AC 2010-1134: MOTIVATING MINORITY HIGH SCHOOL STUDENTS FOR FUTURES IN ENGINEERING THROUGH DREAM (DESIGNING WITH RICE ENGINEERS – ACHIEVEMENT THROUGH MENTORSHIP)

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Motivating Minority High School Students for Futures in Engineering through DREAM (Designing with Rice Engineers – Achievement through Mentorship)

Abstract

DREAM (Designing with Rice Engineers – Achievement through Mentorship) was created to motivate underrepresented high school students to pursue higher education and careers in the STEM (science, technology, engineering, and mathematics) fields. Rice University undergraduate and graduate engineering students (mentors) volunteer weekly with underrepresented high school students (mentees) at three Houston public schools to solve a specified engineering design problem. The design project mechanism allows mentor/mentee relationships to form naturally, and thus opens up communication regarding college, financial aid, and futures in engineering. Perception and Environment Surveys (P.E.S.) are administered to the mentees at the beginning and end of the DREAM program, each semester, in order to gauge mentee knowledge of college admissions, financial aid, careers, and long-term earning potentials in STEM fields. Analysis of mentee responses to the P.E.S. provided very promising evidence of the effectiveness of the DREAM program. Questions 10 and 12 on the P.E.S. ask, "How much math do you plan to take in high school," and "How much physics do you plan to take in high school," respectively. In spring 2009, the number of mentees planning on taking a greater number of years of math and physics increased from the initial survey to the final survey, while the number planning on taking the minimum number of years of math and physics dropped. This directly shows that DREAM has been effective in stressing the importance of taking math and science courses for success in higher education, specifically in the STEM fields. It also shows that DREAM has been successful in generating mentee interest in math, science, and engineering. In fall 2009, DREAM instituted a College Prep group for seniors who participated each semester at AHS. In the survey, all eight AHS seniors reported they wanted to attend college and seven out of eight indicated interest in engineering majors. Recently, it was found out that all eight seniors have been accepted into college. This confirms the DREAM program's effectiveness in helping underrepresented high school students get accepted into college and pursue a higher degree.

Introduction

The DREAM (Designing with Rice Engineers - Achievement through Mentorship) program was founded in 2007 to promote science, technology, engineering and math (STEM) careers to Houston students to address the growing dropout trends and decreasing numbers of minority students in higher education. The program started its outreach efforts at Austin High School in the Houston Independent School District (HISD), Texas. Since, DREAM has grown by two more campuses: Chavez High School (CHS) of HISD and the Knowledge is Power Program (KIPP) High School. Each campus has provided new opportunities and challenges in addressing the inadequate understanding of STEM career paths observed in underrepresented high school students.

The program model since its inception utilizes Rice University engineering students in STEM fields as mentors to high school students by providing a design project to work on for 5-7 weeks

during or after school, each academic semester. The students build and learn about physics and engineering principles with their college mentors. The design project provides a natural mechanism to spur a mentoring relationship. After the mentorship sessions, mentees demonstrate how their designs fulfill the design requirements via a competition held during DREAM Day. DREAM Day takes place at the end of the program and includes lectures and panel discussions on financial aid policies, tours of engineering laboratories, and information on STEM careers. Many of the students do not realize the opportunities that engineering and college present to them, but when the Rice mentors inform them that they can launch space shuttles, build satellites, or design superstructures with engineering degrees, they begin to understand the importance of a college degree in the STEM fields.

The research methods used to assess the mentees and mentors on the core principles of the DREAM program are discussed and the schools are profiled. The conclusions show both successful program components and suggest areas for improvement and future research. The findings are used to continuously improve DREAM and to encourage minority high school students toward study in STEM degrees, particularly engineering.

Research Methods

Inventories and surveys are administered to the mentees at Austin High School, Chavez High School, and KIPP High School twice during the DREAM program each semester, once at the beginning of the program and once on DREAM Day at the end of the program. KIPP mentees completed an additional round of inventories and surveys several weeks after DREAM Day, in order to gauge retention of key concepts. Also, inventories and surveys were administered to a control group at KIPP, once at the beginning of the DREAM program and once several weeks after the end of the program, in order to qualify improvements in mentee knowledge arising solely from DREAM. Physics Concepts Inventories (P.C.I.) and Intuition Inventories (I.I.) are meant to test the mentees' knowledge of physics concepts. Perception and Environment Surveys (P.E.S.) gauge mentees' understanding of general college admission information, financial aid availability, and career opportunities in the STEM fields. In addition to giving inventories and surveys to the mentees, an altered version of the P.E.S. is administered to the mentors to assess general mentor knowledge, determine areas where instruction of mentors is necessary, and to provide a data set for cross-correlations between mentor and mentee knowledge of the college admission process, financial aid availability, and career possibilities. This paper is limited to the analysis of the results from the mentee and mentor P.E.S. Only spring 2009 data from CHS and KIPP is presented. This is compared to first year data at AHS (from 2007). More recent AHS data will be presented in an upcoming longitudinal study.

School Profiles and Mentee Selection

The DREAM program varies at each of the three high schools, due to the individual school characteristics and the pre-defined class schedules. At all campuses, the mentors are assigned to a specific day of the week throughout the seven week program. Between three and five mentors attend on each assigned day, and each work with a team of two to five mentees.

Austin High School (AHS)

Austin High School (AHS) is a member of the Houston Independent School District (HISD). The student body consists of approximately 1920 students, with the following demographic breakdown: over 95% Hispanic, 4% African-American, 1% white and less than 1% Asian. Thus the vast majority of students at AHS are underrepresented minorities. In addition, a large percentage of students also come from economically disadvantaged families, as indicated by its Title I school classification[1]. Title I schools have at least 40 percent of students coming from low-income families[2]. That percentage is generally determined by looking at the number of students receiving reduced-price or free lunch. Approximately 91% of AHS students qualify[1].

The DREAM program was initiated at AHS in fall 2007. Mentees were tasked with designing a mechanism, using a specified material list, that would move a ping-pong ball from a certain height in a duration of exactly two minutes. The DREAM program has been in existence at AHS ever since, and a different design project has been completed each semester. The outcomes from this school are part of a longitudinal study, and will be treated in an upcoming paper.

Rice University students (mentors) go to Austin High School five days a week for approximately seven weeks each semester. The mentees at AHS self-select to participate in DREAM and come to the daily after-school meetings on their own time. The students must come at least one day a week for five out of the seven weeks to qualify to participate in the DREAM Day competition. The mentees may, however, come multiple times during the week. There is no limit on the number of days the students are allowed to participate, and many come three or four days every week, allowing for very strong mentoring relationships.

Chavez High School (CHS)

Chavez High School (CHS) is located in South-East Houston, at the municipal boundary between Houston and the city of Pasadena. CHS opened in fall 2000 and has a student population of 2,611. The school mostly serves minority students as the student body is 83% Hispanic, 11.5% African American, 3% Asian, 1% white and less than 1% Native American[1]. Approximately 48.5% of the students are female, 83% are considered economically disadvantaged, 13% are indentified as English Language Learners and 74% are at risk for dropping out (all demographics are based on 2004 - 2009 averages, and there is little variation year to year)[1].

The Texas Assessment of Knowledge and Skills (TAKS) standardized testing statistics from CHS demonstrate need for improvement, particularly in the areas of math and science, as seen in the Appendix. CHS has established a math, science and engineering focused curriculum through the Academy of Engineering (AoE) program. To participate in AoE students sign up before coming to CHS for 9th grade and do so out of their own will or the will of their parents. All the students that participate in DREAM as mentees are currently enrolled in AoE[3].

DREAM has been in operation at CHS since spring 2009. In spring 2009 (S09), mentoring sessions were held twice a week during both the 6th and 7th class periods. Because CHS implements a block schedule, each mentee attended two mentoring sessions a week. In fall 2009

(F09), mentoring sessions we also held twice a week during the 6th and 7th periods, however, each period only had one mentoring session per week. In S09 and F09, the mentoring sessions were held for 6 weeks and 7 weeks respectively. CHS is the only school where mentoring sessions take place in a formal classroom setting, therefore AoE students are required to participate in the program although their performance is not graded. For all the data presented in this paper regarding CHS, n=33 unless otherwise noted.

Knowledge Is Power Program Houston High School (KIPP)

KIPP, the Knowledge Is Power Program, was founded in Houston in 1994. The KIPP program is a national network of charter schools with the mission to 'develop in underserved students the academic skills, intellectual habits, and qualities of character necessary to succeed at all levels of pre-kindergarten through 12th grade, college, and the competitive world beyond'[4].

The KIPP network has 15 Charter Schools (6-elementary, 8 middle schools,1-high school) in Houston. KIPP Houston High School was founded in 2004 and has a student population of 448. The demographics of the population are 79.6% Hispanic, 18% African-American, 1.6% Asian, and 0.8% white, and 87.5% of students are also considered low-income[5]. KIPP is a college-preparatory school and graduation is contingent on obtaining college or university acceptance. Approximately 90% of KIPP students matriculate into a college or university.

All students graduate with either a State Recommended or Distinguished Achievement Program high school diploma. Both degree plans require students to take chemistry and physics, with AP level options. For mathematics the students have the opportunity to take up to pre-calculus or an AP level calculus course. KIPP HS TAKS scores for spring 2009 show that students are weakest on math and science scores during their first examination, with increasing passing rates to nearly 100% by 11th grade[6].

The DREAM program affiliation with KIPP started in spring 2009. DREAM is implemented through the Co-Curricular Opportunities (CCO), which are mandatory 2-hour after-school sessions. Students choose one or more CCOs in which to participate. CCO activities range from athletics to music, and include the DREAM program. The initial group of mentees consisted of 9th graders. DREAM mentors go to KIPP two days each week. Each day they meet with a separate group of mentees. The mentees work on the projects and receive guidance from their mentors only in these times. The program has and will continue to expand systematically each year by offering the DREAM CCO to each new incoming 9th grade class, while also offering opportunities for older mentees. For KIPP data presented in this paper, n=26 unless otherwise noted

The scope of this paper is limited to the analysis of the results from the mentee and mentor P.E.S.; analysis and results for the P.C.I and I.I can be found in the paper by Goza *et al.*[7]. The spring 2009 project involved designing a ping-pong ball launching device. This dealt primarily with the concepts of projectile motion and invariance of gravitational acceleration.

Results and Discussion – Mentee Data

Mentees' Perceptions of College Costs

One of the biggest deterrents to college enrollment is its perceived cost. A teenager from an economically disadvantaged background will most probably rule out going to college solely because he/she thinks the cost is prohibitive. As stated by Watson[8], a student's motivation can decrease if he/she believes college is not affordable. Thus, elucidating mentees on the true cost of college plays an important role in motivating them to pursue a higher degree. Further, informing underrepresented minority students of the financial aid available helps them realize that college can be affordable. In order to quantitatively measure how mentees view college costs and affordability, the P.E.S. includes questions related to college expenses and financial aid.

In spring 2009, the mentees at CHS and KIPP were asked if they thought they could afford college. Figure 1 shows that for both CHS and KIPP, the number of students that thought they could afford college decreased after DREAM. This could be directly related to Figure 2, which shows the increased awareness of college costs after DREAM. In subfigure 2-i, before DREAM, 18% of the mentees from CHS did not answer the question "How much do you think a year of college costs?" This answer is displayed as "Unknown" in Figure 2. Similarly, in subfigure 2-ii, 24% of the mentees at KIPP also failed to answer the same question. However, after DREAM Day, the percent of mentees not responding fell to 12% for both CHS and KIPP. Simultaneously, there was a large increase in the number of mentees that gave answers between $10,001-40,000 per year as the annual cost of college after DREAM Day. There are a large number of public and private higher education institutions that have tuitions that range from $10,001-40,001 per year. Thus, DREAM was successful in informing the mentees on the average cost of college. However, due to this increased awareness, even more mentees thought they couldn't afford college – which explains the results in Figure 1. At first, mentees that had little knowledge of the cost of college thought they could afford it but, at the end of DREAM, after learning how much college actually costs, realized that their families could not support them in such an endeavor.

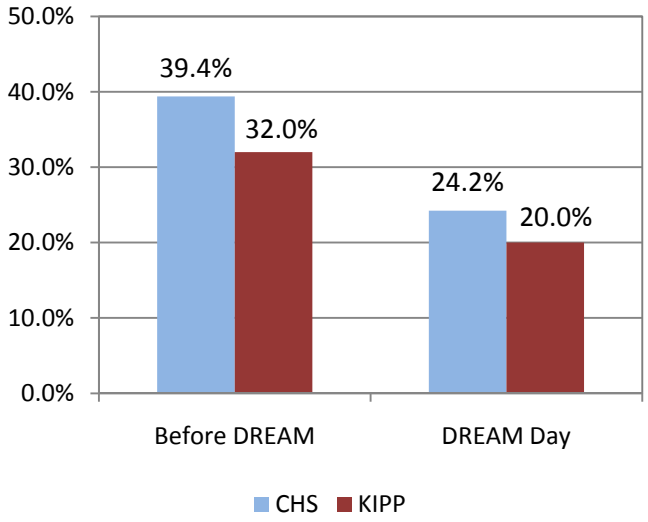

Figure 1 – Question 3a) "Do you think you can afford college?" 39.4% and 32% of the mentees from CHS and KIPP, respectively, responded affirmatively before DREAM. After, the positive responses fell to 32% and 20%.

From the analysis of Figures 1 and 2, it becomes clear that one semester of participation in DREAM wasn't sufficient to clarify to the mentees the difference between college cost and affordability. Although tuition may be $40,000 per year, by combining scholarships, loans and work-study jobs, college can become very affordable for low-income families. Due to the informal nature of the mentorship in the program, not all mentees are deeply exposed to the variety of financial aid options that exist to help them pay for college. Even though they attend a workshop during DREAM Day about financial aid options, the brief exposure to the subject was not sufficient to make the mentees believe that college can be affordable.

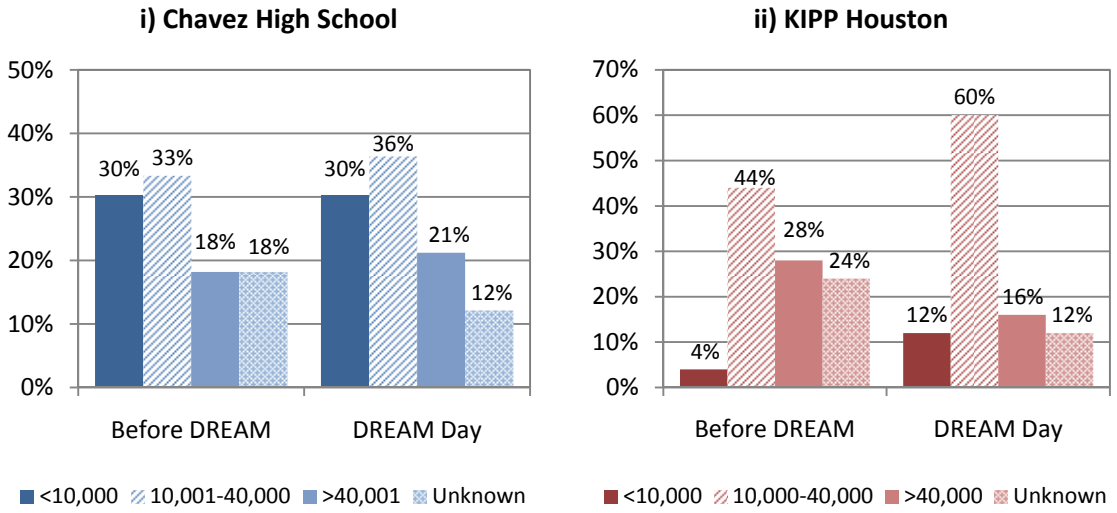

Figure 2 – Question 3b) "How much do you think a year of college costs?" Annual college costs displayed in 3 distinct brackets: $0-10,000 per year; $10,001-40,000 per year; and over $40,001 per year. Unknown was also included as a possible answer, which demonstrates that many students have little idea of the annual cost of college. We see a large migration of answers from unknown to the $10,001-40,001 per year bracket for both CHS and KIPP.

This conclusion seems to contradict Figure 3, which shows the fraction of college tuition that the mentees think can be covered by financial aid. At CHS (subfigure 3-i) and KIPP (subfigure 3-ii), the number of mentees that selected "most" increased from before DREAM to after DREAM Day. This is a positive result, which indicates that DREAM was able to convey to the mentees that a large amount of financial aid is available for students from underrepresented, socioeconomically disadvantaged groups. By selecting "most" as an answer, the mentees demonstrate not only knowledge of the existence of financial aid, but also the belief that they qualify for and can benefit from the available aid. Nonetheless, having "most" of your college expenses paid for may not be sufficient for many of the mentees. This may explain why, after DREAM Day, the mentees still believe that they cannot afford college. Another possible explanation is that mentees interpreted the question "Do you think you can afford college?" as "Do you think you can afford college on your own, without financial aid?"

It is not possible from the current survey to determine what the mentees deemed to be financial aid when answering the question "What portion of college do you think might be covered by financial aid for you?" In fact, "financial aid" is a term that could have different meanings in different situations. For example, financial aid could be just scholarships, or it could be

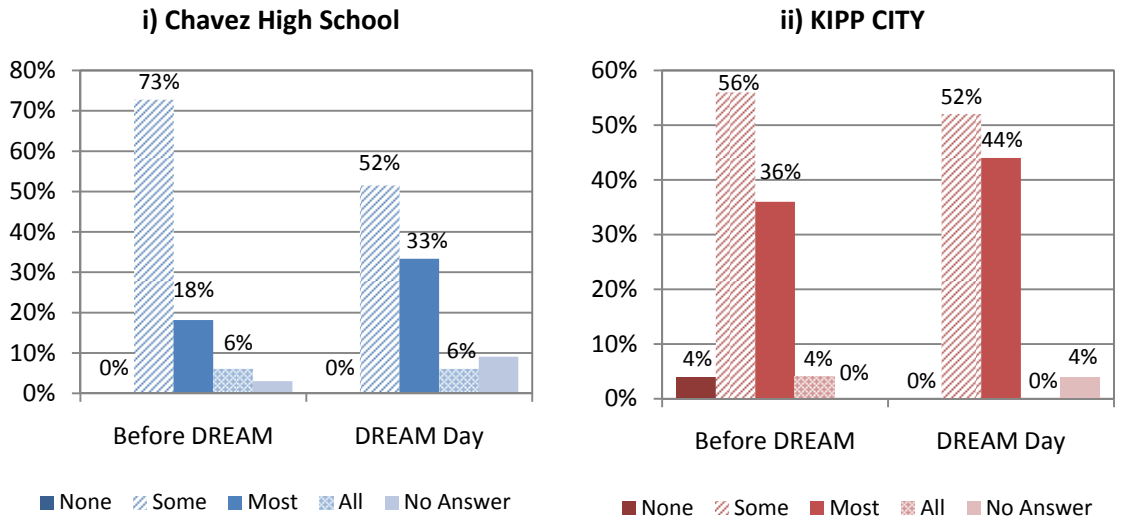

Figure 3 – Question 5) "What portion of college do you think might be covered by financial aid for you (circle one)?" DREAM raised mentee awareness of how financial aid can contribute to college tuition. Before DREAM, at CHS and KIPP only 18% and 36%, respectively, thought financial aid could cover most of their college expenses, while after DREAM Day these numbers rose to 33% and 44%, respectively.

scholarships and loans. Educational loans are crucial in making college more affordable. Many students that do not qualify under the "no-loan" financial aid policies of many universities can still apply for an educational loan and finance their college studies without stressing their family economics. However, most mentees did not choose loans as a possible source of aid and also did not fully demonstrate understanding of a "no-loan" policy for an institution like Rice. These results are illustrated by Figures 4 and 5.

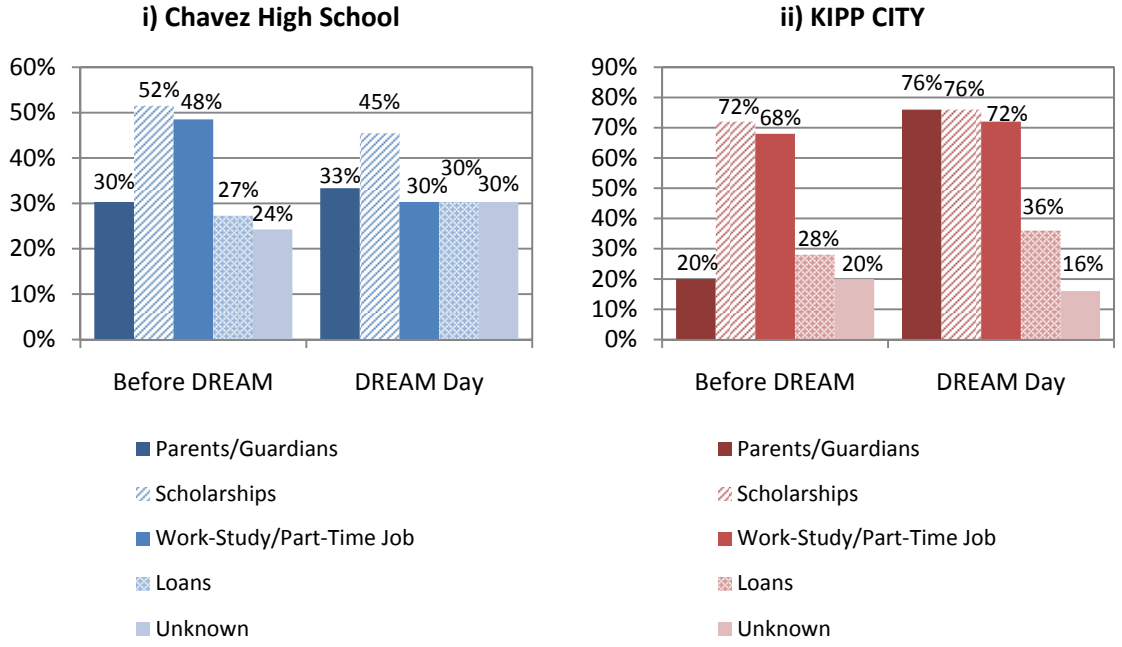

Figure 4 – Question 4) "If you are going to college, how do you plan to pay for college (circle all that apply)?" Mentees were allowed to select the combination of methods that they deemed appropriate. "Unknown" represents mentees that marked "I don't know" as an answer and did not mark any other answer.

In subfigure 4-i, before DREAM the percentages of CHS mentees that chose scholarships and work-study as possible ways to pay for college were 52% and 48%, respectively. Note, mentees were allowed to select multiple responses to this question. The expectation was that these numbers would increase after DREAM. However a decrease was observed, with 45% selecting scholarships and 30% selecting work-study as ways to pay for college. Concomitantly, a small increase in the percentage of mentees that chose their parents/guardians and loans as economical options was observed. The increase in both of these categories is reasonable, since often parents or legal guardians actually apply for the loans. Nonetheless, on DREAM Day, only 30% of the mentees from CHS selected loans as a possible way of paying for college. This number is rather small, considering that taking a loan may be the gateway to achieving a higher education. In subfigure 4-ii, there is a similar increase in the percentage of KIPP mentees that selected parents/guardians and loans on DREAM Day as a way to pay for college. However, the number that chose loans as a viable option is still small: on DREAM Day only 36% chose loans as one way to pay for college. From both CHS and KIPP, in spring 2009 only one student indicated the intent to pay for college solely using loans. This answer was consistent before DREAM and maintained even after DREAM Day. The apparent dislike for loans as a way of financial support has been previously observed in mentees. In fall 2008, no AHS mentees marked that they intended to pay for college using only loans[9]. For the future success of the mentees and DREAM, it is necessary that mentors explain more clearly the advantages and disadvantages behind educational loans and how they are crucial in financing a higher degree.

Not only do most of the mentees from CHS and KIPP eliminate loans from their prospective ways to pay for college, they also do not understand "no-loan" policies. "No-loan" policies vary by university, but generally provide an income threshold that if not met by an applicant's family, provides the student a full-tuition, no-loan education. The results can be seen in Figure 5. Before DREAM, 32% of the mentees at KIPP did not have a guess for what the "no-loan" policy at Rice

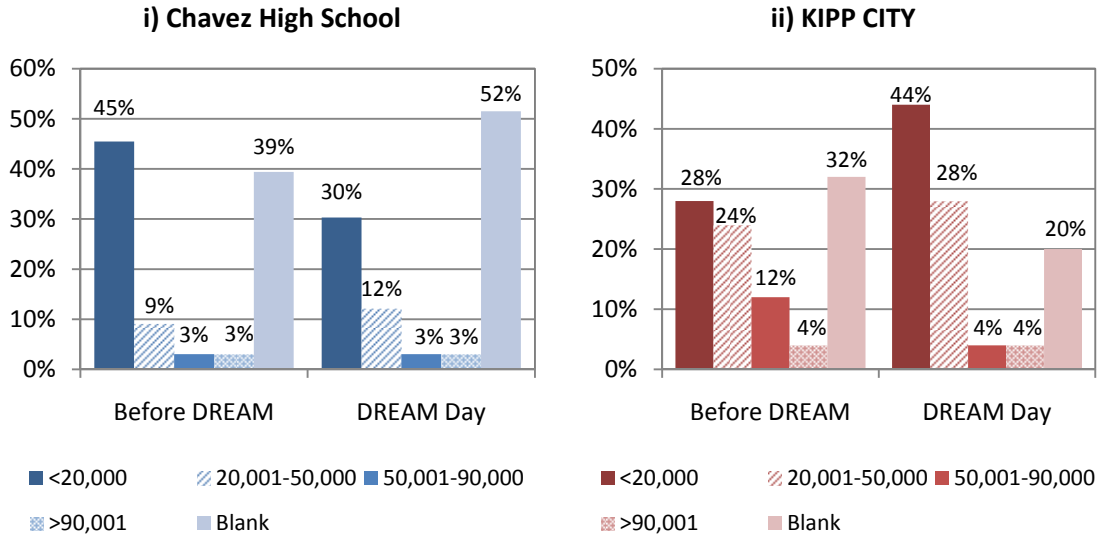

Figure 5 – Question 7) "Many universities have 'no-loan' policies based on family income. This means, if your parent(s) or guardian(s) make less than a certain amount of money per year, the university will you a scholarship. How much do you think the 'no-loan' family income is at Rice?" "No-loan" university policies displayed in 4 distinct brackets: $0-20,000 per year; $20,001-50,000 per year; $50,001-$90,000 per year; and over $90,001 per year. "Blank" represents the mentees which failed to complete the question. Blank answers for CHS represented 39% and 52% of the answers "Before DREAM" and "After DREAM Day", respectively. Blank answers for KIPP represented 32% and 20% of the answers "Before DREAM" and "After DREAM Day", respectively.

was and left the question blank. It can be inferred that these mentees had no previous knowledge of "no-loan" policies and they did not comprehend the explanation imbedded in the question. During DREAM Day the mentees learn that the "no-loan" policy for Rice University is $80,000 per year. On DREAM Day, only 20% of the mentees from KIPP left this question blank, indicating a better understanding of the policy. However the majority of the answers were within the $0-20,000 per year bracket (44%), when responses in the $50,001-90,000 per year bracket were expected. At best, this signifies a lack of retention of the specific Rice policy. More likely, mentees instead answered what they thought they would have to pay. Nonetheless, the decrease in blank answers in the KIPP data is already encouraging. On the other hand, in subfigure 5-i, the percentage of CHS mentees that left the question blank increased on DREAM Day. This could be explained if, before DREAM, many mentees answered the question without truly understanding what "no-loan" policy meant. It is clear that at CHS in particular, it is necessary to disseminate larger amounts of information on "no-loan" policies and financial aid as a whole.

Figure 6 represents the results to the question "Do you know what the FAFSA is?" Knowledge of the FAFSA is crucial for all college applicants because it is the first step in the financial aid application. Before DREAM, 12% of CHS mentees indicated knowledge of the FAFSA, but this fell to 9% on DREAM Day. Here again, it appears that mentees that initially claimed knowledge of the FAFSA were not being truthful. There is no clear reason to explain why only 9% of the mentees knew what the FAFSA was even on DREAM Day. This again indicates the need to increase the focus on financial aid subjects during mentorship days and DREAM Day. The percentage of KIPP mentees that knew about the FAFSA increased from 4% before DREAM to 20% on DREAM Day, an encouraging increase. Nonetheless, 4/5 KIPP mentees left DREAM without knowledge of the FAFSA. This statistic was brought to the attention of a collaborating teacher at KIPP, who took measures to mitigate the result. Weeks after DREAM concluded, the mentees were surveyed once more and 68% indicated knowledge of the FAFSA. Collaboration with the teachers was instrumental to the dissemination of this information. Therefore the best manner to deliver important financial information may be in a more structured lecture setting.

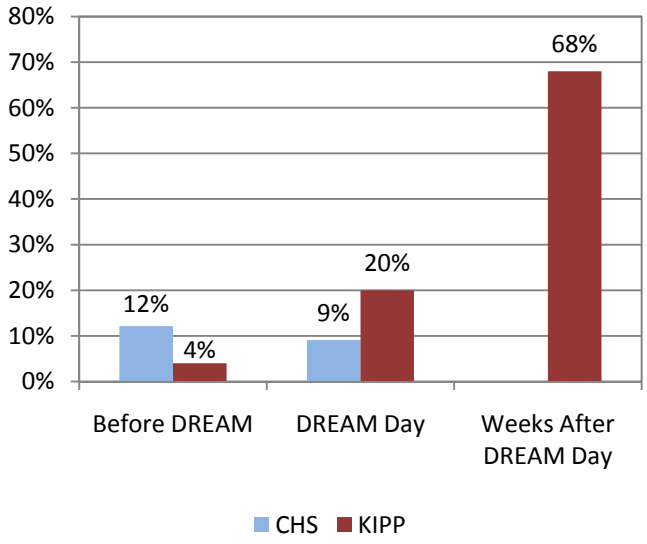

Figure 6 – Question 6a) "Do you know what the FAFSA is?" At KIPP the percentage of students that had knowledge of the FAFSA increased "After DREAM Day", with the largest increase weeks after DREAM was over, following independent instruction by KIPP teachers.

Correlation of Mentees' Perceptions with Parents' Education Levels

In the year 2002, only 23% of African-American high school students and 20% of Latino high school students graduated high school prepared for college, as compared to 40% of Caucasian high school students[10]. These findings show that underrepresented high school students are less "college-ready" than their Caucasian counterparts. Thus, DREAM incorporates teachings and activities to help correct for this variance in college readiness. The one-on-one interaction between mentors and mentees allows for open communication about the college admissions process, what pursuing a higher education entails, and the career opportunities that result. In addition mentors hold a student panel on DREAM Day in which the mentors answer mentees' questions about college, tell the mentees about their personal college experiences and offer advice they found particularly valuable regarding college-readiness.

Several hypotheses have been created to try to understand why the racial discrepancies in college preparedness exist in the first place, as well as to test DREAM's effectiveness in preparing minority students from three public Houston high schools for college. The responses to specific survey questions before and after the program are used to verify or contradict the hypotheses.

A hypothesis seeking a correlation between parents' highest education levels and mentees' expectations about college is stated as follows: it is expected that mentees with parents who have not received post-secondary degrees will exhibit a greater increase in knowledge of college, the admissions process and costs from the beginning to the end of the DREAM program, as compared to those mentees with parents who do have post-secondary degrees. To test the validity of this hypothesis, question 19 on the P.E.S., "Parents' highest education levels (circle one choice for each parent)," was cross-correlated with question 2, "What do you plan to do after high school?". This comparison is meant to see if mentees with parents with higher levels of education are more likely to plan to go to college after high school versus immediately entering the workforce. This is helpful in trying to understand the motivations that belie students' decisions to go on to receive a higher education. Also, it is expected that there will be a larger *increase* in the number of mentees planning to go to college for mentees with parents who do *not* have a post-secondary degree, than for those mentees with parents who have a post-secondary degree.

Figure 7 provides data correlating parents' highest education level, taken from the initial survey, with the percentage of CHS mentees planning to go to college. Although there is a slight increase in the percentage of mentees whose parents do not have a post-secondary education or whose education level is unknown, the data remains inconclusive. This is due to the fact that, of the three initial mentees not planning to go to college, two changed their answers to plan to go to college by the end of the DREAM program. However, one mentee changed in the opposite direction. Therefore, the hypothesized correlation is null. Importantly, there is a discrepancy between the number of CHS mentees indicating that they plan to go to college and the actual number of CHS students that have matriculated in the last few years. Further research needs to be done in order to understand the reasons for this inconsistency.

For the same question, the data from KIPP is not informative due to the nature of the high school itself. As stated in the high school profile section, KIPP requires that students be accepted into at

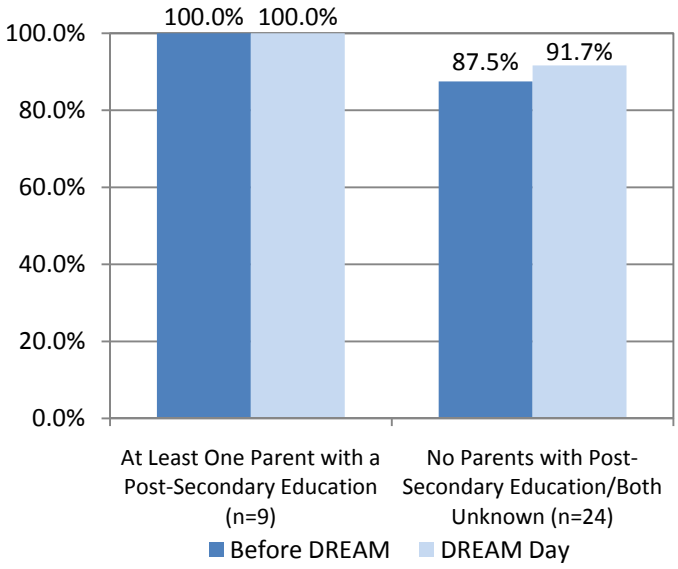

Figure 7 – Question 2) "What do you plan to do after high school?" Percentage of CHS mentees that circled the answer choice "go to college" according to their parents education level.

least one college in order to graduate. Thus, the fact that 100% of DREAM mentees plan to go to college in the initial and DREAM Day surveys is not surprising. This shows that expectations can powerfully influence the desire to pursue higher degrees.

The second set of data used to verify the above hypothesis is the comparison of the initial responses to question 19 on the P.E.S., "Parents' highest education levels (circle one choice for each parent)," with the before and after results of question 3b, "How much do you think a year of college costs?" It is expected that there will be less of an increase in the number of mentees, who have at least one parent with a post-secondary education, answering in the correct cost bracket ($10,000-$40,000) than the increase in the number of mentees whose parents do not have a post-secondary education or whose parents' highest level of education was unknown.

The data shown in Figure 8 does provide some conclusive evidence. Looking at the second set of data on the graph ("No Parents with Post-Secondary Education/Both Unknown") provides good evidence that DREAM impacts mentees' awareness of college and the college admissions process. As can be seen, the percentage of mentees with parents who do not have a post-secondary education answering in the correct cost bracket doubled from the initial survey to the final survey in the spring 2009 semester. One important point to note that cannot be seen in the bar graphs is, all of the mentees whose parents do not have a post-secondary education initially answering in the proper cost bracket, also answered in the proper cost bracket on the DREAM Day survey. That means that three additional mentees whose parents do not have a post-secondary education chose the proper cost bracket after the seven week DREAM program. Unfortunately, this point does not hold for data contained in the first category ("At Least One Parent with a Post-Secondary Education"). This means that, certain mentees in this category that initially chose an answer in the correct cost bracket changed their answers to an incorrect cost bracket on the DREAM Day survey. Similarly, mentees who initially wrote an answer in an incorrect cost bracket changed their answer to the proper cost bracket on the DREAM Day.

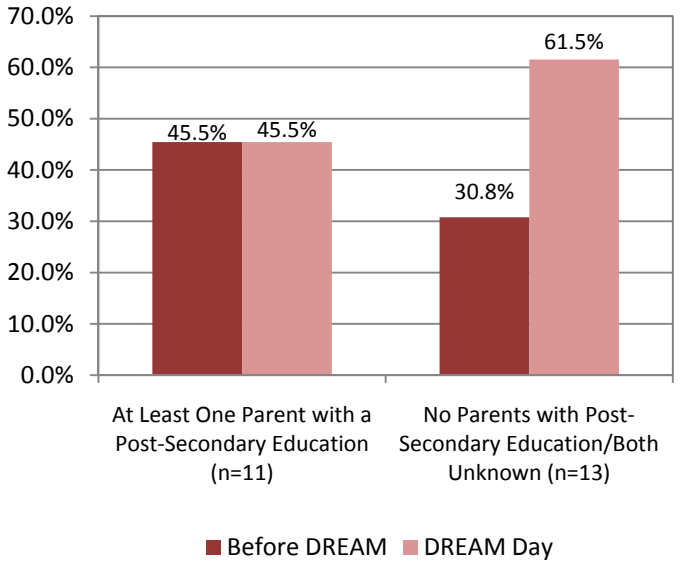

Figure 8 – Question 3b) "How much do you think a year of college costs?" Percentage of KIPP mentees which gave an answer between $10,000 and $40,000 per year, according to their parents' level of education.

On the whole the percentage of mentees, with at least one parent with a post-secondary education, answering in the correct cost bracket did not change from the initial to the final survey, for either school. This is a very interesting finding, and more analysis needs to be done in order to further understand what implications this may have. One possible explanation is that the DREAM program is successful in getting mentees, whose parents have lower education levels, interested in college and wanting to learn more, while those mentees whose parents have a higher education are not quite as excited about the prospect of going to college. However, much more research is required to substantiate this or devise alternate explanations. A possible explanation for the mentees changing their answers from the correct cost bracket on the initial survey, to an incorrect cost bracket on the DREAM Day survey is their increased knowledge of financial aid. One of the key concepts explained through DREAM is that a large portion of college costs are covered by financial aid through loans and scholarships, especially for underprivileged minority students. The DREAM program also introduces mentees to the concept of no-loan policies and stresses the importance of applying for a variety of scholarships, not just those that are university specific. The fact that DREAM teaches the mentees about financial aid may explain why a few mentees (with at least one parent with a post-secondary education) selected lower cost brackets on DREAM Day than before DREAM. In the next round of surveys administered the question was clarified from, "How much do you think a year of college costs?" to ask, "How much do you think a year of college costs without any financial aid or scholarships?"

Unlike at KIPP, analyzing the same data from CHS in Figure 9 shows no conclusive correlations exist. For mentees with at least one parent with a post-secondary education there is no change in the number answering in the proper cost bracket from the initial to the final survey. Similar to this data set at KIPP, there is a two-way exchange of mentees between the correct and incorrect cost brackets from the initial to the DREAM Day survey. The second category actually shows a decrease in the number of mentees correctly answering what a year of college costs. This shows that one area that CHS mentors must work on is providing the mentees with facts about college,

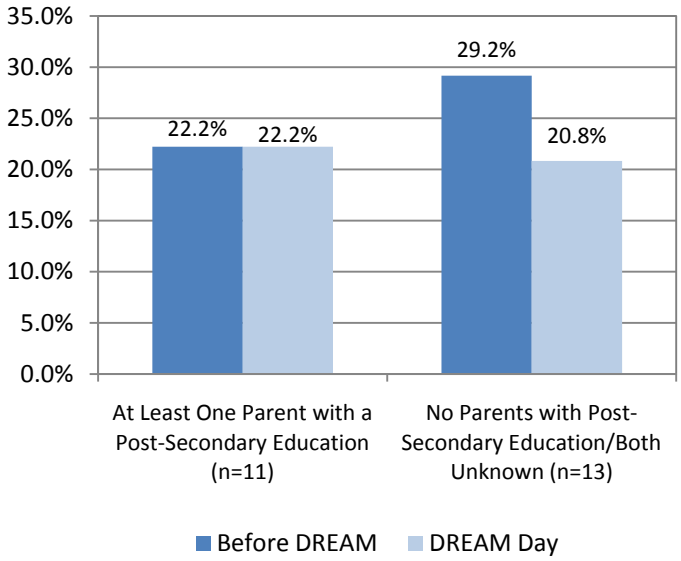

Figure 9 – Question 3b) "How much do you think a year of college costs?" Percent of CHS mentees answering between $10,000 and $40,000 per year as the annual cost of college, correlated with parents' level of education.

so these mentees have realistic expectations when college applications begin. Furthermore, differences in the mentoring programs at KIPP and CHS need to be identified to try to understand why the data varied so much between the two schools.

Course Selection and Mentees' Valuation of Quality Courses

A hypothesis regarding the mentees' preparedness for college is that mentees, after having participated in the DREAM program, are expected to plan to take the highest number of years of high school math and science courses available to them.

One of the key concepts the mentors try to convey to the mentees is the importance of taking as many math and science classes as offered by their high schools. "The impact of a high school curriculum of high academic intensity and quality on degree completion is far more pronounced—and positively—for African-American and Latino students than any other pre-college indicator of academic resources. The impact for African-American and Latino students is also much greater than it is for white students" [11]. Not only will exposure to these classes give the mentees greater fundamentals in mathematics and the sciences, these courses are also viewed as "quality courses" by college admissions officers. This may also afford mentees the opportunity to get college credit and possibly test out of certain introductory college courses in the STEM fields, if courses are at the Advanced Placement (AP) level.

In addition to emphasizing the importance of math and science classes for success in higher education, the DREAM mentors also encourage genuine interest in math and science among the mentees. This is accomplished by working directly with the mentees on hands-on engineering design projects. This mechanism facilitates the development of natural mentoring relationships, which allow for comfortable and open conversations. The mentees are able to ask specific math, science, or engineering questions, related to concepts and formulas, to futures in the STEM fields and to what college math and science courses are like. By having mentors share their own

experiences in engineering, teach the mentees central math and physics concepts, and expose mentees to the opportunities available with an engineering degree, DREAM hopes to impassion mentees to study math and science. This interest should be evident in the fact that mentees plan to take the most math and science courses that their high schools offer.

Several questions were incorporated in the P.E.S. to measure the effect DREAM has on mentee intentions to take the most high school math and science classes. Question 10 asked "How much math do you plan to take in high school?" and mentees were asked to circle one of the following answer choices: minimum required to graduate, 3 years, or 4 years. A study completed by Adelman in 1999 shows that the highest level of math achieved by high school students is the best indicator of completion of a bachelor's degree[11]. Thus, students completing more math courses in high school have a much greater chance of being successful in graduating college. Figures 10 and 11 below show the results to this answer for CHS and KIPP both before DREAM and on DREAM Day for the spring 2009 semester.

As can be seen in Figure 10, subfigure i, the total percentage of CHS mentees wanting to take 4 years of math in high school increased from 38% to 54%, a marked increase. Also, the number of mentees wanting to take the minimum required number of years of math fell from 28% to 23%, indicating that mentee perception of the importance of high school math classes, for success in college, did improve. Although the total number of mentees planning to take 3 years of math did decrease, this can be attributed to the fact that many who initially only planned on taking 3 years, planned on taking 4 years of math at the end of DREAM. This decrease was due to an increase in a preferred answer category and thus does not contradict the original hypothesis.

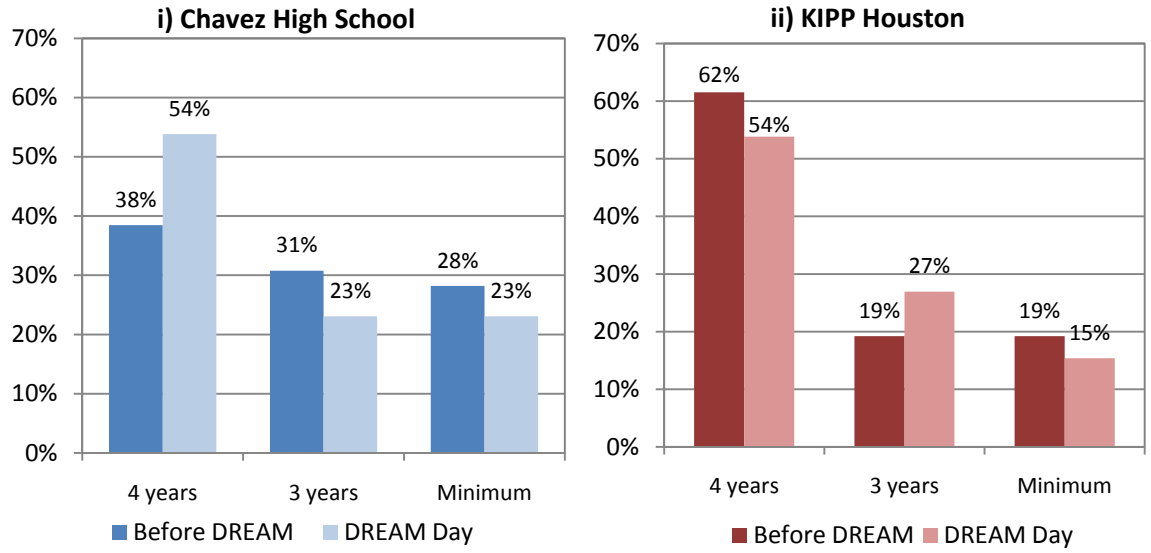

Figure 10 – Question 10) "How much math do you plan to take in high school?" Percentage of mentees that wanted to take four, three or the minimum required years of mathematics in high school.

Subfigure 10-ii shows the total percentage of KIPP mentees planning on taking four years, three years, or the minimum number of years of mathematics. Unlike at CHS, the total number of mentees at KIPP planning on taking 4 years decreased. However, the percentage of mentees planning on only taking the minimum number of years also decreased, which is promising. From

the data, it can be inferred that mentees are beginning to realize that only completing the minimum high school math requirement is not preferable. In essence, the mentees have realized the negative effects of taking the minimum mathematics requirements, however they have not quite conceptualized the positive effects of taking the most math classes offered. This can be seen by the fact that the number of mentees planning on taking 3 years of math increased from 19% to 27%. It is apparent that the next step for DREAM is to emphasize the potential benefits of taking 4 years of math instead of just 3 years. The most effective way of achieving this is probably through more extensive training of mentors.

Questions 11, 12, and 13 on the spring 2009 P.E.S. were also used to analyze whether the DREAM program helped encourage mentees to take the most science courses offered by their respective high schools. Question 11 asks, "How much chemistry do you plan to take in high school?" The possible answer choices are "none, 1 year, or 2 years." Figure 11 shows the responses of CHS and KIPP mentees to this question.

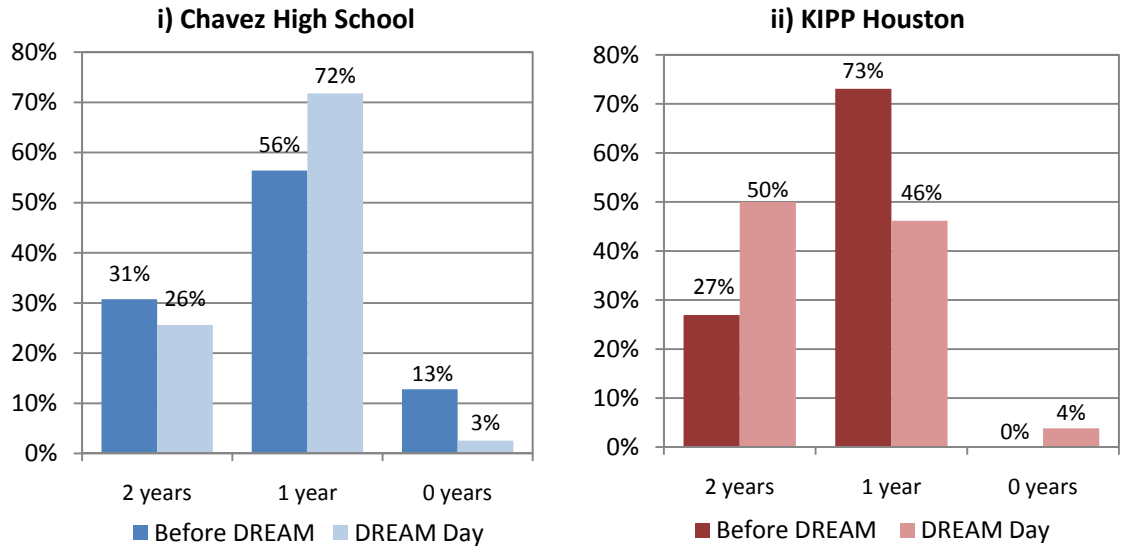

Figure 11 – Question 11) "How much chemistry do you plan to take in high school?" Percentage of mentees that wanted to take two, one or no years of chemistry in high school.

Similar to the KIPP data regarding question 10, there is an increase in the number of CHS mentees planning to take 1 year of chemistry, but a decrease in the number of mentees planning to take 2 years of chemistry in high school. Even though there was a small drop in the percentage of mentees planning on taking the maximum number of years of chemistry, there was an even more substantial drop in the number of mentees planning to take no chemistry.

Analyzing the KIPP data from question 11 on the spring 2009 P.E.S., the trends seen from the data confirm the original hypothesis. The percentage of students planning to take 2 years of chemistry increased drastically from 27% to 50%, and the number of mentees selecting "1 year" decreased accordingly. The slight increase in the percentage of mentees planning on taking no chemistry throughout their high school careers accounts for one mentee of the 26 surveyed. On the initial survey, 0% of the mentees planned on taking no years of chemistry, and thus the baseline was already as low as it could possibly be, making it difficult to improve or even

maintain such positive statistics. Even so the increase is negligible is comparison to the magnitude of the increase in the percentage of mentees planning on taking 2 years.

Responses to question 12, "How much physics do you plan to take in high school," appear in Figure 12. The number of CHS mentees and KIPP mentees planning to take 2 years or 1 year of physics increased from the initial survey to the survey taken on DREAM Day. Also, the number of mentees wanting to take no years of physics in high school decreased at CHS. These findings directly support the hypothesis, though more statistically significant results were expected.

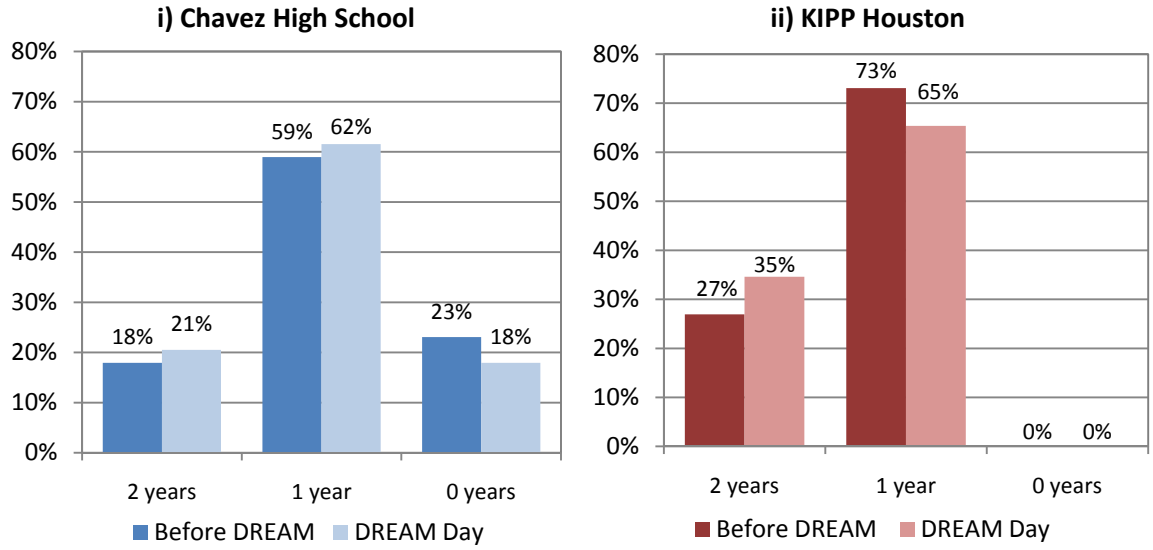

Figure 12 – Question 12) "How much physics do you plan to take in high school?" Percentage of mentees that wanted to take two, one or no years of physics in high school.

The trends shown in subfigure 12-ii provide convincing evidence that the DREAM program does encourage mentees to take the highest number of science courses offered to them, specifically physical science courses. None of the KIPP mentees planned on taking 0 years of physics either before or after the spring 2009 DREAM program. However, the percentage of students wanting to take 2 years of physics increased by 7.7% by the end of the program. Although DREAM may not be the only factor influencing the mentees, the fact that the time between the initial and final assessments was, at most, 7 weeks verifies that DREAM is a contributing factor.

The results from CHS shown in Figure 13, subfigure i, also directly support the outlined hypothesis. The number of mentees planning to take 1 or 2 years of biology increased while the number planning on taking no biology over the course of their high school career decreased by over 10%. Surprisingly, the results in subfigure 13-ii show a drop in the percentage of KIPP mentees wanting to take 2 years or 1 year of biology. Also, there is a significant increase in the percentage of mentees planning to take zero years of biology. Although these results are not consistent with the proposed hypothesis, there is a probable explanation for these findings. DREAM mentors tend to emphasize physics and engineering, due to both the mentors' own majors as well as the nature of the design projects. As such, the importance of natural sciences, specifically biology, can get lost in all the information the mentors provide to the mentees. It may be worth including natural science concepts in the DREAM surveys, or possibly seeking out more bioengineers to serve as mentors in the DREAM program to test this explanation.

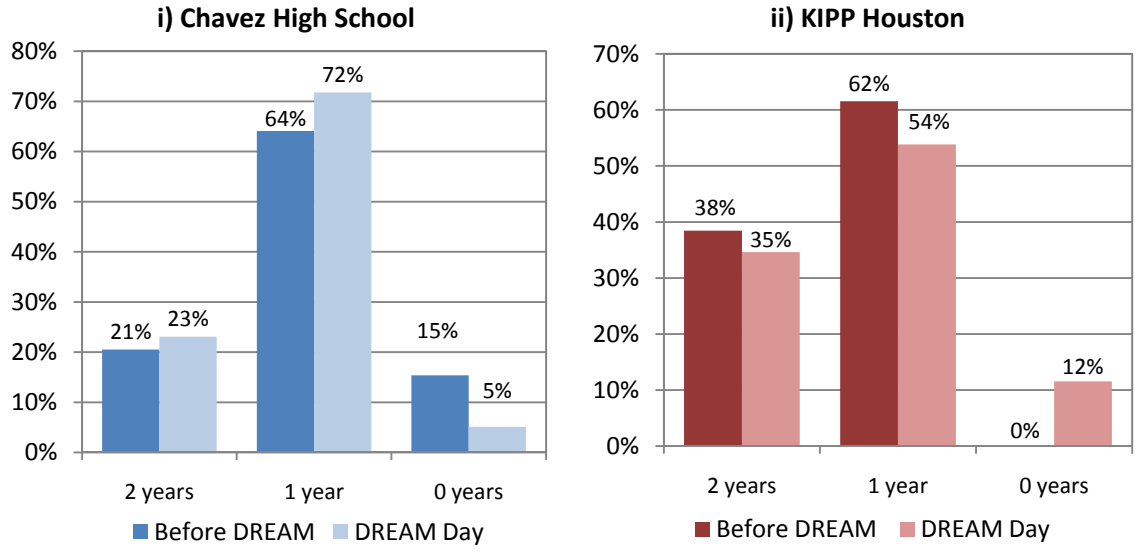

Figure 13 – Question 13) "How much biology do you plan to take in high school?" Percentage of mentees that wanted to take two, one or no years of biology in high school.

Mentees' Perceptions of Engineering Careers

One of the main goals of DREAM is to promote the career paths of engineering degrees along with the opportunities that become available through earning a college degree. Current outreach program models are to 'increase the exposure of underrepresented groups to engineering practice and careers'[12]. This has been a focus throughout the development of DREAM due to the fact that a 'student's perception of a profession can strongly influence their career choices'[13].

As mentors progress in their degree programs they become more knowledgeable about employment in engineering fields through research and internship experiences. Mentors can then relay this information to mentees, who are encouraged to participate year after year in DREAM. Previous research by Gottfredson notes the importance of connecting students with their current level of perception of professions, based in part on their age. This model 'Circumscription and Compromise', show that students between age 9-13 and students of age 14+ have different values on career choice as shown below [13]. This method is inherently integrated into DREAM, as mentors range from college freshman to graduate students.

Age 9–13 Children establish a social valuation for different careers. This considers the child's perception of social classes, access to certain careers, the level of the work, and value and prestige in society. Children will keep certain careers as desirable in their aspirations and eliminate others in this stage.

Age 14: Adolescents start to identify how they may uniquely fit into some of the careers they have kept in their set of desirable options. Self-awareness and esteem, as well as peers, exert major influence on their choices.

The adolescents, according to Gottfredson, distinguish occupations along two dimensions, 'masculinity-femininity and social desirability (prestige)' as well as stereotypes of the personalities of professions. Most importantly noted is that their job aspirations will mostly

match those of their parents. Thus it follows that students in low-income areas will be predisposed to lower-level jobs than those from high-income areas[14].

In order to address these predispositions, DREAM continuously provides information to the mentees through the mentorship process. DREAM's model hypothesizes that mentees will have better knowledge of what is necessary to obtain a career in the STEM fields and what to expect in such careers. The P.E.S survey analyzes mentees' perceptions of the academic foundation needed to pursue engineering degrees, as well as that of the engineering profession. Several questions were formulated to measure the impact that mentoring had on mentees' perceptions.

The P.E.S. surveyed mentees regarding their plans post-high school (Question 2). The question had three answer choices: 1) get a job, b) go to college, or 3) both. The question comes before any mention of engineering and is used as a baseline to assess the mentees' college aspirations. By the hypothesis, there should be an increase in the response of 'go to college' and 'both' due to DREAM. For analysis, 'go to college' and 'both' are shown as one category noted as 'go to college'. Figure 14 indicates that mentees at KIPP had a response rate of 100% expectation to attend college after high school. This is attributed to the graduation requirement that KIPP students must obtain acceptance into at least one college. For CHS, the levels of response before and after DREAM are consistent, with no significant change.

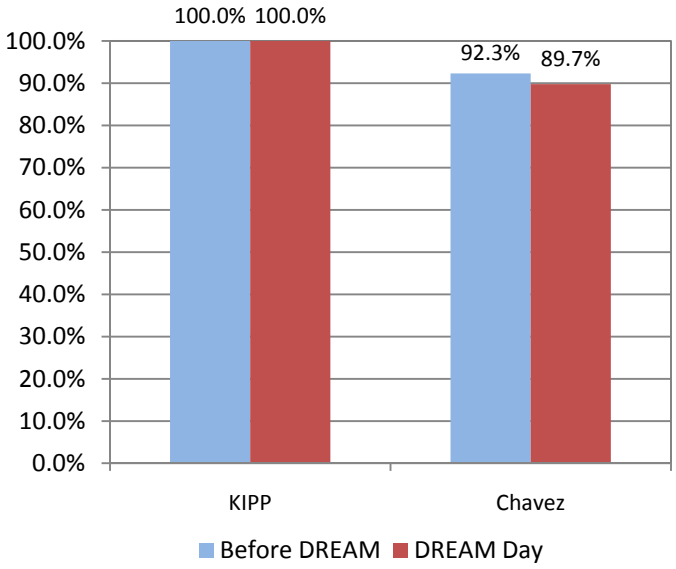

Figure 14 – Question 2) "What do you plan to do after school?" Percentage of mentees planning to go to college or planning to work and go to college after high school.

The P.E.S. also assesses mentees' understanding of the importance of academic coursework to prepare for the rigors of an engineering curriculum in college. The initial question regarding academics assessed the relative importance of math courses toward an engineering career. Figure 15 notes the modest increase KIPP mentees placed on mathematics courses. This change supports the hypothesis that DREAM provides mentees a more realistic perception of the necessary academic coursework needed to pursue an engineering degree, though the significance is questionable. For CHS, the decrease in perceived importance is attributed to two respondents choosing 'Maybe' rather than 'Yes', and one giving no answer on the DREAM Day survey. Again, this most likely indicates no significant change in the perception of mathematics at CHS.

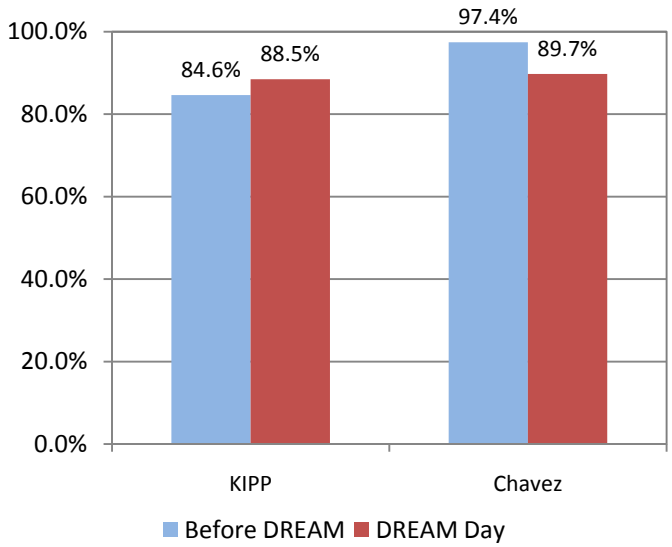

Figure 15 – Question 8) "Do you think math courses are important for entering science and engineering?" Percentage of mentees that selected 'yes' as their response.

The survey then questioned mentees on the correlation between math courses and the influence that it has on life-time earning potential. The degree and number of math courses was assumed to vary between Algebra I to Calculus, which are offered at the high school level. A correlation of higher income potential is assumed since calculus is a baseline course for engineering disciplines at most institutions of higher education. Subfigure 16-i for CHS shows a significant increase in the number of mentees indicating the importance of math courses from the beginning to the end of the program. KIPP mentees, all freshman students in spring 2009, showed little change in their perception of the number of math courses needed to increase earning potential over the DREAM spring 2009 program (subfigure 16-ii). The question may be a bit abstract for the population of freshman surveyed at KIPP, and therefore improvement may be difficult to observe.

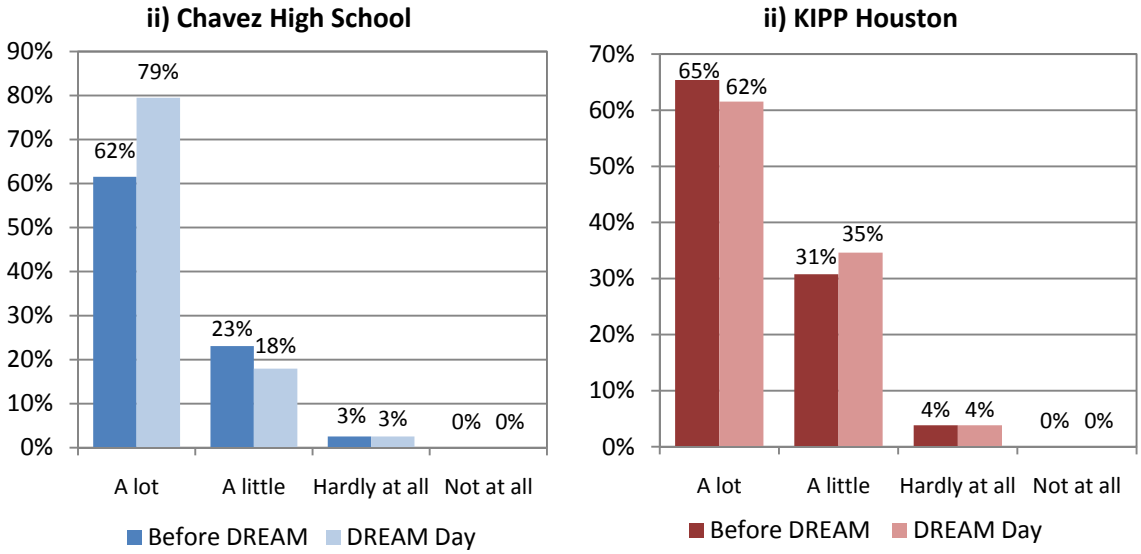

Figure 16 – Question 9) "How does the number of math courses you take influence how much money you can make in your career?" Mentee's perceived influence of mathematics on their future professional salary.

The P.E.S also asked the mentees to describe what a professional engineer does. The question was open-ended and allowed the mentees to express their perceptions in their own words. In order to assess the data, the responses were graded on a qualitative 0-4 Likert scale. The lowest score, 0, showed that the respondent answered but had no understanding of what an engineer or scientist was, while the highest score, 4, signified exceptional understanding. Common words were used to classify the responses to understanding levels. Phrases such as: 'makes things', 'building', or 'fix', were classified as level 1 understanding. Those that used the phrases 'create', or 'design', were classified as 2. Phrases of 'math' or 'science', and 'invents' were classified level 3. Level 4 was exceptional understanding and was to resemble a phrase such as 'someone who uses science and math, with design skills, to solve problems.'

For CHS, subfigure 17-i, results were affected by several blank responses on the surveys. However the overall trend shows an approach to a normal distribution in the understanding of the engineering profession over time. Figure 17, subfigure ii, shows that KIPP mentees increased their understanding of engineering careers from the initial survey. The shift in knowledge shows that mentorship is effective for conveying understandings of STEM related careers.

Throughout the DREAM program and on DREAM Day, mentees received information and mentoring on the vast number of opportunities available to a graduating engineer. From aerospace companies to exploration and production with oil and gas, mentees were exposed to a variety of careers via the mentors' experiences in industry through internships. These were shared and the P.E.S. questioned mentees on their knowledge of the average pay for an engineer. The correct pay is approximately $55,000 for an engineer with a bachelor's entering the workforce [14,15]. CHS mentees (subfigure 18-i) have a somewhat bi-modal response with one mode below the low end of the pay scale, and another ranging from the correct to the high end of the scale. Figure 18, subfigure ii, shows that KIPP mentees' perceptions of earning potential of new hires in the engineering profession were initially skewed toward the high end, but became more realistic on DREAM Day.

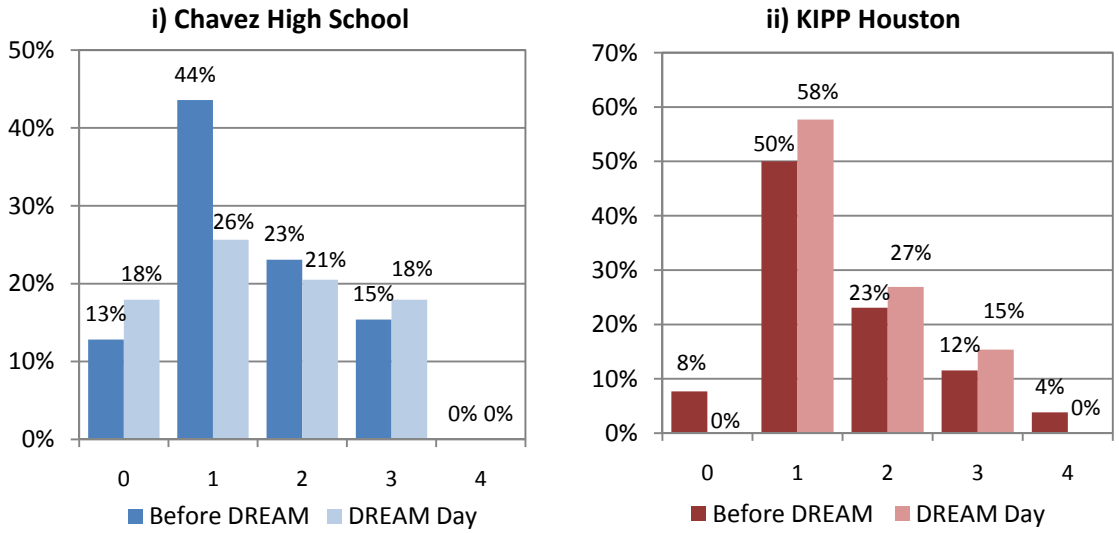

Figure 17 – Question 16) "What do you think an engineer does?" Mentee responses rated from 0 (no understanding) to 4 (excellent understanding).

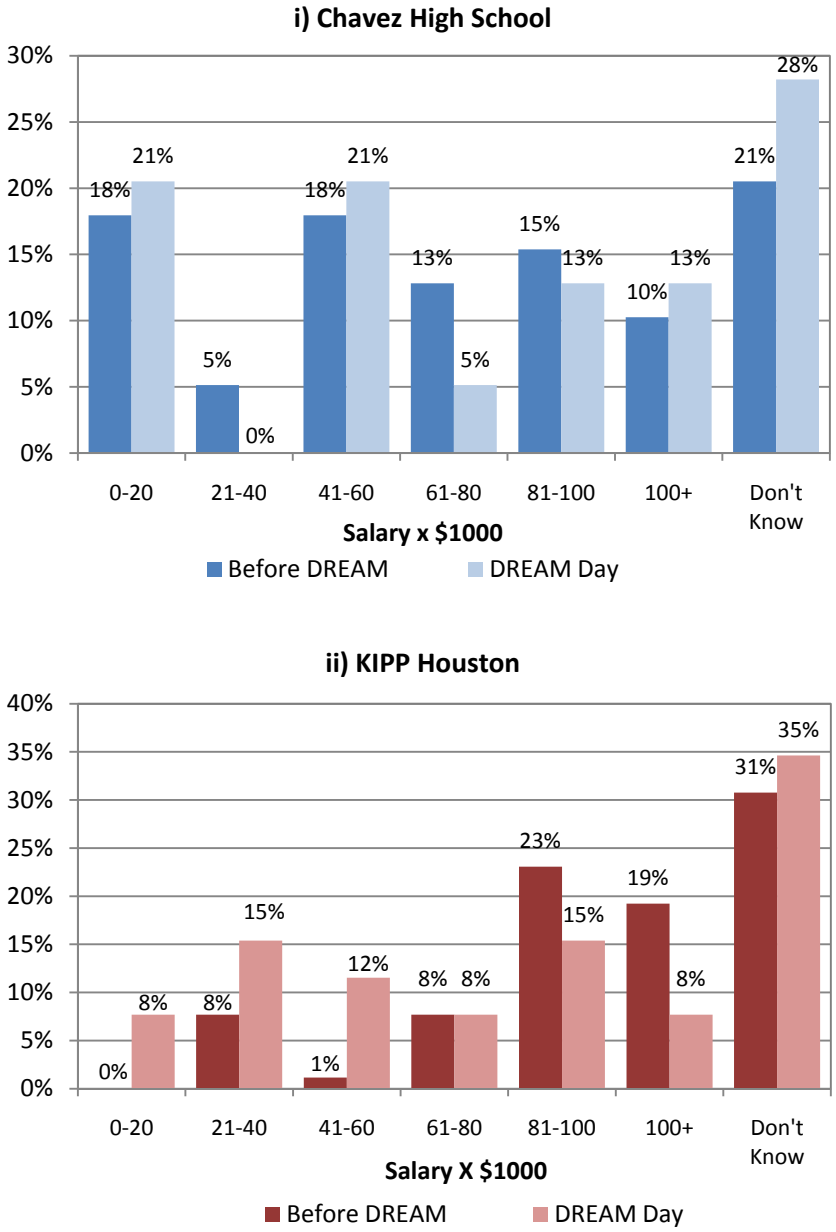

Figure 18 – Question 18) "What is your best guess at the annual (yearly) salary of an engineering major after graduating from college?" Annual engineering graduate earnings in 6 distinct brackets: $0-20,000 per year; $21,00-40,000 per year; $41,00-$60,000 per year; $61,000-$80,000; $81,000-100,000; and over $100,00 per year. "Don't Know" represents the mentees which failed to complete the question.

Results and Discussion – Mentor Data

In the fall 2009 semester of DREAM, for the first time, all DREAM mentors were asked to take a survey similar to the mentee P.E.S., to gauge mentor knowledge of financial aid, the college admissions process, and opportunities available with a degree in the STEM fields. A recent study showed that three of the four key characteristics of successful pre-college programs aimed at the diversification of the engineering workforce are that they "(1) promote awareness of the engineering profession, (2) provide academic enrichment, (3) have trained and competent

instructors” [15]. In order to be an effective pre-college program, the DREAM program must have mentors that are knowledgeable both about engineering as well as about college and the admissions process. This ensures that the information the mentors share with the mentees is both accurate and consistent. Evidence of mentors’ knowledge on certain topics allows the DREAM program to gauge areas of weakness that can be included in mentor training or instruction.

Since the fall 2009 semester was the first semester the mentor survey was administered, the results of this survey provide baseline initial data. One specific question that was asked on the fall 2009 mentor survey, question 9a, was “Give your definition of an engineer.” This question was meant to test the mentors’ understanding of what an engineer does. The question was short answer, and the answers were rated on a 0-4 scale with 0 indicating no understanding of the term “engineer” and 4 indicating exceptional understanding of the term “engineer.” An example of an answer indicating exceptional understanding was “someone who uses science and math, with design skills, to solve problems.”

Figure 19 shows that out of the twenty-eight DREAM mentors that took the mentor survey, 82% had either excellent or good understanding of what an engineer does. This is very convincing evidence, as it shows that the vast majority of mentors involved in the program are knowledgeable about what it truly means to be an engineer. This is important when trying to explain such concepts to mentees. As seen in the pie chart, 11% of the mentors only have a basic understanding of the term “engineer” and 7% showed no understanding. This combined 18% indicates the necessity of training the mentors in basic concepts central to the DREAM program.

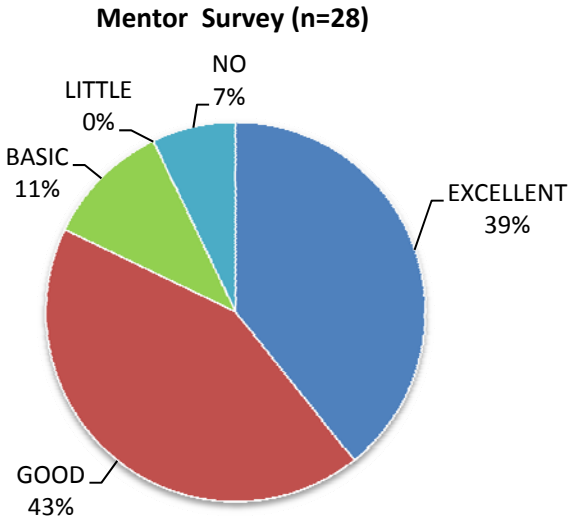

Figure 19 – Mentor Survey Question 9a) “Give your definition of an engineer?” Fall 2009 mentor responses to defining an engineer ranked on a scale from 0 (no understanding) to 4 (excellent understanding).

Eliminating the responses of the two mentors who showed “no understanding,” which were not serious responses, the twenty-six remaining mentors displayed an average understanding rating of 3.3 out of 4. This shows that the average mentor has between a “good” and “excellent” understanding of the term “engineer,” proving that the mentors are “competent instructors” and have the ability to “promote awareness of the engineering profession”[15]. This is crucial in creating an effective mentoring program.

Although this initial survey can only currently be used to gauge general mentor knowledge at a discrete time, by continuing to administer this survey in future DREAM semesters, trends and changes in mentor knowledge will be traced and analyzed. Also, several questions included on the fall 2009 mentor survey directly correlated with questions on the mentee P.E.S. survey. One hypothesis is that having more mentors with "good" or "exceptional" understanding of important concepts will directly correlate with a larger increase in mentee knowledge of career insight, preparedness for college, and financial aid. This increase should be seen both over any specific semseter as well as in long-term trends. The specific questions on the mentor survey that should be looked at for this future analysis include question 8, "Some universities have 'no-loan' family income policies. Do you know what these are?" and question 8b, "If you answered 'yes' or 'I have a guess' [to question 8], what do you think the 'no-loan family income limit is for Rice?" as well as question 9a, "Give you definition of an engineer," and 10a, "What is your estimate of the annual (yearly) salary of an engineer entering industry after graduating college (ug)?" The variety of these questions shows the range of mentor knowledge from financial aid to engineering to future opportunities in the STEM fields. The mentor responses to these questions can then be compared to the mentee responses to similar questions on the P.E.S. A positive cross-correlation is expected between a large number of mentors answering the above questions correctly and a larger improvement, from the initial survey to the final survey over the course of one semester, in the number of mentees answering these same questions correctly. The fact that the mentor survey was just recently administered for the first time does prove valuable. There are several semesters of DREAM mentee data without corresponding mentor data, which will provide undiluted baseline data that can be used for future comparisons and to substantiate trends and changes observed over time. As can be seen, a large amount of future research and analysis of the mentor survey must be done to understand the impact more knowledgeable mentors have on mentees, and to identify those concepts important for the mentors to understand.

Future Work

Results show that DREAM has seen successes in informing mentees of financial aid, college preparedness, and future opportunities in the STEM fields, and that there are still many areas for improvement. The necessity for the development of further hypotheses and the continuance of research has also become very apparent. Long-term effects of DREAM need to be analyzed, as this is one of the ways to see the larger impacts the program is having on the mentees, and offers objective evidence of areas of program success, as well as areas that need improvement.

Regarding financial aid, more emphasis must be put on informing mentees of financial aid as a whole. As noted in the results section, mentees seem confused about what types of packages are actually included in the term "financial aid." Thus, it is important for the DREAM mentors to continue to stress the importance of all types of financial aid, including loans, scholarships, and work-study programs. Emphasis should be placed on teaching the mentees about the FAFSA and "no-loan" policies. It may be beneficial to attach one or two additional mentoring days each semester devoted directly to discussing financial aid and the monetary resources available to help underprivileged minority high school students afford college.

By analyzing data gauging mentee preparedness for college, a variety of new hypotheses have emerged. Understanding the discrepancy between the number of mentees stating that they plan to

go to college and the number of students that actually matriculate is critical. Some possible explanations include: mentees are giving the answers that they think the DREAM program wants them to give, the mentees are too self-conscious to provide an honest answer, or the mentees do not quite understand what is required to gain admittance into and attend college. It is important to understand the underlying reason for the discrepancy and to reconcile it.

Continuing to administer mentor surveys at the beginning of each DREAM semester will allow for cross-correlating changes in mentor knowledge with changes in mentee knowledge. The current research also shows that it is necessary for the DREAM mentors to become more familiar with the high schools they serve. This will prove helpful in advising mentees on what classes they should be taking in order to have the best chance of getting into college, as well as informing mentees of those classes that would be most beneficial for pursuing certain STEM careers. Mentors must also be very knowledgeable about financial aid, the college admissions process, and future possibilities in the STEM fields. Thus a mentor-training program has been implemented. This will help ensure that the information mentors are disseminating to the mentees is both correct as well as consistent. This is especially important at AHS. There are a large number of mentors, each attending different days of the week, while most mentees come several days each week, and therefore see different mentors.

In addition to mentoring for seven weeks using the mechanism of a design competition, in fall 2009, college preparatory sessions were introduced at AHS. These sessions, aimed at mentees in their senior year, provided mentees with binders filled with the most pertinent information regarding college application deadlines and standardized testing dates. Hard copies of the Texas Common Application and the FAFSA were also included. Two scheduled meetings took place, in which a small number of mentors worked with the senior mentees to assist with resume writing, editing college essays, and beginning the actual college application. In addition, a Rice University student trained in professional development advising gave a presentation on how to write a resume then worked with the mentees on completing their own resumes. It became apparent early on that the mentees really need role models helping them through the application process and keeping them on schedule. When the first college preparatory meeting took place, only a small number (25%) of the senior mentees had completed the SAT, and even fewer were signed up to take it on the next date it was being administered. These college preparatory sessions will definitely be continued. However, the goal is to start these sessions when mentees are in 11^{th} grade, and continue the college application process into 12^{th} grade. Each year, 11^{th} grade mentees will join the program. Once fully initialized, this will cater to 11^{th} and 12^{th} graders, with each individual group completing a unique set of requirements. Mentors will work with 11^{th} grade mentees on SAT preparation and college searches. A second group of mentors will work with seniors on resume building, essay writing, and filling out college applications.

Conclusion

A series of important findings show how the mentorship process of DREAM provides mentees with new perspectives about college and STEM career paths. The areas studied include (i) mentees' perceptions of college costs, (ii) correlations of mentees' perceptions with their parents' education levels, (iii) mentee's valuation of quality courses and (iv) mentees' perceptions of engineering careers.

It is noted that one semester of participation in DREAM is not sufficient to differentiate between affordability and the cost of college. This is due to the complexity of the many different sources and types of financial aid available upon gaining acceptance to an institution of higher education. However, one semester of participation in DREAM did demonstrate to the mentees that financial aid is widely available and can offset most or all of the cost of college. Nearly all mentees wish to avoid student loans. More research as to why is necessary, and the mentors must find a better way of presenting the importance and convenience of loans when used in combination with other forms of financial aid. Financing a college education is a complicated subject for parents and students. More emphasis on the details of financial aid will be integrated into the mentorship process in the future to better help the mentees comprehend the process. One notable outcome came from collaborating with teachers at KIPP. Large gains in understanding of the FAFSA by KIPP mentees signified the importance of collaborating with teachers and sharing the goals of DREAM with the staff and teachers at the campuses involved.

Results suggest that parental education levels influence how prepared mentees are for college, as expected. DREAM helps mentees understand college costs, particularly those whose parents did not have the opportunity for post-secondary education. In comparison, no significant change was observed in mentees whose parents have post-secondary education, at least over one semester. Furthermore, for those with no previous knowledge of opportunities of college, understanding was improved at KIPP. A previous study at AHS also showed improvement. However, this hasn't yet been observed at CHS.. This highlights some differences between the campuses that need to be addressed. At CHS, DREAM sessions take place during the school day, but at KIPP and AHS DREAM takes place after school. Some CHS mentees may view DREAM as a class rather than an opportunity to learn more about college, requiring more time for "buy-in" of mentees.

Significant gains were noted in the mentees' perception of the importance of mathematics and physics classes toward preparation for study in engineering. CHS and KIPP showed gains in the number of years of mathematics and physics that mentees wanted to take signaling a positive effect due to DREAM.

As it relates to STEM career awareness, mentees demonstrated improved understanding in the correlation between more quality coursework, such as mathematics, and the potential to increase their income in the long-term. However, in one semester mentees were not necessarily able to increase their understanding of what an engineer does, as observed previously at AHS. Although the message is transmitted through the design project, the mentors, and the overall process of DREAM, 'using math and science to problem solve' did not solidify as mentees' definitions of what an engineer does. With all the information presented, it is understandably difficult for mentees to grasp the concept of a career in just one semester. Therefore more research and a more unified message must be created to define STEM careers in a way in which mentees can relate. As mentees repeat participation in DREAM from 9th -12th grades, their perceptions of engineering careers will continue to improve.

In fall 2009, to address the college application process, DREAM instituted a College Prep group for seniors who had participated in DREAM for at least 3 previous semesters at AHS. All eight seniors reported the desire to attend college and seven out of eight indicated interest in

engineering majors in free-response surveys. Since, all eight seniors have been accepted into college. This confirms the DREAM's effectiveness in helping underrepresented high school mentees gain acceptance into college and pursue a higher degree.

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Appendix A: High School Academic Information

All three high schools that are a part of the DREAM program offer Pre-Advanced Placement (Pre-AP) and Advanced Placement (AP) courses. Pre-AP Courses prepare students for the difficulty level of AP courses, while AP courses prepare students for the rigors of college courses while also providing college credit should the student pass the nationwide AP examination.

All high school students in the state of Texas must also take the Texas Academic and Knowledge Skills (TAKS) exam that the Texas Education Agency administers each year to track and assess students in three core subject areas in the high school curriculum: mathematics, science, and reading. Examination results from spring 2009 are shown below for each campus.

Austin High School (AHS)

The TAKS examination shows weak understanding in the mathematics and science subjects for AHS 10th grade students, with only about half passing the exam. Scores for 11th graders were higher in all testing categories showing an overall higher mastery of the subjects.

Austin High School (AHS)						
	Reading		Mathematics		Science	
grade	passing	commended	passing	commended	passing	commended
9th	77%	N/A	60%	N/A	N/A	N/A
10th	74%	N/A	54%	N/A	49%	N/A
11th	89%	N/A	78%	N/A	81%	N/A

Table 1 – AHS TAKS spring 2009 scores[1]

Chavez High School (CHS)

The passing rates for the subject area examinations were higher than Austin HS and shows higher passing rates in all areas. However, first year examinations in Math and Science show just over 1 in 2 students show mastery of the STEM related areas.

Chavez High School (CHS)						
	Reading		Mathematics		Science	
grade	passing	commended	passing	commended	passing	commended
9th	79%	--	55%	--	N/A	N/A
10th	84%	--	64%	--	59%	N/A
11th	90%	--	84%	--	84%	N/A

Table 2 – CHS TAKS spring 2009 scores[1]

KIPP Houston High School (KIPP)

KIPP HS TAKS show near uniform mastery of Reading Comprehension and high scores in Math and Science upon first examination of the subject areas as compared to Austin or Chavez. Commended status was available for KIPP, and indicates on average less than three questions

answered incorrectly in each of the subject areas independently. Commended status increases substantially from first examination showing exceptional performance with many students excelling in STEM areas.

Knowledge Is Power Program (KIPP) Houston High School						
	Reading		Mathematics		Science	
grade	passing	commended	passing	commended	passing	commended
9th	99%	30%	85%	29%	N/A	N/A
10th	99%	33%	93%	28%	85%	13%
11th	99%	62%	97%	49%	99%	33%

Table 3 – KIPP TAKS spring 2009 scores[6]

Appendix B: Mentee P.E.S. and Mentor Survey

The mentee P.E.S. administered during the spring 2009 DREAM program and the mentor survey, administered first in fall 2009, are included for reference.

Questionnaire P.C.I. Spring 2009 Name _____ (first) (middle) (last)

Current Year (circle one): Freshman Sophomore Junior Senior Gender (circle one)*: Male / Female

Race/Ethnicity: (circle one or more)* African-American/Black Asian-American Caucasian/White Hispanic/Latino
Native American other _____

1a) What is the primary language you speak at home? _____ 1b) What is the secondary language, if any? _____

2) What do you plan to do after high school? get a job go to college both

3a) Do you think you can afford college? Yes No 3b) How much do you think a year of college costs? $ _____

4) If you are going to college, how do you plan to pay for college (circle all that apply)?

parent(s)/guardian(s) scholarships loans work-study/part-time job don't know

5) What portion of college costs do you think might be covered by financial aid for you (circle one)? all most some none

6a) Do you know what the FAFSA is? Yes No 6b) If Yes, have you ever filled out the FAFSA? Yes No

7) Many universities have "no-loan" policies based on family income. This means, if your parent(s) or guardian(s) make less than a certain amount of money per year, the university will give you a scholarship. How much do you think the "no-loan" family income is at Rice?

$ _____

8) Do you think math courses are important for entering science and engineering? Yes Maybe No

9) How does the number of **math** courses you take influence how much money you can make in your career?

a lot a little hardly at all not at all

10) How much **math** do you plan to take in high school? minimum required to graduate 3 years 4 years

11) How much **chemistry** do you plan to take in high school? none 1 year 2 years

12) How much **physics** do you plan to take in high school? none 1 year 2 years

13) How much **biology** do you plan to take in high school? none 1 year 2 years

14) What are your **favorite** subjects in school? _____

Why? _____

15) What are your **least** favorite subjects in school? _____

Why? _____

16) What do you think an **engineer** does? _____

17) What do you think a **scientist** does? _____

18) What is your best guess at the annual (yearly) salary of an engineering major after graduating college? _____

19) Parents' highest education levels (circle one choice for each parent)*:

Mother	middle school or below	some high school	graduated high school	technical or trade school	some college	graduated college w/ associates degree	graduated college w/ bachelors degree	higher level college degree	unknown
Father	middle school or below	some high school	graduated high school	technical or trade school	some college	graduated college w/ associates degree	graduated college w/ bachelors degree	higher level college degree	unknown

* We would be grateful if you would answer every question, but you may skip the ones you prefer not to answer.

Mentor Survey Fall 2009 Name _____ (first) (middle) (last)

Current year based on matriculation, **NOT** credits (circle one): Freshman Sophomore Junior Senior Grad.

Gender: Male / Female* (circle one) Major: _____ College: _____ Foreign National? Yes / No / dual citizen

Race/Ethnicity:* (circle one or more) African-American/Black Asian-American Caucasian/White Hispanic/Latino
Native American other _____

1a) What is the primary language you speak at home? _____ 1b) What is the secondary language, if any? _____

2) What do you plan to do after your undergrad studies (if applicable)? get a job go to grad school go to med school other _____

3) How many **semesters** (including this one) have you been a DREAM mentor? this is my first 2 3 4 5

4a) Do you think that DREAM mentors should be paid for the time they spend mentoring? Yes No

4b) Why? _____

5a) Do you think that academic credit should be awarded for participation in DREAM? Yes No

5b) Why? _____

6) How would you evaluate your public speaking skills? Very Strong Strong Moderate Fair Weak

7) How would you evaluate your team leadership skills? Very Strong Strong Moderate Fair Weak

8) Some universities have "no-loan" family income policies. Do you know what these are (circle one)? Yes I have a guess No

8b) If you answered Yes or I have a guess, what do you think the "no-loan" family income limit is for Rice? _____

8c) If you answered Yes or I have a guess, explain a no-loan policy in words. _____

_____

_____

9a) Give your definition of an engineer. _____

_____

9b) Why did you join DREAM? _____

_____

10a) What is your estimate at the annual (yearly) salary of an engineer entering industry after graduating college (ug)? _____

10b) How much would you expect to pay or be paid while obtaining a graduate engineering degree? explain _____

_____

_____

11) Parents' highest education levels (circle one choice for each parent)*:

Mother:	middle school or below	some high school	graduated high school	technical or trade school	some college	graduated college w/ associates degree	graduated college w/ bachelors degree	higher level college degree	unknown
Father:	middle school or below	some high school	graduated high school	technical or trade school	some college	graduated college w/ associates degree	graduated college w/ bachelors degree	higher level college degree	unknown

* We would be grateful if you would answer every question, but you may skip the ones you prefer not to answer.