

NSF ATE CREATE Targeted Research Study

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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 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 in November 2016 from College of the Canyons she is a Professor Emeritus and had also served as Dean of Professional Programs and Academic Computing from 1996-2000. 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

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Overview of the NSF ATE CREATE Targeted Research Study

The goal of this NSF ATE research project is 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. A secondary goal is to serve as a model for longitudinal data mining and analysis for the hundreds of other ATE projects and Centers, especially those based at community colleges. Measures of achievement include progress to degree and retention, certificate and degree attainment, transfer to four-year institutions, and wage increases and wage levels by technical discipline. As part of this research the research team seeks to identify the best ways to assess student achievement (using College, State, and Federal databases) and to demonstrate successful methodologies to generate and analyze these data, which includes working with a California state funded organization to obtain longitudinal data for the project and a California state funded tool to obtain wage gain data.

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.

This ASEE poster session will highlight the recent analyses of CREATE student longitudinal data across the CREATE community colleges to measure student achievements.

Introduction:

CREATE was formed in 1996 as a joint effort of California community colleges, universities, and employers to develop a regional approach to the preparation and training of engineering technicians and the faculty who educate them. While emphasizing strong fundamental engineering technology skills, the CREATE colleges have addressed particular needs of the southern and central California employment community in credit curricula that has been institutionalized and sustained in several areas of engineering technology over more than a decade. With a focus on developing curricula and pathways for emerging technologies, CREATE focused on three specialized pathways: information technology; manufacturing technology; and renewable energy. By utilizing data in College, State, and Federal databases, the strong research team assembled for this project are analyzing the impact of long-term NSF funding in these technological areas and will make recommendations to assess post-grant achievement of students funded by NSF ATE, better elucidating the impact of the overall program.

Building on prior NSF ATE grants related to this proposal and CREATE Consortium:

NSF DUE: 9850283 (ATE Planning), 9950015 (ATE Project), ATE Regional Centers (0202396), (0602615), (1002653), (1239631), (1345306), and (1540493).

CREATE's initial project had four primary goals: curriculum development, enrollment and retention, work-based site experiences, and professional development. Project CREATE met or exceeded all of its objectives. The project completed the local, regional, and state curriculum development and approval processes and began offering 30 new engineering/manufacturing/electronics/ information technology associate degree and certificate programs. These curricula resulted in 105 new courses integrating academic and vocational subject matter with industry skill standards and/or competencies.

The CREATE Regional Center, which evolved out of Project CREATE's successes, established objectives, activities, outcomes, and timelines designed to target the seven chief areas of need or goals that the CREATE project identified. These areas include teacher preparation, high school feeder linkages, articulation and access, student worksite and internship experiences, curriculum development, curriculum delivery, and longitudinal evaluation of student success. A primary focus of all years of CREATE was faculty development especially focused micro-teaching faculty workshops both in California and later in 17 other states called the Teaching Skills Workshops and targeted disciplinary workshops both in the U.S. and in international learning exchanges. The mission continued to be on improving, institutionalizing, and sustaining specialties in emerging technologies in: manufacturing and information technologies (0202396 and 0602615) and renewable energy technologies (1002653). (123961 and 1345306 were supplements to 1002653 for international faculty learning exchanges in renewable energy

in Australia/New Zealand and Germany/Denmark). All of the targets for the Centers were achieved and exceeded. Over 27,000 unduplicated students at the CREATE colleges completed at least one CREATE credit course since the beginning of the NSF ATE project grant in 1999 and over 500 faculty attended or were impacted by the TSW and disciplinary outreach and workshops.

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 time frame 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 data mining and 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 to 10 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.

Initial measures of impact for the 2002 and 2006 Information Technology and Manufacturing Technology grants (using partner college data supplied before the end of each grant) indicated 2,135 unduplicated students successfully completed a technical sequence between 02-08. 1,450 students have graduated with an associate's degree. For the 2010-2015 renewable energy Center, most of the degree and certificate programs (in solar photovoltaics, solar thermal, energy efficiency, energy auditing, weatherization, wind turbine technology, geothermal, and energy systems) were new programs built course by course so some programs started full degree programs later in the grant term. Even so, as the chart below indicates, 107 degrees and certificates had been awarded and

with the State approval of full degree programs the partner colleges experienced former students returning to complete degrees.

CREATE Partner Colleges and Counties Served

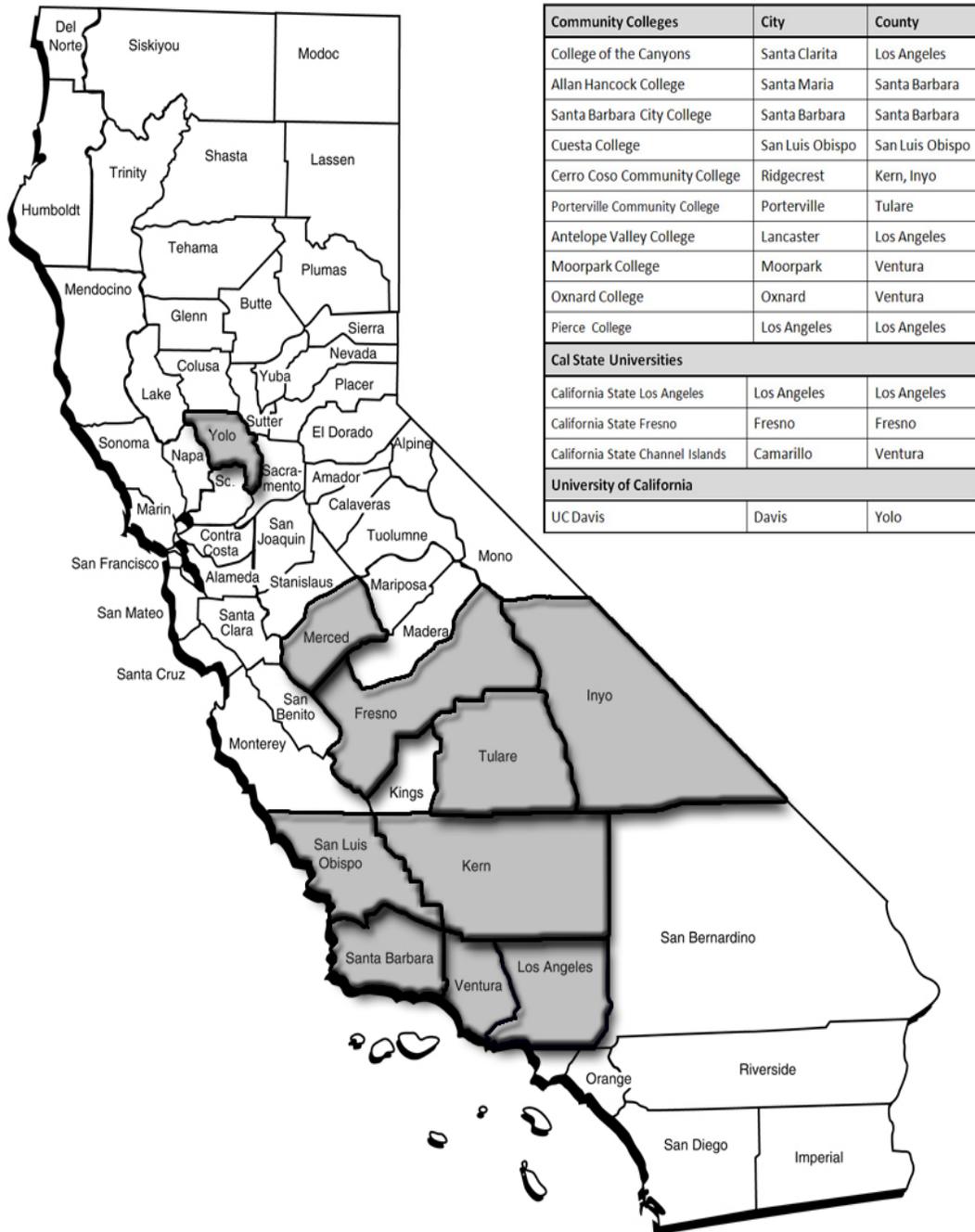
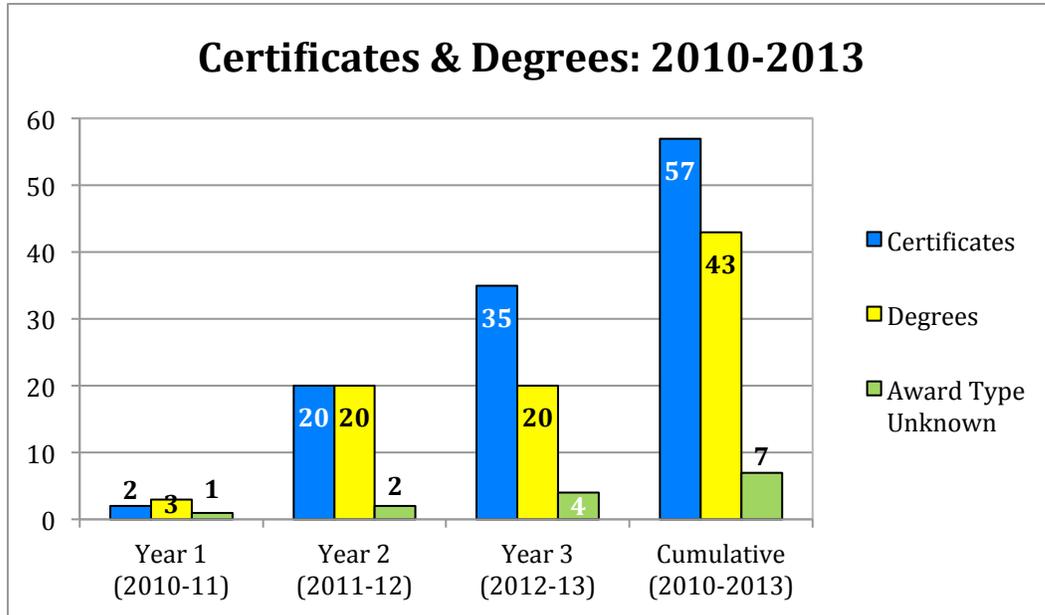


Table 2: College Statistics For Fall 2008: Information Technology/Manufacturing Technology Focus						
College	# students	% minorities	Counties	Population	Sq Mileage	# Students in Feeder Programs
Canyons	23,416	55%	Los Angeles	10,363,850	4,079	326
Cerro Coso	4,946	33%	Kern, Inyo	835,669	18,267	604
Porterville	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

Table 3: CREATE Course Renewable Energy Focus Enrollment 2010-2013*	Year 1 (2010-11)	Year 2 (2011-12)	Year 3 (2012-13)
Merced College	140	187	167
Santa Barbara City College	85	71	62
Cerro Coso Community College	165	124	115
Porterville College	60	60	49
Oxnard College	542	520	202
College of the Canyons	0	119	79
Cuesta College	1004	1133	939
CUMULATIVE ALL COLLEGES (2010-2013)	1996	4210	5823

* Due to their lack of full renewable energy programs, College of the Desert and Lompoc High School data were not listed in this table but were included in the overall study.



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 up to 27,000 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.

Methodology/Timeline/Personnel

This project is seeking to determine the best ways to assess student achievement (using College, State, and Federal databases) and to demonstrate successful methodologies to generate and analyze these data. While each College and State have a unique set of data and database resources, all States should have access to Federal databases such as the National Student Clearinghouse and the Bureau of Labor Statistics. Since all of the CREATE partner schools are located in California, this pilot research study is using predominantly California database sources, although some derive data from federal sources.

The project team investigated which resources would provide the matching of CREATE student data in a manner allowing for analysis while maintaining confidentiality for both educational and labor market wage data for the time periods involved. The team agreed that Cal-PASS Plus, created through leadership and funding by California Community

College Chancellor's Office, provided an accessible, and collaborative pre-K through 16 system of student data. Cal-PASS Plus' mission is to provide:

actionable data to help improve student success along the education-to-workforce pipeline." (<https://www.calpassplus.org>)

Cal-PASS Plus offers longitudinal data charts, detailed analysis of pre-K through 16 transitions and workplace outcomes, information and artifacts on success factors, and comparisons among like universities, colleges, K-12 school systems and schools.

Cal-PASS Plus also facilitates Regional Learning Councils to regularly convene pre-K through 16 leaders, representatives and stakeholders throughout the state so they may share data and success factors and collaborate to improve education and workforce outcomes.

Cal PASS Plus has access to K-16 California educational data but also has access to Employment Development Department (EDD) Labor Market Information. Since initial project research plans included measures of achievement such as progress to degree and retention, certificate and degree attainment, and wage increases and wage levels by technical discipline, the access to this data and the ability to manipulate and analyze the data is crucial.

Project Team Research leaders Drs. Gribbons and Meuscke were able to discuss this project with Cal PASS Plus Project Director, Ken Sorey and at the end of February 2016 CREATE was able to send the multi-college course set to Cal PASS Plus so they could provide the matching of student requested data to College of the Canyons. We also confirmed that all CREATE Colleges are members of the Cal PASS Plus agreement so that we do not need to negotiate separate agreements with each College to access and analyze their data. Using the third party matching gave our project another layer to ensure privacy of individual student data.

The research methodology being used is a quasi-experimental design which has included the following steps:

1. Validation of the list of NSF ATE CREATE-funded courses in each year from 2002 to 2014. 2002 has been chosen as the base year because it is not only the year that CREATE was first funded at the Center level, but also because that is the year which Cal PASS verified that they could begin to guarantee data availability for all of the CREATE colleges and transfer institutions. Expert faculty from each school were paid (or volunteered their time) to verify the levels (technical emphasis, certificate, degree, terminal, other) of each of the courses in each of the years. (Alfano, CREATE College lead faculty, Jan 2016)
2. Review of the faculty validation of courses by the full research team. Discussion of the possible parameters for the data sets to be generated, discussing how to

compare or contrast college cohorts and possibilities for generating usable data beyond the basic measures of achievement to be used including: progress to degree and retention, certificate and degree attainment, and wage increases and wage levels by technical discipline. (Please note: continued discussion of the datasets will be performed. For example, the research team has already defined a CREATE student as a student who has successfully completed a CREATE course. Therefore, only data from students with grades of A, B, or C will be analyzed as a completer. The research team is in agreement that students who did not satisfactorily complete a course did not benefit from the successful learning that we are trying to trace into future wage increases and educational attainment). (Meuschke, Alfano, Sando, Feb. 2016)

3. Request for datasets from Cal PASS Plus. The data was requested to be returned in aggregate. We have requested that they strip out the unique ID used by Cal-PASS Plus and put in a dummy code so we can get a student level file. This would allow us to unduplicate the records. (Cal PASS Plus expects to take 6-8 weeks to generate the datasets as requested). (Alfano, Meuschke, Sent at the end of Feb 2016)
4. Multiple iterations of datacleaning of the resulting huge big data set were needed. Among the queries and modifications needed were:
 - a. Files received on 8/1/16
 - b. Files are being pulled into SPSS 8/3-8/4/16
 - c. Return files for the period Fall 2002 – Summer 2015 include:
 - i. Course and grade information from the CB and SX referential files
 - ii. Award data
 - iii. First File (allows search for transfers)
 - d. Files not included: Employment and Wage data. These need to be pulled from Launchboard (<https://www.calpassplus.org/LaunchBoard/Home.aspx>)
 - e. Review of the faculty validation of courses by the full research team. Discussion of the possible parameters for the data sets to be generated, discussing how to compare or contrast college cohorts and possibilities for generating usable data beyond the basic measures of achievement to be used including: progress to degree and retention, certificate and degree attainment, and wage increases and wage levels by technical discipline. (Please note: continued discussion of the datasets will be performed. For example, the research team has already defined a CREATE student as a student who has successfully completed a CREATE course. Therefore, only data from students with grades of A, B, or C will be analyzed. The research team is in agreement that students who did not satisfactorily complete a course did not benefit from the successful learning that we are trying to trace into future wage increases and educational attainment). (Meuschke, Gribbons, Alfano, Sando, August/September 2016)

5. Perform first level student achievement sorting using SPSS including: progress to degree and retention, certificate and degree attainment, and wage increases and wage levels by technical discipline (Meuschke, Gribbons, Fall 2016 and Jan 2017)
6. Review first level analysis. Note any problems with datasets. Meet with research team to do formative review of research parameters and adapt if needed. (Meuschke, Gribbons, Alfano, Sando, Jan and Feb 2017)
7. Disseminate results and lessons learned of California dataset and review process and make recommendations for use by other projects and Centers and in other States. (Meuschke, Gribbons, Alfano, Spring 2017 and Fall 2017)

Please note: Cal-PASS receives data from the National Student Clearinghouse (NSC) and the Employment Development Department (EDD) allowing matching to the dataset for the colleges. If any problems are encountered with Cal-PASS not having adequate records for a college we have alternate plans to address those issues at that time. This includes working with individual colleges, if needed (not preferred but an option). One aspect to note about NSC is that over time the information available (e.g., major, etc.) has expanded. Not all institutions provide all the data elements but the NSC database has greatly improved over time.

Results:

Research Question #1:

Do students from ATE consortium programs have higher course retention and success rates compared to students from programs with the same Taxonomy of Program (TOP) codes at non-ATE consortium colleges?

Results:

Small differences in overall retention rates, two percentage points, were found between ATE and non-ATE consortium college groups. ATE consortium college students had an overall retention rate of 81.7 percent compared to 79.8 percent for non-ATE consortium college students. Using a chi square test, the differences between groups' retention rates were found to be statistically significant, $\chi^2(1, N=16,474,803)=4158.254, p<.000$.

Crosstab

		reten		Total	
		.00	1.00		
Consortium	.00	Count	2870763	11376117	14246880
		% within Consortium	20.2%	79.8%	100.0%
	1.00	Count	407606	1820317	2227923
		% within Consortium	18.3%	81.7%	100.0%

Total	Count	3278369	13196434	16474803
	% within Consortium	19.9%	80.1%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	4158.254 ^a	1	.000		
Continuity Correction ^b	4158.138	1	.000		
Likelihood Ratio	4232.429	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	4158.254	1	.000		
N of Valid Cases	16474803				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 443340.88.

b. Computed only for a 2x2 table

Research Question #1 (continued)

Modest differences in overall success rates, two percentage points, were found between ATE and non-ATE consortium college groups. ATE consortium college students had an overall success rate of 60.6 percent compared to 59.4 percent for non-ATE consortium college students. Using a chi square test, the differences between groups' retention rates were found to be statistically significant, $\chi^2(1, N=16,474,803)= 1108.374, p<.000$.

Crosstab

			success		Total
			.00	1.00	
Consortium	.00	Count	5784773	8462107	14246880
		% within Consortium	40.6%	59.4%	100.0%
	1.00	Count	878395	1349528	2227923
		% within Consortium	39.4%	60.6%	100.0%
Total	Count	6663168	9811635	16474803	
	% within Consortium	40.4%	59.6%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	1108.374 ^a	1	.000		
Continuity Correction ^b	1108.325	1	.000		
Likelihood Ratio	1110.972	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	1108.374	1	.000		
N of Valid Cases	16474803				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 901074.52.

b. Computed only for a 2x2 table

Research Question #2:

Do students from ATE consortium programs have higher numbers of completers (associate degree and/or certificate) compared to students from programs with the same TOP code programs at non-ATE consortium colleges?

Results:

Modest differences in degree completion rates and students not completing a degree or certificate, 3 percentage points each, were found between ATE and non-ATE consortium college groups. No differences were found between ATE and non-ATE consortium college students completing certificates. Specifically, the percentage of ATE consortium college students earning a degree was 17.7 percent compared to 14.8 percent of non-ATE consortium college students. The percentage of ATE and non-ATE consortium college students earning a certificate was 3 percent, each. The percentage of ATE consortium college students not earning a degree or certificate was 79.4 percent compared to 82.2 percent of non-ATE consortium college students. Using a chi square test, the differences between groups' degree and certificate completions rates were found to be statistically significant, $\chi^2(2, N=4,732,819)= 2486.705, p<.000$.

Consortium * completer Crosstabulation

		completer				
		Non-Completer	Certif	Degree	Total	
Consortium	.00	Count	3541598	128967	637638	4308203
		% within Consortium	82.2%	3.0%	14.8%	100.0%
	1.00	Count	336944	12674	74998	424616
		% within Consortium	79.4%	3.0%	17.7%	100.0%
Total		Count	3878542	141641	712636	4732819
		% within Consortium	81.9%	3.0%	15.1%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2486.705 ^a	2	.000
Likelihood Ratio	2389.777	2	.000
Linear-by-Linear Association	2415.842	1	.000
N of Valid Cases	4732819		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12707.66.

Research Question #3:

Do students from ATE consortium programs have higher numbers of transfers to four-year institutions compared to students from programs with the same TOP code programs at non-ATE consortium colleges?

Results:

Large differences in transfer rates, 8.7 percentage points, were found between ATE and non-ATE consortium college groups. Specifically, the percentage of ATE consortium college students transferring to a four-year institution was 8.9 percent compared to 0.2 percent of non-ATE consortium college students. Using a chi square test, the differences between groups' degree and certificate completions rates were found to be statistically significant, $\chi^2(1, N=4,734,287)= 306568.391, p<.000$.

Consortium * Transfer Crosstabulation

		Transfer		Total	
		.00	1.00		
Consortium	.00	Count	4301559	8112	4309671
		% within Consortium	99.8%	0.2%	100.0%
	1.00	Count	386720	37896	424616
		% within Consortium	91.1%	8.9%	100.0%
Total	Count	4688279	46008	4734287	
	% within Consortium	99.0%	1.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	306568.391 ^a	1	.000		
Continuity Correction ^b	306559.313	1	.000		
Likelihood Ratio	144486.056	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	306568.326	1	.000		
N of Valid Cases	4734287				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 4126.44.

b. Computed only for a 2x2 table

Research Question #4: Do students from ATE consortium programs have higher wage gains compared to students from programs with the same TOP code programs at non-ATE consortium programs?

Results (analysis still in progress):

These data still need to be pulled. The plan is as follows:

- Run a T-test on difference between mean wage gain for ATE and non-ATE supported programs using the CTE Launchboard data
- Provide a descriptive display of wage gain by ATE college with the colleges anonymized in the display

Note: Threats to internal validity: observed differences in outcomes for ATE consortium colleges could be due to nature of the intervention or because of other confounding variables. It is important that we document the nature of the intervention in any write up and materials that we disseminate, as this will help in understanding the impact of the ATE grant on the outcomes presented below.

Conclusions

The analyses are still ongoing so only preliminary results are available. Preliminary results indicate that there were modest gains in the areas of the research questions analyzed so far. With the large N this allows the team to have some confidence in the significance of the difference, however attribution to this intervention alone should include other factors which could also have contributed to these changes. Threats to internal validity are mentioned above. There are other factors that are worth investigating in future research including the idea that the consortium schools may attract faculty who are more open to innovation regardless of whether they have grant support. However, since the grant provided additional faculty development opportunities, specifically the Teaching Skills Workshop and targeted disciplinary workshops, it is very possible that this does make part of the difference.

Acknowledgements

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