

CAHSI ANNUAL EVALUATION REPORT

ACADEMIC YEAR 2010-2011

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EXECUTIVE SUMMARY

The CAHSI alliance has made considerable progress towards its goals in the 2010-2011 year. Some evaluation highlights include the following:

- *From 2006-2010, CAHSI founding mainland institutions produced 10% of all Hispanic Computer Science Master's graduates of U.S. Public and non-profit institutions*
- *In 2010-2011, CAHSI provided semester or year-long computing experiences to over 1,200 students. Five hundred thirty seven of them were Hispanic students.*
- *Since 2006, founding CAHSI institutions have increased their PhD computing graduation rate by 86%.*
- *Three students have received NSF fellowships/honorable mentions since the start of FellowNet and MentorNet. One of these students was the first fellowship awarded in the past 10 years at that institution. Two former recipients mentored by CAHSI faculty are now CAHSI faculty members.*
- *Since 2002, CAHSI has remained relatively steady in bachelor degree production while US mainland Master's and doctoral institutions granting computer science degrees declined 43%.*
- *CAHSI is finalizing an agreement with Society to Advance Chicanos and Native Americans in Science (SACNAS) that would provide infrastructure and resources to support and sustain the CAHSI annual meeting. The collaboration will help to sustain CAHSI's annual event, considerably reducing the need for travel funds and will lessen workload for CAHSI staff.*

INDIVIDUAL PARTICIPATION AND OUTCOMES -HIGHLIGHTS

CAHSI serves students in undergraduate and graduate computing programs through three related major initiatives. Computer science zero (CS-0) gives students a gentle introduction to programming concepts, targeting underprepared computer science majors. The effort has been institutionalized at nearly all CAHSI schools (impact measured by Social Cognitive Career Theory surveys of interest, self-efficacy, and perceived support; student progress analysis). Peer led team learning assists students in undergraduate computing "gatekeeper" courses. CAHSI has paired this nationally recognized undergraduate science initiative with cooperative learning strategies that enhance students' perceptions of support in the department (impact measured by Social Cognitive Career Theory surveys of interest, self-efficacy, and perceived support; student course completion analysis). Undergraduate student researchers receive graduate school preparation and work cooperatively in research efforts through the faculty-led ARG model. Students in Mentorgrad and FemProf engage in Research Experiences for Undergraduates, participate in intensive training regarding academic pathways, and apply for national graduate fellowships. Students disseminate their work and network with graduate and undergraduate peers and faculty at the national CAHSI meetings (URSSA, a statistically reliable and validated survey; comparison to national data from REU sites using the same instrument).

At the beginning of their computing experience in college, CS-0 students—typically under-prepared for college-level computing work—successfully completed this introductory course with an 86% pass rate for all students.¹ Of those students entering CS1 from CS-0, 78% completed CS1, which is slightly higher than the 75% for the general CS1 population. Hispanics who had taken CS-0 completed CS1 at higher rates than Hispanics who had not taken CS-0 (79%, 76% respectively), although the difference is not statistically significant. This year's evaluation results show similar and in some cases superior results for SACI students involved in CS-0: students' interest in computing and positive regard for computing careers increased from participating in CS-0. Students reported increases on the interest scale from their experience in CS-0 (averaging 9.0 on a 10.0 scale of interest following the course) and students reported higher regard for careers in computing (averaging 8.39 on a 10.0 scale).

Prior to the implementation of PLTL in “gate-keeper” courses in the major, only 77% of students completed the course, while 87% of students completed the course after the advent of PLTL. This ten percent increase in course completion rates is statistically significant (χ^2 (1, N=5195)=53.07, $p<.01$). Likewise, Hispanic students showed a six percent increase in course completion (χ^2 (1, N=2716)=17.4, $p<.01$) after PLTL was implemented, also statistically significant.² SACI students demonstrated increased computing self-efficacy (mean of 8.04 on 10.0 scale) following their PLTL courses, as well as greater commitment to reaching academic goals (8.73) and higher regard for computing careers (9.24).

Students are socialized into the computer science profession from participating in ARGs. Students' educational aspirations have been influenced by ARGs: 87% of students reported that they are more interested in graduate school after their ARG experience. Students are also enhancing their preparation for graduate school. ARG students have authored or co-authored journal articles at twice the rate (13% for ARG students vs. 6%) of a large, diverse national sample of REU students, and presented a poster at a national conference at nearly three times the national rate (40% for ARG students vs. 14% for national sample of REU students). Both findings are statistically significant ($p<0.001$).

CAHSI students are also supported in their path to graduate school. Following the CAHSI annual meeting, most students indicated they had received informal career path mentoring from faculty (76%); this figure compares favorably to a recent study by MentorNet, which indicated that of 1,876 STEM students surveyed, only 62% had an important mentor in their undergraduate years.

The graduation rate from all CAHSI departments has stayed relatively steady (at or above 90% of 2002 graduate rates) over the past nine years, while a comparison group of all US Mainland Master's and Doctoral granting public and not-for-profit colleges and universities showed a decline of 43% over the same time period. Thus, CAHSI schools have remained moderately steady in their graduation rates, while the nation has experienced steep declines in computing degrees. In addition, CAHSI institutions graduated Hispanic students at nearly ten times the national average in the last few years.

¹ Data set 2005-2009, updated data to be computed in 2011-2012

² This data reflects data from 2002-2009. Data will be updated for the 2011-2012 report

ORGANIZATIONAL CAPACITY DEVELOPMENT-HIGHLIGHTS

The development and sustained growth of an alliance that thrives beyond grant funding depends upon the institutions' collective and individualized attention to human resources, leadership, knowledge development, revenue development and opportunities for continuous engagement (Eib & Miller, 2006; Henderson, 2007; Newmann, Kings, & Young 2000). The four **organizational capacity** measures are rooted in institutional change, program capacity, and sustainability research, particularly the model presented by Johnson, Hays, Center, and Daley (2004). **Healthy educational pipeline development** refers to the activities occurring at each institution to feed, support, and improve the flow of students into the academic pipeline. **Resource Development and Training** illustrates ways institutions are supporting faculty and student knowledge development related to educational innovation, through training, resource creation and resource sharing. The **Faculty/Staff Engagement** strand reports the proportion of faculty members and instructors who teach undergraduate courses and are 1) aware of or 2) engaged in and 3) trained in reform activities. As this funding cycle will mark the end of National Science Foundation funding of the alliance, a fourth strand, **CAHSI sustainability**, measures the extent to which CAHSI initiatives are institutionalized at member sites and/or funded by other sources.

CAHSI is still developing in some areas of Healthy Pipeline development, and exemplary in others. To improve student recruitment and preparation, six of seven CAHSI institutions are engaging in K-12 outreach activities. Five of these institutions host CS-0 summer courses and camps for high school students, and one institution holds a computer and engineering exposition for high school students. To improve retention in the major, four of the seven institutions have funded a faculty member to develop or restructure curriculum in key courses. To strengthen the pipeline to graduate school, all CAHSI institutions are offering Affinity Research Group experiences for students. Additionally, three schools provide graduate preparation workshops for a significant proportion of students and two provide hands-on technical assistance to students in preparing graduate school and fellowship applications.

CAHSI institutions are exemplary in hosting and leading faculty trainings. All CAHSI institutions have hosted trainings in CAHSI undergraduate initiatives. In all, CAHSI departments since 2006 have hosted 22 trainings. CAHSI institutions are still developing faculty awareness of CAHSI within their departments and on their campuses. Only one department was rated exemplary in departmental awareness of CAHSI (over 50% of faculty survey respondents are aware of CAHSI's activities). CAHSI overall is also still developing in participation rates among its faculty. Four departments are rated as exemplary for faculty participation in CAHSI activities (over 33% of faculty are involved in CAHSI initiatives). CAHSI overall is rated exemplary in faculty training (over 15% of CAHSI faculty have been trained in its initiatives). Since 2006, 17 faculty have been trained in CS-0, 18 faculty have been trained in PLTL, and 33 faculty have been trained in ARG.³

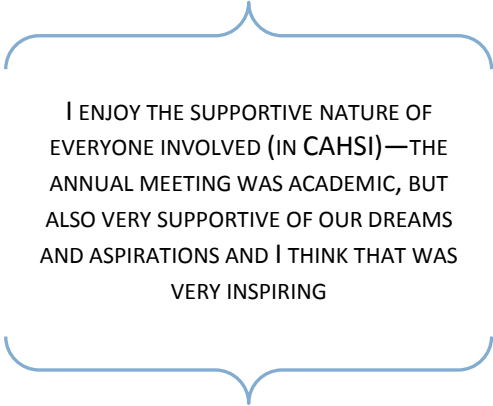
³ Data represented from 2009-2010 faculty survey. Data to be updated for 2011-2012 academic year.

ALLIANCE IMPACT-HIGHLIGHTS

CAHSI initiatives will need to be fully funded by outside resources within four years. While CS-0 courses have been institutionalized, additional student support via PLTL and ARG is only partially supplemented with external funding. Developing strategies for institutionalizing and funding these initiatives through other means is vital to CAHSI sustaining its impact in undergraduate education.

RECOMMENDATIONS

CAHSI undergraduates show aspirations and promise as graduate students in computing. To date, evaluators have anecdotal evidence that many bachelor degree earners advance towards MS and PhD degrees in their home institution. Survey data, however, do not corroborate this information—for example, few annual meeting participants have taken the GRE or have applied to graduate school. A better method of tracking post-baccalaureate outcomes for students is needed. Two possible avenues for improving this data collection include: partnering with the departments to design questions specifically for alumni surveys, and/or submitting a request to the National Science Foundation for additional funds. The funds would be used to purchase data from the National Student Clearinghouse, an organization that has the capability of tracking student enrollment and graduation nationwide.



I ENJOY THE SUPPORTIVE NATURE OF EVERYONE INVOLVED (IN CAHSI)—THE ANNUAL MEETING WAS ACADEMIC, BUT ALSO VERY SUPPORTIVE OF OUR DREAMS AND ASPIRATIONS AND I THINK THAT WAS VERY INSPIRING

Fem Prof has been a successful initiative to support and advance women in computing at the undergraduate and graduate levels. On average, CAHSI institutions graduate women at or slightly below the national rates. Targeting attention towards women in the department and towards recruiting new female students is encouraged.

CAHSI has thus far had personal, deep commitments to new institutions joining the existing alliance. Members receive intensive training and support to become well versed in advancing CAHSI's mission. As the alliance extends implementation of proven practices, technological means and processes for a) communicating across sites b) sharing materials and training resources with new members, and c) extending the reach of CAHSI to new institutions and individual partners will be needed.

INTRODUCTION

CAHSI has developed a system of initiatives that support student success in computing. Through mentoring, building skills and knowledge in community, introducing computing concepts in innovative ways, and integrating students into higher-level research practice, CAHSI's initiatives are proving effective. In the next stage of CAHSI that began with the five-year extension grant, we shift focus in evaluation from an emphasis on initiative effectiveness to look towards institutional and organizational sustainability and growth. The goals of CAHSI include becoming a voice for policy and organizational change for Hispanic student success in STEM, creating cyber infrastructure to support innovation and collaboration, and building upon the research excellence of CAHSI schools.

In keeping with the BPC common core indicators, the CAHSI evaluation focuses on three strands of programmatic improvement: participant outcomes, organizational capacity, and broader impacts. Evaluation in years 6-10 focus on the following participant outcomes: institutional data and tracking student advancement through the major, experience of the annual meeting, and ARG researcher experiences. In addition, evaluators focus each year on a case study that deepens understanding of student experiences in specific initiatives. Initiative effectiveness is now tracked in the SACI schools, institutions that began to scale and adapt CAHSI initiatives in 2009. Organizational capacity measures the extent to which CAHSI departments are institutionalizing CAHSI initiatives and broader impacts focuses on the reach of CAHSI beyond the original institutions and change agents.

BPC Goal	Goals and Desired Outcomes	Activities	Sample measures	Data
Participant Outcomes	<i>Sustain Recruitment</i> (e.g., increased interest for CS-0; CS-0 leading to major in CS)	CS-0, K12 outreach	Lent's SOCT survey (Interest & educational outcomes); Institutional records	Surveys for new adopters Interviews Institutional research data for all institutions
	Results to Date: 1) CS-0 students experience increase in interest (74%), though increase stronger for K12 populations; to date no measured CS1 success increase with CS-0 participation.			
	<i>Sustain Retention</i> (e.g., positive comparison between PLTL/non-PLTL pass rates; positive comparison to national grad rates)	PLTL, annual meeting	Lent's SOCT career survey Student level course outcomes database	
	Results to Date: 1) PLTL data from student course taking databases show a statistically significant effect favoring PLTL, with a ten percent increase in course completion after PLTL was introduced) CAHSI schools see steady CS BS graduation rates during huge decline nationally (2002-2007).			
	<i>Sustain Advancement</i> (e.g., preparation for graduation school, intention to go to graduate school, comparison #s from NSC)	ARG, Mentor-Grad/ Fem Prof, annual meeting	URRSA for ARG (Hunter et al, 2009); annual meeting follow-up survey; National Student Clearinghouse analysis.	
	Results to Date: 1) ARG students were 2X more likely to author journal articles/papers (13%) and 3X more likely to present papers (51%) than sample of 500+ REU participants; 2) All 5 of the 5 spring 2009 graduates from the Fem Prof program were accepted to PhD programs; 3) Nearly 75% of ARG researchers report the experience increased graduate school intentions.			

Object 1: Current CAHSI Evaluation Plan

INDIVIDUAL PARTICIPATION AND OUTCOMES

In this section, we describe the effects of CAHSI at the individual level, with a focus on how CAHSI programming has influenced students' (particularly underrepresented students') degree attainment and enrollment in computing programs. In addition, we draw attention to other indicators of CAHSI's influence on students' experiences with computing, particularly:

- a) STUDENT ADVANCEMENT: Student behaviors, planned behaviors, and aspirations leading to computing careers and advanced computing degrees
- b) COMMUNITY: Student experience of CAHSI initiatives as fostering a sense of community around excellence in the field
- c) SKILLS and KNOWLEDGE: Student and faculty assessment of researchers' gains in skills and knowledge

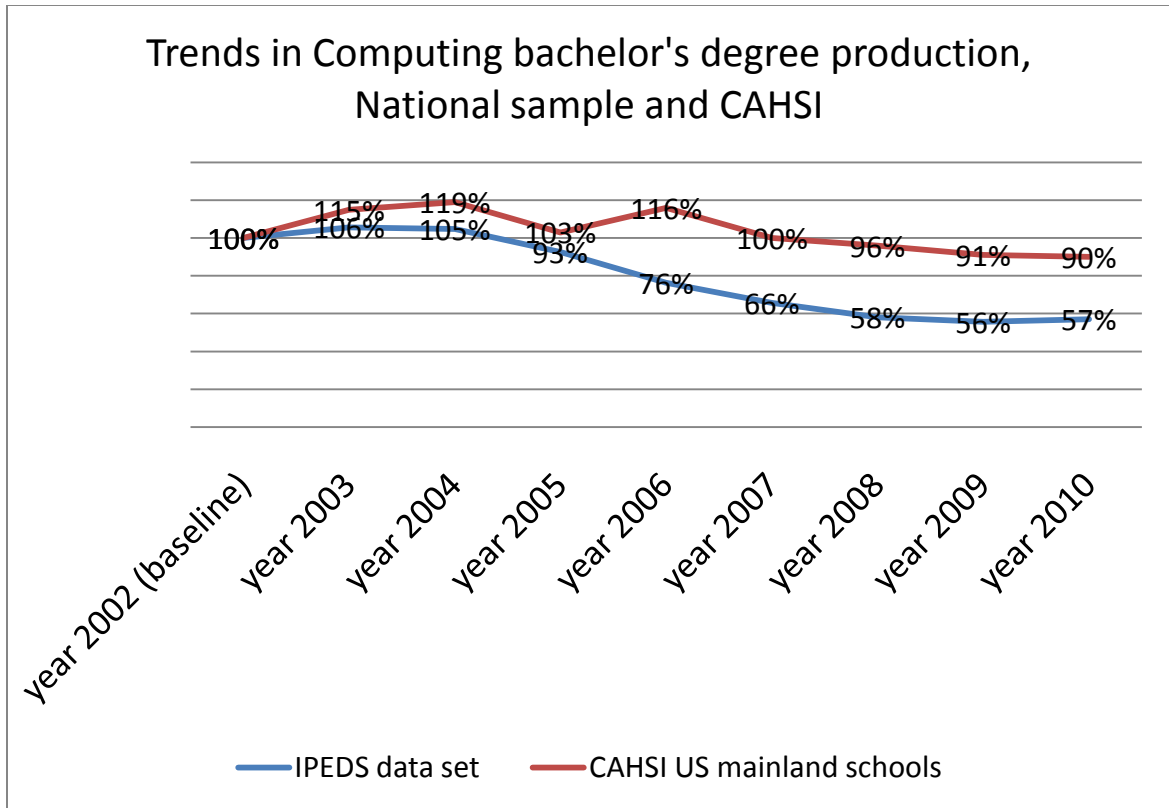
In accordance with BPC alliance evaluation practices, the Participant Outcomes section begins with the national context regarding computing degree production, and with the number and demographic information related to CAHSI participants from the 2010-2011 school year.

The National Context

For nearly a decade, the U.S. has declined in rates of bachelor's degree production in computing fields. To place CAHSI within the national context, institutional data from CAHSI schools were compared to data from a nationally representative sample of 1,709 master's and doctoral-degree granting, public and private, non-profit institutions from the Integrated Postsecondary Education Data System (IPEDS)⁴. The national comparison sample demonstrated that ***Computing degrees dropped from 3% of total bachelor's completions to 1% of total completions in the U.S. from 2002-2010.*** Thus the U.S. is in a period of steep decline in producing baccalaureates in computing fields. The latest national numbers show a slight upward trend but, overall, the current rates of bachelor's graduation in computing are far below the levels seen in the early 2000s.

In contrast, CAHSI has held relatively steady in bachelor's graduation rates since 2002. While the national sample declined by 43%, CAHSI has only declined by 10% since 2002. Although CAHSI has also experienced a recent decline in baccalaureates, CAHSI's 10% decline is less steep than the overall national decline in computing degrees. Thus, CAHSI is producing more computing baccalaureates than might be expected given national trends.

⁴ The methodology is described in detail in Appendix 1.

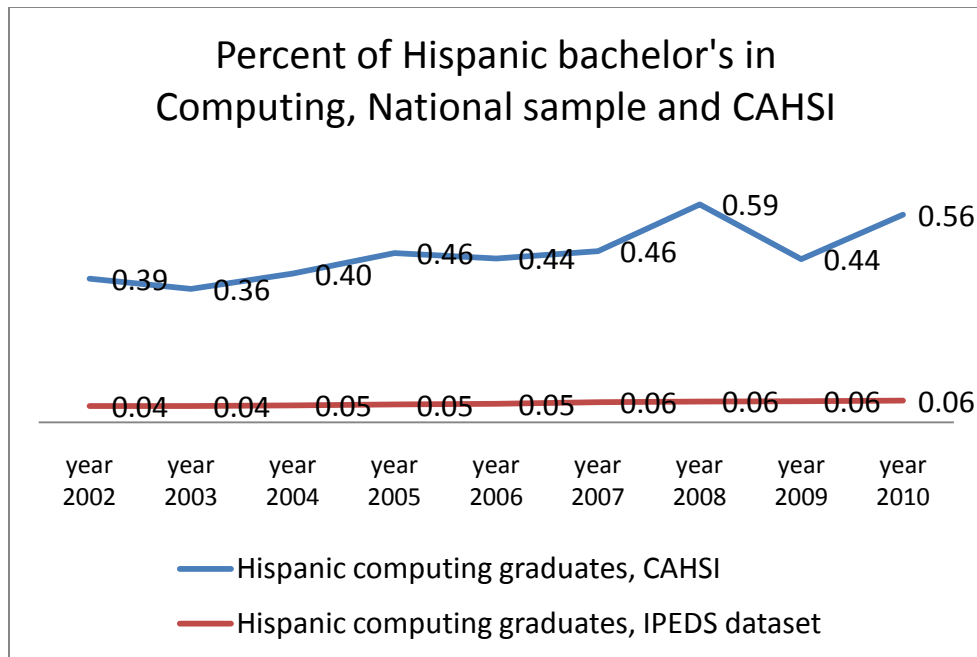


Object 2: Trends in computing bachelor's degree production, US and CAHSI

The National Context for Hispanics

In recent years, Hispanics have consistently comprised 4% to 6% of all Computing baccalaureates at public and non-profit master's and doctoral-degree granting institutions. Hispanics are still severely underrepresented in computing fields given that Hispanics make up over 16% of the U.S. population (US Census, 2010). However, ***CAHSI has consistently graduated Hispanic baccalaureates in computing at nearly 10 times the national average.*** In CAHSI departments, Hispanics typically range from 36% to 56% of all bachelor's level graduates.⁵

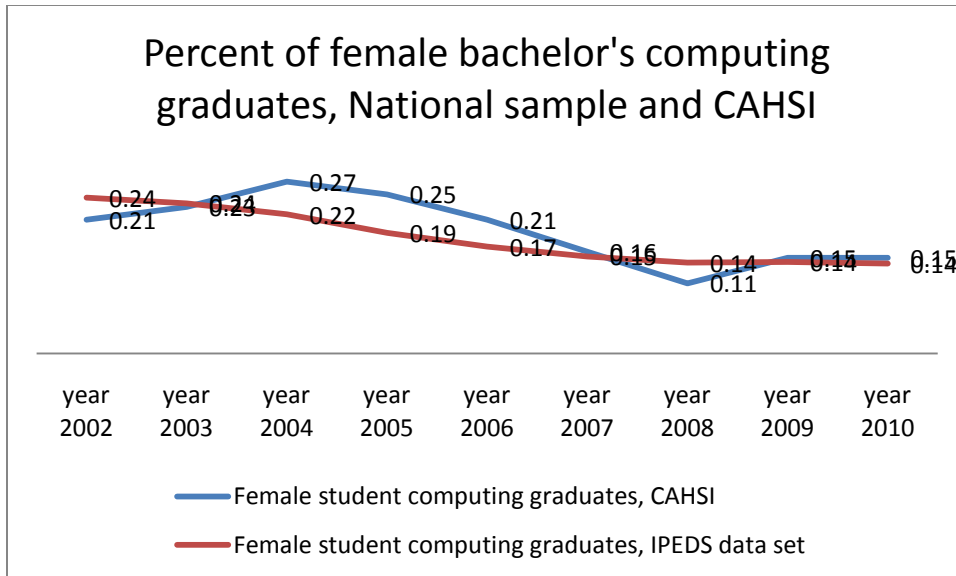
⁵ Averages of Hispanic baccalaureate graduation were calculated by dividing the raw number of Hispanic graduates from the raw number of total bachelor's graduates from all CAHSI institutions for each year. Methodological details are described in Appendix 1.



Object 3: Hispanic students' degree production in computing, US and CAHSI

The National Context for Women

Since 2002, the rate of female graduates in computing at the bachelor's level has steadily declined. In the early years of the decade, CAHSI bucked this trend and produced higher than expected rates of female graduates at the bachelor's level. However, in recent years CAHSI has reflected the national average found at all public and private, non-profit, master's and doctoral-degree granting institutions. Both CAHSI and the national comparison set of institutions produced about 15% female baccalaureates in computing in 2010. Thus, CAHSI has not fallen below the national average, but is not maintaining as high a graduation rate of female baccalaureates as earlier in the decade.



Object 4: female student computing degree production, US and CAHSI

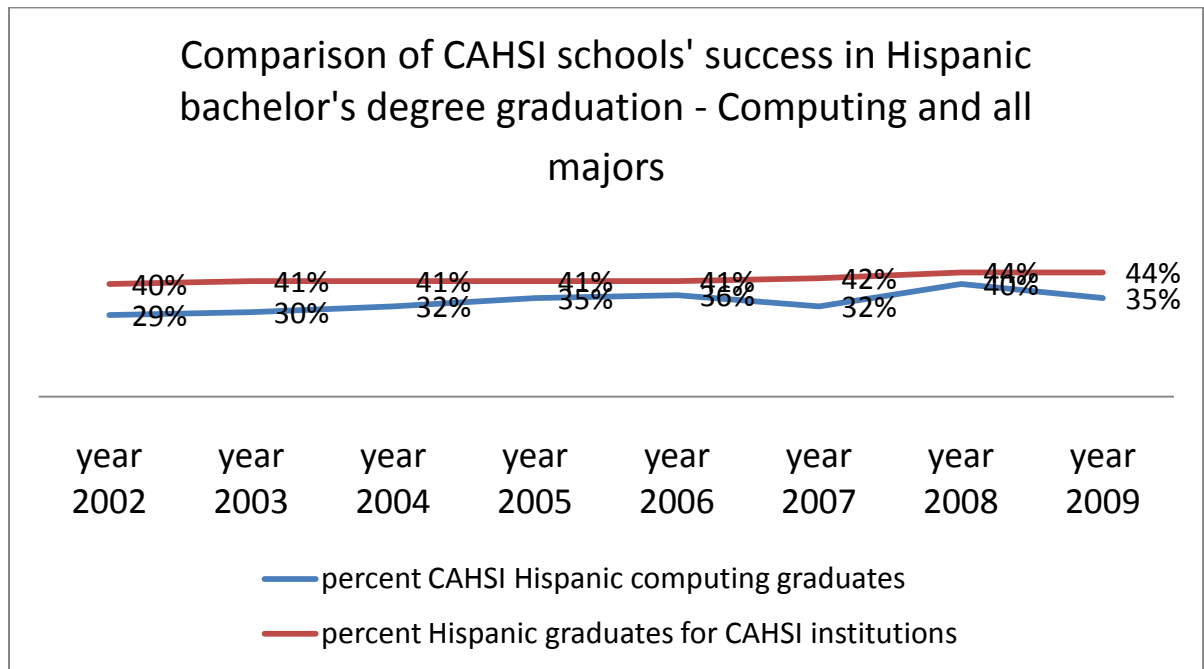
The Institutional Context

Nationally, the rates of Hispanic bachelor's degrees conferred in STEM fields from Hispanic-Serving Institutions have not achieved parity with the overall graduation rates of Hispanics from HSIs. Any effort to increase Hispanic STEM degree attainment should focus on HSIs because they are responsible for graduating a large proportion of Hispanics in the country. However, this success has not necessarily transferred to STEM departments at HSIs (Dowd, Malcolm, & Macias, 2010). For instance, although 40% of all bachelor's degrees conferred to Hispanics in all fields are granted by HSIs, only 20% of STEM degrees granted to Hispanics in the U.S. are from HSIs (Dowd, Malcolm, & Macias). However, CAHSI computing departments are closer to parity with overall Hispanic graduation rates at their institutions than the national STEM average at HSIs.

CAHSI computing departments confer about one-third of bachelor's degrees to Hispanics,⁶ while the bachelor's degree conferral rate to Hispanics at CAHSI institutions in all fields is around 40%. **CAHSI departments are graduating Hispanic baccalaureates at 50% above the national average of Hispanic STEM graduation rates at all HSIs.** In other words, CAHSI computing

⁶ In an effort to capture the overall picture of Hispanic degree production by CAHSI department, rates of Hispanic student degree production were calculated for each school and averaged across 7 departments. This number gives us a different perspective regarding CAHSI departments, and can mitigate the influence of large departments.

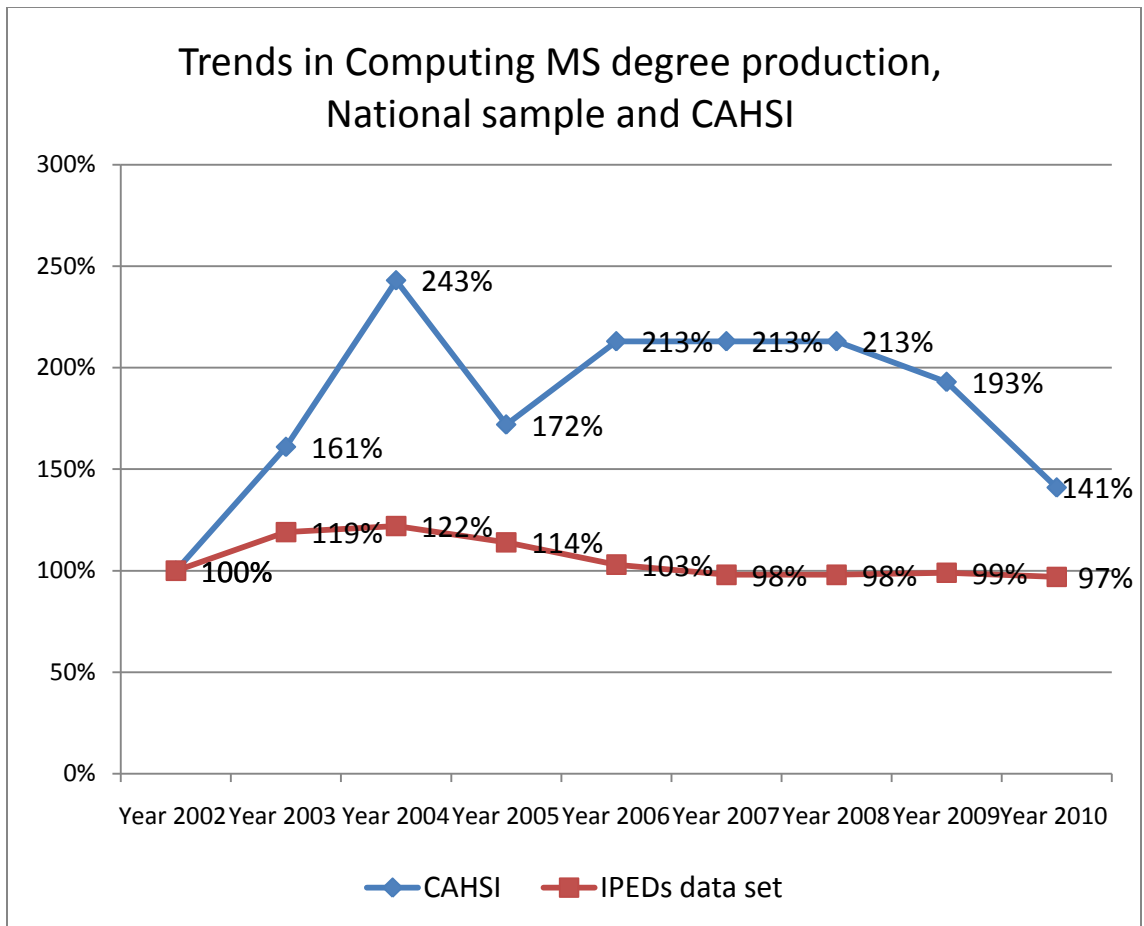
departments are producing Hispanic graduates at higher rates than the national average of STEM departments at HSIs.



Object 5: CAHSI Hispanic student degree production, across disciplines and in computing

National trends in computing master's degree graduation rates

CAHSI has also remained above the national average in master's degree graduation rates. After a slight peak in the early 2000s, national graduation rates of computer science master's students have remained relatively steady since 2006. In contrast, CAHSI experienced a sharp peak in the early 2000s, and still remains at 41% above their 2002 master's degree graduation rate. From 2005-2009, CAHSI remained at nearly double their 2002 master's graduation rate. Thus, ***while the nation has remained steady in master's degree production in computer science, CAHSI has substantially increased their master's graduation rates.*** In part, this is due to the addition of new master's programs in CAHSI departments. However, other institutions that added master's programs since 2002 were also included in the national sample from IPEDS. The recent downward trend in master's degree production in CAHSI departments in 2010 most likely reflects declining enrollment rates of master's students in a few CAHSI departments. For instance, due to budgetary constraints, FIU no longer funds master's students and, subsequently, master's enrollment on that campus has declined dramatically.

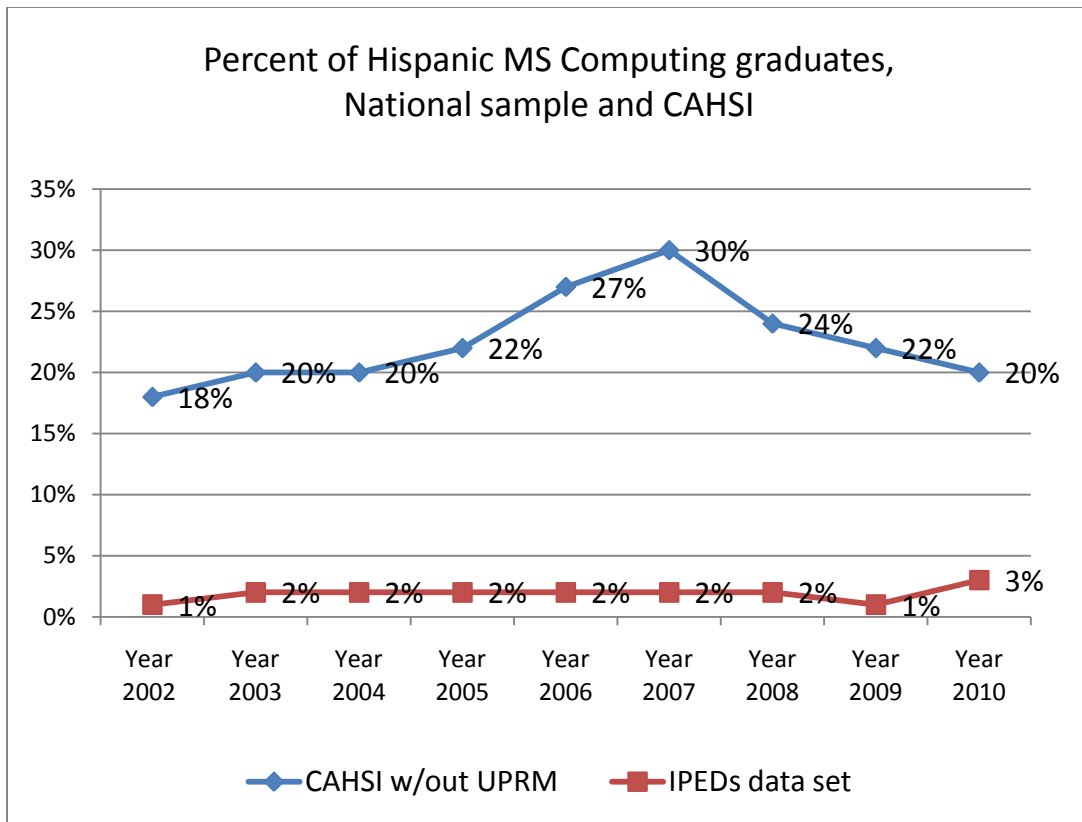


Object 6: Computing degree production at MS level; US and CAHSI

Graduation rates of Hispanic master's degrees in Computing

Despite an anomalous uptick in 2010, Hispanics have consistently remained at 1% to 2% of all master's graduates in Computer Science in the nation. CAHSI is far surpassing this national trend. CAHSI departments consistently award about 25% of all Computing master's degrees to Hispanic students.⁷ In fact, ***in the past five years, 10% of all Hispanic master's degrees in computing in the mainland U.S. were conferred by the six founding CAHSI mainland schools.***

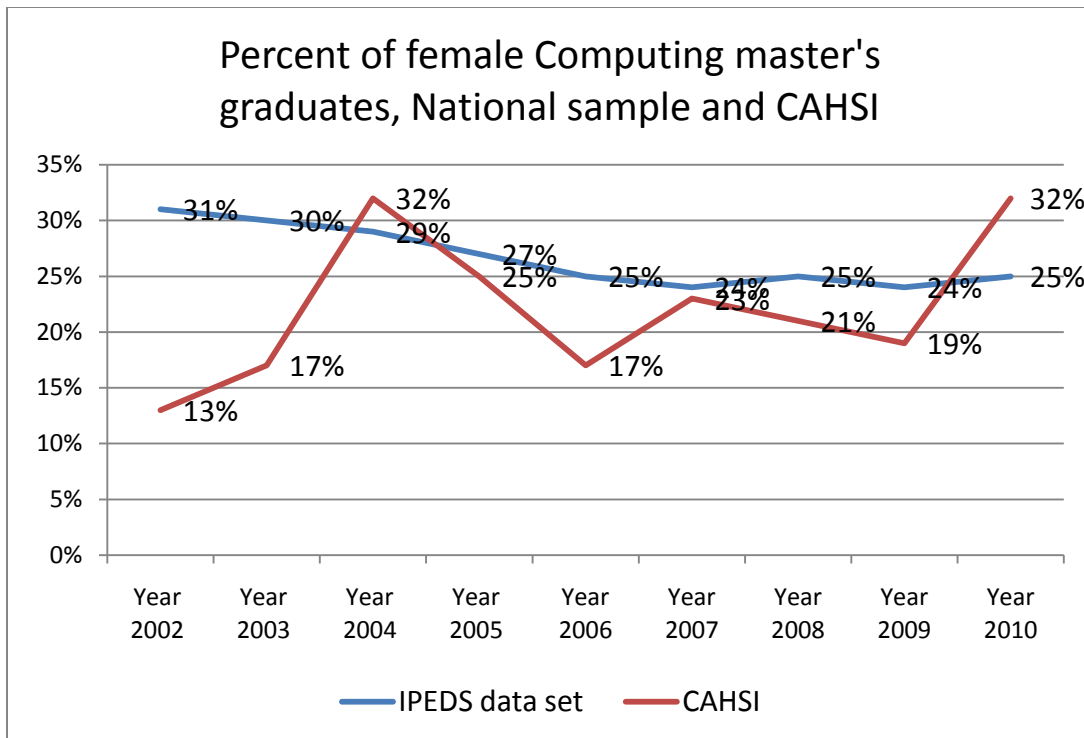
⁷ Raw numbers of Hispanic graduates were divided by raw graduation numbers for all CAHSI departments. There was not a need to average the data for each department because department size does not have as large an effect on master's degree analysis.



Object 7: Percent of Hispanic students graduating with MS degrees in computing, US and CAHSI

The national context for female master's completion in computing

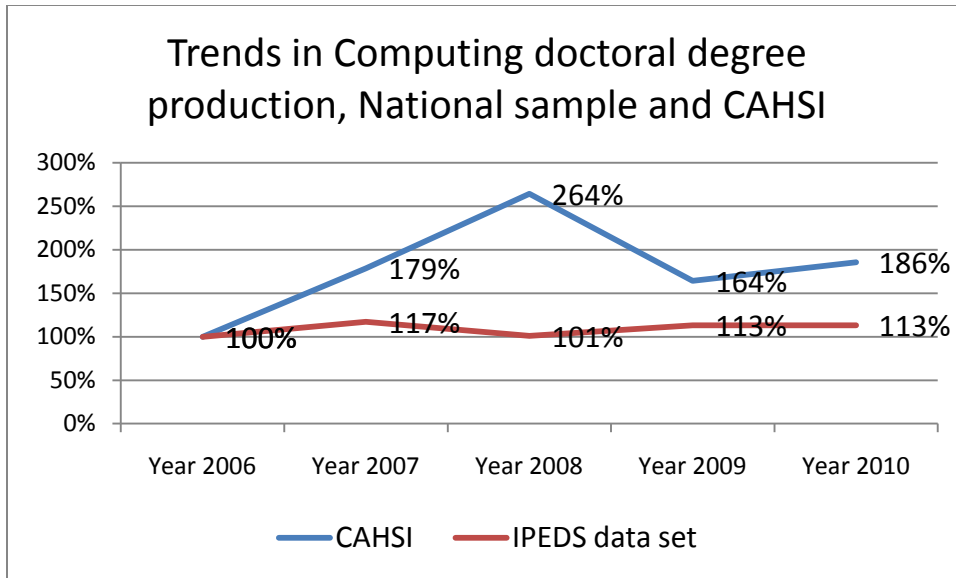
For nearly a decade, the proportion of master's degrees in computing awarded to women has followed similar trends to female bachelor's completions in computing. The proportion of female master's graduates in computing has decreased steadily for the past eight years. CAHSI has not quite followed this trend; however, the number of female master's graduates from CAHSI departments has fluctuated quite dramatically in recent years. For several years, CAHSI produced fewer female master's graduates than national averages, although in 2010, CAHSI graduated a higher proportion of women than the national average. It is too early to tell whether this increase in female master's graduates is a trend for CAHSI or not. Nevertheless, CAHSI might benefit from more targeted efforts to recruit female master's students. Enrollment data demonstrate that CAHSI has reasonable retention rates for female master's students, indicating once students join the program they persist. Recruitment efforts might increase the pool of female master's candidates in CAHSI departments.



Object 8: Percent female computing MS degree graduates, US and CAHSI

National trends in Ph.D. graduation rates in computing

As with computing master's degree production in the U.S., doctoral degrees in computing have remained relatively steady in recent years. However, since 2006, CAHSI has substantially increased their graduation rates of Ph.D.'s in computing. Unlike other comparison sets, the analysis only encompasses 2006 to 2010, because the University of Texas El Paso only has data for Ph.D. graduation from 2006 and on. Thus, a comparison of trends from 2002 to 2005 was not possible. Nevertheless, ***in the past five years, CAHSI has increased their completion rate of Ph.D.'s in computing by 86%, while doctoral degrees in computing have only increased by 13% nationally.*** Data could not be disaggregated by ethnicity or gender because the sample sizes of doctoral degrees in computing is so small, thus the validity and reliability of the analysis could not be assured. For instance, a slight change in one year (e.g., two more Hispanic computing doctorates) could substantially change the outcome. However, this further demonstrates the need for alliances such as CAHSI to increase the completion rate of Hispanics doctorates in computing fields. On average, about 33% to 50% of Ph.D. graduates in CAHSI departments are Hispanic, indicating that CAHSI is contributing to the overall production of Hispanic computing doctorates in the nation.



Object 9: Computing doctoral degree production, US and CAHSI

CAHSI Student Progress and Advancement

Overall, CAHSI has held relatively steady in bachelor's degree production, while the rest of the nation has experienced sharp reductions in graduates. While the U.S. has experienced slow, but steady, growth in master's and doctoral degrees in computing, CAHSI has experienced substantial growth. In 2010, CAHSI graduated 41% more master's students than in 2002, and 86% more doctorates than in 2006. CAHSI has also graduated Hispanics in computing at much higher rates than the national average at both the bachelor's and master's levels. The sample is too small to disaggregate data by ethnicity at the doctoral level. Nevertheless, CAHSI is producing more graduates than expected at all levels, given national trends. Additionally, CAHSI is far exceeding national graduation rates of Hispanics at all levels.

CAHSI Student Participation, 2010-2011 by Initiative

The section includes data from institutional research offices and comparison data from the Educational Statistics resource IPEDS, National Science Foundation databases of funded fellows, annual meeting surveys following the March 2011 event in Puerto Rico, ARG research student surveys, and focus group data from peer leaders, former CS-0 students, and Mentor Grad students. This section features two case studies of CAHSI experiences and practice to provide a richer analysis of CAHSI efforts this year.

initiative participants	count total	count women	proportion female	count Hispanic	proportion Hispanic	underrep. minorities	proportion other underrep. minorities
CSO	331	79	0.24	176	0.53	44	0.13
PLTL	885	201	0.23	337	0.38	108	0.12
ARG (undergraduates)	36	14	0.39	24	0.67	3	0.08
annual meeting (graduate)	21	9	0.43	15	0.71	0	0.00
annual meeting (undergraduate)	83	28	0.34	67	0.81	1	0.01
annual meeting (professionals)	22	12	0.55	14	0.64	0	0.00
totals	1378	343		633		156	

Object 10: Participation in CAHSI, 2010-2011

Data for the participation matrix come from three sources, and because of this are uneven and in some cases low estimates of CAHSI participants. CS-0 and PLTL initiative data comes from departments and institutional research offices, and count each student enrolled in one of these courses at the seven initial CAHSI schools. Over 1,200 student experiences with CS-0 and PLTL occurred in 2010-2011—remarkable given two of the CAHSI schools were only able to give the program for one of the two semesters in this academic year. Numbers in this category will increase for 2011, as enrollments increase and an additional school resumes PLTL. ARG student data is less reliable than CS-0 and PLTL, and in fact is an underestimate of participants. The data for this row comes from survey responses. Many ARG students did not participate in the ARG survey—this may be due to issues with survey distribution or survey fatigue, as the annual meeting survey for CAHSI arrived at nearly the same time in the academic year.

Semester and year-long initiatives involve an average of over 50% Hispanic students, and nearly 30% female students. In addition, other underrepresented ethnicities (African American/black, Native American) represent one out of 10 of the students engaged in year or semester-long CAHSI activities. Annual meeting data were derived from survey participation, though in this case response rates were a great deal stronger. Note that annual meeting data indicate greater representation of Hispanic and underrepresented students, as this initiative specifically targets and recruits Hispanics and other underrepresented groups.

Students excelling in the field: National science foundation fellowships

CAHSI builds on its members' strengths by leveraging the successful initiatives of each institution and sharing those practices across all institution members. One of the goals of the two-year CAHSI extension grant was to expand the success of Florida International University in preparing students for successful application to the National Science Foundation Graduate Student Fellowship to all CAHSI institutions. Mentorgrad students received coaching, targeted workshops, and one-on-one mentoring from CAHSI faculty to apply for the prestigious award. Evaluators reviewed NSF fellowship award lists from 2001-2011 to measure the tendency of CAHSI institutions to educate NSF graduate fellows. The first number in the table below indicates the number of fellowships awarded to undergraduate students in all fields from the CAHSI institution, and the number in brackets following indicates the number of those fellowships that were computing-related. Note some of the schools had a history of successful applications.

Institut	20	20	20	20	20	20	20	20	20	20	20	201
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Department level changes influencing Hispanic student success: Two contexts that expand participation in computing:

CSUDH

While undergraduate rates of completion have slowed at CSUDH, the enrollment of Hispanic students in computing at this institution has grown, in number and percent, since 2005-2006. In the 2010-2011 academic year, 35 Hispanic students (30%) were enrolled in the computing majors at CSUDH, compared with 19 Hispanic students (10%) in 2005-06. The Master's degree, instituted during CAHSI, has shown substantial growth in four years. In fact, it enrolls Hispanic students at higher rates than the undergraduate computing program (35%, or 9 of its 28 currently enrolled students, as of May 2011).

UTEP

In 2009, University of Texas at El Paso received funding from the United States Department of Education for a Master's degree in software engineering. The program currently enrolls twenty students, the majority of whom are UTEP graduates and are Hispanic.¹ Participants attend night courses and work during the day. At the end of the program, students will be certified from IEEE computer society, earning Certified Software Development Associate (CSDA) or Certified Software Development Professional (CSDP) recognition, depending upon their years of experience in the field.

ion	01	02	03	04	05	06	07	08	09	10	1
UTEP	0	1 [1 EE]	3 [0]	0	1 [0]	0	0	1 [0]	2 [0]	3 [0]	5 [0]
FIU	0	2 [1 CE]	1 [1 CE ⁸]	2 [1 CS]	2 [1 CE]	1 [1 CE ⁹]	1 [0]	0	1 [0]	0	1 HM ¹⁰ [1 CE]
CSUDH	1 [0]	0	0	0	0	0	0	0	0	0	0
UHD	0	0	0	0	0	0	0	0	0	1 [1 CS] ¹¹	0
UPRM	1 [0]	0	4 [0]	0	3 [0]	0	2 [0]	1 [1 CS]	1 [0]	5 [2 EE]	10 [2 EE ¹²]
TAMUC C	0	0	0	0	0	0	0	0	0	0	0
NMSU	0	2 [1 EE]	1 [0]	0	0	2 [0]	1 [0]	1 [0]	0	0	0

Object 11: NSF fellowship history, non computing and computing fields

Data show that three CAHSI students received NSF Fellowships and honorable mentions since the institution of the FellowNet initiative, and two FIU fellows, one who earned his fellowship during CAHSI, remain engaged in CAHSI as faculty members. Students earned these fellowships following the encouragement and assistance from CAHSI mentors. We note that, unlike many larger or more highly ranked schools¹³, fellowships were not common at CAHSI schools, as is evident in the table above. In fact, one CAHSI student was the first and only fellow at her institution in the past 10 years. By providing structured mentorship around application

⁸ This NSF fellowship at FIU was awarded to Dr. Miguel Alonso Jr., currently serving as PI on the Scaling and Adapting CAHSI Initiatives (SACI) grant, and Associate professor at Miami Dade College.

⁹ This NSF fellowship at FIU was awarded to Dr. James Poe II, currently teaching at MDC and CAHSI faculty attendee of the 2011 meeting.

¹⁰ This indicates an honorable mention awarded to an FIU computer engineering student at FIU.

¹¹ This NSF fellowship was awarded to Araly Barrera, a member of the first FemProf cohort. She attends the University of Houston in a PhD program.

¹² While one EE student recipient was not engaged in CAHSI, Marisel Villafane is a member of FemProf and will attend the PhD program at Maryland College Park in the fall of 2011.

¹³ In 2011, 27 fellowships went to students from Yale, and 42 went to undergraduates from Harvard, for example.

and workshops that address the important elements of fellowship application, CAHSI students received funding for graduate school and a prestigious award for their Curricula vitae.

Data from the NSF fellowship list indicate that there may be faculty mentors from other departments at CAHSI institutions to engage in CAHSI efforts. For example, NMSU has had multiple NSF fellows in chemistry, and UTEP has had multiple geosciences and geophysics fellows. Also, an engineering faculty member at UPRM has been very successful in his mentoring of undergraduate researchers.¹⁴ Investigating the work of these departments in mentoring students towards successful applications may increase CAHSI student success, and provide a network of aspiring graduate students across departments.

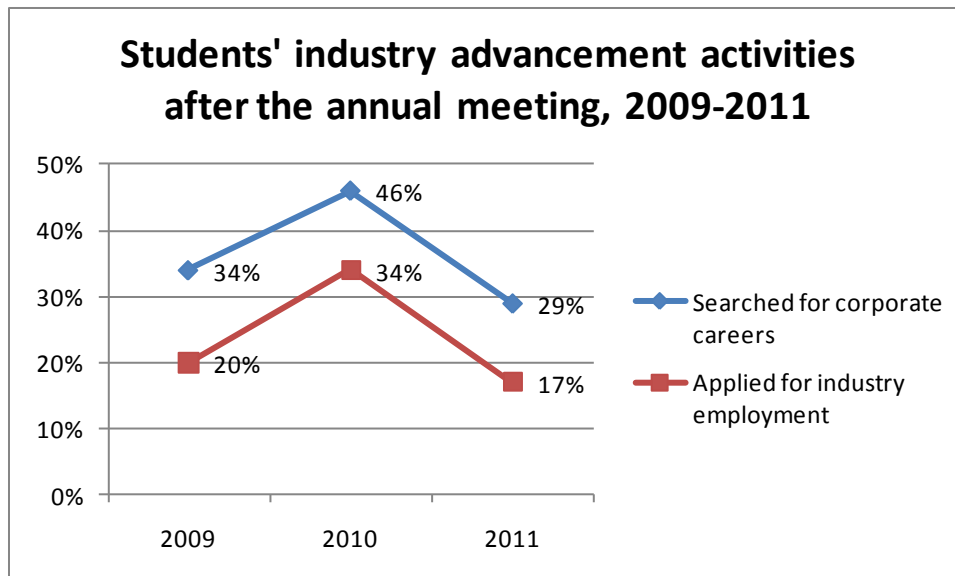
CAHSI students: evidence of academic and industrial advancement behaviors

Industry Advancement after the annual meeting

The annual meeting is a time for professional development, community building, and glimpsing possible selves within a small group of computing professionals. In this section, we detail the participant outcomes related to the annual meeting. This year, the meeting was held in San Juan, Puerto Rico in March of 2011.

Students engaged in several career development behaviors following the 2011 CAHSI annual meeting. Over one-quarter of students who responded to the annual meeting survey have searched for corporate careers based on information received at the conference (29%, 16 students). Also based on information from the annual meeting, students applied for industry careers (17%, 8 students). These rates were lower than students' career advancement activities in 2010 and similar to 2009 levels, as demonstrated below.

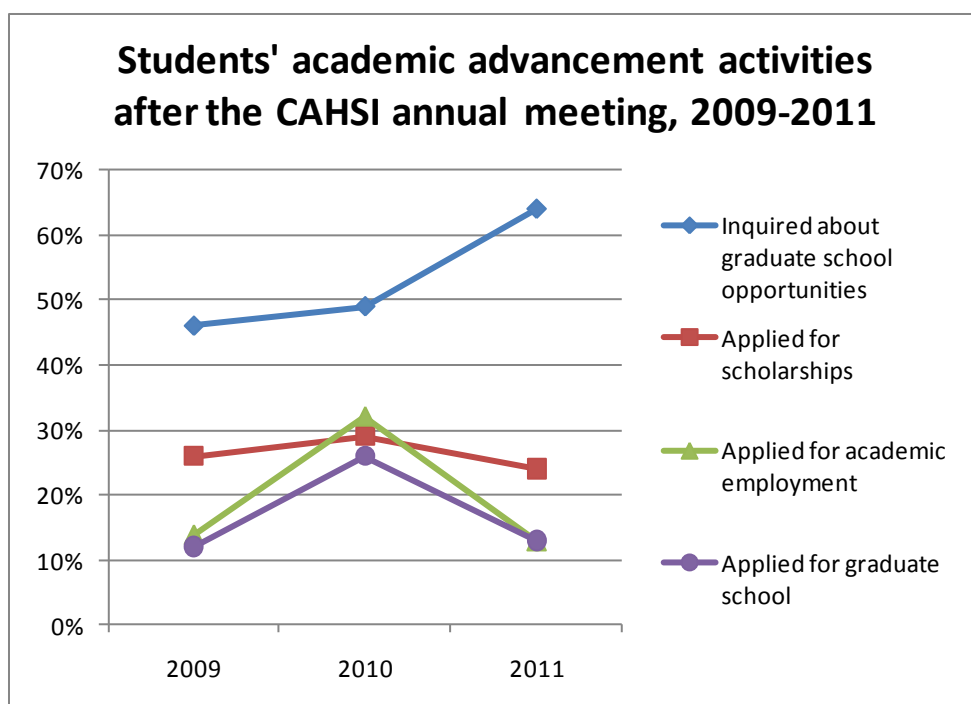
¹⁴ The CAHSI PI has plans to collaborate with this professor during a summer trip to UPRM for ARG training



Object 12: Students' Reported Activities Following CAHSI Meeting—Industry Advancement

Academic advancement after the annual meeting

CAHSI students advanced their academic careers across the academic computing pipeline following the annual meeting. The rates of students' career development behaviors peaked in 2010 and have fallen in 2011, though given the increased interest in graduate school, this decline in applying for and searching for corporate jobs may mean students are shifting their intended career pathways. The only academic career path behavior that increased in 2011 was inquiring about graduate school opportunities. Students seem to be more interested in pursuing further education after the annual meeting, yet they were less likely to follow through on their aspirations in 2011 than in 2010. For instance, in 2011, five students reported that they had applied to graduate school, yet 32 students had inquired about graduate school. Students report strong interest in advanced degrees, yet they are not necessarily pursuing those aspirations in large numbers. Percentages are reported in comparison to all student respondents to the annual meeting survey, though it is important to note that none of the students would be in a position to complete all of the listed activities.



Object 13: Students' Reported Activities Following CAHSI Meeting—Academic Advancement

Students are successful in scholarship and REU applications

Student advancement to graduate school often depends upon engaging in opportunities beyond the home campus and receiving funding needed to persist in their fields. Students were asked if they have ever applied for a scholarship, internship, or fellowship. In contrast to the other career advancement survey question, which only inquired about behaviors resulting from experiences at the CAHSI annual meeting, this item more accurately gauges the overall rates of scholarship and fellowship application among CAHSI students. As might be expected, a larger number of students responded that they had applied for a scholarship or fellowship at some point in time (36 students) than responded that they had applied after the annual meeting (12 students). By this measure (all CAHSI students over time), 57% of CAHSI students have applied for a scholarship, fellowship, or internship at some point during their undergraduate careers. **Moreover, 97% of these students reported that they were successful in at least one of their applications.** Students who answered the survey mentioned applying for the following awards¹⁵:

¹⁵ One student mentioned applying for the NSF fellowship unsuccessfully, though he did receive another award
(footnote continued)

- REUs (14 students)
- Scholarships (12 students)
- Internships (2 students)

CAHSI students' scholarship evidence of advancement: ARG participant behaviors

As in previous years, ARG students have participated in academic scholarship and gained exposure to their disciplinary research community at higher rates than a large, diverse national sample of summer REU students. For instance, 66% of 2011 ARG students reported that they attended a professional conference, while only 23% of the national sample of REU students had done so. As in previous years, ARG students engaged in academic publication in refereed journals at twice the rate of the national REU sample. ARG students also presented conference posters at higher rates than typical summer REU students. See object below.

"In the past year I have..."	# of ARG respondents (n=30)	% of ARG respondents	# of national REU sample (n=464)	% of national REU sample
Attended a professional conference.	20	66%	105	23%
Authored or co-authored a journal paper.	4	13%	25	6%
Presented a conference paper.	3	10%	67	14%
Presented a conference poster.	12	40%	67	14%

Object 14: Professional activities of ARG students

CAHSI students develop aspirations, envision futures as computing scientists

Student aspirations are another measure of programmatic impact important for the CAHSI alliance. As CAHSI students take on more expert roles in computing (e.g., researcher roles, presenters of computing information and content) they indicate stronger motivations to pursue

their current degree and advanced degrees as well. In this section, we describe the changing aspirations of CAHSI participants, particularly in the ARG and annual meeting initiatives.

CAHSI annual meeting supports students' aspiration and preparation for advancement

The CAHSI annual meeting helped to increase students' confidence, motivation, interest, and knowledge about graduate school. Students were asked how, if at all, the CAHSI annual meeting influenced their sense of academic support. Twenty students responded to this open-ended question. While there were a variety of responses, the four most common are noted in the table below.

Student response on open-ended item [n=20]	# of responses	% of respondents whose coded response indicated the topic listed
Increased my knowledge about the path to graduate school and funding.	5	25%
Increased my motivation.	4	20%
Increased my confidence.	3	15%
Increased my academic/professional skills.	3	15%

Object 15: The influence of the CAHSI annual meeting on students' sense of academic support


The focus of the annual meeting on Hispanics in computing helped to boost students' confidence in themselves as Hispanic computer scientists. Students also reported that they gained knowledge about the steps they need to take to go to graduate school, and the resources and funding that are available to support their graduate studies. Other responses included: the CAHSI annual meeting enhanced my professional network, increased my interest in research, and increased my understanding of diversity.

"I realized that there are an abundance of resources available to the student that wishes to continue their education to a higher level, including research opportunities."


ARG students' academic advancement: Comparing behaviors and aspirations

Affinity Research Groups are a central element of the MentorGrad initiative, designed to support students' preparation and pursuit of graduate school, and ultimately, the professoriate. Affinity Research Group students reported on the steps they had taken to reach graduate school. Only one student in each of the years 2010 and 2011 reported that he or she had submitted an application for graduate school, while 18 students reported in 2011 that they *planned* to apply for graduate school. Students' actual behaviors in taking the GRE also did not necessarily match their aspirations. For instance, in 2010, 26 junior and senior students reported that they planned to take the GRE; however, a year later, only one student had achieved this goal. Similarly, 19 students stated last year that they planned to apply to graduate school, yet only one student reported doing so this year. Therefore, CAHSI students do not seem to be pursuing their aspirations to attend graduate school in concrete ways as of yet. On the other hand, anecdotal data along with master's and doctoral level graduation rates from CAHSI departments indicate that some students are advancing to graduate programs at their home institutions.

A few factors may influence the way we interpret this data. First, juniors and seniors at



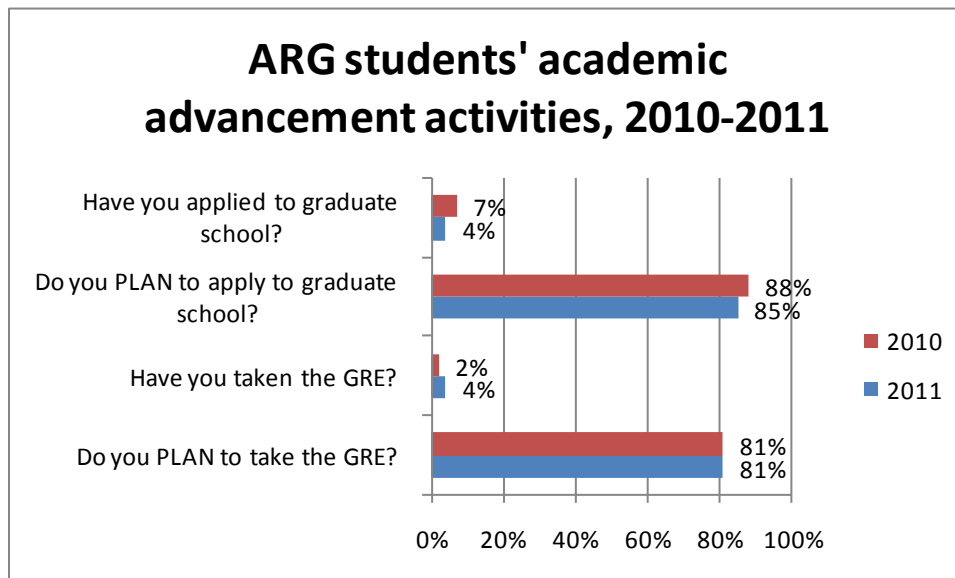
"I feel more confident being a Hispanic in the CS area."



CAHSI schools may or may not be approaching graduation in the next academic year—in fact many students with whom we have communicated note that they are fifth year seniors, that they took time off to work, and that they go to school only part-time, particularly at commuter colleges involved in CAHSI. Because of these reasons, non-traditional students and students in traditionally more intensive majors like those in the sciences may not follow activities in typical timeframes that lead them towards graduate school. In the future, we intend to ask students when they intend to graduate, rather than what year they are in school. This should improve our data analysis and allow us to ascertain whether students approaching graduation are taking steps needed to attend graduate school.

Another factor that may impede our interpretation of planned activities for graduate school is the revision of the GRE test. Anecdotally, a few students described their advisors' strategy for them to wait to take the GRE until the new version has launched in August 2011. Finally, undergraduates engaged in research describe graduate school "back-up plans", in which they

continue their education at their current institutions in graduate level coursework. Faculty describe unofficial pathways into the MS graduate programs, in which students take courses and officially enroll in the programs following a semester of coursework. It is unclear when the students taking these indirect pathways may take steps towards graduate school application and preparation.



Object 16: ARG students' academic advancement activities, 2010-2011

Nevertheless, participating in ARGs seemed to have a significant impact on students' aspirations to further their education: **87% of ARG students reported that they were more likely to attend graduate school because of their research experience.** In prior years, closer to 75% of students stated that their ARG experience had increased the likelihood that they would pursue graduate school. Thus, students seem to gain significant interest in graduate school from participating in ARGs; however, their actions to date have not advanced them towards their goals.

Building a CAHSI community: Participant Outcomes in Context

Annual meetings' size and focus fosters community

The small size of the CAHSI annual meeting and the focus on broadening participation in computing helps to build community and support among participants. In an open-ended question, survey respondents were asked, "What, if anything, sets the CAHSI annual meeting apart from other conferences?" Participants responded that the small size of the conference

fostered personal interactions and opportunities for networking. The focus on Hispanics in computing also sets CAHSI apart from other conferences. Some also felt the CAHSI annual meeting offers encouragement, inspiration, and support for participants. Object 17 details participants' responses about the uniqueness of the CAHSI annual meeting.

Response. (n=50)	# of respondents	% of respondents
Personal interaction, small size	18	36%
Focus on Hispanics	14	28%
Don't know/first conference	10	20%
Encouraging, inspirational	4	8%
Focus on students	3	6%
Shared goals/values	3	6%

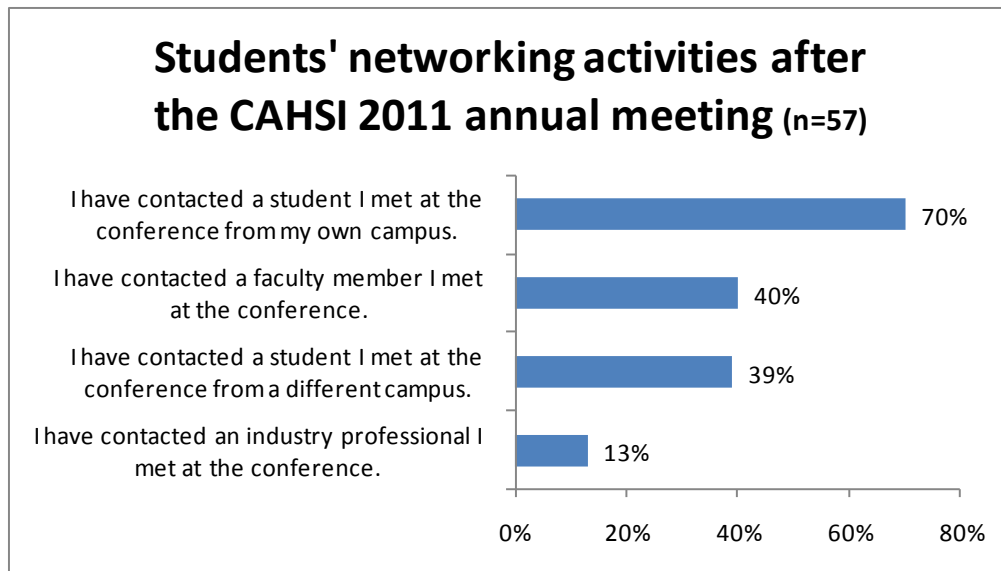
Object 17: Participants' responses to what sets CAHSI apart from other conferences.

The (best part of the CAHSI meeting) is the sense of unity with the Hispanic community, faculty and students.

Expanding the CAHSI Community: Professional Networking Following the Conference

Students enhanced their networks

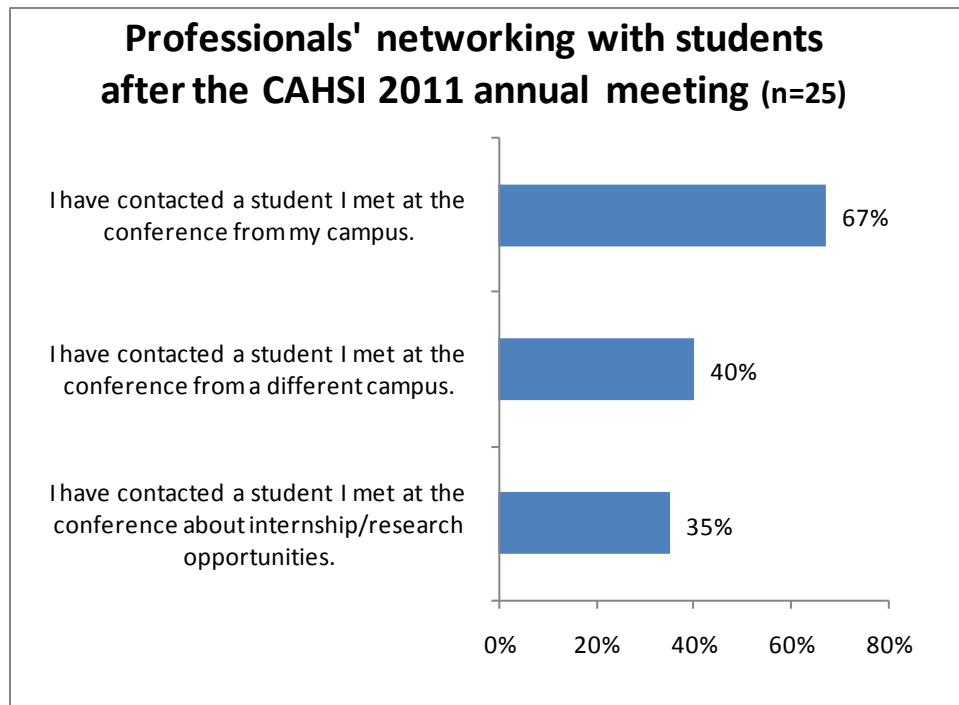
The 2011 CAHSI annual meeting seemed to have an impact on students' professional development and networking. Student survey participants from the annual meeting reported similar rates of post-conference networking activities to students after previous meetings. As in previous years, students were more likely to contact other students than they were to follow up with faculty or industry professionals. However, in 2011, students contacted other students at a much higher rate than in previous years (70% in 2011, 46% in 2010). In 2011, students contacted faculty and industry professionals at exactly the same rate as in 2010.



Object 18: Students' Reported Networking Activities Following CAHSI 2011 Meeting

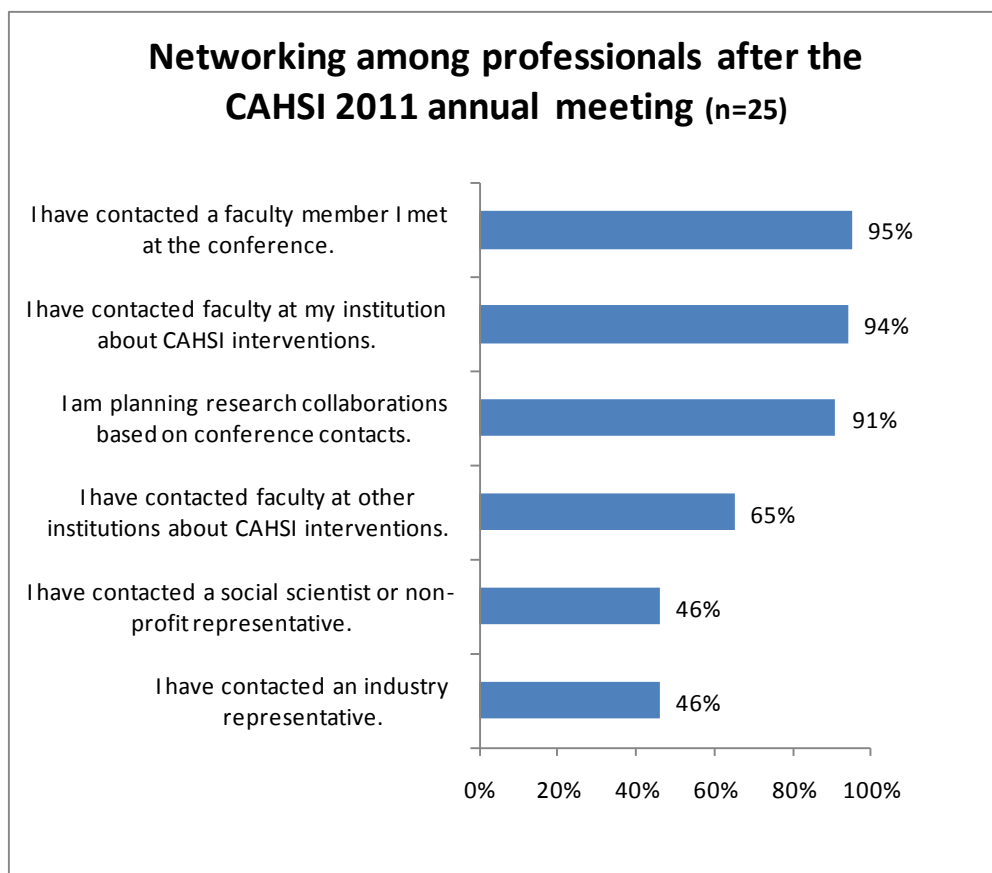
Faculty and professionals extended their networks from CAHSI

Computing professionals networked with other conference attendees at a high rate. Faculty and industry professionals were asked to describe their networking and other professional follow-up activities in the month following the 2010 CAHSI annual meeting. They contacted students after the annual meeting at slightly higher rates than in previous years (67% in 2011, 56% in 2010), although most professionals contacted a student from their own campus. Faculty and industry professionals reported that they contacted students about internship or research opportunities at the same rate as they did in 2010.



Object 19: Faculty Reported Networking Activities Following CAHSI 2011 Meeting

One of CAHSI's goals is to develop formal and informal networks of computing professionals, particularly for Hispanics. Networking among professionals has increased substantially in the past few years. Faculty have contacted other faculty at their own institution at increasingly higher rates (50% in 2009, 81% in 2010, 94% in 2011). Thus, faculty networking within their home institutions has almost doubled since 2009. Professionals' rates of networking with faculty at other CAHSI institutions have also increased substantially since last year (39% in 2010, 63% in 2011). In addition, professionals are networking with non-academics at higher rates. For instance, in 2011, computing professionals contacted industry representatives at a rate 50% higher than 2010 (31% in 2010, 46% in 2011). An overwhelming majority of industry and faculty professionals reported that they were planning research collaborations based on interactions from the 2011 annual meeting. Thus, ***networking among industry professionals and faculty after the annual meeting has increased dramatically in the past few years.*** The CAHSI annual meeting may be strengthening ties over time.



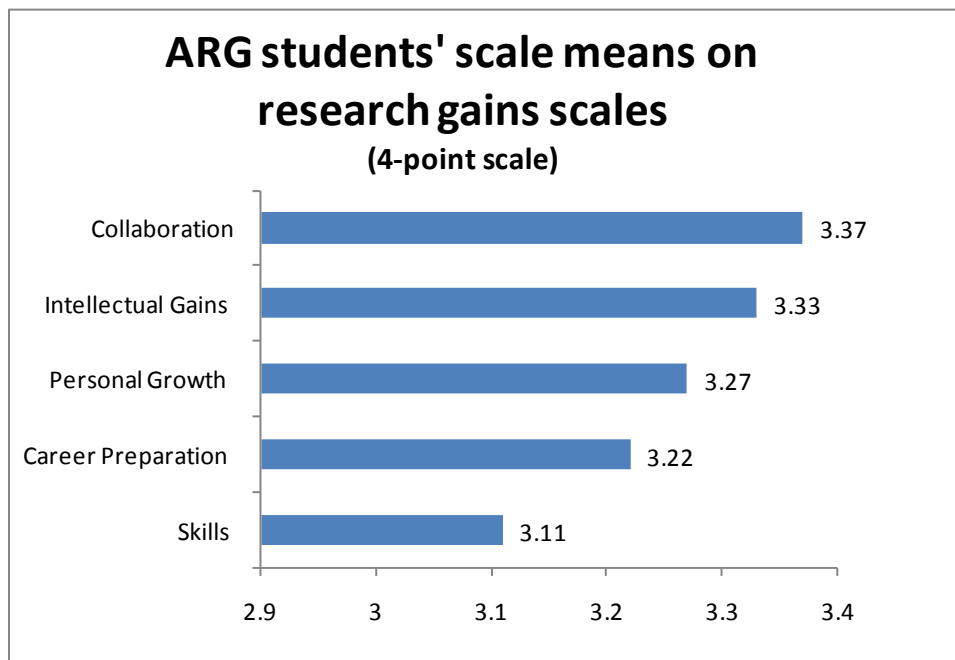
Object 20: Professionals' Reported Networking Activities Following CAHSI Event

The CAHSI annual meeting provides a forum for Hispanic computing professionals and students that is not available elsewhere. No other national conference specifically fosters professional development and community among Hispanic computer scientists and engineers. The relatively small size of the CAHSI annual meeting, its focus on student development, and Hispanic audience make it unique and valuable for attendees. Participants reported similar, or stronger, networking gains compared to previous years. An overwhelming majority of both students and computing professionals reported that they had contacted someone they met at the CAHSI annual meeting in the month following the meeting. Thus, the CAHSI annual meeting continues to foster and enrich connections among the Hispanic computing community.

Developing skill and knowledge: evidence from ARG/mentorgrad/femprof

Students' gains from research prepare them for graduate school

Students are gaining confidence that they are prepared for graduate school and computing careers from their participation in ARGs. Students reported reasonably strong gains on all the Undergraduate Research Student Self-Assessment (URSSA) gains scales (between 3.0 and 4.0 on the 4.0 point scale, or between “good” and “great” gain). Students' highest gains were in collaboration, intellectual growth, and personal growth. The collaboration scale also measures the extent to which leadership is distributed, the research group works cooperatively, and other markers of a high-functioning Affinity Research Group. Because students reported their strongest gains in collaboration and they affirmed many of the ARG indicators on the collaboration scale, this suggests that the ARG model has been adopted across CAHSI institutions. Students also reported large intellectual gains in critical-thinking, problem-solving, and understanding the research process. Finally, students reported personal growth from their ARG experience, including increased confidence in the discipline and increased interest in computing. The object below illustrates the scale means for the research gains scales (4-point scale, 1=no gain, 4=great gain).



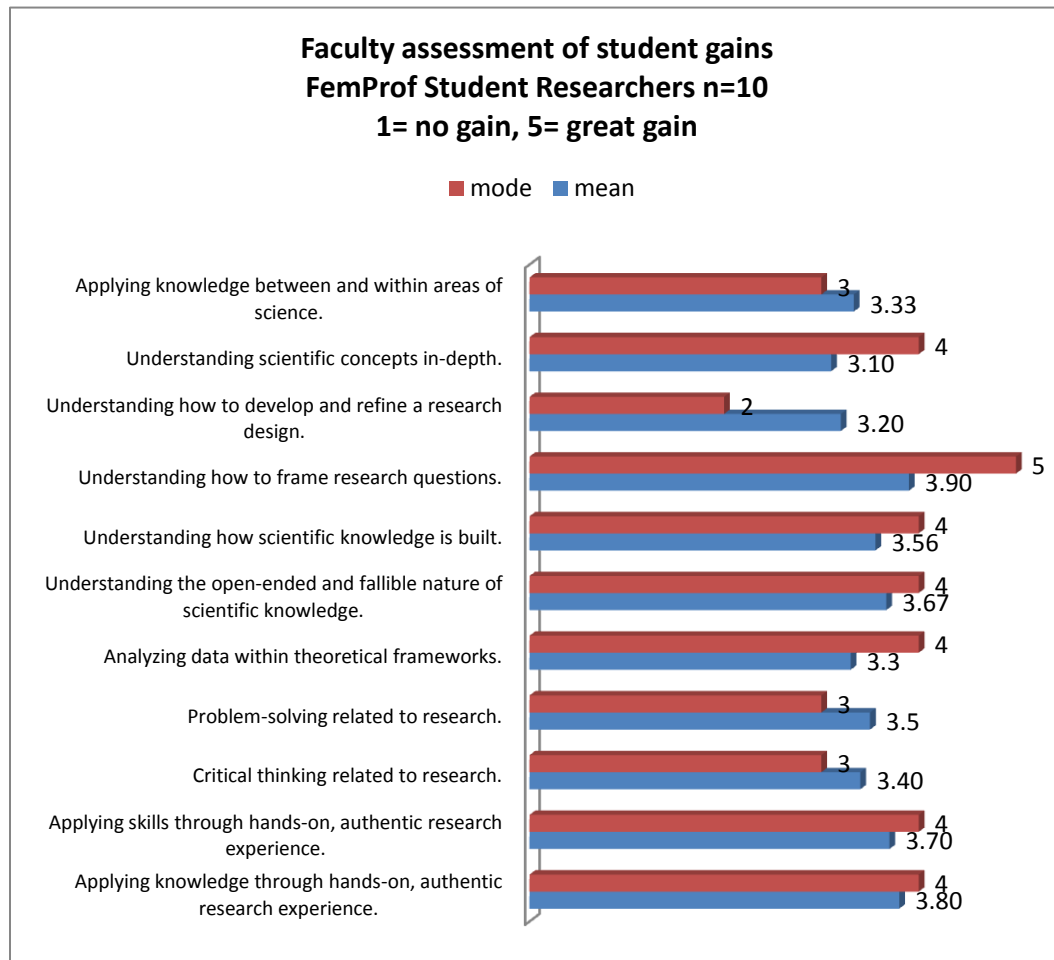
Object 21: ARG students' scale means on research gains scales

As in prior years, ARGs seemed to be especially successful in the academic and professional development of Hispanic students. Hispanics ranked their gains similar to, or higher, to the scores of students from groups overrepresented in computing fields (Caucasians and Asians) on the gains scales. In particular, Hispanics rated their gains substantially higher in career preparation (Hispanic mean= 3.36, overrepresented student mean=2.63) and skills (Hispanic mean=3.17, overrepresented student mean= 2.86). The career preparation scale measures the extent to which students feel prepared from their research experience for advanced coursework in their major, graduate school, and computing careers. The skills scale measures students' gains in communication, writing, presentation, and organizational skills from research. Thus, Hispanics felt more prepared for graduate school than their majority peers and reported larger gains in communication skills. However, none of these differences were statistically significant, most likely due to the small sample size of survey respondents.

On the other hand, women scored themselves significantly lower on each of the research gains scales. In particular, women reported statistically significant lower gains in intellectual development [$t(19)=3.15, p<.01$] and personal growth [$t(19)=2.56, p<.05$]. Therefore, women do not seem to believe that they are achieving the same gains from Affinity Research Group experiences as their male peers. Research in social science indicates that women tend to underreport ability, particularly in fields where they are underrepresented, such as in computing research. It is unclear whether this tendency is causing the differences in scores, or whether young women are experiencing research in a qualitatively different way. However, interviews with both male and female ARG researchers indicate that women are having similar positive experiences as men in their ARGs and are receiving the same quality of mentoring. Thus the evidence demonstrates that women's lower means may be due to underreporting.

Student reports of activity and experiences are promising in regards to how CAHSI students are prepared for professional computing careers. Studies using the URSSA instrument and faculty assessment of student gains indicated that faculty and student reports of skill and knowledge development often align. In other words, self-report from students do not differ very much from how mentors would rate the students' development of the same skill. Evaluators had the opportunity to survey some faculty mentors regarding their students' development in the computing field. Reports referring to ten FemProf students were obtained in the summer of

2011, and serve to validate evidence of student progress. A selection of items is reported below, focusing on the students' developing understanding of the nature of science, the research process, and application of skills. Average scores on this 5 point scale are nearly all between moderate and good gain. The modes (most common ratings) for items are typically "4" corresponding to good gain. See object 12.



Object 22: Faculty assessment of student gains

Case study 1: an in-depth look at mentorgrad

In the new five-year extension grant cycle, evaluators plan to focus in-depth on one of the CAHSI initiatives each year. We studied MentorGrad in depth for the first CAHSI case study, holding five focus groups with undergraduate students and their graduate student peers when appropriate. Including the graduate students in the focus group allowed us to better understand the roles each student took in the research team, and provided additional information regarding how graduate and undergraduate student members of CAHSI interacted at the campus level.

Themes emerged regarding students' experiences in MentorGrad, in particular, how research experiences serve as engaging learning environments, how research experiences can influence students' identities as researchers as well as increase their interest in graduate school, and how CAHSI might improve its support of undergraduate computing students.

Research experiences as engaging learning environments

CAHSI participants reflect on how the research experiences in which they are engaged serve as ideal learning environments for computing. Students value hands-on application of knowledge through testing out programming and hardware solutions to problems. They find that research opportunities give them a sense of the "big picture"- about how what they learn in class and in the lab can connect with what they know about the world. Students mentioned they are intrinsically motivated by their research work, and exhibit ownership of their efforts in the lab/research setting. Working on undergraduate and graduate research supports increased campus involvement and interest in the major. Most students described how the research opportunity was mediated so that their work was appropriate to their level of understanding and experience. Through communicating about their research to multiple audiences, they learn communication skills necessary for advancement and for landing jobs in their discipline. Through the research experience, they perceive care from the department (from faculty and peers), and indicate that faculty value and are invested in student learning.

Evidence of ownership/self-directed learning

A student involved in research described his motivation for joining the group. He indicates the desire to get involved in what the field is like as a motivating element of participating in research, as the environment is conducive to exploring subject matter.

"I wanted to experiment, you know, because I, I got into the first classes (in the major), and I wanted to experiment what the field is like or what experiences I could get or what was my field of interest and that's the reason why I chose (research). I said I didn't want any monetary compensation, I just wanted the experience and see where that led to."

Scaffolded support

In an ARG research environment, team members are responsible for one another's development. For example, an undergraduate describes how his work in a new subject area complemented the work of a graduate student. The undergraduate's tasks were supportive of the work of the graduate student, though at a more appropriate level of technical difficulty.

"I would be given a task and I would go out and it was part of a piece of a larger puzzle, so we got this smaller task he would assign to me, and he would get more or less equal task and it was, it was all connected together. Essentially my introduction to (the topic) would complement (the graduate student's work)—like, he explained it to us; he's very open about what he's doing. He's very, he knows what he's talking about and it's one of the best experiences I've had."

Gaining perspective through research

Learning in a discipline is best realized when students have access to the "big picture", or how the detailed work they do in courses relate to broader aspects of the professional field. In a focus group with MentorGrad researchers, a student described work produced in the ARG lab, and how the work related to the broader field of electrical engineering.

"Well I'm working with a very new thing in technology, it's called cognitive radio, it's a device, like a normal radio, but the only thing that they have, that it has in hardware is the antennae and the analog to digital converter and then the dotter board that includes like the mixing, the amplification, stuff like that... You have the opportunity to mingle with it in software, which is actually, you can have a slow radial box like this and you can, you can basically program in all the frequencies, all you need to change is basically the, the antennae. It's, it's a new thing, it's like it's been ten years in the making."

Learning communities that care

Deep learning is cultivated in communities where individuals perceive care—from their team members as well as their supervisors. ARG researchers describe how they perceive care from faculty advisors, from the one on one and group time they spend with students, the sharing of resources to develop their understanding of topics, and the ways they recruit students to participate.

"And (my research advisor) was at the meeting because she was the club advisor. I already had a couple of java classes with her and she liked how I did my homework assignments and she saw my capabilities with java at the time. So, she picked me out and asked "do you want to work for me making games?"

"She makes everybody feel good about themselves, about what they've become, about what they've accomplished and she motivates you to reach your goals."

Researcher Identity development

Developing a sense of becoming a researcher is an important step towards graduate school and professional academic pathways. Students engaged in research at CAHSI institutions indicated emerging researcher identities, evident in the ways they described the following: their orientation towards research; their affiliation with the group of campus-based researchers; the contributions they make, both locally and globally, to their fields; and how their work fits into the larger scope of computing research. They also describe how they have experienced, at least peripherally, authentic research data collection, analysis, and dissemination, and the ways their efforts relate to others' efforts in their group, what ARG developers describe as positive interdependence.

Making global contributions to research in support of local goals

A student explained how participation in the research lab brought his attention to a gap in the overall literature regarding computing research. With support from his lab group and advisor, he was able to focus on a written piece that would serve as a framing article for the rest of the work the team created.

"Half-way through I noticed that there's this huge gap of knowledge inside the group, like everybody talks about cloud computing, but nobody, you don't actually find papers describing what cloud computing is, in itself, like not talking about functionality, just literally saying what it is, a bunch of computers connected to each other."

This is an example of how ARGS focus on individual accountability as well as positive interdependence—while the individual has a specific task that is negotiated with group consent, the effort is closely tied to the aims of the group as a whole.

Flexible hierarchy and individual accountability in the research group

Participants in the research group have defined tasks in the group, and yet each task is essentially linked to other tasks. ARG researchers become experts on various topics in the research group, then lead the other members in understanding the concepts they mastered in their work. In essence, everyone is a teacher and a learner in this model. Participants get the opportunity to try on more expert research roles through this practice.

"Research has taught me teamwork. Definitely, you can't know everything, or maybe you can, but it would be very difficult. Everybody has a different task and of course if you want to, if you

want to keep going on, then everybody should know about everything. A little bit about everything so when somebody researches their part, they actually teach everybody else that part. Without that many, without much work actually, so everybody can concentrate on their own things but everybody (on the team) learns them also."

Experience of the research process

A graduate student building his thesis from the research work in the research group took part in a focus group. He discussed how the undergraduate efforts contribute to his project, and how their involvement gave them direct access to the content of the research as well as the process of developing a thesis in graduate school. In this way, students become aware of and knowledgeable about the research process, and see first-hand what graduate students do.

"I guess since it's part of my thesis you know, obviously it's, my (part of the) work is mine... but the (undergraduate students) are sort of learning about what I'm doing to do my thesis. They're learning about the concepts in general and they're also, in, like in this case, (student name)'s part of speech tagger, you know, we're taking it and we'll compare it against a real tagger. ... (They are helping to answer) good technical questions."

Connection to other researchers via CAHSI network

Researcher identities are linked inextricably to the communities of which they are a part. The department, the faculty mentor, and the other researchers are a part of that local community. However, ties to professionals beyond the everyday participants are also important for individuals to see themselves as part of a greater community of practice. The "global research community" for CAHSI researchers included the faculty, graduate students, and industry researchers who attend the CAHSI annual meetings. Focus group participants describe how dissemination of research via poster sessions and papers influence their work. One student describes how his interactions at CAHSI gave him new insight into the importance of his work on the CS-0 initiative, and another student mentioned his positive experiences networking during the CAHSI poster session.

"[My research is] more or less on the CS 0 initiative. [My advisor] handed that over to me in 2008. Late 2008 I think. It has been my project since. It wasn't until this last CAHSI conference I realized how important CS-0 actually was. For the longest time I thought it was kind of another

way to recruit. I just realized recently it was more of that and always has been. And at that, it's kind of disappointing now. It shifted my research direction and how I wanted to approach (my study). CSO has the potential to be much more than recruitment, such as something that CS majors can take later on to refresh their skills. It can be something that is just general education for people who want it; it could be like computer literacy. It has the potential to be something similar. Even more so, it has a potential for outreach. There can be a lot more that can be done with it than just recruitment. "

"I had some good talks with some people; sharing stuff with people. One guy was doing an expert system and you know, (my advisor) teaches a lot of that stuff, so I mean I've had a lot of AI stuff with her... we kind of bounced some ideas you know. He was talking about doing an artificial intelligence, or rather a rules-based system on a cell phone. ... It was good interaction."

CAHSI recommendations based on CASE study one

The annual meeting location was ideal for learning from one another—the relaxed atmosphere in San Juan was conducive to networking and learning while still exploring the conference location. Adding less formal ways of presenting student papers and panels would improve the interactions between presenter and audience—students described round table presentation settings as a possible way to both improve networking among students and ensure that students have opportunities to ask questions of presenters.

Some students in the earlier stages of MentorGrad mentioned that they would benefit from assistance in creating a good resume. While graduate school workshops were the most common element of CAHSI annual meetings this year and in the past, the students mentioned that one could not receive the experience he or she needed to be marketable as potential graduate students without a solid resume.

Similarly, students mentioned that not all of them are looking to apply for PhD programs and academic-track jobs. Having more information regarding industry opportunities, including internships, would benefit students so that they could make informed decisions about their career options. At CAHSI meetings, students typically learn about Research Experiences for Undergraduates (REUs) rather than internship opportunities. One student mentioned she could

envision an industry track that followed the same format, with student experiences described in detail and a specific “how –to” workshop to prepare students for next steps in this pathway.

The CAHSI grant is designed to increase the number of students, particularly underrepresented students, who receive degrees in computing fields. While research opportunities are often framed as the initiative to *advance* students to graduate studies, it is important also to note how research opportunities work to retain students in their undergraduate majors as well (Seymour & Hewitt, 1997). Future work in evaluating MentorGrad and ARG will include measures to ascertain whether and how research experiences influence students’ continued study in undergraduate computing programs.

Researchers value the CAHSI meeting as a time to discuss their research with a new community of professionals. In focus groups, they mentioned the need for more structured opportunities for collaboration at the departmental level and across CAHSI. They note that having an internal directory for connecting with peers and faculty following the meeting would enhance their development beyond the annual meeting. Stories of their peers’ success are extremely powerful for CAHSI students—they describe the continued need to hear personal pathway stories that show traditional and non-traditional ways individuals have become successful in academic and industrial careers.

Some students note that though they are interested in graduate school as a career path, they have not had the opportunity to find the one research area for which they are completely passionate. Without that internal motivation to explore a subfield of computing, they are not sure that graduate school would be “worth it” for them. Finding ways to expand students’ experiences with research beyond CAHSI departments, such as through REUs, for example, may assist students in finding the topic that would drive them towards graduate school.

Case study 2: CAHSI at one institution

This case study details focus group data and observation information from two sets of TAMU-CC students interviewed during the April 2011 site visit, former CS-0 students currently in CS1 and PLTL leaders. Information from undergraduate researchers were combined into a larger case study of undergraduate researcher experiences across CAHSI.

CS-0 students reflect on their experiences

Four students participated in the CS-0 student focus group at TAMU-CC, two male and two females from underrepresented ethnic groups. Students were asked to describe their experience with CS-0 and to list the benefits and drawbacks of taking CS-0 before Problem Solving 1.

Prior experience

The female students in the focus group had never programmed a computer before enrolling in CS-0, though one woman stated her interest came from her father's work as a webmaster. One student learned Alice in a high school course abroad. The final student enrolled in CS-0 after an unsuccessful experience in CS1. He had prior programming experience with his father, who got him interested in Visual Basic in the fourth grade.

The course

Students described CS-0 as being interactive—the instructor modeled programming in front of students, who followed along with the instructor to create visual programs and videos. Assignments were completed in groups and individually, with conceptual written tests used to ensure students understood the programming vocabulary that pertained to the concepts they were practicing. As they presented their final group projects, students were encouraged to describe the process of building their projects, and discussed the issues they encountered along the way.

Benefits

Students described an approach to learning programming that is well suited to novices as well as those having trouble with the jargon of programming in a more advanced course. They noted the importance of having an interactive, engaging instructor who was willing to answer questions students posed. As the students were interviewed towards the end of CS1, they were able to describe how the supported, structured, and visual nature of CS-0 allowed them to

understand concepts they later used in more advanced programming. According to the novice students:

"It was like a beginners guide to how to write programs with pictures. It was step by step... I love how you learned what an argument would be – and how the new terms you use (in programming) apply to one another."

"It shows you visually what you need to know- like for loops and while loops. (CS-0) shows visually what the concept means in the program."

The advanced student who took CS-0 as a refresher course also found CS-0 beneficial. He stated:

"I took CS-1 first-- the jargon was hard for me to understand- (CS-0) solidified a lot of ideas- easier to get back into the CS-1 class... It was hard to go backwards, though. ...The good part about CS-0 is you could make it as hard or as easy as you want through the projects you create."

The two novices stated they could not imagine taking CS1 without first experiencing CS-0. The interviewer mentioned that computer science majors in most schools start with CS-1, and the CS-0 focus group participants felt that would be challenging.

"(Starting with CS1) would make me want to change my major; without Alice, that is the basic foundation- you build up in the one class; Alice is black and white. I feel like with the (CS1) class everyday its learning something new and learning like "to do loops" and stuff like that..."

Another student agreed, stating *"CS1 is like, SWIM!"*

When asked how to improve CS-0, students reiterated the importance of the course to their learning in CS1. They did mention, however, that easing the transition to CS1 would be beneficial. For example, developing projects that are more difficult for the end of the CS-0 semester was one suggestion for easing the transition to CS1. Students said the introduction of another language (either the target language for CS1 or a more friendly language with similar syntax, such as python) may also help students adjust to the fast pace, abstract nature of CS1.

PLTL- superheroes, super mentors

PLTL sessions in action

The computer lab is lively; group conversations carry around the room. Screens are dark, and plans for domination ensue. PLTL peer groups are devising the “functions” that will ensure their designated peer leader fighter will eliminate the opponent. Groups devise strategies based on the rules of the game, which were object-oriented in nature and forced groups to consider more than one variable at a time, in this case, a player’s health and damage they could inflict, and “mana”(which in Dungeons and Dragons circles, refers to magic ability).

The purpose of the activity was to create functions that would “run” given the parameters of the game and the limits set by different factors. What happens at each turn, and with each code command, is dependent on what happened before. This was a lesson where gaming knowledge and/or magic interest was particularly important- and seemed to engage nearly everyone, from fantasy buffs to first-person shooter enthusiasts. In the end, the brute force strategy with a strategic number of “power” points won the game, though other groups had elaborate functions that would block at multiple levels. The four groups engaged simple and more complicated strategies for devising their functions, and for choosing the functions during their turns. After two rounds and three battles, the winning group was dubbed champion. Discussion regarding the multiple function development strategies led to appreciation of each groups’ methods of approaching the problem.

Following the session, leaders discussed how they developed the lesson activity based on the experiences of the other peer leaders from a different course level. They related the needs of the students, as described by the course instructor, and the ways they felt the needs of students were reflected in their activity. This is typically how the PLTL program operates at TAMUCC, according to peer leaders.

Focus group findings

The evaluator sought to understand leaders’ reported gains of participation, needs, and identified best practices in leading the PLTL sessions. Nearly a dozen peer leaders attended the focus group, all were male, and approximately half appeared to the evaluator to be members of underrepresented ethnicities.

Benefits of participating in PLTL as leaders

Peer leaders state that developing and implementing lessons for students helps them strengthen, confirm, and refresh content knowledge. ***They develop and recognize their abilities in helping people one on one.*** Leaders shared the following perspectives regarding their own content knowledge:

"I definitely have a better grasp on what I was learning last semester- it is like 'Ohhh.' It's helping me with (next computing class). I forgot about that, then I use the ideas in the labs."

*"This semester I'm not taking any C++ programming courses, so it is a good refresher."
"When you have to explain it to somebody... there were a couple of times where I was explaining it and it clicked more- because we have to—so, I could regurgitate the book definition or ask leading questions to help them understand it themselves. I have to figure out how to get them there."*

Similarly, serving as peer leaders gives students new skills and approaches to learning in current and future courses. Leaders draw upon their experiences to study in different ways, and to create learning goals for themselves.

"I was reviewing for a test I was going to have in (the class I am taking). I did what we did for the PLTL students."

"I find (what I am learning) is carrying over to other classes; I treat other classes like I need to learn it to teach it."

Elements of effective PLTL activities

Peer leaders ascribe to the notion that their role is to help students arrive at conceptual understanding. They find multiple ways of describing the concepts, including through actions, analogies, drawings, and gathering others into the conversation most effective in conveying material. Leaders said they try to rely on group discussions to allow students to help other students understand, and when they feel they are not conveying information to a student in the best way, they draw on other resources, such as the tutoring center, the instructor, and the

other peer leader. One student described how actively participating in a computer sorting activity allows students to visualize processes described in the textbook, indicating the importance of learning computer science through multiple modalities.

Challenges to effective PLTL activities

Peer leaders identified the following challenges to effective lesson implementation:

- Leaders struggle with using time effectively. Pacing of cooperative lessons sometimes means that groups are alternating activity, or waiting to engage in their portion of the larger effort. Constant leader circulation and leader's questioning of the group can help engage those who stray off task, and restructuring of lessons on the fly sometimes alleviates this issue.
- There is a tension when leading ones' peers—leaders struggle with the dual role as authority figure and friend. For some, establishing authority in the classroom has been difficult. Students used to more traditional computer science coursework want to use the time working on labs rather than engaging in peer-led activities.
- Coming up with new activities is often challenging, though weekly meetings provide opportunities for leaders to brainstorm ideas and reshape tested lessons for new audiences. Some lessons involve materials that are created from scratch, and take lots of time to develop (e.g., cutting apart multiple copies of code into strips for a sequence lesson). Having mechanisms for sharing, storing, and reusing such materials among leaders may cut down time for lesson development.

Case study 2: Conclusions and recommendations

CAHSI initiatives seem to be thriving on the TAMU-CC campus, and students perceive support for their learning and their development as leaders of PLTL. Recommendations include the following:

- ***Easing the transition from CS0 to CS1 would be beneficial. Developing projects that are more difficult for the end of the CS-0 semester or getting a taste of a more common, syntax-heavier language may help students see what is on the horizon.***

- *Creating a set of reusable electronic and physical (paper, string) PLTL materials may allow students to share ideas more readily and reduce the amount of time spent on creating new materials.*
- *Spending some time researching ways to maximize time in the classroom so that all students are busy at all times may improve PLTL as experienced by leaders and students. This may also be a good modeling activity, in which a group of leaders runs an activity with other leaders who are charged with acting in “off-task student” roles. Also, sharing evaluation data regarding why PLTL is helpful for increasing student achievement may assist student buy-in.*

BPC ALLIANCE INDICATOR #2: ORGANIZATIONAL CAPACITY

Building on research in sustainability and organizational capacity development literature in the social sciences, the evaluators developed the rubric, below, to measure CAHSI's progress towards sustainability beyond the years of the grant. Research literature indicates that an alliance aiming to increase the number of underrepresented students who earn degrees in computing must have the capacity to do the following:

- a) Replenish and fortify the pipeline at each stage through continuous improvement of initiatives and pedagogy (K-12 through graduate education),
- b) Train new educators and hold training sessions at their various sites within and outside CAHSI institutions to inform one another about best practices in supporting students in computing,
- c) Develop staff and faculty engagement in new practices in the initiatives and understanding of the mission of CAHSI, and
- d) Engage a cadre of staff and faculty who are aware of CAHSI's goals and take up the new practices.

Research shows the most sustainable models of organizational change include more than just a handful of faculty, but must be infused into common departmental or institutional practice. In addition, fostering connections with common goals, deliverables, and actions (e.g., technical research projects, additional curriculum development projects) beyond the years of the grant will be important to sustain collaboration beyond CAHSI's life as a National Science Foundation-funded project. These tangential or additive programs and projects maintain CAHSI collaboration and at the same time help the alliance grow and create broader impact- because of this potential to create broader impact, this idea is introduced in the third BPC evaluation metric, alliance impact.

CAHSI will receive five years of funding before it will need to become self-sufficient financially. The program's goal is to move towards economic sustainability over the course of this grant. The rubric measures the extent to which CAHSI departments have leveraged other funds to support the aims of CAHSI at each initiative, and overall.

CAHSI Organizational Capacity Rubric: Orange color indicates school or department is achieving the goal; light blue indicates rubric metric not measured in year one; for sustainability: black indicates no additional funding, yellow indicates partial fulfillment via other means, and orange indicates fully "other" funded.							
Indicator (colors used to show different types of indicators)	S1	S2	S3	S4	S5	S6	S7
healthy pipeline: K12 outreach using CAHSI initiatives (e.g., CS-0)	Orange	Orange	Orange	Orange	Orange	Black	Orange
healthy pipeline: faculty staff or students have yearly plan to collect and analyze data to inform classroom or departmental practices ¹⁶	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
healthy pipeline: undergraduate research opportunities (goal is 15% of departmental students)	Orange	Black	Black	Orange	Black	Orange	Orange
healthy pipeline: graduate school preparation (goal is 15% of departmental students)	Black	Black	Black	Black	Black	Orange	Orange
healthy pipeline: CAHSI graduate application (as defined by intent, measured across departments, above baseline for 2010 annual meeting rates)	Orange	Orange	Orange	Orange	Orange	Orange	Orange
healthy pipeline: CAHSI graduate application (as defined by application to graduate school, measured across departments, above baseline for 2010 annual meeting rates)	Black	Black	Black	Black	Black	Black	Black
resource dev train: host training in 1 or more CAHSI initiatives	Orange	Orange	Orange	Orange	Orange	Orange	Orange
resource dev train: lead training in 1 or more CAHSI initiatives	Orange	Orange	Black	Orange	Orange	Orange	Orange
fac/staff engage: undergraduate faculty CAHSI awareness measured every other year (75%)fac survey ¹⁷	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
fac/staff engage: fac CAHSI participation (33%)PI report	Orange	Black	Orange	Orange	Black	Black	Black
fac/staff engage: undergraduate faculty CAHSI-trained continuously (e.g., every other year participate in training)(25%)PI report	Orange	Black	Orange	Orange	Black	Black	Orange
CAHSI Alliance sustainability: funds for CAHSI supplemented at the department/institutional level- <u>CS0 outreach</u>	Orange	Orange	Orange	Orange	Orange	NA	Orange
CAHSI Alliance sustainability: funds for CAHSI supplemented at the department/institutional level- <u>CS0 undergrad</u>	Orange	NA	Orange	Orange	Orange	NA	Orange
CAHSI Alliance sustainability: funds for CAHSI supplemented at the department/institutional level- <u>PLTL</u>	Orange	NA	Yellow	Yellow	Black	NA	Yellow
CAHSI Alliance sustainability: funds for CAHSI supplemented at the department/institutional level- <u>ARG</u>	Orange	Yellow	Yellow	Yellow	Black	Black	Yellow
CAHSI Alliance sustainability: funds for CAHSI supplemented at the department/institutional level- <u>mentorgrad/fellownet/femprof</u>	Orange	Yellow	Yellow	Yellow	Black	Black	Black

Significant proportions of upper level students are receiving undergraduate research and graduate school preparation, though again the size of the school and department effects the ability to provide services to significant proportions of students. The details regarding which

students engage in research was not addressed in this evaluation, a weakness to be remedied given CAHSI's goals to advance those who may not otherwise be successful in the major. While faculty awareness and involvement will be measured again next year, last year's findings indicate this is an area in need of additional attention. We find anecdotally that some faculty members are aware of initiatives and to a lesser extent aware of the overall CAHSI program aims and goals. Continuous improvement of initiatives and instruction is important for CAHSI—supporting a method for self-evaluation and improvement of practice will be needed in coming years. This is an area of evaluative weakness to date and so the measure is postponed until year two—defining this process and supporting its institutionalization is necessary in coming years. Student application to graduate school has not increased since 2010, though intent has increased. Evaluators will investigate what factors limit students' activity in this area.

Evidence suggests that CAHSI departments are beginning to sustain CAHSI efforts through other financial means, with Mentorgrad and ARG remaining the most difficult to support with institutional monies. Smaller programs and departments have had greater opportunity to train and engage significant proportions of their faculty, though this may be easier to do given a smaller group of faculty to engage. Finding ways to train and engage faculty from larger, more distributed departments will be important for the institutionalization of CAHSI initiatives. Beginning with targeted full time faculty who teach introduction courses and faculty who engage in undergraduate research has been the typical pattern of engaging faculty, as well as bringing assistant professors into the network to support professional development.

BPC A INDICATOR #3: BROADER IMPACT OF CAHSI

CAHSI intends to broaden its impact beyond computing departments at H-SIs, and aims to serve Hispanics in computing at the national level. CAHSI leadership views the issues they address as part of a broader educational access problem, and aim to influence the national conversation regarding Hispanics and higher education achievement. The goals CAHSI set forth in the 2010 proposal included deepening and broadening proven educational efforts beyond CAHSI institutions, focusing a greater deal on departmental collaborations towards technical research innovation, and becoming a unified voice for Hispanics in computing with the ability to influence national and local policy and practice.

To do this, CAHSI leadership will need to build cooperative agreements with national organizations that promote Hispanics in education, become advocates for CAHSI at regional and national venues for policy and education reform, and strategically align the accomplishments of CAHSI initiatives with national and institutional goals.

The CAHSI Alliance rubric measures the reach of the alliance in disseminating its work to multiple audiences, elevating the mission to the public consciousness, extending the fruitful collaboration already experienced among CAHSI leadership, and creating quality tools for collaboration within and beyond CAHSI. The rubric is calibrated towards the end of the grant, and as such, the first years will potentially show a need for extreme growth. The intention is for the rubric—which was developed with the input of the CAHSI executive team—to drive practice and action in the alliance and to potentially shift with the evolving goals of the group.

Much of the progress to date has occurred in year 2, and so evaluators anticipate change on these measures for next year's report. For example, in September of 2011 (beyond the scope of the evaluation period) CAHSI partnered with Excelencia in Education, a policy-focused organization for Hispanics in higher education for their annual celebration. This event increased CAHSI's visibility on a national scale, and gave CAHSI leadership the opportunity to describe the success of the alliance and its mission to increase Hispanic representation in computing.

CAHSI Alliance Impact Rubric: Orange color indicates score; light blue indicates rubric metric not measured in year one			
IMPACT INDICATOR	Beginning/needs substantial improvement	Moderate/needs some improvement	Proficient
CAHSI Alliance impact: CAHSI annual meeting resourced through other organizations/ funding sources	Travel scholarships for some students covered; else CAHSI funded	Site collaborations lead to shared costs for annual meeting site, some travel covered by scholarships, funding from industry	Annual meeting speakers, faculty and student travel scholarships, and site costs covered by non-profits, industry support, endowments, or institutional funds
CAHSI Alliance impact: social science engagement	Evaluation report data focusing on social science elements of CAHSI disseminated (baseline practice)	One to two social scientists well versed in higher education, Hispanics in education, and or STEM education collaborate with CAHSI and produce 1-3 disseminated works; advise re: multicultural training	Three or more social scientists well versed in higher education, Hispanics in education, and or STEM education collaborate with CAHSI and produce 4 or more disseminated works; social scientists partner to develop multicultural training with CAHSI for internal and external dissemination
CAHSI Alliance impact: policy voice [annual activity]	1-2 national or regional venues	Less than 5 national or regional venues	Multiple CAHSI Pls served as CAHSI delegates to higher education and STEM education organizations in leadership roles in 5 or more national or regional venues across a spectrum of organization types. Pls discuss lessons learned from CAHSI rather than focusing on own institution specifically
CAHSI Alliance impact: faculty dissemination – education	0-4 engaged Pls/faculty publishing or presenting in 1-2 venues	5-9 engaged Pls faculty publishing or presenting in two or fewer venues	10-15 engaged Pls/faculty publishing or presenting in more than 3 total venues
CAHSI Alliance impact: cyber infrastructure to support broader educational impact via web dissemination [CS0 PLTL ARG mentorgrad fellownet =5 initiatives]	0-40% of initiatives available for deployment in new settings (0-2)	41%-99% of initiatives available for deployment in new settings (3-5)	100% of initiatives available for deployment in new settings
CAHSI Alliance impact: cyberinfrastructure national impact via web dissemination	0-14% of all website downloads/views occur outside of original CAHSI regions	15-29% of all website downloads/views occur outside of original CAHSI regions	30% or more of all website downloads/views occur outside of original CAHSI regions (website analytic data)
CAHSI Alliance impact: cyberinfrastructure to support collaboration	Cyberinfrastructure metric to be determined: focus is on research collaboration, usability, and quality of communication – survey of users to be developed		
CAHSI Alliance impact: cross institutional funding-technical/scientific research	1-3 CAHSI institutions	4-6 CAHSI institutions	Each CAHSI institution is involved in a collaborative research grant that supports continued contact and scholarship among students and faculty
CAHSI Alliance impact: alignment of initiatives (for this indicator, CS0, PLTL, ARG, mentorgrad, fellownet =5 initiatives)	0-40% of initiatives	41%-99% of initiatives	All CAHSI initiatives have documentation fit for wide distribution showing how they align to national and local goals in education
CAHSI alliance impact: promoting aligned initiatives	0 meetings	1 meeting (e.g., CAHSI collaborates with Excellencia at their conference (fall 2011))	CAHSI established more than 2 meetings or summits with multiple national stakeholders and local leaders to describe and promote this alignment
CAHSI Alliance impact: collaboration beyond original 7 CAHSI institutions	8 or fewer departments with documented implementation of initiatives (baseline is 6 in 2010)	9-15 departments with documented implementation of initiatives (baseline is 6 in 2010)	16 or more departments with documented implementation of initiatives (baseline is 6 in 2010-2011)

CAHSI intends to broaden the CAHSI community by sharing its practices beyond current participating institutions, creating infrastructure to support collaboration around pedagogical initiatives, including social scientists in the study and promotion of CAHSI's efforts, and through the continuation of the CAHSI annual meeting as an opportunity to align with related community efforts (e.g., SACNAS).

While improvements to the sustainability of the annual meeting have not solidified, an arrangement with SACNAS is underway that will over time merge the CAHSI meeting with the SACNAS event, providing computer science content to the SACNAS proceedings and opportunities for funding participant travel via SACNAS scholarships. The CAHSI leadership team will assist with the planning of the event, vet computer science poster submissions, and send their CAHSI students to the conference annually. The event supports Native American students as well as Hispanic students—and so the CAHSI team hopes to maintain the cultural focus and community feeling of the CAHSI annual conference. The planning of the annual meeting is time intensive, particularly for CAHSI staff and faculty—having SACNAS' expertise and labor to plan accommodations and meeting space will allow CAHSI to spend more time on other initiatives.

Broadening the social science network has been difficult for CAHSI. A lack of funding for this element of the program has played a part in the curtailed growth. Through the BPC community, CAHSI has made connections with social science researchers at EdLab and ETR Associates in which two faculty members and support staff engage in a collaboration for K12 outreach—this may lead to deeper connections with social scientists in time. Recommendations for growing the social science network include inviting social scientists and graduate students in the social sciences from home institutions of CAHSI to take up particular research questions of interest to faculty in their home schools. The research questions could be addressed through qualitative research, and might serve as graduate student projects for coursework or thesis requirements.

Currently, CAHSI initiatives have been underway at 16 institutions, including the original seven schools (FIU, CSUDH, UTEP, UHD, UPRM, NMSU, and TAMUCC) three SACI schools (UTPA, MDC, and CSUSM) and seven additional schools not receiving funding through the CAHSI grant though trained by CAHSI faculty in one or more of the initiatives. The schools include two of three ARG hubs, one of which is engaged with another BPC Alliance, A4RC. Two community

colleges are beginning conversations with a CAHSI founding member as well, though they have yet to begin implementing CAHSI initiatives. ARG trainings have touched a large number of adopting institutions through a related grant to scale the model—it will be important to expand trainings of other initiatives as well to develop the full CAHSI model that supports student advancement in computing.

Many of these community connections have come from CAHSI networks in computing education and research rather than from inquiries beyond institutional contacts. Continuing to build the community through network contacts and beginning to build the web presence of CAHSI as a national resource for pedagogical reform in STEM will be essential for CAHSI's development as the national voice for Hispanics in computing. The fall 2011 events with partner institutions (e.g., co-hosting a workshop with ALASS, Excelencia; potential collaborations with SACNAS) may elevate the presence of CAHSI among higher education institutions. Next year, evaluation will include faculty surveys of initiative implementation at new institutions to ensure faculty have the support necessary for success.

The annual meeting has been an important element of CAHSI community building, and an effective method for recruiting interested faculty in taking up CAHSI initiatives. Continuing the annual meeting beyond the 5 years of the NSF funding is vital to CAHSI's continuity. Currently, PIs have leveraged additional institutional and grant funds to support student participation at the CAHSI meeting, and the CAHSI meeting budget has ensured broad participation to date. CAHSI is currently negotiating with the Society for Advancement of Chicanos and Native Americans in Science (SACNAS) director to co-locate and co-brand the CAHSI meeting with the larger SACNAS event. The collaboration, if finalized, will enhance the presence of computing at SACNAS and provide some shared funding and scholarships for students. The evaluation of the annual meeting will seek to address student and faculty attitudes towards the merged event once the CAHSI meeting is held concurrently with SACNAS.

As of October 1, 2011, the website has extensive material (including lesson plans and example activities) available for download for CS-0 PLTL and ARG¹⁸, three of the five major initiatives evaluated. A stumbling block for CAHSI in the area of broader impact has been the

¹⁸ PLTL materials were added following the relevant time period of August 2010-2011 for data collection on the alliance rubric.

dissemination of materials in a format that would allow a new institution to implement CAHSI initiatives easily. This issue has multiple influencing variables, including: a) the lack of resources to develop and maintain “slick” materials of high visual and content quality, b) the lack of uniform implementation and presentation of content across the institutions, and c) the idea that many initiatives require training to understand the process of educating in a new way rather than a more straightforward presentation of information to students.

In the new proposal, CAHSI suggested development of primers that allow interested parties to understand the initiatives, then Cyber infrastructure to support members in implementation. This is currently in development—the first large-scale working meeting to address cyber infrastructure was held during the CAHSI annual meeting in March 2011. As cyber infrastructure is developed, evaluation will address use in two ways—measuring who accesses web tools and materials (via google analytics) with a focus on geographic region and evaluating the experience of users via a survey of collaborators. The survey will focus on ease of use and quality of communication.

In addition, growing the social science network may be an important way to build support for CAHSI initiatives. A CAHSI leader is developing a collaboration with the Association for Institutional Research. This partnership may lead to a social science connection, as the group has researchers on staff who promote Latino/a success in higher education. In addition, a social science alliance member is engaging in developing materials for CAHSI regarding Latinos in higher education. As the rubric measures disseminated works, there has not yet been progress in this area beyond the baseline level of social science involvement with the evaluation team. Clearly, collaborations beginning now will allow CAHSI to make strides towards this goal.

Research on organizations that succeed beyond their start-up funding indicate that creating multiple connections and working projects enhances collaboration and creates new reasons to meet together. CAHSI has historically been strategic in balancing its aims with related networks and responsibilities- for example, the annual planning meetings have been co-located with the Tapia conference and the Snowbird conference in past years. Seeking funding to support technical research across CAHSI schools has the potential to do three things for CAHSI members—create additional connections and collaborative activity among departments, provide student research opportunities, and build the individual and collective research

reputations of HSIs through quality computing research. Currently, a few institutions have collaborations that cross institutions and focus on technical research. A PI mentioned that as cyber infrastructure is developed, the ability to collaborate on proposals will increase, potentially leading to more funded technical projects.

RECOMMENDATIONS

CAHSI initiatives will need to be fully funded by outside resources within four years. While CS-0 courses have been institutionalized, additional student support via PLTL and ARG is only partially supplemented with external funding. Developing strategies for institutionalizing and funding these initiatives through other means is vital to CAHSI sustaining its impact in undergraduate education.

CAHSI undergraduates show aspirations and promise as graduate students in computing. To date, evaluators have anecdotal evidence that many bachelor degree earners advance towards MS and PhD degrees in their home institution. Survey data, however, do not corroborate this information—for example, few annual meeting participants have taken the GRE or have applied to graduate school. A better method of tracking post-baccalaureate outcomes for students is needed. Two possible avenues for improving this data collection include: partnering with the departments to design questions specifically for alumni surveys, and/or submitting a request to the National Science Foundation for additional funds. The funds would be used to purchase data from the National Student Clearinghouse, and organization that has the capability of tracking student enrollment and graduation nationwide.

Fem Prof has been a successful initiative to support and advance women in computing at the undergraduate and graduate levels. On average, CAHSI institutions graduate women at or slightly below the national rates. Targeting attention towards women in the department and towards recruiting new female students is encouraged.

CAHSI has thus far had personal, deep commitments to new institutions joining the existing alliance. Members receive intensive training and support to become well versed in advancing CAHSI's mission. As the alliance extends implementation of proven practices, technological means and processes for a) communicating across sites b) sharing materials and training resources with new members, and c) extending the reach of CAHSI to new institutions and individual partners will be needed.

CAHSI Institutional research methodology

Data Collection Methods

With the assistance of CAHSI program staff, evaluators submitted requests for student graduation and enrollment data to the institutional research offices of the seven original CAHSI schools in summer 2011. Specifically, graduation and enrollment data were requested at the bachelor's, master's, and doctoral levels for the academic years 2001-2002 through 2010-2011. Spreadsheet templates were sent to each institutional research office and data were also requested to be disaggregated by gender, ethnicity, and residency status. Several CAHSI institutions have implemented new master's degrees in computing fields in recent years and data were requested for these new programs at CSU-DH and UTEP. After multiple requests, data were received from six of the seven CAHSI schools. Data were not received from NMSU and evaluators obtained data for NMSU from the Integrated Postsecondary Education Data System (IPEDS).

Data Analysis Methods

In previous years, evaluators used the Taulbee survey data from the Computing Research Association (CRA) for national comparison purposes with CAHSI departments. However, there were several drawbacks to using the Taulbee survey. For one, the Taulbee sample only consists of Ph.D. granting departments, while several CAHSI departments do not grant doctorates. Second, the Taulbee data comes from a survey and does not represent all Ph.D. granting departments in the U.S. The Taulbee sample also contains Canadian institutions. Given that most HSIs are located in the southwestern United States, the inclusion of Canadian institutions does not reflect the demographic or regional make-up of CAHSI institutions. Several CAHSI institutions are also master's granting institutions so the comparison to Ph.D. granting institutions is not necessarily representative of these CAHSI schools.

Evaluators sought a more accurate and representative national sample of institutions with which to compare CAHSI's graduation and enrollment trends. The evaluators created a custom

sample of institutions from IPEDS. Specifically, evaluators downloaded IPEDS data from institutions that met the following criteria: U.S. only; Title 4 participating; public 4-year or private, non-profit 4-year institution; and highest degree conferred master's and doctorate institutions. These search criteria created a national sample of 1,709 institutions. Specifically, evaluators only sampled from the mainland U.S. so that Puerto Rican universities would not overrepresent the graduation rate of Hispanics in the U.S. Because one of the CAHSI institutions, UPRM, is a Puerto Rican institution, data on graduation and enrollment of Hispanics were analyzed in two ways, with and without UPRM represented. Evaluators also sampled from national institutions that are participating in the federal Title 4, or financial aid, program. All CAHSI institutions are Title 4 participants. Evaluators included both master's degree and doctoral degree-granting institutions to better reflect that several CAHSI institutions are master's degree granting only. Finally, evaluators did not include for-profit institutions because none of the CAHSI institutions are for-profit. The national sample drawn from IPEDs more accurately reflects the demographic and regional composition of CAHSI schools than the sample from the Taulbee survey.

Finally, evaluators downloaded computing degree completion and enrollment information from the nationally representative sample of 1,709 institutions. Department-level data on IPEDS is classified into CIP codes. CAHSI departments are represented by the following CIP codes: Computer and information sciences, general; Computer Science; and Computer and information sciences, other. Computer engineering data were also downloaded but were not included in the analysis because only two CAHSI institutions are computer engineering departments. Due to the small representation of CE departments in CAHSI, evaluators thought that the inclusion of CE data in the national sample might skew the comparison. Overall degree completion and enrollment data at the bachelor's, master's and doctoral levels were downloaded from the nationally representative sample of 1,709 institutions for the academic years 2001-2002 to 2009-2010 (the most current year available on IPEDS). Evaluators noticed that some institutions added bachelor's degree programs in computing during that timeframe, although none of the CAHSI departments had added a bachelor's level program. Thus, evaluators created a comparison set of bachelor's level programs that have been in existence since the 2001-2002 academic year. Because several CAHSI departments added master's degree programs during this time frame, all master's degree programs were included in the analysis, even programs created

after the 2001-2002 academic year. Data were also disaggregated by gender and ethnicity for comparison purposes.

Evaluators compiled IPEDs data into Excel spreadsheets and calculated ratios and frequencies for overall degree completion and enrollment at each level (bachelor's, master's, and doctoral). Ratios of female and Hispanic degree completion and enrollment were also calculated from the disaggregated data. National enrollment and graduation trends were then compared to CAHSI trends for academic years 2001-2002 through 2009-2010.

APPENDIX B: REFERENCES

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