

AC 2007-1691: EXPERIENCES AS A NON-MAJORITY ENGINEERING STUDENT

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Academic Struggles and Strategies: How Minority Students Persist

Introduction and Background

Sufficient progress has not been made in the participation of underrepresented minority (URM) students in STEM education and careers. Although over the past 10 years URM students comprise a higher percentage of students intending to major in science and engineering, they continue to earn degrees at a rate much lower than the majority¹². Much of the research focused on understanding the problems with persistence of URM students in science and engineering has taken the approach of aggregating URMs into a single group or focusing exclusively on one racial/ethnic group at a time. Little comparative research exists that disaggregates the experiences of students of different racial/ethnic groups.

Our approach to examining URM student participation in engineering is to look at students from different racial/ethnic groups and to identify factors that lead to success in an engineering discipline. We define success as *obtaining a degree from an accredited program in engineering*. Our research is primarily qualitative and comparative and seeks to identify the similarities and differences among African American, Hispanic, Asian American, and Native American students. While Asian Americans are not underrepresented in a College of Engineering, we were interested in their unique experiences as students of color. This research examines the experiences of engineering students of color at a predominately white institution. The research used an interview protocol to hear firsthand from students stories of their experiences in an engineering program. The protocol was designed to identify experiences of the students that either challenged or contributed to their persistence in their degree program.

This paper represents the first of a series of analyses focused on persistence of students of color in a College of Engineering at a predominantly white institution. However, as the first step towards disaggregating the differences among and within racial/ethnic groups, we examine the academic struggles that are common among African American, Hispanic, Native American, and Asian American engineering students and the strategies the students employ to overcome these barriers to success. We define academic struggles as specific experiences that students have that lead to difficulty in maintaining academic progress. This paper does not include reference to the more general daily struggles often encountered by students of color. We will continue to address the realm of student struggles in future papers.

Methods

The study is a mixed methods study that utilizes data obtained from student interviews, questionnaires, and academic transcripts. The interview transcripts provide the richest data as they convey the lived experiences of our students of color. The interviews followed a protocol that was designed to investigate factors related to student success in engineering. Following the examples of Seymour & Hewitt, and Margolis & Fischer, the interview protocol provided a list of questions and probes to guide the interview^{15,10}. The protocol was designed to get students to talk about racial identity and how their own identity impacts their experiences in an engineering

college. The interview was structured such that it asked students to talk about their experiences chronologically; participants were asked to talk about what brought them to the institution and college, their early experiences at both, their current life in engineering, and their reflections on the sacrifices made and the strategies that helped them the most. Specific questions were based on 6 factor categories that we felt the research literature identified as critical to student success: 1) engineering culture, 2) student background, 3) academic communities, 4) personal support structures and responsibilities, 5) student communities, and 6) student future.

Potential participants were identified using the institutional database which reports student major and race/ethnicity as self-identified at the time of admission. Students were chosen from this list if they reported to be African American, Hispanic, Native American, or Asian American and if they were listed as an engineering major. Seniors, juniors, and second semester sophomores were contacted for interviews via letters, email, and phone solicitation. Participants were also recruited from student technical organizations and through personal contact. Attempts were made to balance our sample across major, student classification, and racial/ethnic group. We also attempted to include in our data set students of color who were significantly isolated in their discipline to capture the experiences of those who may be at greatest disadvantage. To gain a semi-longitudinal perspective, repeat interviews were conducted with willing students at least one year after their previous interview.

Students agreeing to participate were sent an email with the informed consent and the participant questionnaire. The participant questionnaire was used to solicit demographic information regarding the student, their family history, and their educational background and experiences. Interviews were conducted by a student interviewer of the same race/ethnicity as the participant and lasted between sixty and ninety minutes. Participants were compensated for their time with a credit to their university debit/exchange card. Student interviewers were well trained in interview techniques and in the experimental protocol prior to data collection. Interviewer focus groups were held weekly for continued mentoring of the interviewers and discussion of issues that came up in the week's interviews.

The process of data analysis involved transcribing the interviews from the recording, reviewing the transcription to ensure data quality, coding all potentially critical identifiers in each transcript (e.g., faculty names), and then coding the transcript. The process of coding was undertaken by four coding teams organized to each examine transcripts only from a particular racial/ethnic student group. Each coding team was led by a member of the PI team and had at least one research assistant (including the interviewers) of the same race/ethnicity assigned to the team. Teams developed their own code book and processes for coding the transcripts from their group of students. The transcripts were coded, realigned, and updated to ensure maximal consistency within and between teams.

Currently, we have interviews from 46 African American students, 42 Hispanic students, 38 Asian American students, and 34 Native American students. Most of these interviews have begun, but not yet completed, the lengthy analysis process. To provide a well-defined sample for our analysis of academic struggles and strategies, we decided to select 10 transcripts from each racial/ethnic group to provide a set of 40 total transcripts. These transcripts were chosen randomly if a larger set of analyzed transcripts was available. A summary of the characteristics

of our sample is provided in Table 1. The persistence data were extracted from the transcripts by the coding teams. Each team reviewed their code book for nodes related to academic persistence in terms of identifying both struggles and strategies. These nodes were reviewed and aligned by all PIs and the persistence data were updated as needed.

Table 1. Sample Characteristics of Engineering Students of Color.

	Asian American	Native American	Hispanic	African American	Total
Males	5	7	6	6	24
Females	5	3	4	4	16
Aerospace Engineering	1	0	1	1	3
Computer Science	1	1	0	0	2
Electrical Engineering	1	1	1	2	5
Environmental Science	1	0	0	0	1
Industrial Engineering	2	1	2	2	7
Mechanical Engineering	2	3	2	1	8
Petroleum Engineering	1	2	1	1	5
Chemical Engineering	1	2	3	2	8
Civil Engineering	0	0	0	1	1
Sophomore	4	2	2	3	11
Junior	2	3	0	3	8
Senior	4	5	8	3	20

note: One African American participant was a freshman.

Results and Analysis

In this section we discuss two topics: (1) the academic struggles that our participants talked about and (2) the strategies they used to persist in engineering majors despite the struggles. While we recognize that students of color experience some of the same struggles that majority students do, and employ some of the same strategies, they tend to experience these struggles at a greater level¹⁵. Furthermore, students of color face additional struggles that majority students tend not to face^{4,5}. We are interested in the struggles faced specifically by students of color from any population, struggles faced by students of color from specific populations, and struggles faced by the individual student of color. As the first step in the series of analyses to disaggregate these differences, we identified academic struggles that were expressed by most or all of the racial/ethnic groups we studied. As we discuss each topic – struggles and strategies – we begin by describing the categorization of the struggles the students expressed. We continue by presenting the specific struggles, beginning with the most mentioned struggle and proceeding through the struggles that emerged as most prominent for all or most of the racial/ethnic groups. This paper does not address struggles faced by individuals; however, notable struggles faced by students of color from specific populations are discussed. This same progression is followed for the presentation of strategies.

Struggles

We learned of the academic struggles experienced by the engineering students of color in our samples from various interview questions and follow-up probing. The protocol provided a framework for the discussion of academic struggles with direct questions about academic issues (e.g., *Who do you go to for help?*) and more provoking questions about personal expectations and sacrifices (e.g., *What were the first couple of months like? What price have you paid to be here?*), and the role of race in the students' lives (e.g., *Describe the daily experiences you have as a student of color? Does it matter if there are other students of color in your classes?*). Analysis of the discussions elicited from these questions revealed 36 different academic struggles faced by students of color. We grouped each struggle rather broadly into one of four data-driven themes. Table 2 presents a summary of the struggles and shows how many of the 40 students in our sample experienced each particular struggle. Only the struggles that were expressed by three or four of the racial/ethnic groups are listed explicitly in the table. Those struggles that were described by only one or two of the groups are combined in the count labeled as other.

Table 2. The Number of Engineering Students of Color experiencing Academic Struggles.

Struggles		Asian American	Native American	Hispanic	African American	Total
Personal Intersection With System	Current Grades / GPA	2	4	5	4	15
	Loss of Status	1	2	1	1	5
	Lack of HS Preparation		1	4	4	9
	Class Environment-Isolation	1		2	4	7
	Pace / Behind in class	2	2	1		5
	Weed-Out	1	2	2		5
	Internal Pressure	3	1	1		5
	Other	22	1			23
						74
Administrative Issues	Curriculum Load	1	4	3	2	10
	Curriculum Sequencing	1	2	1	3	7
	Large Classes	1		4	1	6
						23
Classroom Issues	Course content & structure	8	1	4		13
	Difficulty in a particular class	4	3	3		10
	Gender discrimination		1	4		5
						28
As related to class	Faculty	7	1	6	4	18
	English Second Language	1		2		3
						21

note: Total sample size was 40 students with 10 students from each race/ethnicity.

The majority of the academic struggles described the student's personal response or reaction to some aspect of the academic system. These struggles present a complex portrait of students as individuals with multi-faceted, distinct backgrounds and in most cases include a response that could virtually be hidden from others. There were 74 references to such struggles. Both administrative issues and classroom issues represent struggles that can be controlled to a larger degree by faculty and the administration. Students made 23 references to factors under administrative control (i.e., administrative issues) and 28 references to factors related to experiences in the classroom (i.e., classroom issues). References were also made to factors that

specifically related to delivery of the class (21 references to factors associated with poor teaching or difficulty due to non-native English speakers).

Looking now at specific struggles, the single factor reported most often by our students of color as a cause of academic struggle was the faculty member in the classroom (18 of 40 students). This finding is somewhat troubling as Astin considers quality interaction with faculty to be the most important single factor in determining minority students' persistence¹. Students from each race/ethnicity reported this to be a factor contributing to academic struggles; in particular, a majority of Asian American and Hispanic students (7/10 and 6/10, respectively) reported difficulty with faculty. Most of the comments received about engineering faculty were negative. In general, students described the faculty as poor teachers; some implied that faculty don't know how to teach while others implied that faculty like to make classes difficult. The following passage expresses a level of resentment that this student seems to feel towards faculty who are perceived to be poor teachers:

"I don't like the attitude of some of the faculty members. And just the whole thing that, especially large classes, where you're more just a number rather than student. Cause then you have teachers, teachers who just teach the material, and don't really care about who gets it or not. Because all they have to do is teach, and I feel like that's the teacher's job. I feel like the teacher's job or professor's job is the students understand the material. And I've ran into so many professors who just get up there and write stuff down and copy examples off the book. But when it comes to doing the actual work it's so much more difficult because you're not teaching me, you're just showing me stuff."
(Male African American junior)

Some students expressed hesitation in asking the professor for help during office hours. For example, the following student described a disconnect between himself and professors that makes him uncomfortable approaching professors for help:

"No, I very rarely speak to the TAs or professors just because, I mean for me it's hard because they're not going through what I'm going through." (Male Asian American sophomore)

The majority of the student comments were rather disparaging with regard to engineering faculty suggesting that the faculty themselves create unnecessary academic struggles for the students. However, there were instances of students reporting positive interactions with faculty where the faculty provided good academic advice, effective help on assignments, or moral support during difficult times.

Grades or GPA was the second most mentioned academic struggle experienced by students of color in our study (15 of 40 students). This factor was mentioned by students from each race/ethnicity and had the fewest observed differences in expression of this struggle. Students referred to receiving poor grades in a class and not being able to progress to the follow-on course. Other students referred to the larger impact of a low GPA. As grades are directly tied to matriculation in a curriculum students seem most frustrated by this academic struggle. Some of our students reported strategies that helped them overcome grade struggles while others reported

that they were doing the best they could and that they were still struggling. The following student describes his sense of defeat at receiving low grades:

“At this point it’s hard to even know what to make of when I get a low grade but you know of course you know they make you feel not that great you know after you’ve studied your ass off. It’s not very fun to get an F on something or even a D, uh you know, after you know, that you know you probably really couldn’t try any harder to do better on that test....” (Male Native American sophomore)

When asked what had been the most difficult struggle, this student’s answer expresses a deep sense of despair:

“Constant Fs you know studying, waiting and figuring out when you get the grade back, and your like man you got the lowest grade in class. I remember one particular incident that I studied hard, hard, hard. I felt like I knew everything and I walked out of that test and I was like, B, A that’s if; no way a C, I answered every question. I got the paper back I made a D. It was like a low D or an F. And I had to walk out of the class, and I was like I’m about to mess around and start bursting into tears. You know you put so much into it and you get nothing, you constantly get nothing back. You know you are like a fighter in the ring just taking shots, taking shots, taking shots you know you can’t get frustrated. You can’t even get a hit in and I was just like at that point I was like, “What is it”? That’s probably those Fs, and then you get numb like whatever. And that’s the worst feeling.” (Male African American senior)

These findings are consistent with those of Hines who describes it more as a crisis situation brought about by low grades⁷. The crisis is particularly critical for those students who did well in high school because they never had to learn appropriate strategies for success. Now that they are struggling in college, they must learn success strategies quickly or risk failing out of school. This crisis is heard in the words spoken by our students.

While most of the students described grade struggles that put them academically at-risk, two students actually described their grade struggles in terms of maintaining high GPAs.

“And I guess more of a uh self prophecy, you know if I make four A’s I’m happy, if I make like one B, I just have like a week where I just feel real bad and then things go on from there.” (Male Hispanic sophomore)

The other factors that were mentioned by at least 3 racial/ethnic groups and at least 25% of our sample are related to curriculum and courses. A very high proportion of our Asian students (80%), as well as Hispanic and Native American students, reported difficulty with course content and structure. Difficult content, too much homework, too much theory, and not enough hands on projects were all reasons listed for struggling with course content. Curriculum load, referring to the prescribed course load each semester required to graduate within 4 years, was a common struggle among all racial/ethnic groups, although it was mentioned by only one Asian student. This Native American student describes how he modifies his enrollment after he has seen his advisor:

“All I ever did was went to my advising things and I said so what I am supposed to take this year? And they said you’re supposed to take this, this, this, and this according to the layout. And I said OK, I’ll do it but not that one. That one would be too much so just put that one off, I’ll take that one next... I don’t know. I’m just taking as many classes as I can every year that they tell me that I think I can.” (Male Native American sophomore)

Similar to course content and structure, Asian American, Native American, and Hispanic students reported struggling due to difficulty in a particular class. These struggles typically refer to struggles due to pedagogy, ambiguous guidance from the professors, and the style of learning required (e.g., memorization). Many of the difficulties students experienced were related to exams:

“... And go home and study for Thermo and fell asleep for an hour or something. And then I studied, and after I studied and before the test I feel I didn’t study at all. ... I’m like good thing is like open notes, and stuff but that’s kind of sucks. ... That’s why I don’t like it, sometimes open book and open notes tend to make you do worst, because you tend to relay on that, and not on your own. But like I study for it but when I get to the test, I totally forget everything besides having notes. I felt bad about yesterday, why are you studying? Why don’t you just go home and sleep and when you take the test you will be able to think better? And I was like yeah oh well.” (Female Asian American sophomore)

“It was Thermo Dynamics and I don’t know the professor might have had something to do with it and just how. I don’t know he was kind of intimidating I don’t know. I don’t know we have these tests like three hour long; we had one Thursday night before the [holiday] week-end. And it was until ten o’clock at night and it was just like I just couldn’t, I don’t know. A lot of times you know, you didn’t know what to expect on a test and I just never knew what was going to be on there and it was, just felt like I didn’t prepare for it so.” (Male Native American senior)

While this paper focuses on the factors we identified that were common among racial/ethnic groups, distinctive differences among the groups emerged that speak to ethno-cultural disadvantages. Rodriguez highlighted the poor preparation for higher education that many Latino/a students experience in high school. He suggests that Latino/a students often attend poorly funded schools and that they are not encouraged by their teachers to pursue 4-year college degrees¹⁴. Both Hispanic and African American students talked about being poorly prepared for college. This Hispanic female thought she was adequately preparing for college by taking advanced courses in high school as well as completing all available math and science courses. She discovered that her high school preparation was inadequate:

“... our whole high school was like a joke. We have my AP classes and stuff, but they are not hard. I mean, I am not kidding, you could just make in an A just sitting there. So I did. I took all the math and science classes I could. I mean, it didn't prepare me for college at all.” (Female Hispanic senior)

In response to a question about what the first couple of months were like in the College of Engineering:

“Uh, kind of like a slap in the face, because you realize how hard this stuff is and you realize you’re not prepared for this kind of stuff. You’re not at the level where you can study and compete on the same level as some of these other students in the class are. Me coming from a predominantly black high school where like I was saying I could study the day before or the day of and make A’s on the tests. Then come to [our university], and you try to look at the material the night before, and it’s just not going to happen.” (Male African American junior)

These students are expressing an absence of academic and cultural advantages, the rudimentary knowledge required to succeed in a majority-dominated, academic environment. Students born and raised in the dominant culture are more likely to have been exposed to and understand academic expectations: they have a higher probability of attending high schools with sufficiently rigorous academic expectations and of coming from families with understanding of the bureaucracy of higher education. The educational system is constructed to reward these accumulated advantages of certain members of the dominant culture. This absence of both cultural and social capital, while disadvantaging students academically, can also exacerbate a sense of isolation⁵.

Isolation was presented to varying degrees as an academic struggle by three of the four groups. Native American students were the only ones to not express feelings of isolation although Canabal reports that Native American students in higher education that are struggling to retain their cultural identity often suffer from a sense of isolation². However, the Native American students in this sample generally did not strongly identify with Native culture. Their tribal affiliation was often reported for means of accessing financial assistance from the student’s tribe. In fact, most of these students only claimed Native American descent based on a tribal definition of an acceptable fraction of blood traced through their family line. Few participated in Native traditions or culture. Many in this group of students of color came from families more culturally Anglo than Native which gave them a position of advantage compared to the other racial/ethnic groups.

The African American students had the strongest expressions of isolation. To these students isolation is not just about having someone else in the room that looks like them; it is also about having a colleague that understands them – someone with a similar, situated culture. The following exchange between the interviewer and the participant highlights this sense of isolation and the resignation that there is nothing that the student can do about it. He also describes the academic disadvantage that results from this isolation.

“I: Okay, so what about the racial composition of the students in your engineering classes?”

P: Predominantly white, (laugh) that’s the story of my life, but yeah there are a few people who I know and who I’ve worked with that are in the classes, but it’s a majority.

I: Does it make a difference with you whether there are other African Americans in class?”

P: Yes it does because the classes where I'm the only African American or where it's another African American that I might not know, those are the classes that I feel intimidated in and feel less inclined to speak or ask questions. But if there are classes where I have some of my friends or just African Americans in general, I won't feel as bad if I ask a question or if I ask the person next to me.

I: Do you think race influences your relationships with students in class?

P: I guess having said what I said, I guess yes.

I: Okay, how?

P: Just feeling comfortable, just in some classes like I'm the only one in there, the only African American.

I: Uh huh.

P: I can't really feel comfortable, so I just most of the times just sit there and take notes, and not talk to anyone. But if there are other African Americans or just minorities in there, and then I'll feel a little bit better, so I'll be more likely to speak and talk to other people and ask questions about the material. So it does influence my behavior in class."

(Male African American junior)

This female student also describes academic disadvantage she faces in group work. She is forced to search out a group to work with, yet does not trust that the group will allow her to contribute.

"It's not difficult. It's... I guess awkward or weird because, of course... I don't know how they feel, but it's awkward mainly because it's just like: Okay, so who's going to let me be in their group? You know. I'm not friends with any of these people, you know, we just have classes together; we don't party on the weekends together, you know, things like that. It's just like: Okay, can I be in your group? Okay. Alright. Are you going to listen to what I have to say? You know. And that's the other thing, are you actually going to listen to my opinions and actually think about them. So it's awkward. It's another challenge." (Female African American senior)

Gender discrimination was an academic struggle that differentially impacted the Hispanic students. Rodriguez suggests that gender-role stereotyping occurs prior to college, predominantly from high school teachers and counselors. This stereotyping includes the gender-based perceptions that Latinas are docile and submissive and have little aspiration other than having children¹⁴. Four Hispanic students described gender discrimination. The female students generally talked about how the male students were dismissive of their abilities and contributions.

"Guys treat you, like when you have to be in groups, more than likely you're always the only girl in your group. And they tend to kind of treat you like you don't know what you're talking about which drives me crazy. But or they kind of, I don't know, they treat you different. They don't treat you, or they'll do the opposite and treat you like one of the guys and you're not a girl in their eyes." (Female Hispanic senior)

A different perspective on gender discrimination was heard in the interview of a Hispanic male. Here, he describes his perception of gender discrimination that actually favors female students:

“Yeah, yeah, I think within engineering, yeah I think there is a slight favoritism towards girls. You know professors are, they’re different towards, you know, girls but that’s pretty much it. Um, they’ll be, maybe just more uh, just friendlier I guess with them; a lot more open to, I guess with just helping them. It’s just the, it’s kind of subtle, it’s really, I’ve only noticed it a couple of times but um, yeah sometimes a girl she can get in better I guess with the professor than say a guy but sometimes on the other hand I know professors that they were opposites; sometimes they didn’t care if you were from one or the other but I think yeah maybe being a girl helps out a little more but I don’t think that’s true all the time. I’ve seen it a couple of times but it was real subtle.” (Male Hispanic senior)

It is not surprising that the Hispanic women talk about gender discrimination when they are required to work with the men, their classmates, who are simultaneously expressing a feeling of resentment due to perceived favoritism toward the women.

One of the more striking differences is in the prevalence of other factors listed by Asian American students. This group of factors contains six unique struggles, only one of which was mentioned by a student of a different race/ethnicity. There were very dominant themes for Asian American students: 6 of 10 students mentioned a desire to switch majors, 4 of 10 students mentioned developing new study strategies, and 4 of 10 students described feeling overwhelmed by the demands of the engineering curriculum. It is clear that Asian American students have a different set of academic struggles than students of other races/ethnicities.

Strategies

The focus of this research is to learn from students about the strategies that make them succeed in engineering. The discussions about academic struggles provided an opportunity to learn about strategies that students find effective in overcoming academic struggles. In the aggregate, the strategies enumerated by students do not appear to be a result of systematic efforts of the institution. Most strategies identified by the students tend to focus on the student’s efforts towards personal improvement. It is also a possibility that the students aren’t describing effective strategies because they don’t have those strategies or know that they are available. The students may not possess the cultural capital necessary to access available strategies.

Thirty-three specific strategies were identified from the data. These strategies clustered somewhat naturally into one of three groups: 1) finding the right person, 2) personal, and 3) intersection with the system. Personal strategies were the most commonly cited type of strategy with 61 references to the use of such strategies. Students using personal strategies typically looked internally for motivation to overcome academic struggles. Strategies categorized as finding the right person and intersection with the system were equally cited by our students. Forty-two students described proactively seeking out academic help and 41 students described working within the system to overcome academic struggles. Most of the strategies listed in Table 3 were utilized by students in each of three or four of the racial/ethnic groups. Two factors were included that were represented in only two groups; however, these factors are notable and important to understanding our students of color.

Table 3. The Number of Engineering Students of Color describing Strategies for Academic Struggles.

Strategies		Asian American	Native American	Hispanic	African American	Total
Finding the right person	Finding Right Person (friends & classmates too)	8	3	5	4	20
	Go to TA/ Professor	5	2	2	1	10
	Tutoring	1	1	2		4
	Other	5	1	1	1	8
						42
Personal	Commitment/stickwithitness	4	3	3	3	13
	Adapt	4	2	6		12
	Time Management	5	1	3		9
	Work harder	5	1		1	7
	Acceptance	1		5		6
	Other	7	2	3	2	14
						61
Intersection with System	Retake classes		2	4	1	7
	Play the Game	4	2			6
	Other	8	6	4	10	28
						41

note: Total sample size was 40 students with 10 students from each race/ethnicity.

Looking at the specific strategies cited by our sample of engineering students of color, the most common strategy was finding the right person. This strategy (rather than category) refers to students who are able to find an individual or a group of individuals who support them through their academic struggles. The persistence literature is quite consistent in describing the role of social support as critical factor in helping minority students stay in college^{2,3,6,8,11,17}. The supporters are often friends, family, and community⁷ but can also be more experienced students, faculty, and advisors¹⁴. Some of our students of color seek the support of friends who provide a non-academic outlet (e.g., sports, social outings) to work through their frustration and disappointment. Other students of color look to classmates for academic help. While students of color find this strategy useful when struggling academically, it creates an additional stress on the student of color who is often isolated in the classroom:

“Well, for some of my classes I have to go out and reach out to the other races, and try to get help. Because like I said, like my digital signals class, I’m the only black African American, you have a couple of Asians and Africans in there and the rest is white. So I actually go to my neighbors sitting around me and trying to exchange numbers, try to meet up sometimes outside of class, to get help because some of the stuff I’m not getting.”
(Male African American junior)

For other students, the “right person” may be an informal advisor that better understands the student’s abilities and provides an insider perspective to the academic programs

“When I first went to see my advisor he just told me “well just take this, and this, and that”. And I was like well I flunked that and I flunked this so I can’t take that, and I can’t take that, so he said well just take these classes. It was no help as far as if you take this class and this class you aren’t going to make it. I think MEP [Multicultural Engineering Program] advisement is great because you talk to ... [MEP Director] she is like “you

can't take this, are you crazy?" She would really let you know you are just going by curriculum. And the curriculum sheet doesn't cater to everybody. You got to complete everything on the curriculum but you can't do it because they'll have you taking all kinds of at the same time and saying "okay just do it." You get in there and fail every last one and you're trying to catch up." (Male African American senior)

This strategy is used far more frequently than any other strategy identified by our students of color. It is interesting to note that while half of our sample referred to finding the right person as critical for success, only one-third of our sample thought that going to the TA or the professor was an effective strategy for academic struggles. This perhaps makes sense in light of the fact that faculty were listed as a source of academic struggle by 45% of our sample. Our students of color do not feel comfortable asking professors for help and do not trust that they will receive effective support from the faculty if they do seek help.

When asked "how do you think you managed to stay in engineering school when other students have not been able to make it?" our students of color consistently replied (at least 30% of the students in each racial/ethnic group) with an answer that expressed a commitment to earning the engineering degree. Much of what was expressed as commitment was positive, in that the student was expressing an internal resolve that would allow them to persevere in spite of their struggles. Zalaquett describes this intrinsic satisfaction gained from educational achievement as critical to the success of Latino/a students¹⁷. For our students, obtaining a degree in engineering was an important goal:

"I guess that I am more stubborn than other people, like I don't want, I don't want to let you know like a D or F tell me I'm going to change." (Female Hispanic senior)

Other students sounded somewhat more defeated in their expression of commitment. These students expressed a commitment to finishing in spite of being unhappy with their academic choices:

"Tough it out, what else can I do? I only got a few more classes to go, not much I can do, just tough it out. It's hard, but (what am I going to do)?" (Male Asian American senior)

To adapt was a strategy that was used by 12 (30%) of our students of color. In the instances described by the students, adapting refers to learning how to successfully exist in a difficult environment. Here students referred to engineering weed-out courses and large freshman physics and chemistry courses as environments in which they had to adapt.

"Physics I was really tough, it's a huge class and you know they have to, somewhere along the way they have to make sure that whoever is actually going to stick through it sticks through it so it's one of those weed-out classes and so those were like, just the fact that you know we have these big classes that have to weed people out and then it's just a completely different learning environment where professors teach in completely different ways trying to make things difficult. But once I got the hang of it like after the two months you know it kind of became just routine and eventually as the semesters went on,

like no matter what the professor did I would just kind of adapt to what he, you know his teaching style and stuff. I had a lot of weird professors but yeah I'd say the first two months was difficult but if you're willing to just deal with it then you'll be cool you know so that's how I did it." (Male Hispanic senior)

Other students talked about the need to adapt to a different cultural environment, in particular, being a minority at a predominantly white institution. When asked if she fit in at the University, this Hispanic student responded:

"Yeah, now I do. I mean there's people from all over you know. It's a small amount of people but I kind of got over the whole "I'm the only colored person in this class" because I was, I'm not so concerned with it anymore. I started out in a calculus class and there were only twenty-two people, it was four girls and eighteen guys and everybody else was white, and I was the only brown person in there. I know last year it probably would of made me feel uncomfortable and insecure, but this year I'm more sure of myself like I don't care, and we're all here for the same reasons, she's not smarter than me, and I'm probably not smarter than him." (Female Hispanic sophomore)

This analysis of common strategies used by the different student groups highlighted some interesting differences as well. One interesting finding is that most of the strategies reported by the Asian American students involved personal accommodations to try to minimize or alleviate their academic struggles. This follows from Wu who describes the effects of the model minority myth and how many Asians are now living expressions of that myth. Asian Americans perceive themselves as not responsible for controlling things in the external environment and thus often turn inward for solutions to their problems¹⁶. For example, one of the strategies cited almost exclusively by the Asian American students was to work harder in the face of academic struggles. This was sometimes expressed as studying more, but others expressed a level of determination that keeps them from quitting in difficult times. When asked how he handles a difficult class, this Asian American male replied:

"[I go] to my room and not sleep basically. I, you know, sometimes I would take a breather and think about it here and there but if I'm academically in a bind I do my best to get out of it. I study. I talk to my friends and see if they understand anything but it's not my thing to just give up on a problem." (Male Asian American sophomore)

Another Asian American male explains that to work harder was the only strategy he knew when he first began taking engineering classes:

"I didn't really know what I was doing or why I was doing it. All I knew was to hit the books, and I did that. That was it." (Male Asian American senior)

He follows up that comment with a reference to the cultural capital he has gained while being in the engineering program:

“Now I am used to everything and how everything works. I know how to get by.” (Male Asian American senior)

The Hispanic students in our study talked about acceptance as a strategy. These students seem to possess a laid back attitude and were able to work in whatever situation or environment they were placed in. When asked about whether it made a difference to work with other students of color, this student suggested that while it made him feel more at ease, he didn't really think about it:

“Yeah, just because, I'd say yeah because sometimes when I worked in groups where it was like I had a couple of Black people or whatever, you know some of the Hispanic were there like, I don't know, we kind of, you just, I don't know, you felt more, I don't want to say you felt more at ease but you did kind of connect you know. But at the same time it wasn't something that I always think about, that I would think about. I just know that it was always kind of fun you know working on these projects but I would say I never really thought about all this until at the end especially now that we're doing the interview. So it wasn't something that was on my mind. Like I wasn't thinking during class “Man, where did all the minorities go?” It was just, I could, we worked, I worked with everybody at one point or another so um, it just, I don't really think about it, you know.” (Male Hispanic senior)

A similar type of response was obtained during a discussion of gender discrimination. The student expressed feelings of being marginalized when working with groups of males. And while she recognizes this as discrimination, she responds to it with an attitude that expresses acceptance of the male students' behaviors:

“I'm kind of used to it now. I tend to have mostly guy friends. It's like I get along with them better now. I think it's because I've been with them for so long but it's weird. You miss girls every once in a while.” (Female, Hispanic senior)

This behavior that we call acceptance is not uncommon in minority students. Hines reports that African American students did not aggressively challenge racism, sexism, or stereotypes, even when directly encountered⁶.

Another strategy that students of color described as helpful with their academic struggles was understanding the system such that they know how to use it to their advantage to succeed. We called this playing the game. Students from the non-dominant culture do not arrive at college knowing how to play the game of academia as well as majority students. Academia considers the ability to play the game to be the responsibility of the non-dominant who are expected to stretch out and bridge the gap between the experiences of their lives and those of the dominant. According to Lorde, in order for non-dominant students to survive in the dominant culture they carry the burden of observing and identifying the key aspects of the language and customs of the dominant culture and then adapting and adopting those keys. The majority population bears no obligation to reach out and willingly provide insider information⁹. This strategy was learned by both Asian American students and Native American students. Most of our Asian American students attended affluent, predominantly white high schools. Perhaps these students have an easier time accumulating cultural capital because they have more of it to start with:

“Now I am used to everything and how everything works. I know how to get by.” (Male Asian American senior)

“And that is something you learn by being in the college of engineering, not to freak out. Because otherwise you go crazy. Oh, because like test averages on the college of engineering classes are really low. So it would be like in the fifties percentage and you get like a fifty and, you know. Like other majors you freak out, but we are just like yeah we’re used to it, so you learn not to freak out.” (Male Asian American senior)

The Native American students in our sample were also adept at playing the game. These students had little identification with Native traditions and culture and graduated from predominantly white high schools. Perhaps these students know how to play the game because they have the advantage of cultural capital the same as white students. Their methods for playing the game were quite explicit. One student describes his strategy for studying just enough to get the grade that he wants:

“So basically, more than likely whenever you get further in [to the curriculum], you got professors who will pass the majority of the class. You may have 3-4 fail. As long as you know that you are not going to be at the bottom of that list, you are saved. The thing is trying to get to the top of that list, so at the end what I do for most of my classes, at the end try to make it to where the final isn’t a stress at all, where you can kind of study, half-study for it, just enough to get your grade, which is sad to say but it’s one of the things that happens especially if you have other classes that you need to make the grade. You just half study for the classes you know, as a bigger concern because you know that you will be able to bring back the stuff if you need to for your next year.” (Male Native American junior)

A different Native American student talked about playing the game in a way that was somewhat manipulative. He explained that it is important to get to know your professor by attending office hours because if s/he knows a student, they will make sure that student receives a passing grade:

“... it shows that you’re willing to put out the effort and a lot of times, like I said, that’s all that you have. And if the professor thinks that you’re trying as hard as you can, they’re going to pass you.” (Male Native American Petroleum Engineering sophomore)

He goes on to explain that he understands that his grades have to only be better than his peers to do well in a class regardless of the numeric grade earned.

“Getting tests back, you look around and everybody’s flunking, everybody looks down and depressed and you realize that your grade really isn’t that bad in comparison to everybody else’s and so you just have to figure that he’s coming up with the grades somehow else. Even though he tells you, you know, that that’s what you’re going to get, he can tell you that all day long. But at the end of the day he’s not going to flunk everybody. And so you just do the math or whatever way he’s making, you realize that

he's going to flunk everybody except a couple of people unless he does something else."
(Male Native American sophomore)

Conclusions

In the early 1990's, Seymour and Hewitt interviewed several hundred students at a variety of colleges and universities¹⁵. The students were or had been majoring in science, mathematics, or engineering (SME). Their sample was large enough that they were able to examine issues specific to minority students. They identified some of the issues that we have discussed in this paper (e.g., poor high school preparation, sense of isolation). However, while they aggregated across all SME majors, we are focusing on engineering because we believe that different disciplines have different cultures and therefore present different issues for students.

Seymour and Hewitt also recognize that some struggles transcend across the boundaries of racial and ethnic distinctions¹⁵. This paper is similar to their work in that we have also identified common issues. As revealed by our findings, a decade later students of color continue to face a union of problems. They face issues common to all students at research universities (e.g., large classes), issues that all engineering majors face (e.g., curriculum load), and issues that people of color face in predominantly white settings (e.g., isolation). These problems combine to exacerbate the difficulty of obtaining an undergraduate degree in engineering. Even after years of legislative and programmatic emphasis on increasing diversity and equity, these problems are still prevalent for students of color, perhaps even more so in the current political climate.

Beyond issues that are common across racial/ethnic populations, we have begun to disaggregate the issues for specific minority groups. This step is important because institutions tend to treat all minority students as if they are the same, which they are not. For example, common belief is that all minority students experience isolation in a predominantly white institution. The results in this paper point to probable differences among the groups in the degree of feeling isolated. We note here that students of color who have a more advantaged background and/or physical appearance more similar to the dominant culture described less intense feelings of isolation or did not identify this struggle at all. We also note that in this sample we find differences in the degree of gender discrimination, perhaps related to how women are seen in different cultures. Differences among students are particularly important at institutions, like ours, that have a considerable number of students from different populations.

We focused our research on students of color who have successfully persisted in engineering majors. This paper specifically looked at academic struggles identified by students of color and the strategies they described for dealing with those struggles. What we notice, unfortunately, is that the students in our samples have successfully persisted by being proactive in finding their own solutions to problems such as lack of familiarity with the culture of engineering, weak high school preparation, and feelings of being an outsider in engineering. Regrettably, the system continues to place the responsibility for success solely on the shoulders of the students, rather than providing sufficient resources that students trust. While we do want such students to succeed, it is clear that these students of color should not be the only ones who persist.

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