

AC 2007-1182: COMPETITION, CONFIDENCE AND CHALLENGES IN THE ENGINEERING CLASSROOM: AMERICAN AND INTERNATIONAL STUDENTS SPEAK OUT

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Competition, Confidence, and Challenges in the Engineering Classroom: American and International Students Speak Out

Abstract

The need to examine and compare the pre-college preparation provided by the International and American education systems led to the motivation for the study described in this paper. This study is part of a large, longitudinal study designed to understand how students become engineers by examining their experiences from their freshman year through their senior year. This part of the study focuses only on the freshman year experience of five of these students. Using multiple methods of data collection (i.e. ethnographic interviews, surveys, and academic transcripts), we observed differences in the manner in which American and International students speak of competition in the classroom, their confidence, and the challenges they face in pursuing an engineering degree. We conducted an in-depth study of five students from a larger pool of sixteen students in order to feature the students' voice, an often minimized and underutilized resource.

Our study revealed that in their first year at Oliver University, American engineering students began to experience difficulty particularly in the areas of science and mathematics, whereas the international engineering students viewed the same course material as merely a review of information previously learned. The American students were left asking, "Why are they so smart and knowledgeable?" Both survey and ethnographic data indicate a difference between these two student groups in four broad areas: high school preparation, first year GPA, confidence level, and willingness to persist in an engineering major. Not only does national data show that Americans are scoring at lower levels in mathematics and science, but also American and international students are observing and reporting this phenomena as well.

I. Introduction

Achievement scores for US students historically have fallen at or below international averages and have done so for three international comparative assessments of science and mathematics as referenced in the *Third International and Mathematics and Science Study (TIMSS)*¹. The 1983 report *A Nation at Risk: The Imperative for Educational Reform*² charged federal and state governments to reform the educational system so that US students can be better prepared to compete against international economic competitors. It brought forth a federal challenge to state governments to conduct reforms on a grand scale. Although studies have released claims on the inaccuracy of *A Nation at Risk*, it however sparked a nationwide interest and dialogue in high school curricula reform by increasing the quality and number of science and mathematics courses. Yet again, we are reminded by the recent release of the 2006 report *A Test of Leadership: Charting the Future of Higher Education*³ that American high schools are not effectively preparing students for their first year of college.

National data has shown that Americans are scoring at lower levels in mathematics and science than their international peer group. Yet, the data does not feature students' voices. Our study fills that gap by highlighting American engineering students and their international counterparts matriculating at an HBCU. The students' speech provides insight into the root of the achievement gap. While the aforementioned reports have shed light on the nature of US secondary public education, this paper highlights the voices, experiences, and dispositions of first year American and international engineering students at Oliver University in order to continue to validate the urgent need to establish educational public policies that address the level of preparation of US high school students for college, particularly in the areas of mathematics, science and engineering.

II. Theoretical Foundation

Vincent Tinto's theory of student departure is the most recognizable theory that explains student success primarily through matriculation and ultimately retention. According to Tinto, students leave college because they are unable to effectively distance themselves from their family or community of origin and adopt the values and the behavioral patterns that typify the environment of the institution they are attending⁴. Although Tinto's sociological-based theory is useful, it does not take into consideration the cultural mores that make up the home community (particularly for international students) that serve as a foundation for sustained perseverance. Otherwise suggested by Tinto, our study shows that the primary factor contributing to international students' success is the connection that they have to their home communities.

III. Review of the Literature

In 2006, US Secretary of Education, Margaret Spellings, proposed to strengthen K-12 preparation and align high school standards with college expectations. Spellings' proposal stems from several factors affecting student success in college. In the accompanying press release she stated, "There are far too many Americans who want to go to college but cannot because they're either not prepared or cannot afford it."³ The

literature cites a number of those factors that influence college student success including: post secondary institutional practices, students' behavior, high school preparation and student characteristics^{5,6,7,8,9}. This paper revisits the latter two factors through the medium of freshman US and international engineering student voices.

High School Preparation

The quality of the academic experience and the intensity of the high school curriculum affect almost every dimension of success in postsecondary education. The students that do well in college are those who are best prepared, regardless of who they are, how much money they have or where they go^{10,11}.

The quality of high school preparation is not keeping pace with the interest in attending college. Only a handful of states have fully aligned high school standards with the demands of colleges and employers. Of the forty-five percent of students who start college and fail to complete their degree, less than one quarter are dismissed for poor academic performance¹².

The international students that participated in this study were African Caribbeans from Trinidad. Trinidad and Tobago's educational system is modeled after the British educational system. Similar to the British system, public education is free at the primary and secondary levels and the language of instruction is English. Generally, government or government-assisted secondary schools are regarded as a higher standard than private secondary schools. However, placement at the secondary level is limited and competition is intense. Students must compete for entrance into the free public secondary school system through the Common Entrance Examination. This path may lead to a greater assurance of attending a university. African Caribbean parents make huge sacrifices for their children's education because of its means to overcome colonial poverty.¹³

Student Characteristics

Race, also appears to play a role in students' success in college: particularly regarding persistence and retention. White and Asian American students are more likely to persist toward a degree than their African American and Hispanic counterparts¹². Another factor contributing to student persistence and retention is peer interactions. Student interactions with peers can positively influence overall academic development, knowledge acquisition, analytical and problem-solving skills, and self-esteem¹⁴. Such positive interactions in the form of study groups are commonly observed among Asian American students.

Asian American students are often referred to as the "model minority" because they achieve a higher degree of success than the average student population. This label can have a dichotomous effect. On one hand, the label appears to be positive and flattering. On the other hand, the same label causes internal and external pressure to succeed¹⁵. The concept of "model minority" is applicable to our study. The researchers in this study have observed many of the same positive peer interactions as seen with Asian Americans. In this paper, the concept and the characteristics of the "model minority" label are extended to describe the African Caribbean student who attends college in a predominantly African American setting.

IV. Methodology

The study described in this paper is part of a large, longitudinal study designed to understand how students become engineers by examining their experiences from their first year through their senior year. This part of the study focuses only on the first year experience of five of these students matriculating at Oliver University. Within the first academic year of the study, several phenomena through multiple method data collection (i.e., surveys, ethnographic interviews, direct observations, and academic transcripts) emerged; one noteworthy phenomena being how African American and African Caribbean engineering students speak of competition within their discipline, how this affects their confidence level and how this later interprets into academic challenges they face in pursuing an engineering degree. Multiple methods were used to discover what students did and why they did it before meaning was assigned to their behaviors and beliefs. Unstructured interviews, traditionally used in ethnographic designs, were the primary source of data collection.

We conducted an in-depth study of five students (two American and three International) from the larger pool of sixteen students in order to feature the students' voice, an often minimized and underutilized resource. The five students described in this paper were all subjected to the same methods of data collection that included observations, ethnographic interviews and surveys. The remaining students were interviewed and surveyed, but not observed. Therefore the sampling method utilized for this study was a small census. The primary source of data was a content analysis of ethnographic interviews, ranging between one and three hours. The ethnographic interviews provided rich data on a variety of issues including descriptive high school experiences and the academic experiences of the first year in college. It is important to note that unstructured interviews involve free flowing exchanges, with the interviewer asking follow-up questions on relevant topics and issues that are arbitrarily introduced by the student. The themes presented in this paper emerged from the participants' discussion, rather than predetermined questions. Emergent themes around the performance and personal insight of African-American and African-Caribbean students were then sought in the accompanying methods (surveys, and academic transcript analyses) to corroborate results and therefore strengthen internal validity.

V. Findings

This study revealed that in their first year at Oliver University, African American engineering students began to experience difficulty particularly in the areas of science and mathematics, whereas the African Caribbean engineering students viewed the same course material as a review of information previously learned. Both qualitative and quantitative data indicate a difference between these two student groups in three broad areas: (1) high school preparation, (2) first year grade point average (GPA), and (3) confidence level. The data as presented below reveal that the African Caribbean students exhibited a higher level of personal self-confidence as well as high levels of confidence in the areas of mathematics, and science. GPAs for both student groups also are reflective of this pattern.

The students that were observed in this in-depth mixed method analysis consisted of three African Caribbean engineering students from the island of Trinidad and two African American engineering students. This paper is not meant to generalize findings across the diverse set of American and international engineering students studying in the US. Instead it is meant to offer a snapshot from primary sources that will provide further insight on student experiences that are leading to academic persistence and success. Table 1 displays a snapshot of the students that will be introduced in this paper.

Table 1
Student Demographics

Student	Ethnicity/Citizenship	Gender	Major	GPA	
				1 st Semester	2 nd Semester
Douglas	African-Caribbean/Trinidad	Male	Civil Engineering	4.0	4.0
Donna	African-Caribbean/Trinidad	Female	Electrical Engineering	3.8	4.0
Peter	African-Caribbean/Trinidad	Male	Computer Science	4.0	4.0
Morris	African American/USA	Male	Civil Engineering	3.22	2.20
Peggy	African American/USA	Female	Chemical Engineering	3.08	2.94

Note: Student names have been changed to protect the identity of the respondents.

Through the voices, that provide first person account, of these student participants from different backgrounds experiencing the same curriculum in the same academic setting, researchers were privileged to gain insight. This insight allowed us to further understand the dynamics that posed academic challenges or success, which in every case was traced back to two over-arching themes: high school academic preparation and/or individual work ethic.

As discussed earlier, Trinidadian public education, similar to the British system, is very selective and competitive on the secondary level. Due to this structure, students tend to be academically prepared for their freshman college experience. Douglas, an African Caribbean civil engineering major, admits that his interest in engineering stems from “*a love for the sciences in high school.*” When asked if he was prepared for calculus before coming to the US for college, he stated, “*...yeah, because ... we did advanced level math, which is similar to this [calculus]. .. I think I was prepared.*”

Donna, an African Caribbean student majoring in electrical engineering elaborated more on high school “A” level coursework. “A” level courses are comparable to Advanced Placement (AP) courses in the US, where high school students have the opportunity to

earn college credit in the respective course. Donna completed physics, chemistry and math “A” level courses. She states, *“I’ve always loved math, it’s just so practical and rational. It’s just simple and I can get it, and I mean even as challenging as it may become eventually... [if] it wasn’t for “A” levels, I still love to try it...”*

Peter, an African Caribbean computer science major, completed math and physics “A” level courses in his home country. When asked about his transition from high school to college, with ease Peter stated: *“Well I came in, everything was no harder than normal, they teach you something, you learn something, you learn, you understand, you read, and you progress.”* He further commented, *“The classes are fair. Again, it’s how it is. It’s possible for me to get a 4.0. And, well, I consider my case kind of special in that I got 16 credits transferred from my “A” levels...”* However, Peter’s case is not special, at least not when compared to his African Caribbean engineering classmates. It is interesting to note that the other African Caribbean students in this study have the same experience in that they are able to transfer a large number of high school credits for college credit. Note that this phenomenon was observed in all of the study’s randomly selected African Caribbean students.

The high school experiences of American students differ on a structural level, hence allowing for cultural differences or vice versa. In the US, public secondary education is the norm and admission is guaranteed. However, the opportunity to earn Advanced Placement is neither the norm nor a guarantee. Access to these courses is not equitably distributed among US high schools. Additionally, school districts highly populated with African American students are less likely to offer an array of AP courses^{16,17}.

Morris, an African American civil engineering student, graduated from a top-rated magnet high school that has a focus on the sciences. Morris’s discussion about his transition from high school to college highlights a maturation process in becoming a successful student. Morris states, *“...in high school, ... I realized that I would give up on a lot of things. ...I would study and study and then I’d get a test back and I... thought I was gonna get a 100, but I got... a 50, I would just give up. But then ... realized,...If I just keep giving up, it’s not gonna help at all. So I would just keep studying even if I got bad grades, I would just keep going. And that’s really what helped me my first year of college.”*

Similarly, Peggy, an African American chemical engineering student, also had an early introduction to a focused science curriculum before college. *“...in high school, I went through a lot of transitions. It was fun. First year I was really...doin’ whatever, just silly, bouncing off the walls. I got my work done, and I won [the] science fair the first year, and went to the international science and engineering fair and I joined the ... area pre-college engineering program, officially. ...I was in it for middle school. But once you win, you ... automatically are gonna go on all the good trips and travel and learn about scholarship information ahead of time. So that was my first real thrust into how I wanted to do... engineering....”*

In both of the African American students' cases, there was also exposure and interest in the engineering field early in their academic careers. However, disciplined study habits had to evolve through a maturation process that may have temporarily impeded academic success. The stories of the African Caribbean students illustrate that the discipline was present during their secondary education and their success is attributed to coming to college with that work ethic in place.

Consistent with the literature, the work ethic of the international students seem to be largely cultural. Peter, an African Caribbean computer science student declares that he is the type of person that always tries to put his best foot forward. "...[I]f I was to do something halfway and I got half results,... I wouldn't be pleased with myself."

Douglas, an African Caribbean civil engineering student, also spoke of work ethic when he was asked if there is a difference in African Caribbean and African American students. He replied, "Um. I guess work ethics. I mean most American kids... I don't want to say college is not a big thing for them but where I'm from, college guarantees you that further step and I mean most [international] students here are on scholarships as well, so they know the importance of keeping their grades up as opposed to... 'Mom or Dad is paying for me. If I fail a course, Mom has enough money, or I have a loan ... or I could get money easily.' It's not that way with us. So we, actually know... you can't come a thousand miles just to waste time... I would say innately, we ... know the important [sic], they tend to work a little harder as opposed to American students..."

Donna, an African Caribbean electrical engineering student echoes Douglas's sentiments regarding work ethic. "I think from my experiences so far [that the students] from my system, the British system, they... attack work and keep going and study ... I think for most of us who ..., use our system, you had to do, you have no choice." Donna further compares her work ethic to her American peers: "Like one of my American friends, he was like, 'Doesn't matter', you know, and I'm fighting down my B's and getting B's, and doing everything that I can to not get a B....so when they say they'll get a C whereas for most of us ... C's aren't enough, ..., we don't want to even see that... You could tell basically by their mentality in class and by the way they deal with work and assignments and stuff like that."

The acknowledgement of these differences was also cited by the African American engineering students. Morris, an African American civil engineering student discussed gender differences, but made special mention of African Caribbean female students. "...a lot of females don't choose this major... So ... when I do see them, oh, to be honest the only ones I really see are... Caribbean ones, and ... they're just ... really dedicated and they work hard...I can say that they may work a little bit harder than the guys. I think that they study more, but I don't know necessarily how."

Peggy, an African American chemical engineering student also makes mention of African Caribbean students. "...as great as my high school experiences was and all that I know... I'm not as prepared as other students who are here in engineering. Because uh half of them are Caribbean students and they've had exposure to this information that I've never

had exposure to.” Peggy goes on to discuss the importance of peer groups towards persistence. *“People are... prone to hang around what they know or be with people they know so when those groups are there, they won’t integrate and you see it, like the Caribbean students have [the] Caribbean association, they do their thing, the American students do their thing, and it’s like you know we should be more together, pulling together, especially in fields where if we put our heads together we could help each other out.”* First year international students report higher levels of active and collaborative learning than their American peers, but spend significantly less time relaxing and socializing¹⁸.

International students engage more often in effective educational practices than their American counterparts, especially in their first year of college and often report greater gains in social development, practical competence, and general education¹². The achievement gaps between international and American students have been well documented^{1,2}. This paper gives credence to those reports by presenting the voices of the students themselves. Furthermore, students from this study have attributed the primary difference as being work ethic and high school academic preparation. In a survey during their first year, these students were also asked to rank themselves on several traits as compared with the average person their age. A summary of some of the rankings for some of those traits is displayed in Table 2. Rankings ranged from 0 to 4, with 0 = lowest 10%, 1= below average, 2= average, 3= above average, and 4= highest 10%.

Table 2
Student Confidence Ratings

Student	Ethnicity/Citizenship	Math	Science	Self (intelligence)
Douglas	African Caribbean/Trinidad	4	4	4
Donna	African Caribbean/Trinidad	3	3	2
Peter	African Caribbean/Trinidad	4	4	4
Morris	African American/USA	4	3	3
Peggy	African American/USA	0	2	2

Overall, we found that the African Caribbean students at Oliver University have higher GPAs and self report higher confidence levels. Additionally, when all students were asked if they saw themselves studying or practicing engineering next year, they all replied yes. This information provided further context in understanding where the differences between these two student groups may lie. Although the dynamic is not explored in this study, it is interesting to note that both the American and international

female student in this sample rated themselves lower than the males on each confidence scale.

VI. Conclusion

In academia researchers may sometimes relay numerical findings to enforce a sizable change. However, an undeniable strength of qualitative work is providing space and/or empowerment of voices that have been traditionally marginalized. This paper underscores the importance of including our stakeholders' perspectives and voice along with those numbers. In creating or revising educational policies, we must be reminded to describe before we prescribe.

We argue that the "model minority" stereotype/label, as it is applied to Asian Americans in predominant White settings, is showing evidence of application in this academic setting. African American students repeatedly acknowledge the "model minority" label of African Caribbeans and African Caribbean students recognize, accept and in some ways strive to uphold this label. The voices presented in this paper are telling of the US educational system in regards to preparation for higher education. This perception (or reality) needs to be addressed as we attempt to find ways to decrease the number of students that are dropping out of undergraduate engineering programs. It has become apparent that funding for the continuance of pre-college preparatory programs should continue. Until US high schools become more consistently competitive and produce more students that have the necessary skills to compete for the jobs in the global market, supplemental services are needed to fill in those gaps.

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