students. It is an effective tool because it distinguishes key elements that might impact academic progression in the university environment. It sets the stage for expanding our thought patterns and problem solving approaches in a systematic manner that may have demonstrated results. It also can be used with any student, minority or non-minority, because it promotes individual discussion with a student and can serve as a self-help tool outside of the office setting. The key elements in the roadmap include (1) situation/event occurrences; (2) behavioral characteristics; (3) student attitudes; (4) academic consequences; and (5) academic solutions.

Context of the Problem

Over the past 20 years freshmen enrollment in engineering has increased about five-fold by (47.1%), while attrition has remained unchanged over the past decade¹. Seymour authored a critical book, titled Talking About Leaving, which serves as the best illustration of students’ experiences in engineering and the sciences². Although her work is a qualitative analysis of student experiences, it accurately sets the stage for further explanation of these phenomena. She uses a host of statistical information that illustrates the severity of the problem associated with educating minority-engineering students. The following information will serve as a historical perspective of the trends and changes of minority student enrollment and what it potentially means.

Today, more enrolled students are better prepared for engineering, and calculus and have earned increased credits in physics³. They have taken more courses in these subjects prior to undergraduate matriculation and have a better understanding of the subject matter. For African

Americans the percentages in preparation increased from 6.8% in 1982 to 17.6% in 1992 and from 5.5% in 1982 to 15.7% in 1992 for Latinos⁴. These gains in preparation have remained the same today for students who pursue science, engineering, and mathematics (SEM) majors. They are better prepared for engineering, calculus and physics than were their predecessors.

When looking at the number of institutions that graduate minority students in engineering today, NACME (National Action Council for Minorities in Engineering) offers some interesting information about the dynamics of enrollment. Of the 118 schools, which maintain freshman retention rates, only nine of 118 schools computed retention at or above the 68.4% gross national rate for non-minority students. Additionally, the relative rate of graduation for students of color is about half (52%) that of white students. When non-minority students opt out of the SEM they change majors, whereas students of color drop out of school altogether. Of the institutions that do graduate minority students, public institutions enroll and graduate significantly more minority freshmen than privates but private engineering schools graduated a much greater percentage. Half of all minority graduates came from 36 engineering schools. Five institutions produced more than 100 graduates and an additional 17 produced more than 50. Of these 22 institutions, five were predominately Black institutions and five were predominately Latino. When looking at the nation's engineering schools as a whole, 169 graduated fewer than six minority students per year. A total of 58 schools produced no minority graduates between 1991-1993^{5,6,7,8}. On a national level, U.S. engineering production is even scary. It has been noted that the total production of engineering degree graduates in the U.S. is significantly lower than many of the world's competitors. Courter suggests that this is a problem because engineering is dependent on retaining students because so few students change their major to engineering⁹.

A 1997 NACME report offered enrollment data that illustrates this point further¹⁰. For non-minorities, the enrollment numbers are illustrated in the Table 1.

Table 1 Non-Minority and Minority Enrollment Patterns

Year	Non-Minority	Minority
1973-74	48,958	2249
1978-78	86,767	8382
1984-85	93,780	10,594
1990-91	79,427	14,278
1996-97	70,625	13,605
1999-00	78,478	14,474

NACME’s report states that freshmen enrollment for the 1999-2000 academic year was 14,474 for minorities and 78,478 for non-minorities. Minority students were 18.4% of the total¹¹. To further illustrate this point in a 2001 NACME News Release titled, “New Engineering Grad Numbers Provide Little Cause For Celebration”¹², notes that the percentage increases are of single-digit numbers for the number of minority graduates. This is the third smallest increase over the past 20 years and the lowest minority growth since 1989 both in percentages and real numbers.

On a national level, U.S. engineering schools produced 64,189 graduates in 2001, only two percent more than the 62,721 in 2000. In 2000, minorities conferred 6,710 bachelors’ degrees, 11% of the class. Last year 6,603 degrees were conferred, 10% of the total. Latino degrees declined from 3,213 to 3,146 and American Indians from 347 to 215. The graduating numbers of African American females went from 1,113 to 1,098, while African American males rose from 2,037 to 2,084¹³. NACME notes that even though Latinos are the nation’s fastest growing minority, their engineering graduation numbers are nowhere near population parity for this group. For African Americans this is the third consecutive increase in the number of African American men receiving engineering degrees. This is the only group that experienced an increase. This report goes further and notes that some of the nation’s top minority engineering degree producers saw declines as well. Fifteen percent fewer African American engineers

graduated from HBCU's—694 in 2000 compared to 816 in 1999—with the largest decrease, 48 percent, at Howard University. North Carolina A&T State University, a top producer of African American engineers, saw a decline of more than 26 percent. They graduated 98 black men in 2000 compared to 133 in 1999. Likewise, the study noted that many of the top producers of Latino engineering students, Florida International University, Texas A&M, University of Texas – El Paso and Cal Poly – Pomona graduated fewer Latino engineers in 2000 than in 1999. Cal Poly experienced a 30 percent decline¹⁴.

Minority degree confirmation in engineering and mathematics has been declining relative to fields such as psychology, biology/agriculture and social sciences for the past 10 years. This is in spite of the fact that during the past 20-25 years over \$1.5 billion dollars has been spent by the National Science Foundation and \$675 million by the National Institute of health to increase minority participation in science, math and engineering¹⁵. Even more striking is the fact that 35.6% of ethnic minorities complete their degrees as compared to 68.4% of white students. Of the students who continue to their sophomore year, only 56.7% of students of color graduated, compared to 87.4% of white sophomores¹⁶. Reichert notes that the biggest loss of both minority and non-minority engineering students happens between the freshman and sophomore years. Currently, 37 of every 100-minority freshman drop out compared to 22 of every 100 non-minority freshman. Minorities loose an additional 27 students between the sophomore year and graduation while non-minorities loose 12¹⁷. When looking at the research in regards to predicting which institutions did the best job, it was noted that for both minority and non-minority engineering schools, selectivity was the most important predicator of degree attainment. Additionally, the more expensive institutions with higher selectivity had the higher graduation rates for all students¹⁸. These graduation rates have remained unchanged since the 1980's.

Based on the information here one would think that engineering schools would have some idea as to why their numbers continue to decline. But this does not seem to be the case.

To complicate matters more it has also been noted that few engineering schools maintain longitudinal data to measure their successes and losses. When documenting the severity of loss it appears that high loss rates are found among the smaller number of student enrollees, African American, Latino and Native American students.

There have been many reasons identified as to why this decline in matriculation and graduation has occurred in engineering. As previously mentioned, some students select other majors whereas others dropout of school altogether. Public debate over this phenomenon has focused on a variety of causes and cures. Some believed that the U.S. students' level of competence in comparison to international academic abilities has only progressed to average levels. Others have focused on teaching and assessment standards in the classroom. College professionals believe undergraduate teaching and instruction are to blame. Questions have risen about insufficient accountability and the lack of response to the unmet needs of traditionally underrepresented students such as minorities. In spite of this, no one study or approach has clearly identified 'what works' for minority engineering students. The result of this perceived dilemma has been a lack of forward thinking ideas that clearly identify an appropriate cause. Most of the explanations focus on external factors that are difficult to control and have a variety of impact on student persistence.

Qualitative Factors

The previous information sets the stage for understanding some of the deficiencies in the minority-engineering pipeline. But the statistical analysis does not fully illustrate some of the critical elements of the student's experience that may impact their persistence/attrition rates. Many have identified external variables such as financial aid and campus climate as primary in impacting performance. A more beneficial approach would be to focus on the qualitative and "out of the classroom" challenges college and university students face while pursuing

engineering degrees at our nation's institutions. Many of these challenges mirror issues of society-at-large but are sometimes overlooked by professionals who deal with these students.

Model Development

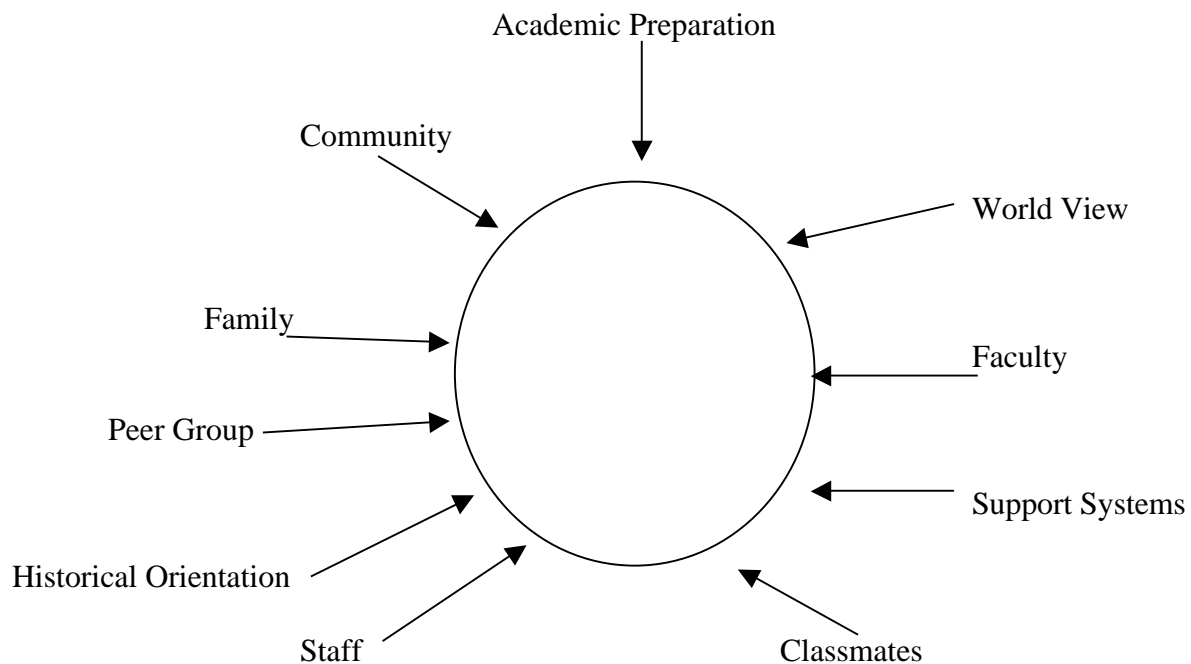
The Roadmap to Academic Success Model was developed through the staff's interaction with students in the Minority Engineering Program using the above issues as a foundation. The model developed was based on Albert Ellis' ¹⁸ work in cognitive behavioral problem solving. The Ellis model focuses on the cognitive beliefs one holds about a particular situation. Rather than reacting to the situation or reality, the individual focuses on the beliefs he/she holds about a particular situation or event. These beliefs may or may not be on target in resolving the situation at hand. The behaviors accompanying the beliefs may be incongruent with what is needed to resolve the situation as well. Oftentimes, when these beliefs and behaviors are ineffective, the individual makes an inappropriate choice that fails to reach the desired result or goal. The goal of the Roadmap is to provide the professionals and students with alternative perspectives, attitudes, and behaviors that may serve as a catalyst for change. This tool encourages the professional and student to consider other approaches in the process of promoting academic success. It can be used with any student who is in the process of making decisions about his/her academic future. It also encourages open dialogue between the student and professional that may promote a better understanding of student motivations.

Model Focus

For minority engineering students there are a variety of factors that impact their academic performance on college campuses. These factors might include the following variables: academic preparation, support systems, classmates, faculty, staff, peer group, family, community, historical orientation, and worldview.

MODEL

Cognitive and Non-Cognitive Variables Influencing Ethnic Engineering Academic Performance



ETHNIC ENGINEERING STUDENT

The above model illustrates some of the issues that minority students experience at entry and matriculation in the university environment. Although academic performance is the primary variable used to determine what type of experience a student is having in college, it is not the sole determinate of how well a student is doing in the academy. In other words, for example, a student peer group can have a very strong impact on how the student integrates him/her self in the academy. If the peer group is not an academically oriented peer group, the influence for most student members might be negative. Contrastly, if family support is positive and plentiful a student may experience less doubt about their choice of major and their ability than a student who has a non-supportive experience with their family.

This model also exemplifies a cultural orientation that the ethnic engineer brings to the academy. If a minority student has an incongruent perception of his/her historical background or

community the perceptions may impact academic performance. This is especially true for students who are commuters. Their cultural orientation is not only on-campus but in the community as well. The variables cited impact performance and orientation of the students. All of the variables that these students bring and encounter upon their entry to the academy are related. The result is the interrelated association of the variables throughout the student's matriculation.

Development of the Roadmap to Academic Success

In an effort to broaden the perspective of the engineering pipeline phenomena, UIC developed the Roadmap tool. The information that follows outlines key components of this tool and its relevancy to better understanding the qualitative and out of the classroom experiences of students. An example of some Roadmap variables are illustrated in Figure 1 below with five focal point areas, Situation/Events, Behavioral Characteristics, Attitude, Academic Consequences and Academic Solutions.

Figure 1

Situation	Behavioral Characteristics	Attitude	Academic Consequences	Academic Solutions
<ul style="list-style-type: none"> • enrolled in 3 or more technical courses for the semester 	<ul style="list-style-type: none"> • stressed out • time conflicts • overwhelmed • burnt out • no social life • forgets • sleeplessness 	<ul style="list-style-type: none"> • overconfident in abilities • wants to graduate early 	<ul style="list-style-type: none"> • poor performance • repeating courses • ineligible for scholarships 	<ul style="list-style-type: none"> • reduce course load • balance level of difficulty of technical and non-technical • seek campus assistance

The following information explains each of these areas.

Situations and Events. Situations and events are where this begins for students and professionals. These circumstances or experiences of situations or events can run the gamut but include things like the number of courses the student is enrolled in; the number of hours a

student works; and/or family responsibilities. Situation and event occurrences result from the usual everyday experiences that a college co-ed might encounter. Some of the events may be a result of student actions or may be a result of his/her particular environment. Because students at UIC are mostly commuter students, both campus and community encounters impact their situations and events.

The Roadmap outlines numerous situation/events that impact student academic performance. The first situation in the Roadmap provides a logical and coherent framework designed to assist a student in developing a positive academic solution. In the above example, a student enrolls in three or more technical courses for the semester. Although there are some students who select this option, those who lack the necessary preparation may not be able to handle three or more technical courses. A better approach would be for a student to select a combination of courses that are balanced in difficulty and time commitment to promote a more positive experience in the classroom. This is a situation and event that numerous students experience. If the courses are not balanced effectively, academic consequences could be negative. By acknowledging this situation as a potential precursor to future academic problems, a preventive approach is used rather than a reactive one.

Behavioral Characteristics. Behavioral characteristics include the recurrent patterns of action or conduct that a student engages in as a result of his/her situation or events. Some of the recurrent behaviors include oversleeping, poor time management skills, performing poorly in class, and inefficient allotment of studying time. A student's recurrent behaviors may or may not be intentional but they serve as the foundation for change in cognitive behavioral problem solving. Behaviors are the actions that many engineering professionals overlook but should be strongly considered when developing academic strategies with students because they are the catalyst for academic change.

This issue in the Roadmap brings into question how a student might respond to the technical course load. It is true that students typically have the freedom to select the number and types of courses they wish, but when not carefully planned the behavioral responses to a heavy technical course load can result in an unwelcome challenge. There are several behavioral results that may surface. A student may 1) become stressed out; (2) experience time management problems; (3) feel overwhelmed; (4) experience burn out; (5) lack a social life; (6) develop an inability to meet deadlines; (7) become forgetful; (8) experience sleeplessness; and (9) lose his/her appetite. These behavioral responses are a result of a challenging course load in addition to their personal and extra curricular commitments. The demands of balancing class time, homework, quizzes, and tests often overwhelm the student and stretch them beyond their limits.

Attitude. Attitude focuses on the student's feelings, thinking, or opinions about a particular situation or event. These attitudes may include perceptions such as a student disliking a professor, challenging engineering authority, nonchalant attitudes about academics, and doubting their abilities. Attitudes are oftentimes the precursor to student behaviors. Similar to the approaches used with behaviors, attitudes must be challenged as well and in some circumstances hold more importance than behavior. Attitudes are sometimes the motivation behind behaviors.

Now, when examining further the choice of registering for three technical courses or more, many students claim that the increased course load will allow them to graduate earlier. In addition, they believe they have the requisite skills to perform well in these courses.

Additionally, peer influence also plays a part in the decision process but the impact of having such an attitude may not always be positive. Despite the fact that students believe overloading on courses will help them to graduate earlier, many are overconfident about their abilities to perform well in their academic tasks, especially with an overload of technical credit hours.

When this type of attitude about the benefits of course overload is strong, appropriate course

planning is overshadowed by a false sense of real ability. Sometimes, there are circumstances where a student may be successful but for the student who is not prepared the challenge might be more than desired.

Academic Consequences. Academic consequences focus on academic results of a student's behaviors and attitudes. Consequences may include poor academic performance, lack of peer academic support, delayed graduation, and failure to understand fundamental concepts of the major. These consequences play a crucial role in whether a student will continue to persist in engineering. If the academic consequences are consistently negative with no resolve, a student may opt to leave the institution or major.

Meanwhile, using the course overload as an example again, the consequences may be less than favorable. Students may find they do not do the best job in their courses; they may repeat courses; take longer to graduate; become ineligible for scholarships; and lack time to benefit from campus resources and life due to course demands. The students typically have not taken into account the impact their choice may have on their academics.

Academic Solutions. Academic solutions are suggestions offered to respond to a situation, behavior and attitude expressed to a student by a professional. These solutions typically focus on positive alternatives that specifically challenge student attitudes and behaviors. It is important that the engineering professional recognize and accept the fact that they must focus on the broad issues in the process of helping the student. The professional should focus on the positive experiences, both personally and academically, that the student has experienced and how reevaluating attitudes and behaviors will result in more positive experiences in the academy.

For the professional seeking to create positive results for the student who makes the above choice, a better approach would be to encourage students to reduce their course load. Ideally, this is better done before the semester begins, but students should be encouraged to use registration procedures that would allow them to reduce their course load. Other choices that

might be utilized are suggesting that students balance the level of difficulty between technical/non-technical courses. And, for those behavioral characteristics that are symptomatic, such as burnout, stress, and sleeplessness students should be encouraged to seek professional help on campus through professors, staff, and student support services. By appealing to both students' academic and somatic needs, there is more likelihood that change will occur.

Concluding Summary

The Roadmap to Academic Success is a tool that can be used with almost any student to provide positive alternatives to student decision-making. Its use supports the ideas of Tinto who suggests that student needs and problems should be approached in an integrated fashion²⁰. He believes that students should receive prompt feedback through a developmental approach that is somewhat "intrusive". This intrusive approach is believed to lessen the number of students that leave the institution because it is tailored to individual needs. The Roadmap does this because it not only can be used with individual students but it provides a variety of academic solutions that have proven to be effective.

Similarly, Levitz²¹ supports Tinto, confirming that an individualized approach is most effective because it focuses on attitudes and motivation of students. It is the attitudes and motivations that most impact student's academic performance. The Roadmap uses a cognitive approach that addresses this issue through modifying cognitive thought.

The Roadmap is as an outline and model for engineering student experiences. It introduces issues that may impact student academic performance and guides engineering professionals and students through a process that typically results in positive academic problem solving. The use of this integrated approach to deal effectively with student academic success communicates a positive message. It is a positive message because it supports Schlossberg's idea of mattering²², that is, if a student believes they matter it enhances their personal worth and mutual relatedness to the campus community. This perception not only is positive for a student's

overall experience in the academy but it clearly is an effective prescription for academic success in engineering.

Finally, if colleges and universities wish to increase and maintain the number of students preparing for the professional world of an engineer, it is important that they continue to develop comprehensive approaches. That is, they should create and develop innovative approaches to engineering student development that focus on qualitative measures as well as quantitative ones.

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