AC 2008-620: IS TRANSFER CREDIT A STRATEGY FOR SUCCESS OR A PRESCRIPTION FOR FAILURE?

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Is Transfer Credit a Strategy for Success or a Prescription for Failure?

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Identifying the factors contributing to successful completion of an engineering degree at a predominately white, research institution by under-represented and under-served minority students is one goal of the Research Institute for STEM Education (STEM = science, technology, engineering, and mathematics). Additionally, we seek to differentiate the strategies and obstacles affecting the success of students from various ethnicities and backgrounds. To this end, non-majority undergraduate engineering students were interviewed using a protocol inspired by Gandara [1], Seymour and Hewitt [2], and Margolis & Fisher [3]. In the early stages of analysis of data from this project, we discovered an unexpected strategy used by our students: credit transferred from other institutions towards their engineering degrees. This report describes, compares, and contrasts the different types of transfer credit and their varying extent among and within the different non-majority populations in our study. Where possible we explore motivations for acquiring transfer credits from the students' perspectives and inferred motivations from demographic characterizations and social and academic constraints. We identify some proactive and reactive strategies to achieve success and some circumstances that seem counter to that goal.

Methodology

Our quasi-longitudinal research design invited students to share their lived experiences as minority students in undergraduate engineering programs at this institution. Invitations to participate were extended to students in their sophomore, junior, or senior years and were repeated annually until graduation. Overall, 140 African American, Hispanic, Asian American, and Native American students participated in 206 interviews. These students represent ten of the eleven undergraduate degree programs available in the college at the beginning of the project.

Secondary data collected for most participants came from academic transcript analysis. We extracted the semester of their initial enrollment at our institution, the science, math, and engineering courses they had taken, including the semester and their grade, the number of transfer credits accumulated, cumulative GPA, and all majors the student had officially declared

Table 1. Occurrence of Transfer Credit by Race/Ethnicity	African American	Asian American	Hispanic	Native American	Caucasian
# interview participants	37	37	37	29	N/A
# providing academic transcript	33	30	35	29	N/A
# with transfer credit	27	23	21	25	563
% of students with transfer credit	82%	77%	60%	86%	60%
# with associate degree	0	2	0	2	?

from an academic transcript pulled after the end of the semester in which the student was interviewed. As indicated in Table 1, not all participants allowed access to their academic transcript. From those who provided transcripts for analysis, we discovered that 96 of the 127 students (76%) had transfer credit hours recorded. This broad extent of transfer credit accumulated by the participants towards their engineering degrees was startling because it was

rarely mentioned in the interviews. Further examination showed that out of the 96 participants with transfer credit only four students had entered with an associate's degree from a two-year school. Table 1 also provides the disaggregation of transfer credit across the ethnicities of our student participants.

Curious as to whether the minority student transfer data was comparable to that of majority students in our College of Engineering, we determined that for Fall 2006 non-freshman Caucasian enrollees the incidence was indeed lower than the minority student incidence. The differences in percentages of students with transfer credit between the participant ethnic groups were intriguing so we further disaggregated the transfer credit to understand the students' pathways.

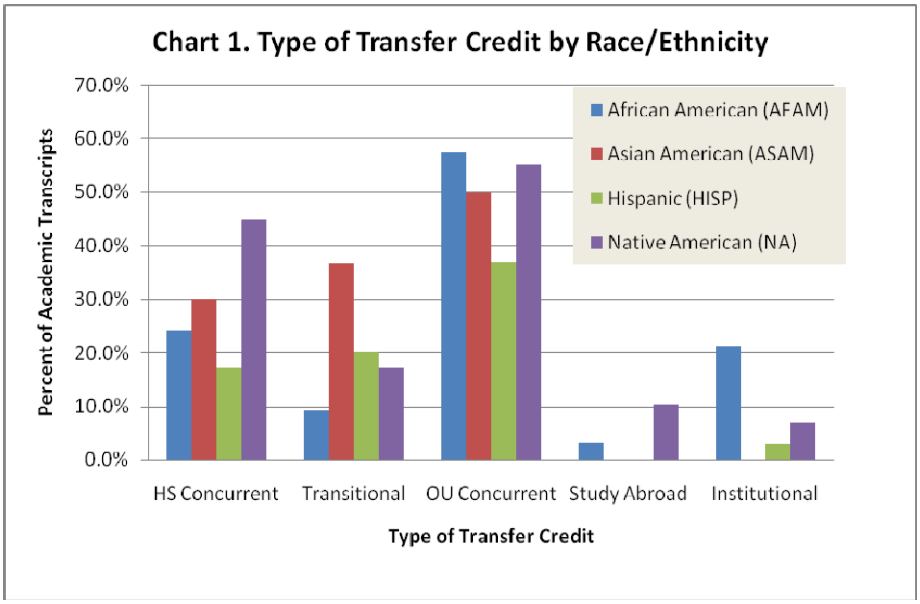
We analyzed student academic records to determine how many classes were transferred, which classes students had transferred into the university, when they had taken these classes, where they took these classes, and, to the extent possible, why they took these classes at another institution. Through this process, we identified five different types of transfer credit accumulated by our student participants:

- High School concurrent (HSC): college level (usually community college) classes taken for college credit while still in HS;
- Transitional-type (TT): classes taken for college credit at a community or junior college or vocational-technical school sometime after HS graduation and before enrollment at our institution, including students starting over after an academic break or enrollment at a different four-year school;
- University concurrent (UC): classes taken for college credit at a community, junior, or other four-year college or university during an active semester or between two semesters of enrollment at our institution, usually during summer sessions;
- Study abroad (SA): classes taken during a study abroad semester for which credit was not earned directly from our institution;
- Institutional (IC): classes taken while enrolled at another four-year institution, prior to attending our institution, and seem to indicate an intent to earn a degree from that institution.

Chart 1 shows the extent of these five types of credit in our study population.[1] Obvious differences in the use of these potential strategies appear among the different ethnic groups. Hispanic students have the least occurrence of each type of transfer credit except for transitional. African-American students are less than half as likely to have transitional credit as Hispanics and nearly one-fourth as likely as Asian American students. We were initially surprised that a significantly greater fraction of Asian American students than any of the other ethnic groups transferred in transitional credit. Adelman [4] examined ethnic breakdown of HS students who enroll at a community college as their first higher education institute. He reports data that suggest very high rates of enrollment across ethnic groups. For example, he reports that 55% of Latino students start their higher education at a community college. Students in the other ethnic

[1] Unless noted otherwise, percentages for transfer credit among participants are out of the set of participants for whom we have academic transcript data.

groups attend at a rate ranging from 36% - 38% (white, African American, Asian). However, when we examine this phenomenon from the perspective of our receiving institution, we find different enrollment trends for our transitional students. In our population of transitional students we find Asian American students have the highest rate of transitional credit, but all other groups are well below the rates found by Adelman. Similarly disproportionate is the fraction of Native American students whose transcripts record college credit earned prior to high school graduation. While the presence of these students on community college campuses has been acknowledged in the literature, little is known about why some students chose this path and what consequences that choice may bring.



Our initial examination of *Institutional* credit does not suggest its proactive use as a strategy for earning a degree. Unlike students with HSC, TT or UC, the IC population and accompanying credit hours seemed to arrive at our receiving institution as a result of the ebb and flow of the life course. Likewise, the *Study Abroad* category does not obviously figure into success strategies for finishing an engineering degree and thus these two types of transfer credit will not be investigated for this report. Instead, we will focus on the three remaining types of transfer credit, which appear to have strategic significance for our student population. Because of the broad variety of courses taken at other institutions, the main focus of discussion of specific courses will be on science, engineering, and mathematics courses (SEM), plus a few prominent exceptions. Furthermore, with three different types of transfer credit, four ethnic groups, and the myriad of demographic characteristics and social constraints that could be used to parse the students into clusters, the possibilities for cluster analysis are mind-boggling. Our analysis is also limited to a great degree, though this is an interesting finding in its own right, by the broad silence of the students regarding these strategies. Therefore, for each type of transfer credit under consideration, we compare and contrast the scope of occurrence across the pool of students, within and among the different ethnic groups, and using other groupings and characteristics for analysis that seem to be the most prominent and significant.

High School Concurrent Type Transfer Credit -

Using a chronological approach, we will begin our discussion of the extent and impact of the different types of transfer hours with High School Concurrent (HSC) hours. Thirty-six of the 127 students in this analysis transferred college credit to our receiving institution and their degree program that had been earned prior to their high school graduation. As shown in Chart 1, the use

of this strategy was not consistent among the students from different ethnic minority groups: the use ranged from 17% of Hispanic students to 45% of Native American students. The most popular courses for students to take through HSC enrollment were Freshman Composition (1, 2, or both) with 16 students and Political Science/U.S. Government with 14 students. All of the students who transferred HSC credits reported matriculating into college directly from high school. Within the students who accrued HSC credit, the distribution across ethnicities is: AFAM – 22%, ASAM – 25%, HISP – 17%, and NA – 36%.

Focusing on the 9 students with HSC in one or more mathematics classes offers some additional trends. Seven of the nine students with mathematics HSC credit are from large towns, suburbs, or cities. The parental education level is known for seven of the nine students and for all seven at least one parent has at least a four-year college degree. Both parents have at least a four-year degree for five of the students and one or both parents has a post-graduate degree for five of the students also. For comparison, parental education levels are known for 33 of the 36 students who have any HSC hours and over one-third (12 of 33) do not have at least one parent with a college degree. Within the total HSC population, the AFAM students have the parents with the highest educational attainment – 87% of students have at least one parent with a four-year degree or higher; they are followed by: NA with 62%, Hispanic with 60%, and ASAM with 43%. Except for the AFAM students, the fraction of students with parents with four-year degrees is comparable in the HSC credit group for each ethnic group to the parents' education level for the respective group in our whole data set. This pattern will be explored in more depth when looking at ethnic group differences.

Eight students with mathematics credit are male; four of those male students attended a local or state-wide STEM magnet school and another one attended an alternative school. Two of the four students who attended a STEM magnet attended an urban school for engineering professions that is contained within a general magnet school. The other two students attended state-wide residential science and mathematics schools where one- to two-thirds of the faculty have doctorate degrees. None of these STEM magnet graduates discussed their college credit classes outside the context of their high school experience. In other words, those who discussed their mathematics background did so without identifying that part of their course work was collegiate level and earned college credit.

Five of the nine students earned credit in college algebra, trigonometry or both. This group includes three students from STEM magnet schools and two from small town or rural schools. For one student who graduated from a STEM magnet high school, the pre-calculus courses were taken to prepare for attending the junior and senior level magnet school. The remaining STEM magnet students talked about these courses as if they were indistinguishable from other high school courses.

> AFAM male: The math course there was like pre-calculus when I came in, so it wasn't that hard, but right now it's definitely a lot harder the concepts are very abstract different, challenging, so it's harder."

The other four students earned credit in some part of a typical calculus sequence, though one young man completed all calculus, ordinary differential equations and linear algebra before high school graduation. He attended a school that he describes as an "independent study school,"

saying that he attended there "to get out of high school." While there he took English, online AP courses, and traveled to nearby colleges to take mathematics and science classes.

The nine students with mathematics HSC credit disaggregate across the different ethnicities as: AFAM – four students, three male and one female; ASAM – two students, both male; HISP – two students, both male; and NA – one student, male. Because of the need to ensure participant confidentiality, only the AFAM students will be discussed separately.

Three of the four AFAM students have both parents with at least a four-year degree; three attended STEM magnet schools; four have college credit for algebra and/or trigonometry; one completed all engineering math before arriving at our receiving institution. Two of the three AFAM students who have pursued mathematics credit at this institution placed into pre-calculus courses on the university's mathematics placement test for freshman enrollees. Though their college mathematics experience did not help these two students begin their engineering degrees "calculus-ready," our data suggests that, in the overall picture, this experience has contributed to their success in pursuing their engineering degrees. Of the 33 AFAM students in our data set of engineering students successfully completing or continuing to pursue their engineering degree, and for whom we have academic transcript data, six began mathematics at this institution in pre-calculus courses. The two students with HSC concurrent credit had completed for credit seven courses out of eight attempts when we accessed their transcripts, with an average GPA in those courses of 2.38 out of 4.00. In contrast, the four students beginning in pre-calculus courses without prior college experience have accumulated 17 completions for credit out of 23 attempts at mathematics courses with an average GPA 1.87 out of 4.00. One of the two students with HSC mathematics credit has a higher mathematics GPA at our receiving institution than any other AFAM student who started in pre-calculus. The other student has struggled a little more with this mathematics classes, but still says:

> Interviewer: Okay. Do you feel that your high school prepared you for your college classes now? Like are you still feeling prepared?
> AFAM male: Yeah, I feel prepared in comparison to other people I want to say…Just looking at the black people that have started out in Engineering and have switched, I think [high school] prepared me as to what to expect from an Engineering program. So, I think that's why I've been able to last as long as I have.

For a student interested in pursuing an engineering degree, a solid foundation in mathematics is paramount [5, 6]. All of the students in our complete data set known to have HSC mathematics have either completed their engineering degree or are still enrolled pursuing that goal. Taking college-level and credited mathematics while still in high school can be a proactive strategy for success in engineering. In the words of one student who came in with calculus 1 and 2 already under his belt:

> Interviewer: And how would you evaluate your high school as far as preparing you for college and engineering?
> HISP male: Um, it was, it helped me. I mean the classes in high school weren't nearly as hard as they were at <our institution> but they did help me in the fact that it got me more interested. So it basically, whenever I got to <our institution> whenever the classes got harder, I just wanted to learn more. That's how my high school experience helped me out.
> Interviewer: What kind of classes did you take that made you become more interested?
> HISP male: Well, I took AP Physics I and II in high school and then my senior year in high school I did concurrent enrollment at the local college. And I was able to get done with almost all of my

> calculus before I even got to college which basically was a huge help. I mean I was able to just basically come in halfway through my freshman year already over with most of that

The most significant difference for the mathematics HSC students relative to other students with non-mathematics HSC seems to be derived from the higher parental education level. Students whose parents have successfully completed a college degree have greater access to information and strategies for succeeding in the academic game. Someone influencing these students prompted them to pursue mathematics college credit before they graduated high school. This HISP male student who completed both calculus I and II while in high school explained:

> Interviewer: Uh huh. And what, I mean what drives you, what, you know because not very many high school students go and take college classes. What made you do that?
> HISP male: Well, it was just, I don't know. I kind of always had the drive to teach myself new things or just learn things on my own. I don't know.
> Interviewer: Did your parents encourage you or your teachers, I mean?
> HISP male: Yeah, early on my parents encouraged us. Well, my dad was a high school math teacher but I mean he would, whenever me and my sister were little he would just take like real life problems and then show us how math was related to it and that got me interested in it at an early age. And so then by the time I got to high school I was, it had already developed on its own. And then it just kept going (c) it was like a snowball effect I guess.
> Interviewer: So your interest pretty much like came from your dad and then it just kind of.
> HISP male: Yeah it just kind of snowballed.

Transitional Type Transfer Credit -

Twenty-six of 127 students received credit for classes taken for college credit at a community or junior college or vocational-technical school between HS graduation and initial enrollment at our receiving institution, including students starting over after an academic break or enrollment at a different four-year school. As shown in Chart 1, the use of this strategy was not consistent among the students from different ethnic minority groups: the use ranged from 9% of African American students to 36% of Asian American students. We also see a pronounced shift in behavior with regard to HSC and TT type credit for African American (24% HSC, 9% TT) and Native American (17% HSC, 45% TT) students. Though only comprising 24% of the participant analysis pool, ASAM students represent 42% of the group with TT credit; the other groups contribute: 12% AFAM, 27% HISP, and 19 % NA. Mirroring HSC behavior, the most popular course for students to take between high school graduation and college enrollment were Freshman Composition (1, 2, or both) with 20 students. Unlike, HSC students, the second most popular course for TT credit was General Chemistry (1,2 or both) with 16 students; though that course sequence tied with U.S. History (16) and barely exceed Calculus 1 (14) and Calculus 2 (14). Only one student who transferred TT credits reported postponing enrollment into college directly from high school, opting to work instead.

Nineteen of 26 students with TT hours transferred one or more mathematics from 12 different community colleges, junior colleges or state colleges; however, 63% of TT hours originated at two institutions located in the same metropolitan area. Nine of the 12 sending institutions were located in the same state as the receiving institution. Both facts reflect the preponderance of students who either attended high school or who have immigrated with their family since high school to within 45 miles of the two primary sending institutions.

TT students are a highly urban population with access to numerous institutions that meet varied needs and schedules attended high schools in urban/suburban communities [7]. Ten of 11 ASAM students with TT hours are from urban/suburban communities. Of these10, nine attended high schools located within ten miles of the two primary sending institutions in the metro-<middle size urban city> area, which in turn are 15-30 miles from our receiving institution main campus. The remaining two attended international high schools in an urban setting. Eventually, **all** Asian American TT students attended one or both of the primary sending institutions.

Six of the seven Hispanic TT students attended high schools in urban/suburban designated communities. The lone Hispanic female came from a small town and had only 4 TT credit hours compared to an average of 60 per student for her urban ethnic peers. As with the ASAM students, four of the seven HISP students, at one time or another, attended one of the primary sending institutions for our TT population. Two of the three AFAM students graduated from urban/suburban high schools. The lone female also attended high school in a small town. Like her HISP counterpart, she only transferred three TT hours and none were in science or mathematics while her two male counterparts transferred a total of 65 TT hours.
Six students transferred all required Calculus credits. Another six students had sufficiently fulfilled all mathematics and science requirements that no more course work in those areas was necessary at the receiving institution. Four students (2 ASAM and 2 NA) complete Associates Degrees while in transition.

Sixteen of 19 students transferred credits in Calculus I and/or II. Average GPAs for that course work was 3.17 and 3.43 respectively. Twelve students transferred hours in Calc III (3.5) and nine transferred Calc. IV (3.44). No student earned a grade less than 2.0 in any Calculus class taken at a sending institution. However, for the three students who did earn a grade of 2.0 in Calculus I, one earned a 2.0 in Calc II taken at the same sending institution and failed Calc III at the receiving institution; one withdrew from Calc II at the receiving institution, took and passed Calc II as UC hours with a 4.0 at the same sending institution where Calc I was attempted and then failed Calc III at the receiving institution. The third student with a 2.0 in Calc I, after struggling with Rigid Body Mechanics and Physics II at the receiving institution, switched out of engineering for a period of time to elevate his GPA and gain re-admittance to the college engineering.

Based on these students' experiences, we suggest that if a student transfers or enrolls in an engineering degree program bringing calculus credits with a 2.0 GPA from a community college, entrance counselors might consider recommending that fundamental calculus courses be repeated, or perhaps offer additional oversight and monitoring to facilitate intervention if needed [8].

Half of the Hispanic males (3) and two Asian males attended high schools outside the U.S. and began their U.S. academic careers in community colleges. All six express confidence that their high school preparation in mathematics and science exceeded that of U.S. high school students and their enrollment in transitional institutions is not a result of poor mathematics or science skills.

> Interviewer: Well tell me a little bit about your high school preparation and how do you think they prepared you for college?

HISP Male: Okay. When I was in, <South American country> now that I'm here and took some American classes here in America in high school, I noticed that they had a very strong high school program in <South American country>. And when I came here I just knew a lot of things that nobody knew, especially in math and sciences. I was more prepared than many others high schoolers especially in that small high school that I went to was only like maybe five hundred people. So I think they prepared very well, especially the high school that I went to. Their goal was to make everybody engineers for some reason. So it had a good math background, and science and I was in Spanish and things like that so I felt really prepared.

Mathematics and science scores earned in transition supports their perception. None earned less than a B+ in calculus I-IV and physics I in their TT course work. Their enrollment in transitional institutions and accumulation of TT hours is less about gaining a grounding in basic math and science skills but more a result of administrative issues accompanying the enrollment of international students, the uncertainties of being an exchange student, satisfying language proficiency requirements, and the relative cost of credit hours at a community college versus a four-year research institution.

Interviewer: Why did you go to community college first?
HISP male: I think it was because of the time frame. Because when I came over to <state in the US> the time for enrollment for <our receiving institution> was already over.

Interviewer: So where did you study before coming to <our receiving institution>?
ASAM male: I took the TOEFL and I passed the TOEFL at <university>.

Asian American and Hispanic American students combine to represent 67% of all students with TT hours. When we look closely at this population, English language proficiency (ELP) emerges as another possible motive for the accumulation of TT credit hours. Of the 369 total TT credit hours accumulated by Hispanic students, 251 (68%) were earned by five students who claimed English was not their first language. The remaining two Hispanic students earned 115 TT hours and three TT hours respectively and both speak English as their first language. The same contrast is noted for Asian students. Of the 419 total TT credit hours for ASAM students, 348 (83%) were accumulated by eight students for whom English is not their first language. Of the remaining 71 hours, 60 (85%) were accumulated by one English speaking Asian American student. As judged by comparable GPAs for TT mathematics courses, mathematics proficiency was not an issue. In a discipline that promotes group projects, the quality of student educational experience is impacted to some degree by language proficiency. As the student quoted below well understands, it is very difficult to participate fully in a learning environment if one cannot effectively communicate.

Ethnicity	English Learned	Total TT hours	Math GPA
Hispanic	First	251	3.417
	Not First	118	3.395
Asian American	First	348	3.818
	Not First	71	4.000

Interviewer: Uh huh. And you think you didn't have enough teamwork?
ASAM male: Uh, not enough team work. No. I just don't have no math connection with my classmates, because the problem of my language.

OU Concurrent Type Transfer Credit -

The last type of transfer credit from our data to be discussed is termed University Concurrent credit (UC). This transfer credit is earned at a community or local college sometime between first enrollment at the receiving university and graduation. The concurrent enrollment at times is truly concurrent, i.e. the student is taking classes at the community college during a semester that they are also enrolled at the university, but it generally occurs during a summer between enrolled

semesters at the university. Across all ethnic groups and for any course, 63 of our 127 participants (50%) recorded UC credit. Over half of the African American and Native American participants (58% and 55%, respectively) accumulated this type of transfer credit. Exactly 50% of Asian American participants and only 37% of Hispanic students have used this strategy.

We will begin the examination of this credit with some noteworthy trends among non-mathematics courses before looking at different student demographic groupings and the mathematics courses. First, 25 of the 63 students received UC transfer credit for a U.S. History course taken at a community or local college. Sixteen students took Political Science or U.S. Government outside the university. One might think that ASAM and Hispanic students with more English language issues would be more likely to take these reading and writing intensive courses in a smaller, and perhaps less rigorous, setting. Contrary to that expectation, 76% of the students taking U.S. history and 63% of those transferring political science credit are identified as AFAM and NA students. Over half of the AFAM and NA students with UC credit counted U.S. History in their hours, as compared to 23% of HISP and 20% of ASAM students. None of the students who took these classes elsewhere disclosed that fact or their motivations in the context of our interviews. While this is unfortunate, it isn't surprising since we were questioning them on their engineering experience. As this trend was emerging from our data, we spoke with engineering undergraduates who work with us (and some faculty who advise students) and were told that the student underground network tells new students that these courses are "unnecessarily" difficult and time-intensive at the university. The student network advice is to take these classes elsewhere. We believe that the ethnic group differences in UC credit for these courses is another indicator of the AFAM and NA students at our institution having a strong student network and more capital to "play the game. [9]"

The student informal advising network is a likely contributor to other trends found in the UC credit data [10, 11]. One example is the course electrical science. An extraordinarily high proportion of students take it outside the university. This course is the engineering core class for non-electrical engineering majors, covering the core concepts of electricity and electronics. Seventeen of our 63 students (27%, second only to U.S. history) with UC credit took this class elsewhere. Data from an earlier study at our institution indicated that this course is considered by students to be "harder than it needs to be. [12]" The underground messages regarding this course are as unevenly distributed as for history and government: 50% NA, 31% HISP, 21% AFAM, yet only 7% ASAM have this requirement fulfilled through UC. In addition to the uneven proportions measured by ethnicity, the message regarding options for taking electrical science on our campus are disproportionately passed through certain majors. The 17 students taking this course are enrolled in three majors: chemical engineering (4 out of 14 having UC credit), industrial engineering (6 out of 11), and mechanical engineering (7 out of 17).

Additional evidence here suggests that the industrial engineering (IE) student network at our institution documented through an earlier study is alive and well [10, 11, 13-16]. Looking beyond the electrical science course to all SEM courses taken by female students at local, or occasionally hometown, community colleges, we find that IE female students are over-represented by both number of students and the average number of UC SEM hours transferred. Seven IE females have accumulated 60 SEM transfer hours through university concurrent enrollment. Three of these seven are Hispanic and the other four are Native American. The other

ten female students with UC hours are pursuing five different engineering majors and have only accrued 43 SEM credit hours. Four of those females, three African American and one Hispanic, with 21 hours, are from mechanical engineering.

Because of the ubiquitous and structured progression through the engineering mathematics sequence of calculus I-IV and differential equations, these mathematics courses offer us a way to infer some student motivations for their UC hours. We have to use this approach as only two of the 23 students with mathematics credit through UC courses mentioned this strategy in their interviews. We should probably explain that at our institution calculus has been offered for many years in a three-credit hour each, four-course format. Every major also requires ordinary differential equations, and many also require linear algebra. Our state regents have orchestrated articulation agreements between state two-year and four-year institutions for many years, but the calculus sequence continues to be problematic: until recently most of the two-year schools used the more traditional four-credit-hour, three-course approach. Some institutions even offered general calculus in two, five-credit-hour courses. Deciphering which course counts for what degree requirement can be quite complicated if a student pursues calculus credit at more than one community college in addition to the university.

By examining the students' academic transcripts, we can, in most cases, attribute their mathematics courses into one of three potential motivation categories: get ahead, catch-up, make-up. Make-up is the tag used to indicate that a student has previous attempted a course, but not received a passing grade, before attempting it at the sending college. Catch-up indicates that the student was behind in the prescribed progression of requisite mathematics courses and was taking the course off-site to re-align with the recommended curricular path. If a student is taking a course at the other institution before the semester it would be expected in her progression through the curriculum, that course is considered a get-ahead course.

	AFAM	**ASAM**	**HISP**	**NA**
# students	7	5	7	4
# course attempts	14	6	10	4
# different math courses	5	4	4	3
% attempts make-up	27%	17%	50%	25%
% attempts catch-up	50%	17%	40%	75%
%attempts get ahead	23%	67%	10%	0%

Recall from Chart 1 that the proportions of students with UC credit decreased from AFAM to NA to ASAM and then a sizable drop to HISP. When examining only math classes, the AFAM students still lead by absolute number of courses taken, but their classes seem to be heavily motivated by the reactive strategy of catching up. Even more heavily weighted towards the reactive strategies of make-up and catch-up are the NA and HISP students' use of UC-type mathematics credit from community colleges. The Asian American students are the most proactive in their mathematics course strategy. One could draw on the Model Minority stereotype to explain these observations ("ASAM students just do better at math, have more supportive families, higher value placed on education"). This paper is not the place to debate that stereotype, but examining these students' backgrounds from a cultural capital theory, we would actually expect them to be the least proactive in working their way through the academic system – a higher percentage of the ASAM students do not consider English their first or primary language (40% vs. 0% of HISP with mathematics UC the only meaningful comparison) and their parents have a much lower average educational level than the other groups (0% with 4-year degree or higher vs. 83% AFAM, 50% HISP, and 25% NA). One Hispanic male (from a

suburban area, English is first language, and one parent has 4-year degree and one has post-graduate degree) provided this description of his experience with mathematics make-up and how the social capital accumulated through classmate networks assisted the use of this strategy:

> Interviewer: Okay. You also mentioned in the last interview that you audited a class.
> HISP male: Yeah, I audited one class. I audited Differential Equations. Like, it just was a really hard class. The professor taught it for only for like math students so only math students understood. There was only a handful of Engineers that actually passed. … I think there was 20 or 30% of the class immediately dropped within, like, the first week. And, then I just stayed in long enough and after the first test I made, like, a really bad score and so that's when I went up to him and said, "Can I just audit this class?" He said, "Sure."
> Interviewer: Did you have to retake another class because of that?
> HISP male: I took it up in the summer. I made it up in the summer.
> Interviewer: The same class?
> HISP male: Yeah. Well I took it up at TCC, <urban> Community College, and so I just transferred it. It was a lot easier.
> Interviewer: So did you decide to take it in <city> because you, it was easier or?
> HISP male: Yeah and because, like, I needed it for the next semester. I needed it for the fall semester and so I just taking it up as a summer class in <city>. So, like I'm from <city> so it was just more convenient.
> …
> Interviewer: Oh, okay. So how did you know that you could audit the class?
> HISP male: Uh, talking with friends, like, they audited a class, like, sophomore year. The first time they took a <engineering discipline> class, like, a lot of people audited the class. So, that's how I found out about it, auditing.
> Interviewer: Okay. Did it work out?
> HISP male: Yeah. Just fine.

Another intriguing trend observed in the data regarding UC mathematics course taking cannot be explained without the students' perspectives, but is worth noting. Within the 17 industrial engineering majors in our data set, seven began their tenure at this institution by placing into a pre-calculus course – in engineering education terms they were not "calculus ready." Six of these seven students (one AFAM, three HISP, and two NA) record UC credit for 12 mathematics courses: five make-up, six catch-up, and one get-ahead. Though we don't know from the students how they learned about this strategy, or if this strategy was successful, the following AFAM male discusses the impact of his high school preparation and the difficulties encountered from starting pre-calculus at the university. His experience is in contrast to the young AFAM males quoted in the HSC section, though all are from a major metropolitan area and all have parents with 4-year degrees or higher.

> Interviewer: Do you think that your high school prepared you for college or to be in the college of engineering?
> AFAM male: No, it didn't, it didn't at all, they tried but I think my high school, it was a new high school, I think it was like three years, it was a charter school….I mean they tried, but like I think it was a little tedious with my math, because I got so high. They didn't have teachers to teach me, so when I came to college; I hadn't taken a math course like the full whole year math course, maybe for a year and a half or two years. You know math you have to keep up with. Or it kind of goes away
> Interviewer: Okay, so did you get behind when you got here, or just started to remember it and picked it back up when you got here?
> AFAM male: No, when I got here I tested into like elementary fundamentals because I couldn't get past the trigonometry part [and] algebra part so I went real low and then worked up and I finally got to I guess, it was pre-algebra, and then after that, I started taking my calculus. But I started out like real far behind.

All of his calculus credit was earned at the community college after beginning in remedial math courses, yet like 61 of his engineering peers, there is no indication in his story that these classes, which are critical for success in engineering were taken anywhere but at our institution.

Discussion

Examination of both academic and interview transcripts indicate an assortment of factors and motivations influencing student decisions to accumulate some type of transfer credit. These factors and motivations are in large measure due to a range of socio-economic and demographic variables impacting college attendance during and after high school. We will employ Bourdieu's theory of social, cultural and symbolic capital as a framework to provide an explanatory option for the differential use of three types of transfer credits. Bourdieu suggests that educational success includes a whole range of cultural behaviors that extend beyond the merely academic to the opportunity to play the game of social interaction within a specific social space. The cultural rules and attendant knowledge which govern social spaces are those of the dominant society. While each person obtains their own class' cultural knowledge, it is the cultural knowledge of the dominant class that prevails and frames the terms of interaction within educational settings. Students born and raised in the dominant culture have been exposed to and understand academic expectations: the educational system is constructed to reward their accumulated advantage. A student's ability to understand the rules and play the game is a result of accumulations of what Bourdieu calls capital [17]. Bourdieu identifies three types of capital. Social capital is the accumulation of resources based on networking and personal relationships; cultural capital is characterized as certain forms of knowledge, education or skill; and symbolic capital is explained as prestige that accumulates as a result of possessing cultural capital relative to another. Education and socio-economic status are directly linked. Parents who have post-graduate degrees will be more familiar with the vagaries of the educational system and can offer insight, guidance, and support to their children based on experience. Conversely, students whose parents have a high school education or minimal college experience have no direct resource for navigating a system that can be intimidating, monolithic and impenetrable [18]. Student success in academia is facilitated by college-educated parents, fluency in English, dominant-culture familiarity, and the social networking that follows from the advantages linked to these forms of capital.

If we examine our population in aggregate across the dimensions of social and cultural capital outlined above, our students seem to be English speakers with highly educated parents, in fact, exceeding the state averages for both. However, when we use a lens consisting of the three different types of transfer credit as strategies for success, it brings into focus differences of accumulated disadvantages for these same students. The differential and strategic use of the three types of transfer credit reflects motivations resulting from accumulated disadvantages which both cut across and parallel ethnic and racial boundaries.

To help us discuss the multiple motivations resulting from capital disadvantages and the resulting use of transfer credit, we will examine the pathways of five students from a particular suburban high school, all ASAM, who accumulated 77 (33 HSC, 17 TT and 27 UC.) transfer credits in mathematics, social sciences and humanities. They attended three different, local, two-year colleges for their early entry classes. The five started at our receiving institution> in three different years 2000, 2002, and 2003. Two students had one parent each who had not completed

high school. Four of these students had no parent who had earned a 4-year degree. One student's parent education level is unknown. For three of the five, English is their first language. But for two English is not their first language, nor is it primary. For all students, both parents were born outside of the United States; however, four of the five students were born in the U.S. No other high school matches the five graduates in our data pool, nor the fraction of participants with HSC credit.

The high school attended by these five students is 80% Caucasian. Asians make up 7% of the student population. Sixteen percent are eligible for free or reduced lunch as compared to a state average of 55%. Within this district 30 % of adults have a college degree and only 10% have less than a high school diploma. This resource rich high school in an affluent area (personal income is 140% of state average) appears to cultivate a culture in which students are encouraged, even expected, to go on to college after high school. In fact, the latest school report card indicates that 70% of high school graduates from this school district do indeed go on to college. Only 32% of first year students at <state> colleges who previously attended this high school were required to take a remedial class math, science, English or reading. Consider the experience of one the <hs> five:

> ASAM female: "My teachers in high school were extremely adamant on kids going to college, especially in my AP classes. That is what AP is for, to kind of get ahead and get into college early and all of that stuff to help us out. They were extremely helpful. My math teacher, my physics teacher, my chemistry teacher, like all of those teachers helped out. Even the faculty from the principles to like all of the vice principals and everybody underneath and almost every single one of the counselors I got to know really well. There are like four of them. I only had one set counselor, but I was in there all the time. I always consulted with them. They helped out with scholarships and everything. Everybody pretty much helped me. My high school is really, really aimed towards going to college. They helped a lot."

Given the racial and ethnic isolation faced in her high school coupled with the accumulated disadvantages in cultural and social capital, her high expectations demonstrates how her path to and during college was both informed and supported by good high school preparation, counseling and peer role-modeling. Her college course taking behavior demonstrates what would be the strategic use of proactive transfer credits. In addition to taking Calc I for AP credit, this student earned nine HSC hours, none in SEM; eight transitional hours, five in SEM and six UC hours, three in SEM.

Compare the difficulties experienced by the following student when high schools do not mediate disadvantages due to lack of capital. The experience of the first student is very different from the experience of one of two female Asian students who attended a different high school in the same metro area:

> Interviewer: Okay, so you went to < metro area high school>, and did you think that < metro high school> prepared you for college?
> ASAM female: Not really. I don't know, like <area metro high school> is okay for <state> system, for <state> high school system. I went to <metro area community college> for community college and I think I am okay.
> Interviewer: Do you think that helped you better than high school? Did going to a community college help?
> ASAM female: Yeah, I guess so.
> Interviewer: Have you applied for any scholarships?
> ASAM female: No, I don't. I don't know how to apply. You know when I was in <metro area community college>; there is no scholarship for <metro area community college>. Yeah, and when I transfer to <our

> receiving institution>, I apply this semester after I got some <our receiving institution> GPA to prove them that I am good enough to get some scholarships

Her behavior does not appear to be informed or directed by good counseling or course preparation. Unlike the high school in the more affluent metro urban area attended by the first student, this student's high school is 33% Caucasian and 2% Asian. Seventy-eight percent of students are eligible for free or reduced lunch. The district household income is only 90% of the state average. Only 24% of adults over the age of 25 have a college degree and 25% of the adult population has less than a 12th grade education. Thirty-nine percent of high school graduates go on to college. Seventy-two percent of first year students at <state> colleges who previously attended this high school were required to take a remedial class in math, science, English or reading.

This student's transitional type hours are more about damage control than any proactive strategy. She had neither HSC nor UC hours. All of her 70 transfer hours were TT hours. She completed all mathematics requirements before transferring to our receiving institution. Her unfamiliarity with the system is indicated by lack of knowledge regarding scholarships at <metro community college>. Although this strategy is not necessarily proactive, it has still been quite effective for this student. Each of these young women successfully accomplished her goal of completing a bachelor's degree in engineering.

Similarly, the experience of one of two Native American students who attended high school in a mainly rural community in <state> reflects one of the many challenges students from small communities must confront. Being prepared for college goes beyond academic preparation to include feeling comfortable in unfamiliar environments. Accumulating credit at smaller community colleges can be a strategy to facilitate that transition:

> Interviewer: So do you think that the Community College allowed you a good kind of stepping stone into <our receiving institution>?
> NA male: Yeah, the community college is by far the greatest thing that ever happened to me. I wouldn't be here today if it wasn't for them…I would definitely advise them (freshman) if they're coming like I was I would go to a community college. Yeah, that was the key for me, if they don't want to jump in and get a taste of it, but you really have to be prepared for this (the receiving institution) the big school. I always called it the big school, you have to be prepared for.

Conclusions

Though the motivations and timing for acquiring transfer credit are varied and many, the students in our study have demonstrated that transfer credit can be a strategy for success regardless of the initiating circumstances or type of transfer credit. Motivations are informed by the relative level of social and cultural capital students possess as a result of socio-economic and demographic factors which both cut across and reside within racial and ethnic boundaries.

High school concurrent hours are most certainly proactive strategies students employ in an attempt to get ahead in demanding course work and restrictive curricular pathway as well as defray the rising cost of higher education. Attending a high school which promotes this behavior and is located within convenient commuting distance is an advantage some students have that others do not.

Transitional type hours appear to be motivated by a different set of factors more closely linked to geographic location (urban/rural), English language proficiency, high school preparation, and parent's education level. Not surprisingly, Asian American and Hispanic students are disproportionately represented in the use of transitional type hours. Sixteen of the 18 ASAM and HISP students came from urban/suburban communities and 13 of these students were not native English speakers. Furthermore, parents' of Asian American students had the least amount of education of all the groups. These students spend longer periods of time at sending institutions, accumulate larger number of transfer hours and more closely resemble the traditional transfer student. Though no less successful as a strategy for success, the motivations for transition type hours seem to be driven by larger structural and social inequalities than do the other type of transfer hours and are therefore more reactive than proactive.

The university concurrent type hours appear to be motivated by either making up a failed class from the receiving institution, catching up because of starting behind or getting behind from a failed class (especially for calculus), or getting ahead by taking classes to advance one through the curriculum more quickly. Other motivations seem to be based in social capital – knowledge of the university grapevine of what courses and professors should be avoided. The make-up motivation, and to a slightly less degree, the catch-up motivation are reactive strategies. Getting ahead and avoiding a particular professor or class to preserve one's GPA are considered proactive strategies. As with other transfer credit strategies, the students' personal experiences and accrued cultural and social capital seem to influence the use of these strategies. Overall, it seems that the Asian American students who have UC transfer credit are much more proactive in their use of the strategy, in spite of lower capital within the group. The five students from an unusually supportive high school seem to be determining this difference. To a smaller degree, the African American students also seem to be proactive more than reactive in their UC credit use; we postulate this is due to the high degree of parent education the African American students in our population report. The Hispanic and Native American students seem to be much more reactive in their use of UC transfer credit.

The authors want to point out that from whatever motivation, and through whatever limitations and constraints contributed to these choices, the strategies are working. Every student discussed in this report has either successfully completed a degree in engineering or is still progressing satisfactorily toward that goal as of December 2007.

While we have thoroughly documented the differential application of transfer hours across the four ethnic/racial groups, individual motivations resulting from particular barriers or opportunities and the impacts of the decisions were harder to discern. Direct questions were not always asked or answered as a result of the original interview protocol. The current data and analyses indicate that these behaviors, actions, and outcomes may help illuminate the structural, cultural, and social issues affecting student retention and progression toward their degree. Therefore, we proposed a supplement to the original grant to support a more thorough investigation of students' decisions to attend community college, accrue transfer type credit, and the outcomes of their decisions.

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