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A Case Study of Community College Transfer and Success in a 2+2 Program

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Kathleen Alfano has a Ph.D. from UCLA in Higher Education with a cognate in administration and evaluation. Her B.S. is in chemistry and she worked as an analytical chemist in industry before pursuing a career in education. She served as founder and Director of the California Consortium for Engineering Advances in Technological Education (CREATE) based at College of the Canyons from 1996 to 2016. Retired from College of the Canyons in November 2016, she is an Emeritus Professor and also former Dean of Professional Programs and Academic Computing. She currently acts as co-PI for the CREATE NSF ATE Renewable Energy Support Center and as PI of a NSF ATE targeted research project. Dr. Alfano served as a Program Director at the National Science Foundation and co-lead of the ATE program in 2007-2008. Dr Alfano also was the only community college representative on the National Academy of Sciences Committee on Workforce Trends in the U.S. Energy and Mining Industries which released their report in March 2013.

NSF ATE CREATE Targeted Research Study
A Case Study of Community College Transfer and Success in a 2+2 Program
NSF ATE grant #1445841

Overview of the Research Study:

The goal of this NSF ATE research project was to investigate, analyze, and disseminate the student success of up to 27,000 students who have completed at least one NSF CREATE consortium-funded course and to better assess the impact of over 12 years of NSF ATE Center funding. In 2016-2017, the research analyzed the significant progress to degree and retention and certificate and degree attainment by community college. This was reported at ASEE 2017. In the 2017-2018 research, a case study will be examined on the on the 12 years of progress in transferring and graduating students from over 20 community colleges to a California State University, Channel Islands (CSUCI) program which was developed under the CREATE NSF grant funds.

Overview of the NSF CREATE Center:

The California Regional Consortium for Engineering Advances in Technological Education (CREATE) was formed in May of 1996 as a joint consortium effort of seven community colleges, two California State Universities and over 55 high tech engineering technology employers to develop a regional approach to the preparation and training of engineering technicians. CREATE emerged as a major education-industry partnership and was selected in 2002 as one of only 40 National Science Foundation Advanced Technological Education Centers of Excellence funded through a grant to College of the Canyons. The goal of the ATE Regional Center, expanded to nine community colleges and high schools, was to address the demonstrated high demand for technicians in engineering technology-related fields especially: information technology (2002-2009), manufacturing technology, electrical engineering technology, and industrial technology (2002 to 2009) and renewable energy technicians (2010 to 2016) * in southern and central California as a multi-County consortium. Additional funding from NSF allowed the Center to include national competitions for renewable energy faculty development learning exchanges in Australia (2013), Germany and Denmark (2014), and the Caribbean (2015).

*Note: Although the original NSF CREATE Center ended after 20 years at College of the Canyons (CA), NSF has funded a NSF CREATE Support Center at Madison Area Technical College (WI) (NSF #1600934) for 2016 to 2020 to continue CREATE's efforts to support renewable energy faculty and curriculum development. Several of the original CREATE team are also involved in the new Support Center.

Motivating Rationale/Need:

The need to increase the number of U.S. students who achieve undergraduate degrees and who successfully achieve skills to contribute to their own and the nation's economy and the success of the workforce is well documented, especially in the President's Committee of Advisors on Science and Technology (PCAST) report to the President: Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics. (February 2012). The PCAST report cites what they call three imperatives:

- Improve the first two years of STEM education in college.
- Provide all students with the tools to excel.
- Diversify pathways to STEM degrees.

In a more recent National Research Council Report (NRC): Emerging Workforce Trends in the U.S. Energy and Mining Industries: A Call to Action. (March 2013), community colleges are specifically mentioned as the best pathways to bring much needed skilled and diverse students to the emerging technologies' workforce. (Note: CREATE PI, Kathleen Alfano, was a co-author/committee member of this NRC committee report).

However, one of the most vexing problems for the CREATE Center, and for many other similar projects, has been how to verify that the skills and education achieved by the students in our programs have resulted in their future success in further education and the workforce. Since most Federal and State grants fund just the development and piloting of these technical programs for only a limited timeframe of three to four years, the student impact measures tend to be limited to student progress to degree and certificate and degree completion during the term of the grant. Even the CREATE consortium, which started in 1996, has not been able to do longitudinal studies as each successive grant has focused on developing and implementing successively changing types of new and emerging technical programs, with no funding to retrospectively assess the previous students' continued progress.

Another difficulty in assessing the success of community college students pursuing career/technology coursework is that their pathways differ from those of university students. Short-term career goals, students returning for new or improved career certifications, part-time attendance and full or part-time work are among some factors that have been shown to shape community college students attendance and success. Also, goals for career competence and certifications can cause community college students to succeed in their goals without attaining a degree or matriculating to a four-year program.

Peter Bahr at the University of Michigan, School of Education has studied the progress and success of community college technical program students. In his papers, The labor market returns to a community college education for non-completing students. (2016) and the deconstructive approach to understanding community college students' pathways and

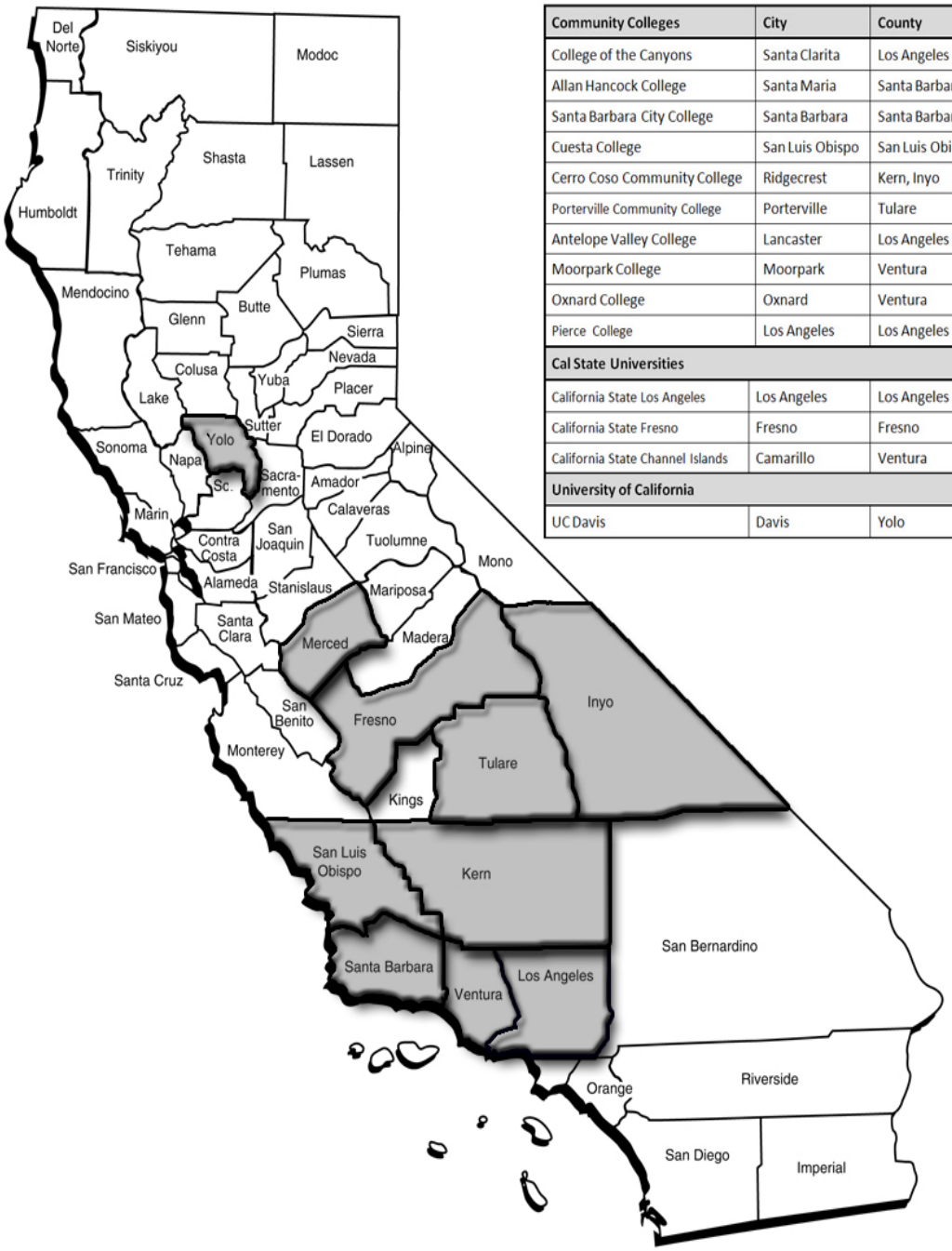
outcomes. (2013), he makes a good case for what he calls a deconstructive approach to understanding their success and outcomes. The CREATE team is using a deconstructive approach to assessing student success and outcomes as it pertains to single course, course sequence, course certification attainment as well as degree attainment and matriculation within different career/technical programs.

Diversity, Geographic Distribution of CREATE Consortium Schools

The NSF ATE CREATE Center is in a unique position to develop a model for longitudinal analysis of ATE student technical programs due to its long-term NSF funding; the diversity of the technical majors funded; the multiple locales and diversity of the student bodies of the colleges, high schools, and universities in the CREATE consortium, and the high level of expertise of the four doctorate-level researchers teaming to conduct this study. As the map, tables, and charts on the following two pages show, the CREATE colleges have represented a wide geographical area encompassing 9 counties in California with large diverse populations. Throughout the CREATE history over 27,000 students have enrolled in NSF ATE CREATE-developed engineering technology, industrial technology, construction technology, information technology, manufacturing technology and renewable energy courses and programs over a span of more than twelve years. (The map, tables and charts have been chosen from the different targeted funding eras of NSF ATE funding which will be investigated).

Since 1996, the CREATE consortium grew from 7 community colleges to 8 to10 Southern and Central California community colleges (some colleges were added or dropped depending on the applicability of the technical focus area of each multi-year CREATE grant to each of their regional workforce needs) plus high school and university partners. As the table on the next page shows, these colleges represented counties with a large diverse population of over 13 million in Central and Southern California.

CREATE Partner Colleges and Counties Served



Community Colleges	City	County
College of the Canyons	Santa Clarita	Los Angeles
Allan Hancock College	Santa Maria	Santa Barbara
Santa Barbara City College	Santa Barbara	Santa Barbara
Cuesta College	San Luis Obispo	San Luis Obispo
Cerro Coso Community College	Ridgecrest	Kern, Inyo
Porterville Community College	Porterville	Tulare
Antelope Valley College	Lancaster	Los Angeles
Moorpark College	Moorpark	Ventura
Oxnard College	Oxnard	Ventura
Pierce College	Los Angeles	Los Angeles
Cal State Universities		
California State Los Angeles	Los Angeles	Los Angeles
California State Fresno	Fresno	Fresno
California State Channel Islands	Camarillo	Ventura
University of California		
UC Davis	Davis	Yolo

Figure 1: CREATE Map and Counties Served.

Table 1:College Statistics for Fall 2008: Information Technology/Manufacturing Focus

College	# of Students	% Minorities	Focus Counties	Population	Sq Mileage	# Students in Feeder Programs
Canyons	23,416	55%	Los Angeles	10,363,850	4,079	326
Cerro Coso	4,946	33%	Kern, Inyo	835,669	18,267	604
Porterville	4,259	68%	Tulare	435,254	4,844	112
Merced	14,099	67%	Merced	255,250	2,008	134
Oxnard	7,739	82%	Ventura	831,587	1,864	202
Moorpark	15,671	42%	Ventura	831,587	1,864	367
Santa Barbara	19,166	49%	Santa Barbara	428,655	2,745	222
Allan Hancock	16,066	61%	Santa Barbara	428,655	2,745	246
Cuesta	13,146	41%	San Luis Obispo	267,337	3,326	799
LA Pierce	23,317	65%	Los Angeles	10,363,850	4,079	346
Porterville High School	1,850	68%	Tulare	435,254	4,844	280
Lompoc High School	1,475	55%	Santa Barbara	831,587	1,864	140
Totals	145,150	57%	9	13,852,856	41,977	3,778

Source: 2008 California Community College Chancellor's Office census

Goals and Methodology for the CREATE Targeted Research Study

Goals

The goal of this targeted research project is to investigate, analyze, and disseminate the student success of students who completed at least one NSF CREATE-funded course and to better assess the impact of over 12 years of NSF ATE Center funding. A secondary goal is to serve as a model for longitudinal data mining and analysis for the hundreds of other ATE projects and Centers. Measures of achievement to be used will include progress to degree and retention, certificate and degree attainment, and wage increases and wage levels by technical discipline. While last year's ASEE paper was on the overall completion/graduation rates and matriculation of the over 27,000 students who studied in one of the NSF CREATE-supported courses, this year's focus is a case study on the initial and long-term success of the joint university-community college partnership

between California State University, Channel Islands (CSUCI) and the CREATE consortium of California community colleges to develop a 2+2 BS IT program.

The CSUCI 2+2 BS IT Program

California State University, Channel Islands (CSUCI) is one of the newest of the California State University campuses, with upper division classes for transfer students first offered in Fall 2002 and freshman classes started in 2003. Located in Ventura County, California, it is within a reasonable driving distance for transfer students from a majority of the CREATE consortium community colleges. Therefore, when the demand for skilled technicians in the computer field began to escalate in 2003-2004 and 2004-2005, the Director of CREATE contacted Computer Science faculty at CSUCI to brainstorm if a partnership could help students to achieve a pathway to both community college and upper division information technology education. Initial discussions combined with a task analysis of skills needed by industry concluded that the computer science degree program offered by CSUCI would not be a good fit for a transfer program for CREATE students. However, university-community college faculty discussions led to a CREATE proposal to NSF to fund the development of a BSIT degree which would meet both community college transfer needs, industry demands for a prepared workforce, and possibly as an alternative for students entering the computer science degree but unable or uninterested in pursuing the higher calculus requirements. While CSUCI was an ideal partner as a young institution open to new ideas and programs, it was still restricted by California State University procedures for adding a new program. A five year plan was developed to use some NSF CREATE funding to write and pilot test the additional coursework needed for the new BSIT degree and to both offer it under the Extended Education program at CSUCI and to proceed with writing the documentation needed under the California State Master Plan review to propose the BSIT as a new regular catalogue degree for CSUCI in 2010, should the pilot be deemed a success. A new curriculum was proposed as outlined below, with some classes to be piloted as an on-line class. Information Technology (IT) classes began offering its new B.S. in Information Technology degree program in Fall 2005.

BSIT PROPOSED PLAN OF STUDY

Core Plan of Study:

Summer:	Comp	162	Computer Arch. & Assembly Lang.(3)	Prerequisite
Junior Year				
Fall:	IT	262	Computer Organization & Arch. for IT (3)	Required
	IT	151	Data Structures for IT (3)	Required
Spring:	IT	280	Web Programming (3)	Required
	IT	362	Operating Systems for IT (3)	Required
Summer:	Math	300	Discrete Mathematics (3)	Required

	IT	420	Database Systems for IT (3)	Required

Senior Year

Fall:	IT	429	Computer Networks (3)	Required
	MGT	307	Management of Organizations (3)	Required
Spring:	CIS	310	Management Information Systems (3)	Required
	IT	424	Computer System Security for IT (3)	Elective
Summer:	MGT	471	Project Management (3)	Required
	IT	499	Capstone Project (2)	Required

Additional BSIT Graduation Requirements:

12 Units of additional IT Electives:

Any IT course may be taken as an elective, such as:

IT	402	Advanced IT Programming (3)
IT	400	e-Commerce (3)
IT	401	Web Intelligence (3)
IT	469	Artificial Intelligence & Neural Networks for IT (3)

Other courses may be considered as electives, such as:

Art	324	Web Design (3)
Art	326	3D Animation (3)
CIS	490	Special Topics in Information Systems (3)

Please consult with your IT advisor before choosing electives.

All elective choices require advisor approval.

Science Requirement: Science II (Bio., Chem., or Phys.) (4)

CSUCI Upper Division Interdisciplinary General Education Requirement:

Choose 9 Units from courses with catalog numbers from 330 to 449, such as:

Math	331	History of Mathematics (3)
Comp	429	Human-Computer Interaction (3)
Comp	447	Societal Issues in Computing (3)

Review after the Four Year Pilot of the BSIT under Extended Education at CSUCI:

At the end of 2009, the program was completing its fourth year. As part of CREATE's effort to recruit students into this new degree program and to train counselors on the degree requirements, checklists listing the degree requirements had been produced for any community college that expressed an interest. At the end of 2008-2009, checklists were available for the following 17 California community colleges:

- Allan Hancock College

- Antelope Valley College
- Bakersfield College
- Butte College
- City College of San Francisco
- College of the Canyons
- Cuesta College
- Fresno City College
- Los Angeles Pierce College
- Moorpark College
- Oxnard College
- San Diego City College
- San Joaquin Delta College
- Santa Barbara City College
- Santa Monica City College
- Santa Rosa Junior College
- Ventura College

These included the original CREATE colleges along with other community colleges in California.

By 2009, 46 students had entered the program. Table 1 summarizes the number of applications to the program and the number of students enrolled during each of the four academic years. This data accounts for 45 of the 46 students. The last remaining student entered the university as another major and changed major into IT. Applications increased in the last two years as the program moved closer to moving from Extended Education to a Regular Catalogue degree program under the California State Master Plan.

Table 2: Applications and Enrollments to CSU Channel Islands B.S. in Information Technology Program

Year	Applications Submitted	Accepted Applicants Enrolled
2005/200	24	13
2006/200	11	9
2007/200	14	13
2008/200	21	10
2009/201	20 (to date)	
Total		45

Table 2: Note that in the 2008-2009 academic year the number of applicants increased but the percentage of applicants who actually enrolled was significantly less. This can be explained by a change in the application process. Prior to Fall 2008, this new program did not yet appear on the California State University online application web site (CSUMentor). To apply a student needed to know about the program from another source and contact the university to determine the application process. As of the fall 2008 application period, the program began to appear on CSUMentor. Students applying to a CSU can apply to multiple universities and majors all at once. Thus, there are more applicants who are not committed to the program. This lower enrollment yield is typical of other degree programs. (Source: CSUCI Institutional Research Office)

Table 3: Number of Graduates from CSU Channel Islands B.S. in Information Technology Program

Semester	Graduates
Spring 2007	2
Fall 2007	1
Spring 2008	4
Fall 2008	2
Spring 2009	3
Total	12

Table 3: Note: Shows the number of graduates from the program. Of the 12 students who had graduated, seven graduated in two years, one graduated in 2.5 years and four graduated in three years. (Source: CSUCI Institutional Research Office)

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Figure 2: Status of CSUCI B.S. in Information Technology Students

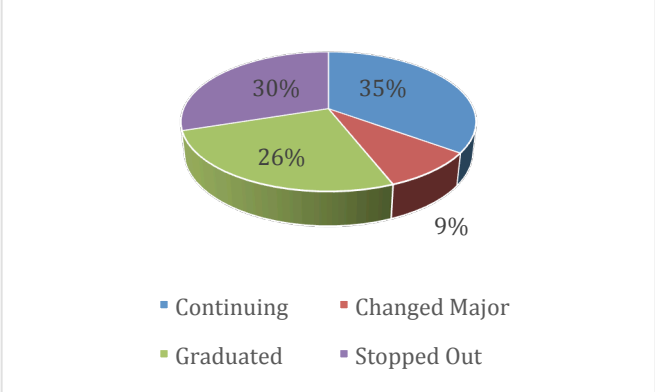


Figure 2: Note: Of the 34 students who entered the program but had not yet graduated, 16 were continuing in the program, four changed major (two to computer science) and 14 stopped out. (Source: CSUCI Institutional Research Office)

The program was offered as a mix of traditional face-to-face and online courses. There continued to be a 50-50 split between students who want traditional face-to-face courses and those who want online courses. The complete degree program requires 60 units of coursework to be taken at the community college followed by 60 units to be completed at CSU Channel Islands.

The 46 students in this program had been a mix of traditional full time students and full time workers who are attending school on a part time basis.

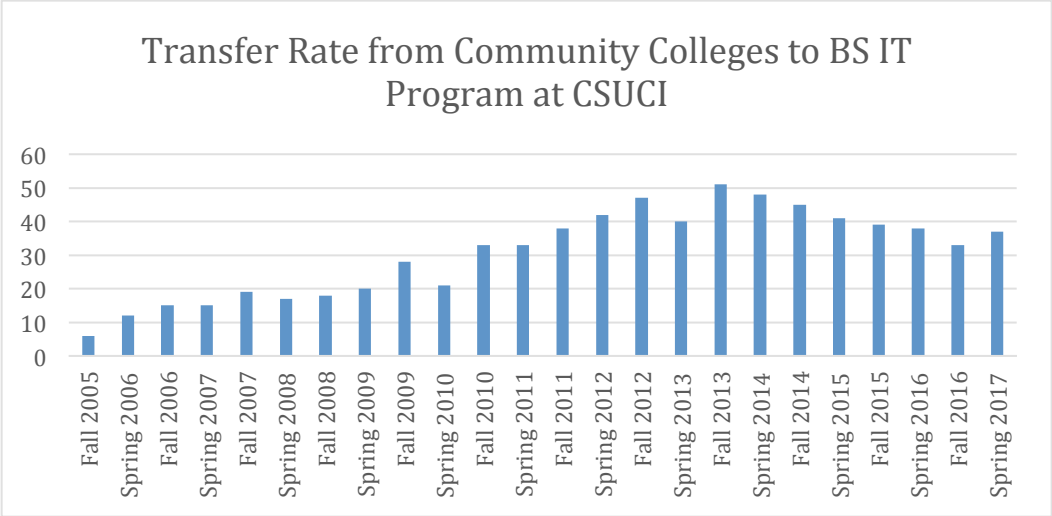
According to the department chair, all of the IT students were fully employed from the moment they came in as upper division transfers, either working in the CSUCI computer labs, in the school's IT division, or for outside companies. Several of the IT students work for the IT division at the college, and the reports from their supervisors are outstanding. Consequently, the department chair is regularly asked to refer more students each semester. The demand for these students outstripped the supply.

Based on their experience with IT students over the past three years, the faculty have found that there is no problem mixing information technology and computer science students in some of the required courses. As a result some of the courses that were offered in separate sections for IT and CS students have been combined into a single section. The pilot was considered a success and the BSIT program was moved fully into the regular program offerings of CSUCI as of fall 2010.

Longitudinal Success of the 2+2 BSIT Program fall 2005 to fall 2017

As part of this research study on the effectiveness and success of programs under these 12 years of NSF funding, CREATE again contacted CSUCI faculty eight years after the previous decision point to see if the program continued to act as a strong 2+2 pathway for student achievement in information technology. The following two factors were requested: 1) student matriculation data: headcount enrollment by community college and by year; matriculation patterns of students from the five closest community colleges, four of which were original CREATE schools and 2) student success and completion/graduation data. The following data was provided in September and December of 2017 by the Office of Institutional Research, Planning, and Effectiveness Office at CSUCI.

Matriculation Measures One: Community College Continued to Expand from 3 original community colleges to 30:



Figures Three and Four: Matriculation Measures Two and Three: Enrollment: As the figure above and below below show, the BS IT degree program continued to grow and there are 63 declared IT majors as of spring 2017. (Source: CSUCI Institutional Research Office)

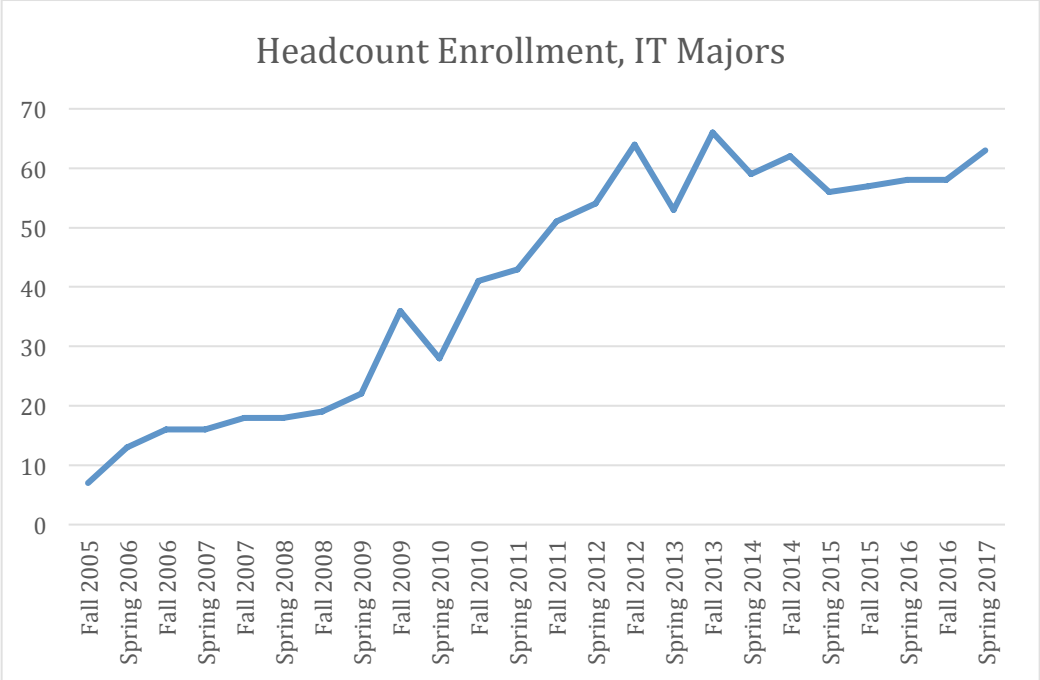


Table Four: Matriculation Measures Four: Matriculation from Closest Community Colleges: The five CA community colleges closest to CSUCI (four of which were original CREATE colleges) continued to provide the majority of the enrollment in the BSIT program. (Source: CSUCI Institutional Research Office)

Matriculation from Five Closest Community Colleges BSIT

Semester	Moorpark College	Oxnard College	Ventura College	College of the Canyons	Santa Barbara City College
Fall 2010	9	3	3	4	5
Spring 2011	8	4	4	4	5
Fall 2011	9	7	6	4	4
Spring 2012	13	6	8	5	4
Fall 2012	15	7	9	4	2
Spring 2013	15	8	8	2	1
Fall 2013	16	10	6	6	3
Spring 2014	15	11	4	4	3
Fall 2014	15	9	3	4	3
Spring 2015	15	8	3	4	2
Fall 2015	14	7	5	3	1
Spring 2016	13	8	6	3	0
Fall 2016	9	6	5	1	2
Spring 2017	7	8	7	1	2
Grand Total	**37**	**24**	**21**	**12**	**10**

Table Five: Students Success Measures One: Student Transfer from IT to CS consisted of a small number of students.

Transferred from IT major to CS Major

	New Freshmen	New Transfer	Total
Spring 2009		1	1
Spring 2010		1	1
Spring 2011		2	2
Fall 2011		1	1
Spring 2012		1	1
Fall 2012		1	1
Spring 2014		1	1
Spring 2015		1	1
Fall 2016	1		1
Spring 2017	2	3	5
Total	3	12	15

Table Six: Student Success Measures Two: IT Majors Time to Degree: Time to degree for transfer majors has grown to three or more years after transfer. (Source: CSUCI Institutional Research Office)

IT Majors Median Time to Degree

	Admitted as Freshmen	Admitted as Transfer
2006-07		2
2007-08		3
2008-09		2.25
2009-10	0	2.75
2010-11	5	2.5
2011-12	0	2.5
2012-13	4.5	3
2013-14	5.25	3.5
2014-15	8	3
2015-16	0	3

Table Seven: Student Success Measure Three A: IT degrees conferred: While the number of students granted BS degrees continues the number is a small percentage of the number of students enrolled. (Source: CSUCI Institutional Research Office)

IT Degrees Conferred

Year	Degrees
2006-07	2
2007-08	5
2008-09	4
2009-10	7
2010-11	6
2011-12	9
2012-13	12
2013-14	15
2014-15	17
2015-16	17
Total	94

Table Eight: Student Success Measure Three B: IT degrees conferred at Five Closest Community Colleges: The CREATE Colleges, especially Moorpark College, provide the largest number of transfer graduates for the BSIT program, but the number still remains much lower than the number of students enrolled. (Source: CSUCI Institutional Research Office)

IT Degrees Conferred by Transfer Institution of Origin

Year	Moorpark College	Ventura College	College Of The Canyons	Oxnard College	Santa Barbara City College
2006-07	2	0	0	0	0
2007-08	3	0	1	0	0
2008-09	1	0	0	0	1
2009-10	2	3	1	1	0
2010-11	0	0	2	0	1
2011-12	3	1	1	0	2
2012-13	3	4	1	1	0
2013-14	5	3	1	2	0
2014-15	5	1	1	4	1
2015-16	5	1	2	2	0
Grand Total	29	13	10	10	5

Table Nine A and B: Student Success Measure Four: Transfer Major Graduation Rates: While Community College Transfers are the majority of the student enrollees for the BSIT program, their graduation rates are decreasing. (Source: CSUCI Institutional Research Office)

All Undergraduate IT Transfers, 4 Year Graduation Rates					
Cohort	N	Graduated in IT Major	Major Grad Rate	Graduated in CS Program	Program Grad Rate
Fall 2010	13	6	46.2%	7	53.8%
Fall 2011	9	3	33.3%	3	33.3%
Fall 2012	16	9	56.3%	9	56.3%
Fall 2013	18	13	72.2%	13	72.2%
Fall 2014	9	3	33.3%	4	44.4%
Fall 2015	11	0	0.0%	0	0.0%
Fall 2016	10	0	0.0%	0	0.0%

Undergraduate IT California Community College Transfers, 4 Year Graduation Rates					
Cohort	N	Graduated in IT Major	Major Grad Rate	Graduated in CS Program	Program Grad Rate
Fall 2010	13	6	46.2%	7	53.8%
Fall 2011	9	3	33.3%	3	33.3%
Fall 2012	16	9	56.3%	9	56.3%
Fall 2013	18	13	72.2%	13	72.2%
Fall 2014	9	3	33.3%	4	44.4%
Fall 2015	11	0	0.0%	0	0.0%
Fall 2016	10	0	0.0%	0	0.0%

Current Status and Recommendations for the Future:

After reviewing the initial data from the CSUCI Institutional Research office, the study's director proposed a meeting between community college faculty and CSUCI faculty to assess the current status of the 2+2 BSIT Program. After a joint conference call, it was decide to conduct an in-person meeting which took place in November 2017 at CSUCI. Faculty leads for Computer Engineering and Information Technology attended from Moorpark College, Oxnard College, Santa Barbara City College, and both the Computer Science and Information Technology departments of CSUCI. One of the first areas discussed was that the curricula at the community colleges and the BSIT program have diverged. Reflective of this is the incoming students surprise at how few of their community college courses are transferring as disciplinary credit. The primary recommendation from this review of the data is the recommendation that the feeder community colleges and CSUCI faculty assess curriculum realignment.

All parties are enthusiastic and future meetings are planned to reassess the curricula alignment in order to assist student progress in transfer and completion. It is noteworthy to look at why this is important and what is at stake. While matriculation rates from the community colleges continue, the numbers of students transferring and successfully completing are dwindling while the potential pool of students is growing. Data from the Computer Network Engineering Department of Moorpark College, the closest community college to CSUCI, show that the single digit transfer numbers of students do not touch the level of potential as the Spring 2017 enrollment is at 289 students. The two closest feeder community colleges to CSUCI are Moorpark College and Oxnard College where there are also a high number of disadvantaged populations including first generation students and veterans and a high number of Hispanic students all who are being underserved.