Colorado Helps Advanced Manufacturing Program

Final Report

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RUTGERS
Education and Employment Research Center

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ABOUT RUTGERS' SCHOOL OF MANAGEMENT AND LABOR RELATIONS

Rutgers' School of Management and Labor Relations (SMLR) is the leading source of expertise on the world of work, building effective and sustainable organizations, and the changing employment relationship. The school is comprised of two departments—one focused on all aspects of strategic human resource management and the other dedicated to the social science specialties related to labor studies and employment relations. In addition, SMLR provides many continuing education and certificate programs taught by world-class researchers and expert practitioners.

SMLR was originally established by an act of the New Jersey legislature in 1947 as the Institute of Management and Labor Relations (IMLR). Like its counterparts created in other large industrial states at the same time, the Institute was chartered to promote new forms of labor–management cooperation following the industrial unrest that occurred at the end of World War II. It officially became a school at the flagship campus of the State University of New Jersey in New Brunswick/Piscataway in 1994. For more information, visit smlr.rutgers.edu.

ABOUT THE EDUCATION AND EMPLOYMENT RESEARCH CENTER

Rutgers' Education and Employment Research Center (EERC) is housed within the School of Management and Labor Relations. EERC conducts research and evaluations on education and workforce development programs and policies. EERC research expertise includes community colleges, state and federal workforce developmental systems, skills development, college completion, and innovative and technology-based educational programs.

EXECUTIVE SUMMARY

TAACCCT PROGRAM/INTERVENTION DESCRIPTION AND ACTIVITIES

Project and Purpose

Under the CHAMP TAACCCT grant, consortium colleges were tasked with developing or redesigning identified advanced manufacturing-centered programs to 1) to build off Colorado's existing and emerging manufacturing sector partnerships and career pathway work to develop employer-driven curriculum; 2) use technology to accelerate training and reach a broad audience, and 3) develop stackable and latticed certificates with institutional articulation agreements between the participating community colleges and Metropolitan State University at Denver (MSU Denver). Methods of reaching the above goals included the creation of the Career Action Tool website for students to explore careers in manufacturing, Massive Open Online Courses (MOOCs), the development of career pathways, the creation of articulation and transfer agreements, and the creation of digital badges. In addition, consortium staff were to redesign the current Colorado Community College System model for credit for prior learning to accelerate certification. Consortium schools were also to hire a navigator to assist students from enrollment through graduation, to help students build employability skills, and to engage and build relationships with local employers and workforce development offices.

This evaluation was prepared by CHAMP's third-party evaluator, Rutgers Education and Employment Research Center (EERC).

Interventions

Across the nine consortium schools, the following interventions were evaluated:

Intervention	**Proposed Change Effect**
Use technology to accelerate training and reach a broader audience	Increase access to courses for rural and non-traditional students through online and hybrid courses; increase alignment with local industry
Purchase equipment for classrooms/shops to create a more "real-world" learning environment	Increase hands-on learning in the classroom, increasing students' skills sets and employability; address industry needs in the classroom
Redesign/restructure prior learning assessment	Increase ability for students who have knowledge/experience outside of formal education to apply that knowledge to higher education, earning academic credits, thereby shortening the time for credentials and reducing costs

Integrate intensive advising through a navigator	Identify and remove barriers to success for students; increase retention and completion; increase job placement
Build/expand relationships with employers and local workforce representatives	Increase employer buy-in for programs; place students in jobs
Create stackable credentials	Allow multiple entry and exit points for non-traditional and incumbent-worker students; create career pathways leading to advanced manufacturing jobs
Develop a portal for students to plan their future career in advanced manufacturing	Create the Colorado Career Action Website, giving students a user-friendly tool to explore and plan their future advanced manufacturing career; facilitating student participation in career pathways in advanced manufacturing
Create and use OER resources	Develop material to expand the available online database of open education resources; reduce cost of learning materials for students; increase collaboration among faculty
Develop and deploy online tools for student self-assessment and to refresh student skills relative to advanced manufacturing and employability skills	Create three Massive Open Online Courses (MOOCs) which will include math fundamentals for engineering and manufacturing, basic employability skills, and prior learning assessment; enable students to refresh their skills and increase their knowledge base in three targeted areas
Streamline transfer and articulation to Metropolitan State University	Allow students to crosswalk their manufacturing program to the university's engineering degree increasing transferability toward a bachelor's degree at MSU Denver
Create badges in specific industry-aligned courses	Create badges for industry-specific skills; enable students to receive badges signifying industry-specific skills, increasing employability

The following components of the above-listed interventions were evaluated:

- Recruitment/enrollment of target population
- Use of the CHAMP online instructional team to collaborate with faculty on course design/redesign
- Navigator role at each college
- Hands-on learning/use of equipment in programs
- Development and use of career pathways/stackable credentials
- Job placement

- Development and use of internships/clinicals
- Use of prior learning assessment
- Use of the Colorado Career Action Website
- Use of the MOOCs
- Implementation of and use of badging

Populations Served

- 4,354 unique participants enrolled in eight[1] CHAMP schools from 2014-2017
- 30 percent of CHAMP students were minority students
- 52 percent of CHAMP students were traditional-age students
- 40 percent of CHAMP students were Pell eligible
- 9 percent of CHAMP students had military experience
- 85 percent of CHAMP students were male
- 15 percent of CHAMP students were female

Evidence-based Model

The proposed strategies for restructuring advanced manufacturing programs through online and hybrid delivery were based on strong research about adult learning models, and best practices in online career and technical education courses (Benson et al, 2004). Research indicates that online and hybrid learning models have a strong affinity with adult learning theory, which stresses the need for autonomy, self-direction, and relevant learning as key design elements (Ausbum, 2004). A strong body of evidence on blended learning models supported CHAMP's approach, and the CHAMP model was based on research from the University of Central Florida (Graham and Dziuban, 2008) and the Center for Technology in Learning at the U.S. Department of Education (Means, Toyama, Murphy, and Jones, 2009).

There was also strong evidence to support CHAMP's student coaching strategy that the navigators used. In a recent randomized experiment of mostly non-traditional students that took place over two years, researchers found that the students who were randomly assigned to a coach were more likely to persist during the treatment period, and were more likely to still be attending the university one year after the coaching had ended (Bettinger and Baker, 2011). Coaching also proved a more cost-effective method of achieving retention and completion gains

[1] EGTC was not included in the analysis

when compared to previously studied interventions such as increased financial aid (Bettinger and Baker, 2011).

EVALUATION DESIGN SUMMARY

The EERC evaluation of CHAMP used the framework of developmental evaluation as the guide for both the implementation and outcomes. The project was focused on expanding access to and improving institutional capacity for advanced manufacturing training and education in primarily rural areas of Colorado. It was hypothesized that this could be achieved using three primary tools and activities: technology, student supports and industry/employer engagement. Data was collected in a variety of ways including site visits, interviews, focus groups, document review, surveys, the CCCS academic tracking system, a navigator activities database, and attendance at project meetings and events.

The implementation evaluation was guided by several broad research questions. More detailed research questions were also posed for many of the activities and interventions in the project and are discussed throughout the main report.

Program and Strategy Design:

- How did colleges understand the goals of CHAMP?
- How was CHAMP operationalized at the consortium level?
- How was CHAMP operationalized at each college?

Program Operations:

- How were the key components (technology, student supports, prior learning assessment, and industry/employer engagement, navigators) implemented at each college?
- What promising practices emerged in implementation?
- What challenges emerged in implementation?
- What role did partner organizations play? How did they collaborate?
- Are colleges scaling and sustaining policies and practices that emerged from CHAMP? If so, how?

The outcomes evaluation considered students served at each college and used a multivariate regression model. The examined outcomes include students served, credentials achieved, grades achieved and employment and wage outcomes.

There are some caveats in interpreting results in the outcomes analysis:

College Calendars and Course Offerings: Colleges did not necessarily have the same semester start and end dates. Further, not all colleges offered CHAMP courses during the summer. The mismatch of colleges across the CHAMP may introduce errors in the calculation of time to credential/degree, the semesters in which student graduated, and students' employment upon graduation.

Demographic Characteristics: Students self-reported on a number of demographic characteristics including military background, Pell status and disability. Self-reported data is not always reliable. There can be errors in reporting or missing data. Therefore, it is not known whether missing data on military background, Pell status, and disability conditions reflected the fact that students did not have these experiences, or they were simply not recorded. In the current analysis, EERC considers any student who did not provide information on Pell status, military background, and disability status as not having these characteristics or experiences.

Size of CHAMP student population: Consortium colleges ranged from rural to urban and from small to large. Student populations thus varied. In addition, larger colleges tend to have access to more institutional resources including teaching faculty than the smaller ones. As such, they may be able to attract and enroll more students. Within this context, EERC found wide variations in the number of students enrolled in CHAMP. As such, readers are cautioned about interpreting some of the consortium level results, i.e., one or two college's experiences may strongly influence the aggregated statistics.

Time Censoring: Time censoring in data collection was a problem for EERC's analysis. Students enrolled at different times in CHAMP courses – some beginning as late as fall 2016. The more time elapsed from a student's initial entrance into a CHAMP course of study, the greater the chance the student completed a program of study and entered employment. EERC was thus better able to capture students' academic and employment outcomes for earlier cohorts than later cohorts. As a result, this report may underestimate graduation and employment rates. To better evaluate the academic and employment outcomes for all CHAMP students, further follow-up data collection and research are needed.

College CHAMP Program Offerings: Colleges did not all offer the same type of credential, and some colleges structured their programs to be a sequence of stacked credentials towards an associate degree. Thus, while EEERC does do some comparisons between the colleges, the reader needs to be mindful that credentials differ in the time they take to complete.

Intersection of Various Student Characteristics: This report presents a broad profile of the CHAMP student populations without analyzing the intersections of different demographic characteristics. For example, individuals who served in the military may be older than those who did not. We present outcomes for each of these characteristics separately when in fact there may be some relationship between age and military background.

IMPLEMENTATION

Institutional Capacity

CHAMP goals were well-aligned with the institutional goals of consortium schools. These included:

- A priority to better align advanced manufacturing programs with the needs of local industry
- A priority to build career pathways and to create/expand stackable credentials
- A focus on hands-on learning in the classroom
- Expansion of advanced manufacturing programs
- Some schools' institutional objectives to move toward hybrid courses
- Most schools' institutional goals to create stronger prior learning assessments

- Because institutional goals and CHAMP goals were closely aligned, institutional buy-in was present, which encouraged both faster implementation as well as sustainability planning

- Institutional capacity was built by restructuring programs to create multiple entry and exit points (i.e., the creation of stackable credentials), restructuring prior learning assessment, the creation of some digital badges, the purchase of foundational and technologically advanced equipment, and the expansion of programs to better serve rural and nontraditional students

Key Steps Taken at Program Level

Each of the nine consortium colleges leveraged internal, consortium-level, and external relationships to inform, redesign/build, and execute their respective curriculum and programs.

- **Internal collaboration included**:
  - Faculty working with institutional instructional designers and/or the CCCS online instructional design team to transition courses to online/hybrid formats
  - Faculty working with instructional designers to find appropriate OER content and integrate it into courses
  - Faculty working with instructional designers to create and upload OER content to SkillsCommons
  - Project leads working with faculty and staff to order appropriate equipment and material for programs
  - Internal IT departments and/or other staff working with faculty to offer assistance and professional development relative to online/hybrid course offerings
  - Faculty working together to create and share new teaching techniques and program curricula
  - Navigators and faculty working together to present program information to students
  - Navigators, faculty, and staff working together across campus offices to provide student assistance; collaboration occurred across student services, academic tutoring, career services, internships, financial aid, and health services among others.

- **Consortium-level collaboration included**:
  - Faculty creating and sharing curricula across the consortium
  - Student-focused navigators sharing promising practices and challenges with other student-focused navigators
  - Employer-focused navigators sharing promising practices and challenges with other employer-focused navigators
  - Project leads sharing promising practices and challenges with other project leads
  - Faculty sharing challenge tests for prior learning assessment

- **External collaboration included**:
  - Faculty and employers working together to develop new/redesigned curriculum and to choose equipment for purchasing
  - Faculty and employers working together to integrate soft skills into the classroom
  - Employers visiting classrooms to discuss job expectations and career paths with students
  - Navigators working with staff from the regional workforce center, interacting with employers, and interacting with members of the CHAMP advisory boards and industry representatives
  - Navigators working with employers to understand expectations for potential new hires
  - A series of collaborative and intersecting industry-sector summits, business advisory groups, task forces, and work groups were convened for actual and potential stakeholders to identify the competencies most needed by industry, to review badging projects, and to explore accessible platforms and standards
  - Several colleges' hosting "Manufacturing Days" events to invite employers, prospective students, and community members to visit shop space and take part in industry-specific activities

- All nine consortium schools implemented their programs with fidelity to the original model even with unexpected delays occurring at some colleges

- Delays in implementation at some schools included issues related to space renovation, equipment ordering and delivery, appropriate staff recruitment, and program acceptance

Strengths and Weakness at the College Level

Consortium schools exhibited an array of strengths and weakness.

Strengths:

Relative to strengths, most schools effectively:

- Collaborated internally and externally to build stronger programs that were better tailored to their respective job markets

- Stimulated some faculty members to embrace hybrid technology
- Built and expanded relationships with employers and workforce centers
- Recruited nontraditional students
- Placed students in jobs
- Began the process of re-structuring prior learning assessment
- Added hands-on learning to advanced manufacturing courses through the addition of state-of-the-art equipment and technology
- Increased graduation rates using intensive advising
- Created a series of badges in technical math, engineering graphics, and machining
- Developed a technical math digital badge in conjunction with the math MOOC
- Used social media platforms as a recruitment strategy to showcase CHAMP program options
- Created marketing materials that included success stories profiling CHAMP students
- Recruited underrepresented populations
- Maintained a regular and active presence in classrooms and labs via the navigator, which helped establish mutual rapport and created opportunities for emerging issues to be identified and addressed more quickly. It also helped students feel "embraced by the college"
- Reviewed transcripts and followed up with students, which increased the number of credentials awarded. This helped students with their job searches and helped colleges build their retention and completion rates
- Reached out to high school students to create a next generation pipeline
- Integrated "soft skills" into coursework in a way that students reported valuing
- Created advisory boards for each program designed/redesigned under the grant
- Engaged employers as "co-designers" of curriculum

Relative to weaknesses, some schools had difficulty:

- Educating employers and some faculty and staff about the benefits of digital badging
- Educating employers about the benefits to students of some certificates

- Convincing some faculty members of the benefits of transitioning certain courses to hybrid formats
- Convincing some faculty members of the benefits of restructuring PLA
- Creating clarity about the focus and activities of the navigator; including defining the navigator's role and functions
- Providing industry knowledge to some navigators who lacked it
- Providing office space for navigators, which reduced navigators' visibility and created barriers to building strong connections with students as well as other campus services
- Funding marketing and recruitment activities
- Dealing with staff turnover, especially navigator turnover
- Integrating the navigator position into the institution's network
- Justifying the need for a dedicated navigator
- Finding employers to host internships; safety and liability issues as well as a lack of resources were frequently cited reasons employers did not offer internships
- Tracking student referrals from workforce centers; Colorado has no formalized statewide data collection mechanism
- Keeping students—especially those doing internships—in their program; students were often offered jobs prior to completion

PARTICIPANT IMPACTS AND OUTCOMES

EERC's evaluation focused on three student outcomes: retention, graduation, and employment:

Retention

- Among CHAMP students who had not earned a credential, a little less than half continued to work on their program (47.3 percent) for at least another semester after their first CHAMP enrollment
- Among those who had completed a CHAMP program, 40 percent of them remained in school for additional study for at least another semester after completing the credential
- For both the non-completers and completers, retention rates declined over time
- Retention rates for the fall cohort was always higher than for the spring cohort

- Compared to the midpoint on the salary range given in the last job title in the career pathway, current students believe ex-graduates earn significantly more money than the data suggest in the fields of production/assembly and welding
- Students expect to earn significantly more than their estimates of the average, or typical, graduate of their program
- A significant majority of students expect to find a job immediately after graduation
- More students consider finding a job immediately after graduation to be more important that finding a job that offers long-term advancement
- Career pathways information has little effect on students' earnings expectations, except in machining, where students expect to earn less after seeing the information
- Career pathways information has a significant effect on students' employment expectations, particularly in engineering and manufacturing

Graduation rate

- Between spring 2014 and fall 2016, 1,290 out of 4,354 CHAMP students (29.6 percent) graduated with at least one credential
- Nine percent of CHAMP students earned an associate degree
- One percent earned a long-term certificate
- 19 percent earned a short-term certificate
- Regardless of the type of credential earned, full-time versus part-time student status appears to be strongly associated with rates of graduation. Graduation rates for full-time students was about 18 percentage points higher than part-time students
- Students with financial aid had a higher graduation rate than those without (35 percent vs. 26 percent)
- Military background also had a positive association with graduation rate (37 percent for students with military background vs. 29 percent among those without)
- Black students had the lowest graduation rate at 25 percent while 37 percent of American Indians/Alaskan natives CHAMP students graduated followed by a graduation rate at round 32 for white, Hispanic, Asian, and students in other racial groups
- Age and gender did not appear to be associated with CHAMP students' rate of graduation

- Time to graduation: About 60 percent of all CHAMP completers earned their first credentials within 2 semesters of enrolling. Over 90 percent of credential earners finished the program in six semesters, or three academic years
- Stacking: 80 percent of CHAMP students focused on and earned a single type of credential. Twenty percent of all graduates (N=253) earned multiple types of credentials. A larger number of completers earned both a short-term certificate and an associate degree, 11.6 percent (N=159).

Employment

EERC examined student employment status at enrollment and upon completing the first credential for non-incumbent workers, as well as any wage increase for incumbent workers.

- 44 percent of CHAMP students were incumbent workers.
- 30 percent of the 773 completers who were not employed at time of initial enrollment were employed in the first quarter after they earned their first CHAMP credential (N=228)
- Employment rates varied by demographic background, financial aid status, and military background
- Of the students who reported their race/ethnicity, white and Hispanic students had a higher than average rate of employment rate (31 percent and 33 percent respectively)
- The employment rates among black and American Indian/Alaskan native students were low at 5 and 7 percent respectively
- Asian students also had a low employment rate at 17 percent
- Traditional students had a 10 percent higher rate of employment than their non-traditional counterparts
- The employment rate of degree earners among students with military background was 7 percent lower than the consortium average (30 percent)
- Wage increase: EERC found that 67.1 percent of incumbent workers had an increase of over $500 in quarterly wages
    - Male incumbent workers experienced a higher rate of wage increase than female incumbent workers—68.4 percent as compared to 58.8 percent
    - About 74 percent of American Indian/Alaskan Native received increases in their wages, the highest rate across all racial/ethnic categories
    - White students also had a wage increase of 67.7 percent
    - Wage increases among Hispanic students was 64.3 percent

- Less than half of Asian incumbent workers experienced a wage gain
- 53.3 percent of black incumbent workers experienced a wage increase
- Wage increases were 6 percentage points higher among CHAMP students without financial aid than their counterparts with Pell assistance (69 percent vs. 63 percent)
- Incumbent workers without military background had higher wage increases than their counterparts without military experiences (68 percent vs. 59 percent).

Navigators

EERC's analysis also included a detailed look at students served by navigators during the grant.

- Between spring 2014 and spring 2016, CHAMP program navigators served 1,215 of the 3,346 CHAMP enrollees (36.3 percent) in eight CHAMP institutions[2] and an additional 544 non-CHAMP students
- 29 percent of CHAMP students served by program navigators were minority students
- 36 percent of CHAMP students (1,208 out of 3,346) were deemed Pell eligible
- Just under 10 percent of CHAMP students were active or former military

Navigators and Retention

Among students who did not earn a credential in the observational period:

- Navigator-served students had higher retention rate than their counterparts not served by program navigators
- The positive association between navigator contact and retention was observed for both the spring and fall cohorts

Navigators and Graduation Rates

- CHAMP students who contacted a navigator had a completion rate 5 percentage points higher than those who did not contact a navigator—33 percent versus 28 percent
- Navigator-served CHAMP students had a higher graduation rate than those not served by navigators regardless of their original declared goal of study

[2] EGTC was not included in the analysis

- There was a higher rate of navigator-served students who stacked credentials than of those who had not been served
- Among those earning associate degrees, 51 percent of students who had contact with a navigator earned at least one additional credential, as compared to 36 percent without navigator contact
- Among those completing only short-term certificates, 33 percent of students who had contact with a navigator earned more than one short-term certificate while 44 percent of their counterparts not served by navigators earned more than one short-term certificate

Navigators and Employment

- Among non-incumbent workers, 539 students earned credentials between spring 2014 and spring 2016
- Employment rates upon graduation were similar for both non-incumbent workers who interacted with a CHAMP navigator and those did not (34 percent vs. 37 percent)

NEXT STEPS FOR RESEARCH

- Re-examine retention and completion outcomes after more time has elapsed
- Re-examine employment outcomes after more time has elapsed
- Re-examine prior learning assessment outcomes after more time has elapsed
- Examine badging as implemented at system colleges after more time has elapsed
- Examine sustainability and scaling of CHAMP activities over time

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PART A: INTRODUCTION

INTRODUCTION

The Colorado Helps Advanced Manufacturing Program (CHAMP) was a U.S. Department of Labor (USDOL) Trade Adjustment Assistance Community College and Career Training (TAACCCT)-funded grant project intended to develop or redesign identified advanced manufacturing-centered programs. The goals of the project were to 1) build off Colorado's existing and emerging manufacturing sector partnerships and work on career pathways to develop employer-driven curriculum; 2) use technology to accelerate training and reach a broader audience, and 3) develop stackable and latticed certificates with institutional articulation agreements between the participating community colleges and Metropolitan State University at Denver (MSU Denver). In addition, CHAMP consortium staff were to redesign the current Colorado Community College System model for credit for prior learning to accelerate and expand certification. Consortium schools were also to hire a navigator to assist students from enrollment through graduation, and to engage and build relationships with local employers and workforce development offices.

CHAMP was an intrastate consortium consisting of seven community colleges, one four-year university, and one technical college located in Colorado. The partner colleges were Pueblo Community College (PCC), Red Rocks Community College (RRCC), Pikes Peak Community College (PPCC), Front Range Community College (FRCC), Community College of Denver (CCD), Lamar Community College (LCC), Aims community college (Aims), Metropolitan State University, and Emily Griffith Technical College (EGTC).

CHAMP ORGANIZATIONAL STRUCTURE

The CHAMP project's organizational structure included an administrative team housed at the Colorado Community College System (CCCS). The CCCS team consisted of a program director, a prior learning assessment coordinator, an instructional design project manager, two instructional designers, a navigator/outreach coordinator, a data coordinator, an administrative assistant, and a fiscal manger. The administrative team was responsible the oversight of all programmatic activities conducted by partner colleges and contractors, as well as data and reporting processes. During the final year of the grant, the program director resigned and the navigator/outreach coordinator stepped into the position for the remainder of the grant, combining both roles.

The CCCS administrative team managed a leadership team consisting of 26 employers, college vice presidents and deans, prior learning assessment representatives, and workforce center representatives. The leadership team met during the grant period to discuss and plan various grant-related project and design/redesign efforts. A 26-member inter-sectoral advisory committee was also managed by CCCS. Its goal was to solicit input from regional employers, prior learning assessment representatives, and college project leads on various grant-related projects.

Each consortium college had its own onsite CHAMP team and leveraged campus resources including information technology, human resources, procurement, accounting, facilities, admissions, and academic departments. College CHAMP teams consisted of a project lead, at least one navigator, an instructional designer[3], key faculty members, and a fiscal lead. The grant's fiscal lead was FRCC, therefore FRCC also had fiscal staff as members of its CHAMP team.

CCCS contracted with the Council for Adult and Experiential Learning (CAEL) to help guide policy recommendations for prior learning assessment, serve as consultants to CCCS' prior learning assessment subcommittee, and to provide trainings to individual colleges relative to prior learning assessment. The prior learning assessment subcommittee was tasked with 1) soliciting input from both consortium colleges and non-consortium colleges and four-year universities relative to existing prior learning assessment practices; 2) reviewing existing Colorado prior learning assessment policies; and 3) identifying potential revisions for policy-makers to consider.

PROJECT CONTEXT

The focus of the CHAMP grant was "advanced manufacturing;" manufacturing that makes extensive use of computer, high precision and information technologies, coupled with a high-performance workforce capable of producing large or small volumes with the efficiency of mass production and the flexibility of custom manufacturing, that can rapidly respond to customer demands.[4] Manufacturing is critically important sector in the United States. It provides high-wage jobs, supports innovation and reduces the trade deficit.

Colorado has experience with manufacturing sector partnerships, the integration of career pathways and sector partnerships, and for the successful outcomes of its National Governors Association Policy Academy on advanced manufacturing in 2013 (Woolsley, 2013). Colorado experienced a growth in manufacturing jobs of 6.9 percent during the period from 2009 to 2013 (The Manufacturing Institute, 2014.) Mirroring national trends, however, Colorado's manufacturing sector has experienced a skills gap with fewer individuals having the requisite foundational knowledge, specialized skills, portable production skills, as well as flexibility and adaptability in work habits. The current workforce is also aging meaning that new workers will be needed to fill positions when baby boomers retire.

The state needs a manufacturing workforce trained in sophisticated new manufacturing methods including automation and high-technology equipment as well as the professional skills to work in a rapidly changing environment. The CHAMP grant was proposed to fill these needs, enabling community colleges to train and prepare individuals for modern manufacturing.

[3] Some schools did not employ an instructional designer

[4] The National Council for Advanced Manufacturing

To effectively recruit, train, and place students in current and future advanced manufacturing jobs, CHAMP colleges recognized the need to work closely with industry employers. As such CHAMP colleges partnered with industry employers committed to helping consortium colleges 1) define goals; 2) identify necessary skills in potential employees; 3) develop curriculum; 4) provide resources, 5) host interns, 6) develop pathways, 7) mentor faculty, and 8) hire students.[5] This synergy of colleges and industry partners helped CHAMP colleges create dynamic, relevant, training opportunities in advanced manufacturing for Colorado students.

EVALUATION

The Education and Employment Research Center (EERC) at Rutgers University was hired to provide a third-party implementation-and-outcomes evaluation for CHAMP. Prior EERC CHAMP project reports can be found on the EERC website.[6] They include:

- CHAMP Year 1 and Year 2 Quantitative Report
- CHAMP Year One Report
- CHAMP Website Brief
- Prior Learning Assessment and Student Outcomes Across CHAMP colleges
- Aims Community College Case Study
- Community College of Denver Case Study
- Emily Griffith Technical College Case Study
- Front Range Community College
- Lamar Community College Case Study
- Metropolitan State University of Denver Case Study
- Pueblo Community College Case Study
- Pikes Peak Community College Case Study
- Red Rocks Community College Case Study
- Lamar Community College Process Brief: Hybrid Welding

This is EERC's final CHAMP report. It is separated into seven parts as an edited volume which include briefs written highlighting important aspects and outcomes of the grant. Each brief is a chapter. Some of these chapters will also be posted later on the EERC website.

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[5] CHAMP proposal

[6] https://smlr.rutgers.edu/content/education-employment-research-center-eerc

Part A summarizes the project's background and context, and outlines CHAMP's goals. It also gives a broad overview of the methodology used for the final report (individual methodologies are detailed in each chapter). Part B details the student profiles—including demographic data—and student outcomes (academic and employment) relative to all four years of the grant. Part C provides in-depth discussion of program activities—implementation and impact—intensive advising, prior learning assessment redesign, industry badges, grant-purchased equipment, and the integration of automation. Part D details skills building and career pathways, major areas of focus throughout the grant period and includes chapters on equipment and student decision-making. Part E focuses on employers and employment outcomes, including industry and workforce relationships. Part F details the student experience during the final two years of the project. Part G discusses sustainability and some of the future plans of consortium colleges.

FINAL REPORT METHODS OVERVIEW

This EERC final report uses qualitative and quantitative data and analysis and provides outcome measures. Because the report was written as an edited volume, each section of the report was written individually and with different methods/frameworks for analysis, including different timeframes and sections of the data. Thus, detailed methods are reported in each section of the report. It is important to understand that this may result in varied findings throughout the report and different numbers that address some of the same ideas in different ways. These differences are a result of variances in populations, timeframes and methods being used. The following is meant to be a general overview of the methods used broadly in the report.

Qualitative methods

Qualitative methodology for this report includes content analyses of consortium goals and activities; relevant proposals and project-, college-, and contractor-specific statements of work; quarterly reports; navigator monthly reports; and project websites. EERC team members also conducted phone and in-person interviews with CHAMP staff, faculty, and students as well as CCCS staff involved with the CHAMP project. Throughout the course of the project, the EERC team conducted the following focus groups and individual interviews with individuals involved with CHAMP:

Positional Relationship to CHAMP	Number of Focus Groups/Individual Interviews*
Administrator (including CCCS staff):	29
Employer	14
Faculty Member	45
Instructional Designer	5
Navigator	27

Prior Learning Assessment Staff	11
Project Lead	31
Student Advisor	1
Student	54

*Some interviews were done individually while others were focus groups with multiple interviewees. Thus, counts are of focus groups/interviews and not of interviewees.

In addition, EERC team members have "observed" conference calls with project leads and career coaches, and joined in on webinars. Most interviews were taped and transcribed; non-taped interviews involved extensive note taking. Both transcriptions and notes, as well as the documents cited above, were coded using NVivo qualitative data management software and analyzed by EERC team members.

Quantitative Methods

Quantitative data were received from the Colorado Community College System as well as from each of the non-system schools (EGTC, MSU, and Aims). More specific information about the data pull, its parameters, and the tools used to analyze the data set are included in the Student Outcomes section of this report.

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PART B: STUDENTS SERVED AND STUDENT OUTCOMES

CHAPTER 1: STUDENT PROFILES, AND ACADEMIC AND EMPLOYMENT OUTCOMES

Li Kuang and Heather McKay

This brief presents EERC's quantitative analysis of CHAMP students' enrollment, academic achievement, and employment outcomes. We define a "CHAMP student" as any individual who enrolled in at least one course identified by the colleges as part of a CHAMP program of study.[7] In the following pages, we will discuss the details of these three broad domains.

- *Student enrollment and demographics*: CHAMP students' sociodemographic background (gender, race/ethnicity, age), registration status at first CHAMP enrollment, financial aid status, and military background.
- *Academic achievement*: CHAMP students' graduation rate, number of credentials earned, time elapsed from initial enrollment to first credential, and students' retention rates.
- *Employment*: CHAMP students' employment status when they first enrolled in a CHAMP program (*incumbent worker* or *non-incumbent worker*); and the employment of non-incumbent worker students after they earned their first credential. In addition, wage increases for incumbent worker students' post-enrollment in CHAMP

DATA

Enrollment in CHAMP programs began in the spring of 2014. The report's study period thus extends from spring 2014 through fall 2016.

All nine CHAMP colleges are included in the study: Aims, Community College of Denver (CCD), Emily Griffith Technical School (EGTC), Front Range Community College (FRCC), Lamar Community College (LCC), Pueblo Community College (PCC), Pikes Peak Community College (PPCC), Red Rocks Community College (RRCC), and Metro State University (MSU). With the exception of MSU and EGTC, all CHAMP participating colleges were community colleges. The community colleges conferred short-term (within one year) certificates, long-term (between one and two-years), as well as associate degrees. MSU, a 4-year university, offered short-term certificates and bachelor's degrees. EGTC a technical colleges, offered short-term certificates.

Quantitative data used in this final report were collected from the Colorado Community College System (CCCS) on behalf of the system schools (CCD, FRCC, LCC, PCC, and PPCC). In addition, EERC received data directly from three of the non-CCCS schools—Aims, EGTC, and MSU.

The data retrieved from the above sources includes CHAMP student registration information, course history, and graduation information. It also includes demographic information, e.g.,

[7] A CHAMP developed or redesigned course.

race/ethnicity, gender, age, disability status, military experience, and financial aid status using Pell eligibility as a proxy.

Employment and wage data for CHAMP students was obtained through a data-sharing agreement with the Colorado Department of Labor and Employment.

For the CHAMP courses redesigned or created under the CHAMP grant, EERC used a list of course compiled by CCCS and each of the non-system schools. From this course list, EERC generated college lists which were then confirmed by each college's CHAMP project lead.

Data collection for the final report was pulled from all data sources in March of 2017 and included data through the fall 2016 semester. Spring and summer 2017 data are not included in this analysis. For the above-cited study period, EERC identified a total of 4,354 students as CHAMP enrollees.

The data primarily represents students taking credit coursework with the exception of the data from FRCC which includes non-credit students. The inclusion of these non-credit students may skew graduation and completion rates at FRCC. CCD also had non-credit students in their program but that data was not available at the time of analysis.

In the sections below, for each research question, we report our findings at the CHAMP consortium level as well as at the college level.

STUDY LIMITATIONS

There are a number of limitations of which the reader needs to be mindful.

College Calendars and Course Offerings: Colleges did not necessarily have the same semester start and end dates. Further, not all colleges offered CHAMP courses during the summer. The mismatch of colleges across CHAMP may introduce errors in the calculation of time to credential/degree, the semesters in which students graduated, and rates of student employment upon graduation.

Demographic Characteristics: Students self-report on a number of demographic characteristics including military background, Pell status, and disability. Self-reported data are not always reliable. There can be errors in reporting or missing data. Therefore, it is not known whether missing data on military background, Pell status, and disability conditions reflected the fact that students did not have these experiences, or they just were not recorded. In the current analysis, EERC considers any student who did not provide information on Pell status, military background, and disability status as not having these characteristics or experiences.

Size of CHAMP student population: Consortium colleges ranged from rural to urban and from small to large. Student populations thus varied. In addition, larger colleges tend to have access to more institutional resources, including teaching faculty, than the smaller ones. As such, they may be able to attract and enroll more students. Within this context, EERC found wide variations in the number of students enrolled in CHAMP. As such, readers are cautioned about interpreting some of the consortium level results, i.e., one or two colleges' experiences may strongly influence the aggregated statistics.

Time Censoring: Time censoring in data collection was a problem for EERC's analysis. Students enrolled at different times in CHAMP courses – some beginning as late as fall 2016. The more time elapsed from a student's initial entrance into a CHAMP course of study, the greater the chance the student completed a program of study and entered into employment. EERC was thus better able to capture students' academic and employment outcomes for the earlier cohorts than their counterparts in the later cohorts. As a result, this report may underestimate graduation and employment rates. To better evaluate the academic and employment outcomes for all CHAMP students, further follow-up data collection and research are needed.

College CHAMP Program Offerings: Colleges did not all offer the same type of credential, and some colleges structured their programs to be a sequence of stacked credentials towards an associate's degree. Thus, while EERC does do some comparisons between the colleges, the reader needs to be mindful that credentials differ in the time they take to complete, e.g., one-semester short-term certificate to four or more years for a bachelor's degree.

Intersection of Various Student Characteristics: This section presents a broad profile of the CHAMP student populations without analyzing the intersections of different demographic characteristics. For example, individuals who served in the military may be older than those who did not. We present outcomes for each of these characteristic separately when in fact there may be some relationship, e.g., between age and military background.

POPULATION PROFILE - ENROLLMENT AND DEMOGRAPHICS

This section begins with the numbers of students[8] enrolled in each CHAMP program year beginning with spring 2014 and ending fall 2016. We then present students' demographic characteristics including, Pell eligibility, employment experiences, and military background. All data are reported for the CHAMP consortium as a whole and for each individual CHAMP institution.

Number of New Students Over Time

During the EERC study period — between spring 2014 and fall 2016 – a total of 4,354 unique students enrolled in one or more CHAMP courses.[9]

Table 1 presents the number of first-time CHAMP enrollees for each semester from spring 2014 through fall 2016. The first semester of CHAMP programs, spring 2014, attracted the largest number of enrollees, 823 or 19 percent of all enrollees. Subsequently, except for fall 2016, the fall

[8] EERC only includes students who were sixteen years of age or older.

[9] We define CHAMP enrollment by taking CHAMP redesigned or new courses.

and spring semesters evidenced fairly stable numbers of enrollees (about 600 each) or about 14 percent. Summer enrollment rates were lower.

The pattern of first-time CHAMP enrollees suggests that CHAMP programs were successful in attracting new students, especially in the first semester when CHAMP was launched with significant preparatory marketing. However, despite significant initial interest in the program and the colleges launching additional credentials plus purchasing new state of the art equipment, the number of new enrollees decreased as the CHAMP grant began to sunset. This may be the result of a variety of factors including the reality that many CHAMP staff, especially the navigators were transitioning at this time. It also aligns with declining enrollments across community colleges as the economy began to improve. Thus both summer and fall numbers are considerably below prior terms.

Table 1. New unique CHAMP Enrollees cross the CHAMP consortium by semester

Academic year	Semester	# CHAMP Enrollees	% of all CHAMP enrollees
2014	**Spring 2014**	823	18.9%
	Summer 2014	152	3.5%
2015	**Fall 2014**	615	14.1%
	Spring 2015	610	14.0%
	Summer 2015	128	2.9%
2016	**Fall 2015**	727	16.7%
	Spring 2016	644	14.8%
	Summer 2016	92	2.1%
2017	**Fall 2016**	563	12.9%

Table 2 below presents the number of new enrollees by college by academic year. Note, in our analysis, we used academic years which includes the fall, spring and summer terms, and labeled the academic year by the year in which it ends. Thus, 2014 refers to spring 2014 and summer 2014 enrollees, while 2015 includes fall 2014 and spring and summer 2015 enrollees.

Given that the 2014 academic year had only two terms (spring and summer 2014) in the study period, and the 2016 academic year only had one term (fall 2016), the reader should use caution when comparing the 2014 and 2017 years with the other years.

The total number of CHAMP students served by the grant varied by institution, ranging from 131 students at LCC to 864 students at Aims. The trend of enrollment over time varied across schools. Comparing new enrollees for academic years 2015 and 2016 (fall, spring, and summer semesters) we find that Aims, LCC, MSU, and PPCC experienced a decrease in enrollment while CCD, FRCC, and especially RRCC had an increase. At RRCC, the number of new enrollees in year 2016 was in fact over four times as large as that in 2015. These increases in enrollments likely result from a college's delayed implementation, as well as the addition of new programs, e.g., CCD and RRCC.

Table 2. CHAMP Enrollees in Each Academic Year

CHAMP school	Academic Year				Total	% of CHAMP Total Enrollment
	2014 *Spring/ Summer*	2015 *Fall/ Spring/ Summer*	2016 *Fall/ Spring/ Summer*	2017 *Fall*		
AIMS	255	291	245	73	864	19.8%
CCD	71	120	113	70	374	8.6%
EGTC	0	87	87	62	236	5.4%
FRCC	64	142	152	46	404	9.3%
LCC	18	39	28	46	131	3.0%
MSU	198	205	191	82	676	15.5%
PCC	125	193	194	85	597	13.7%
PPCC	206	214	190	48	658	15.1%
RRCC	38	62	263	51	414	9.5%
Total	975	1353	1463	563	4354	100%

Demographics of the Consortium

The demographic characteristics of CHAMP enrollees for the full consortium are presented in Table 3, while Table 4 breaks down the statistic by individual college.

The majority of CHAMP students were male, 85.4 percent; 15 percent were female. A greater proportion of the CHAMP population were white, 69 percent, followed by 22 percent Hispanic students, and 4 percent black students. There were few Asian and American Indian/Alaska native[10] students, 2.6 percent and 2.0 percent respectively.

There was a wide age range among CHAMP students - 16 years of age to 74 years old. The average age for all students was about 28. Using the National Center for Educational Statistics' (NCES) definition of *traditional* (under 25 years old) and *non-traditional* students (25 years of age and older),[11] EERC found that just under 48 percent of the CHAMP population were non-traditional students. This proportion of non-traditional students is slightly higher than the

[10] This was the term used in the data set
[11] See NCES website: https://nces.ed.gov/pubs/web/97578e.asp

overall CCCS system of 41 percent, [12] no doubt reflecting higher numbers of incumbent workers returning to college to upgrade their credentials in advanced manufacturing.

Few CHAMP students reported they had a disability (n=86 students or 2 percent of all students).

Nine percent of the CHAMP population reported having a military background. Half of the CHAMP students with military background/experience were enrolled at PPCC (N= 202). This is not surprising, given PPCC's proximity to several military bases, and a community with a large number of active military, veterans, and their families.

Forty percent of the CHAMP student population had Pell assistance.

Table 3. Demographic Characteristics of CHAMP Students[13]

Demographics		N	Percentage
Gender			
	Male	3702	85.4%
	Female	635	14.6%
	Total	*4337*	*100.0%*
Race/ethnicity[14]			
	White	2554	69.0%
	Black	132	3.6%
	Hispanic	807	21.8%
	Asian	96	2.6%
	American Indian/Alaska Native	75	2.0%
	Other	37	1.0%
	Total	*3701*	*100.0%*
Age			
	Traditional student	2274	52.3%
	Non-traditional student	2077	47.7%
	Total	4351	100.0%
Registration status			
	Full time	2127	52.6%
	Part time	1918	47.4%
	Total	*4045*	*100.0%*
Disability status			
	With disability	86	2.0%
	No disability	4268	98.0%

[12] See CCCS website: https://www.cccs.edu/about-cccs/college-fact-sheets/colorado-community-college-system-fact-sheet/

[13] Total n under each category varies as a result of missing data.

[14] 15 percent of the data on race/ethnicity as missing from the pulled data set.

	Total	*4354*	*100.0%*
Military background			
	With military background	397	9.1%
	No military background	3957	90.9%
	Total	*4354*	*100.0%*
Financial aid assistance			
	With Pell	1727	39.7%
	No Pell	2627	60.3%
	Total	*4354*	*100.0%*

Demographic Characteristics by School

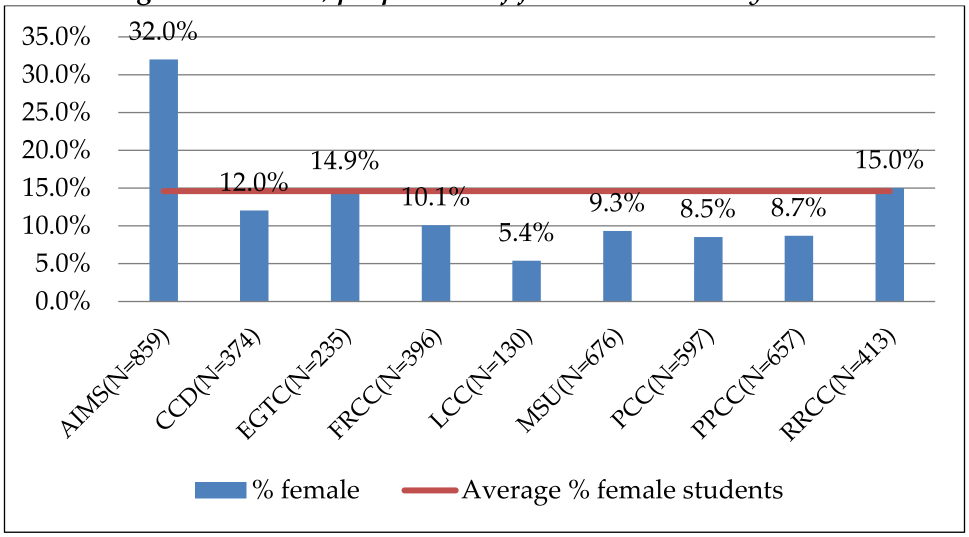
In this section, we analyze CHAMP students' demographic characteristics, registration status, financial aid condition, and military status by individual college. The statistics in this section show the variation in student populations across CHAMP schools that may reflect as much the attraction of CHAMP programs, as the different makeup of the college's general student population.

Gender

Figure 1 shows the distribution of female CHAMP students in each school. As indicated above, across the CHAMP consortium there were far fewer female CHAMP students than male students. On a college level, EERC found more variations in the percent of female students - 5.4 percent at LCC to 32 percent at Aims. The proportions of female students at EGTC and RRCC were at the consortium average line (14.6 percent). Contextually, while more women typically attend Colorado's community colleges, 55 percent of enrollment[15], not many are enrolling in advanced manufacturing courses.

[15] See https://www.cccs.edu/about-cccs/college-fact-sheets/colorado-community-college-system-fact-sheet/

Figure 1. Gender, proportion of female students by school



Race/Ethnicity

CHAMP schools reported six racial categories: white, black, Hispanic, Asian, American Indian/Alaskan Native, and other racial groups. Although the reported racial categories were slightly different between CCCS and non-CCCS schools[16], EERC was able to code them consistently across schools. Table 4 shows the average percent of the six racial/ethnic categories.

Table 4: Mean race/ethnicity across the CHAMP consortium[17]

	White	American Indian/ Alaskan Native	Asian	Black	Hispanic	Other	Total
Number	2554	75	96	132	807	37	3701
Consortium Mean Percent	69%	2%	2.6%	3.6%	21.8%	1%	100%

Table 5 presents the racial/ethnic distributions for each college – numbers and proportional percent. There are some significant population variations across the colleges. To some extent, this reflects regional differences – urban and rural communities, and the type of college. EGTC had the largest percentage of minority students (53.2 percent). This may be a result of the college's work with immigrant and refugee populations. Almost 40 percent of CHAMP students at PCC, Aims, and MSU were minorities as well, 39.2 percent, 35.1 percent, and 37.1 percent respectively. In contrast, 80 percent of RRCC and FRCC students were white.[18]

[16] For example, CCCS would document black non-Hispanic, non-CCCS schools may only report as black African American.

[17] As noted above, the data sets only included race/ethnicity for 85 percent of CHAMP students.

[18] As a comparison, CCCS reports 35 percent minority population across its 13 community colleges. See https://www.cccs.edu/about-cccs/college-fact-sheets/colorado-community-college-system-fact-sheet/

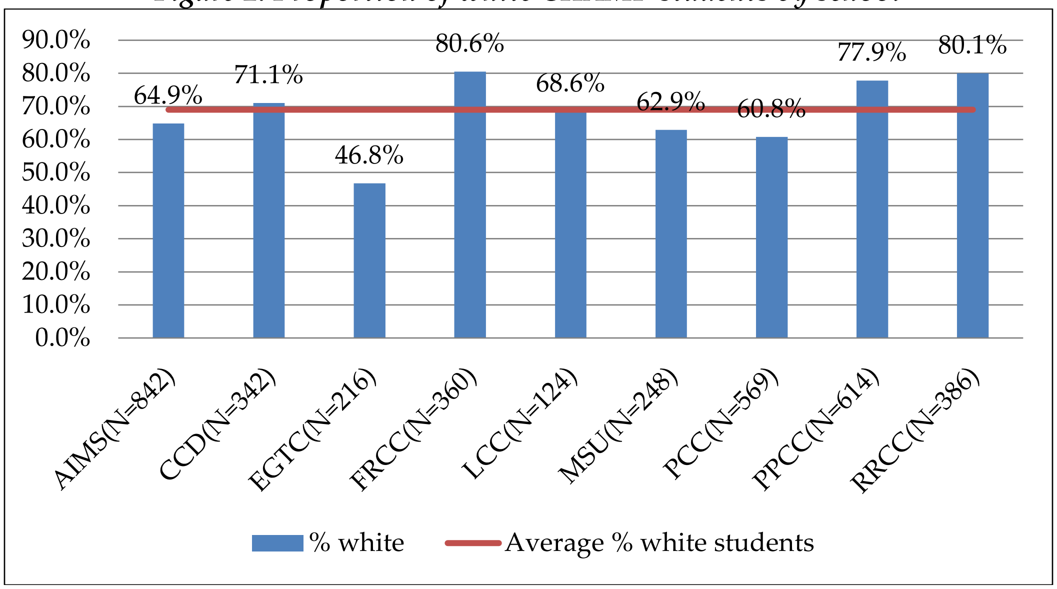
Table 4. Distribution of CHAMP students by race/ethnicity

CHAMP School	White		American Indian /Alaskan Native		Asian		Black		Hispanic		Other		Total N
	N	%	N	%	N	%	N	%	N	%	N	%	
AIMS	546	64.9%	3	0.4%	9	1.1%	19	2.3%	265	31.5%	-	-	842
CCD	243	71.1%	8	2.3%	13	3.8%	21	6.1%	56	16.4%	1	0.3%	342
EGTC	101	46.8%	1	0.5%	4	1.9%	24	11.1%	73	33.8%	13	6.0%	216
FRCC	290	80.6%	8	2.2%	22	6.1%	3	0.8%	37	10.3%	-	-	360
LCC	85	68.6%	3	2.4%	1	0.8%	3	2.4%	32	25.8%	-	-	124
MSU	156	62.9%	2	0.8%	10	4.0%	12	4.8%	48	19.4%	20	8.1%	248
PCC	346	60.8%	30	5.3%	5	0.9%	16	2.8%	171	30.1%	1	0.2%	569
PPCC	478	77.9%	17	2.8%	17	2.8%	33	5.4%	69	11.2%	-	-	614
RRCC	309	80.1%	3	0.8%	15	3.9%	1	0.3%	56	14.5%	2	0.5%	386
Total	2554	-	75	-	96	-	132	-	807	-	37	-	3701

White CHAMP Students

Over 69 percent of the 3,701 CHAMP students who reported their race/ethnicity were white (see Table 4). However, the percent of white students varied across the CHAMP schools, ranging from 47 percent at EGTC to 81 percent at FRCC. FRCC, PPCC, and RRCC had significantly larger than average proportion of white students, while Aims, MSU, and PCC had smaller proportions of white students.

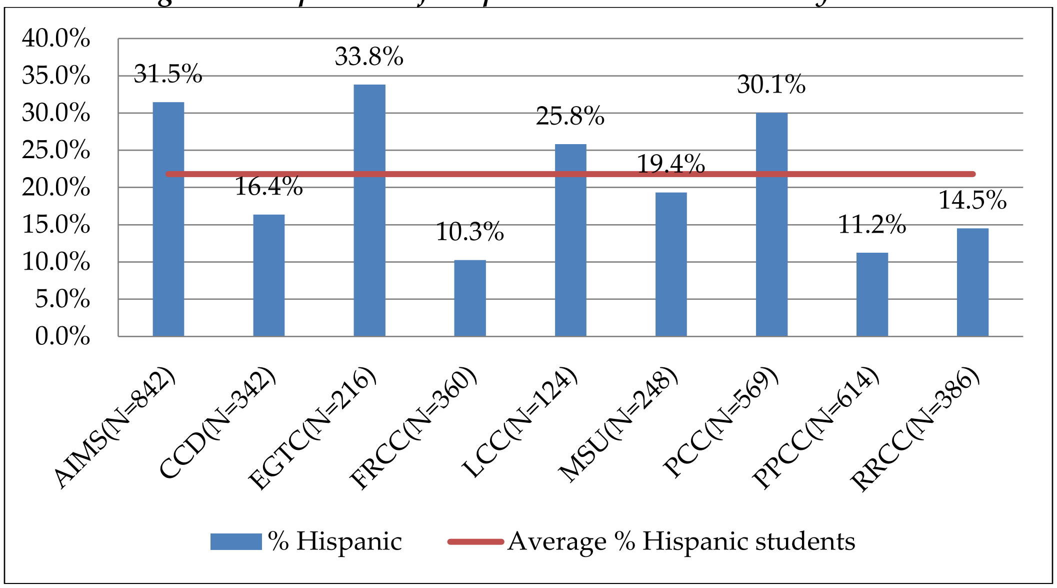
Figure 2. Proportion of white CHAMP students by school



Hispanic CHAMP Students

Across the consortium, Hispanic students were the next largest racial/ethnic group enrolled in CHAMP courses (22%). But again there were differences by college. Aims, EGTC, and PCC each had Hispanic enrollments over 30 percent. At LCC, about 26 percent of CHAMP students were Hispanic. FRCC and PPCC, however, had lower proportions of Hispanic students, 10 and 11 percent respectively. See Figure 3 below.

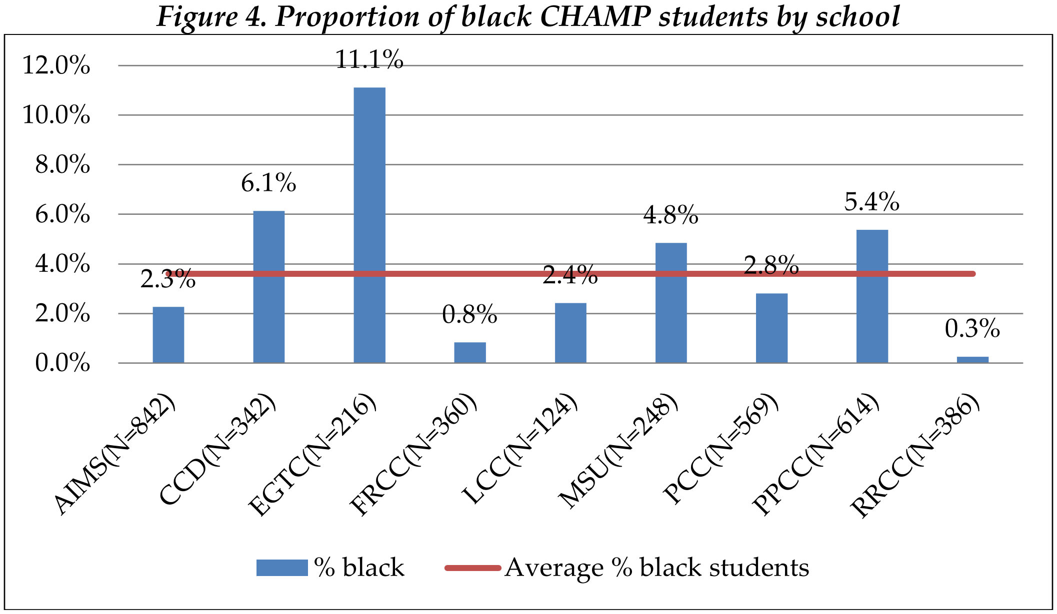
Figure 3. Proportion of Hispanic CHAMP students by school



Black CHAMP students

Black students represented less than 4 percent of CHAMP students across the nine consortium colleges (Figure 4). Compared with other schools, EGTC had a higher proportion of black students (11 percent). Other schools with more than the consortium average for black students were CCD (6.1 percent), MSU (4.8 percent), and PPCC (5.4 percent).) At the same time, Aims, LCC, and PCC had a little over 2 percent black CHAMP students. Both FRCC and RRCC had less than 1 percent black CHAMP students (1 percent and 0.3 percent respectively).

Figure 4. Proportion of black CHAMP students by school



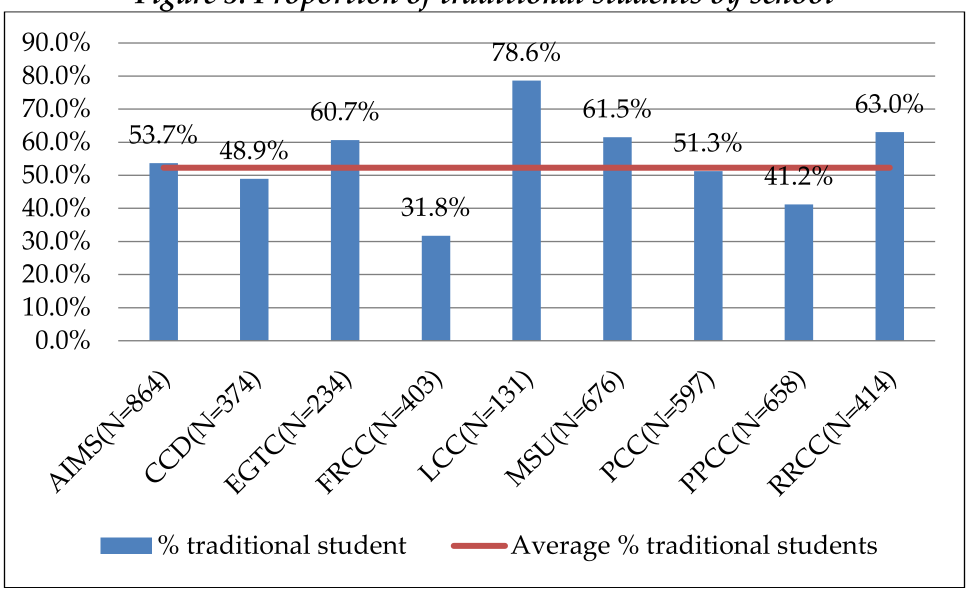
In summary, there were far fewer minority students across the CHAMP continuum than white students. However, the numbers varied by college with EGTC having the most diverse student population, and FRCC and RRCC having the least diverse.

Age

The mean age of all CHAMP students was 28 years old. As with other demographic characteristics, there was a significant variation in the age of CHAMP students - from 16 to 74, across the colleges.

Figure 5 presents the proportion of traditional students enrolled in CHAMP courses across the consortium. Using the threshold of 25 to define *traditional* vs. *non-traditional* students, we find close to 52 percent of CHAMP students were traditional-age. However, 79 percent of CHAMP students enrolled at LCC were traditional age students. In contrast, PPCC and FRCC had the smallest proportions of traditional students, 41 percent, and 32 percent respectively. At PPCC the age of students may be affected by the large number of current and former military attending the college.

Figure 5. Proportion of traditional students by school



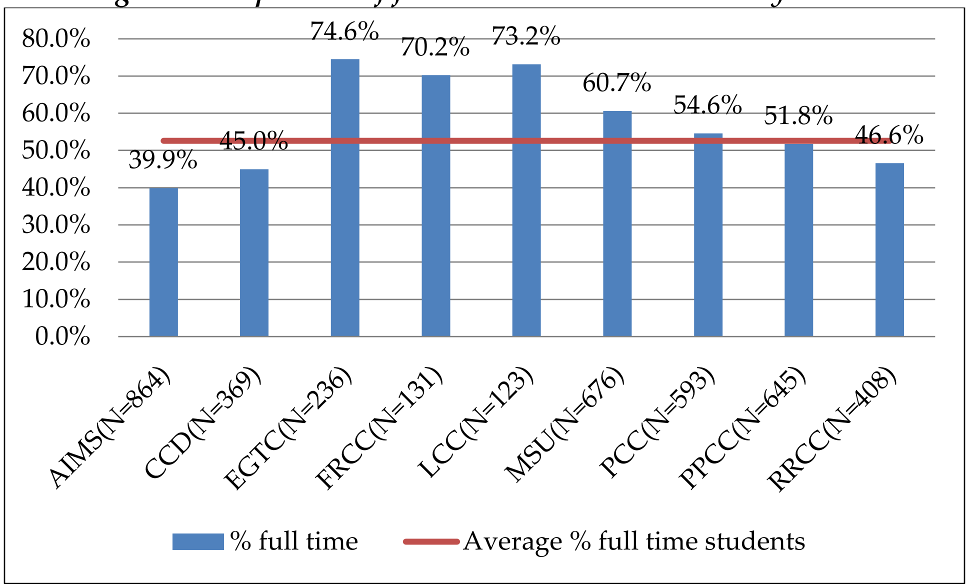
Registration Status[19]

ERRC received registration status (full time or part time) for 4,045 CHAMP students. This status was recorded when students first registered for a CHAMP course and thus does not reflect any possible changes after their first semester in CHAMP. Just over half of CHAMP students enrolled as full-time students (52.6 percent. But once again there was variation across the

[19] FRCC offered non-credit CHAMP courses. The school is a special case. At FRCC 280 students enrolled in non-credit CHAMP courses, thus not registering for credits. As such, these students were excluded in EERC's analysis of registration status. However, these 280 non-credit students are included in the analysis of demographics and other non-academic related analyses.

CHAMP institutions. At Aims, the largest enrollments of the CHAMP schools, 40 percent of CHAMP students were full-time. At schools with smaller CHAMP enrollments such as EGTC, FRCC[20], and LCC[21] there were much higher proportions of full-time students than part-time students, 74.6 percent, 70.2 percent and 73.2 percent, respectively. In contrast, at CCD and RRCC fewer students registered as full-time, only 45 and 47 percent respectively.

Figure 6. Proportion of full-time CHAMP students by school



Linking the data presented in Figure 5 above with that in Figure 6, EERC found that colleges with larger proportions of traditional students also had larger proportions of full-time students.[22]

Disability Status

Only 82 CHAMP students reported that they had some physical or mental disability.[23] Looking across the CHAMP consortium, the average percentage of students reporting one or more disabilities was 2. Figure 7 shows the proportion by college. CCD had the highest proportion, 6.7 percent; followed LCC, PCC and RRCC, 3.9 percent, 3.1 percent and 2.9 percent respectively. None of the students in EGTC or MSU reported a disability. Disability status is often not self-reported by students.

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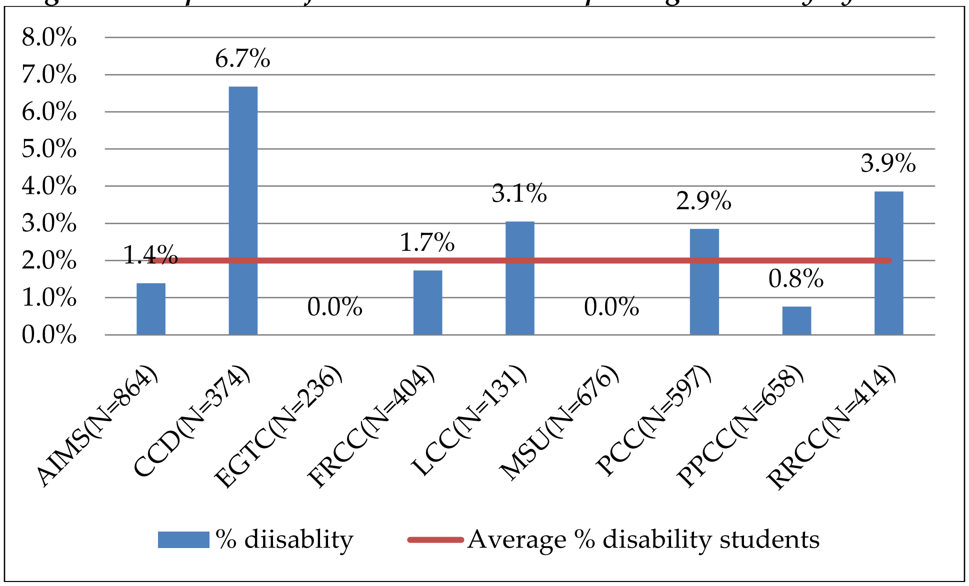
[20] See footnote 12. We only consider 131 FRCC students' registration status.

[21] Note, LCC is both a residential and commuter college the only one in the consortium that has residential students.

[22] See footnote 12 for FRCC.

[23] Disability status is self-reported so this may be an under count of individuals who actually have a physical and/or mental disability.

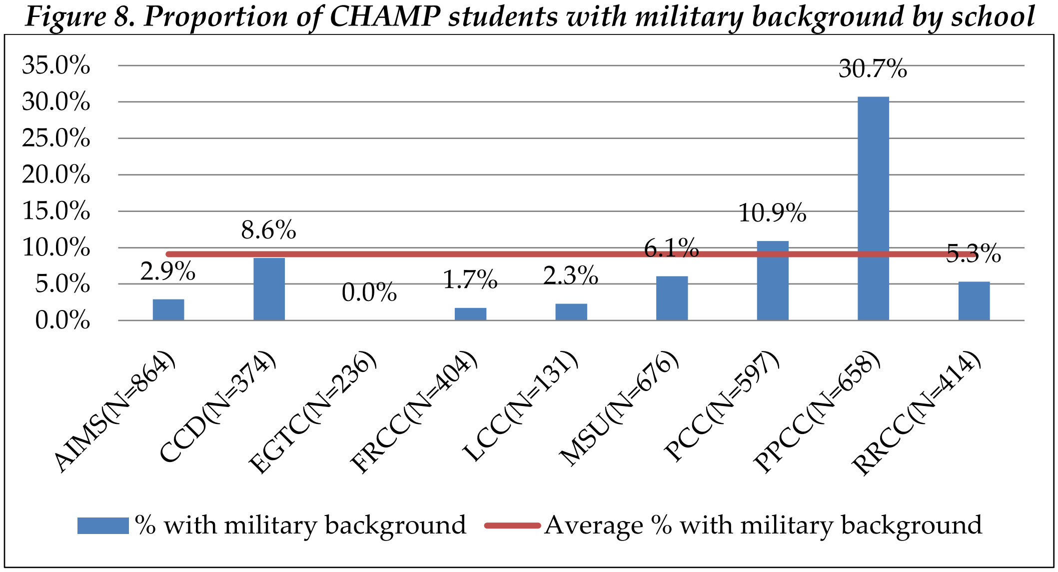
Figure 7. Proportion of CHAMP students reporting disability by school



Military Background

Nine percent of all CHAMP students had some military experience. This is higher than the system average of 6 percent with military experience. However, some colleges like EGTC reported no students with a military background, and others like PPCC which is near several military bases reported 31 percent of its CHAMP students were currently in the military or were veterans. In the general population at PPCC, 20 percent of students have military experience. More typical were the colleges such as Aims, FRCC, LCC, and RRCC which reported less than 5 percent of students with some military experiences (Figure 8).

Figure 8. Proportion of CHAMP students with military background by school

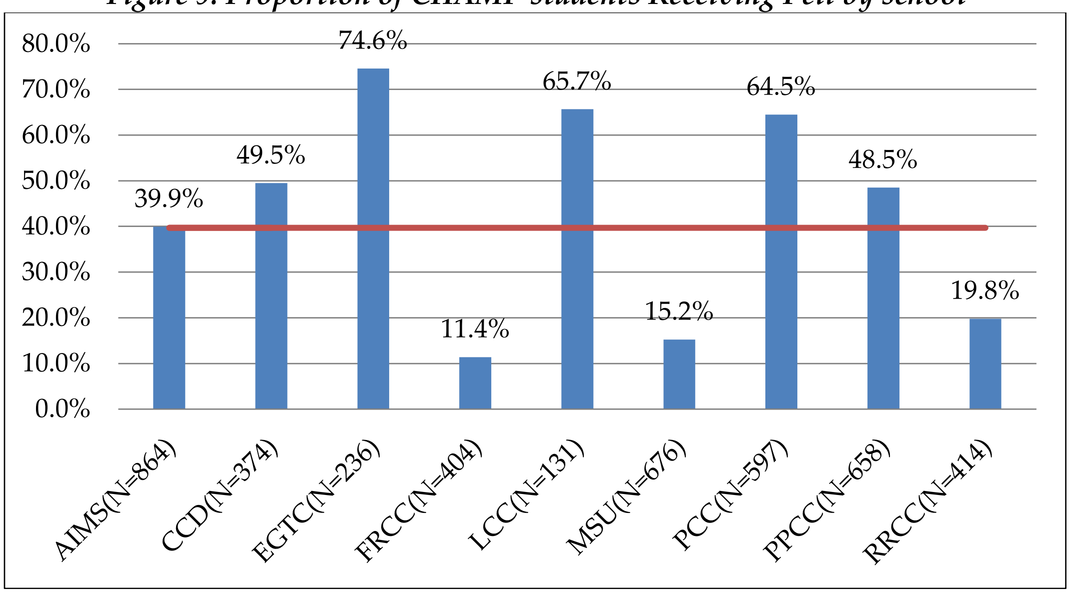


Financial Aid Assistance

EERC used Pell status as a proxy for a student's need for financial aid. Pell status, was recorded at the point a student enrolled in a CHAMP course. Across the CHAMP consortium, 40 percent of students received some amount of Pell support. Figure 9 presents the range of Pell recipients across the colleges. At FRCC[24], only 11 percent received Pell as compared to 75 percent of CHAMP students at EGTC. LCC and PCC both reported 65 percent of students on Pell, and CCD and PPCC reported about half their CHAMP students receiving Pell. MSU and RRCC both indicated less than 20 percent of their students receiving Pell.

The proportion of Pell receivers to some extent reflect the employment rate of CHAMP enrollees. Incumbent workers in CHAMP program were, in general, less likely to receive Pell assistance while their unemployed counterpart may be more likely to receive financial support. For example, FRCC and MSU had low rates of Pell support. As we will see below under "Employment," these colleges also had large proportions of students who were incumbent workers.

Figure 9. Proportion of CHAMP students Receiving Pell by school



[24] The low rate of Pell receivers at FRCC may be due to the large proportion of their non-credit students most of whom were employed when enrolling in CHAMP. These non-credit students were not eligible for Pell.

ACADEMIC OUTCOMES

This section reports on CHAMP students' academic outcomes. EERC focuses on three major outcomes: retention rate before earning the first credential (certificate, associate or bachelor's degree); the number and types of credential earned; and the time elapsed until earning the first credential. We also examined the number of CHAMP students who went on to pursue a second credential after completing their first credential.

Retention

One of the important questions in this study is whether participation in CHAMP programs was associated with students staying in school and continuing their studies. To assess retention, EERC followed CHAMP students from their initial enrollment in a CHAMP course through the end of the study period, fall of 2016. Two populations emerged – the non-completers and completers.

The non-completers are CHAMP students who did not earn a credential or degree. Some non-completers were not retained and did not earn a credential, and some continued to be retained during the study period, but had not yet earned their first credential. Among those who stayed, some are pursuing a bachelors' degree which may take at a minimum three or four years to complete; others are students who first enrolled in a program of study late in the CHAMP grant, and have not yet earned a credential.

Completers are those students who have completed a credential or degree. The completers may leave school after earning their first credential. Nevertheless, some continued their study to accumulate credits, stacking additional credentials or transferring to the four-year, CHAMP Partner College, MSU or another school.

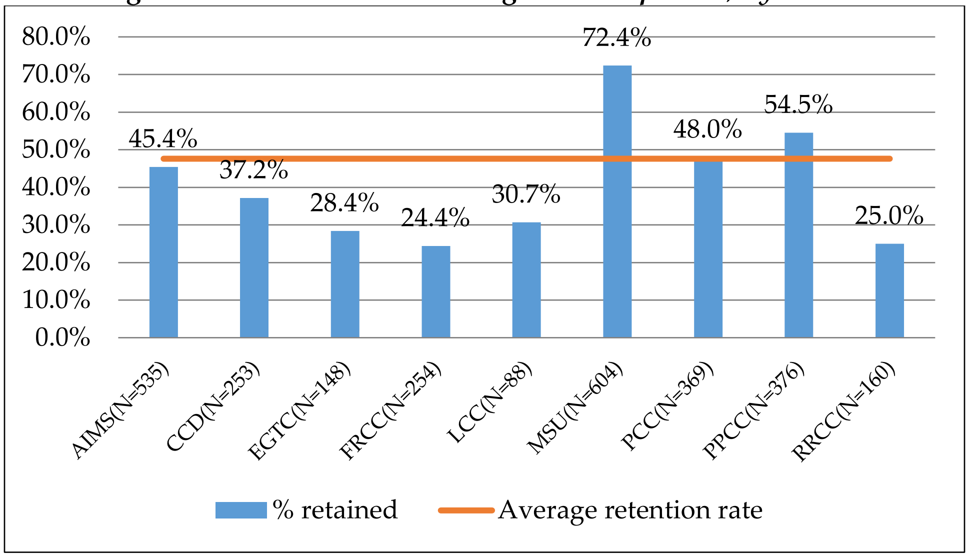
Retention Rates Before Earning a First Credential

EERC found that across the consortium, a little less than half of the non-completers remain enrolled (47.3 percent). These retention rates are in line with the system average from fall 2014 to fall 2015, 49 percent. More than half of the non-completers were not retained.

Retention rates varied by CHAMP schools (Figure 10). MSU, the only four-year university in the CHAMP program, had the highest rate of student retention across CHAMP institutions. As of fall 2016, the end of the study period, 72 percent of all MSU non-completers were still registered. Of the community colleges, PPCC had the highest rate of retention, 54.5 percent; and PCC and Aims reported rates close to the consortium average of 48.0 percent and 45.4 percent respectively. Lower rates, hovering around a third of CHAMP students, were reported by LCC, EGTC, and CCD. FRCC and RRCC only had a quarter of their students continuing to register following initial enrollment, 24 percent, and 25 percent respectively.[25]

[25] As a comparison, retention rates at CCCS from fall 2014 to fall 2015 are as follows: CCD: 40.8%, FRCC: 51.2%, LCC: 59.6%, PCC: 52.8%, PPCC: 51.1%, RRCC: 50.8%.

Figure 10: Retention rate among non-completers, by school



Retention Over Time

EERC also tracked students' registration from first enrollment until they earned their first credential. The longitudinal retention rate reflects how long students persist in their program of study.

Table 5 presents the retention rate for each of the spring and fall CHAMP cohorts[26]. The first spring to fall retention rate, spring 2014, was 52 percent indicating 52 percent of the spring 2014 cohort re-enrolled in the program in fall 2014. For the spring 2015 cohort, however, the rate of retention was ten percentage points lower, 43 percent. The rate for the spring 2016 was just slightly lower than that of spring 2015, at 41 percent. The first fall-to-spring retention rates among the fall cohorts were better than the spring cohort. In contrast, EERC found much higher overall rates of retention for those students in fall cohorts. Over 60 percent of the starting sample were retained in the first fall-to-spring transition. At the same time, it is important to note that every cohort over time saw a decrease in enrollment for non-completers, Table 5. The fall 2016 column reflects those students who have not yet completed a credential by the end of the study period but remain enrolled, non-completers.

Table 5: Retention rate over time for non-completers

CHAMP student cohort by semester	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016
Spring 2014 (N=823)	429 (52.1%)	351(42.6%)	229 (27.8%)	163 (19.8%)	106 (12.9%)
Fall 2014 (N=615)	--	404(65.7%)	194(31.5%)	141(22.9%)	73(11.9%)
Spring 2015 (N=610)	--	--	265(43.4%)	211(34.6%)	150(24.6%)
Fall 2015 (N=727)	--	--	--	438(60.2%)	267(36.7%)
Spring 2016 (N=644)	--	--	--	--	265(41.1%)

[26] We do not track summer cohorts as the samples are small.

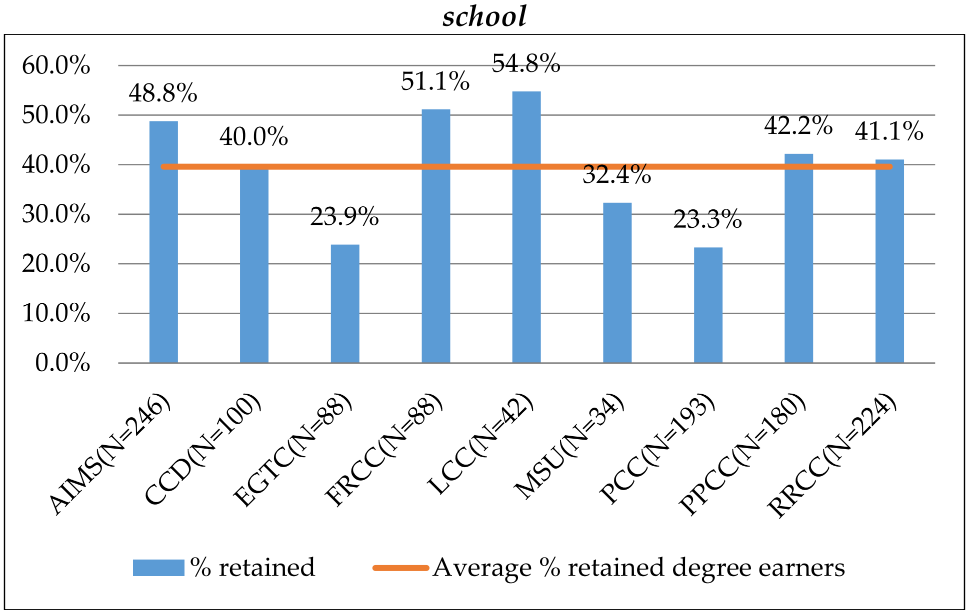
Retention Rates Among CHAMP Completers

In the following analysis of CHAMP *completers,* EERC again uses the spring-to-fall and fall-to-spring cohorts. Here, we look at CHAMP students who completed a program of study and earned a credential and continued to be enrolled as they pursued additional or stacked credentials such as certificates or associate's degrees. Note, for those students who completed their program during a summer term, we considered their credential as of the prior spring and include them in the statistics for spring to fall retention.

Collectively, over the three years, 1,195 CHAMP students (29.6 percent of all CHAMP students) registered for fall or spring semesters and earned one or more certificates or degrees. Differences existed between the colleges, but again, the reader should be mindful of the different credentials each college offered and thus the opportunities potentially available for students. Further, some colleges explicitly stacked their certificates towards a higher credential, e.g., LCC where student could take three welding certificates as a sequence on the way to an associate's degree.

Overall, 40 percent (473 out of 1195) of all CHAMP credential earners continued to be registered at one of the CHAMP colleges over the three years (Figure 11). CHAMP graduates from Aims, FRCC, and LCC evidenced higher than average retention rates. Fifty percent of FRCC and LCC completers also re-enrolled in school after earning certificates or degrees, followed by 49 percent at Aims. This likely results from the program designs at these colleges which encouraged stacked credentials. The retention rate among certificate earners at MSU was 32 percent. Retention rates at CCD, PPCC, and RRCC were at the consortium average. At EGTC and PCC, however, the post-credential retention rate was close to 23 percent.

Figure 11: Post-credential retention rate among those who enrolled in spring or fall terms, by school



To further explore the retention rate over time, especially spring-to-fall and fall-to-spring retention, EERC examined CHAMP credential earners' retention rates by spring and fall cohorts. The results are presented in Table 6. Like their counterpart non-completers, fall-to-spring retention rates were higher than that for spring-to-fall rates for the completers. The fall 2014 cohort had 77-degree earners, and 48 of them (62.3 percent) enrolled in spring 2015. Moreover, 74.9 percent of the degree earners in the fall 2015 cohort stayed enrolled in schools after getting their credentials in fall 2014. In contrast, the spring to fall retention rates were much lower. This is not uncommon. Less than half of the 111-degree earners in the spring 2014 cohort continued to be enrolled in fall 2014, and only 44.6 percent of the 294 completers from the spring 2015 cohort remained registered in fall 2015. Despite a higher number of program completers (N= 311) in spring 2016 cohort than in the previous cohorts, their retention rate was only 30.5 percent which was much lower than all other cohorts.

As expected, when EERC tracked all completers over time – we saw a steady decrease in their continued enrollment. For example, for spring 2014 for which we could track through the 5th semester, we found that of the original 111 completers, only 11 students were still registered in fall 2016, just under 10 percent. Again, we saw smaller rates of post-credential retention for the spring cohorts than for the fall cohorts. For example, half of the 111 spring 2014 credential earners left schools in fall 2014. However, 87.3 percent (48[27] out of 55 students) were still enrolled in spring 2015.

Table 6: Retention rates over time for completers

Degree Earners	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016
Earned credentials in Spring or Summer 2014, Spring 2014 cohort (N=111)	55 (49.5%)	48 (43.2%)	27 (24.3%)	21(18.9%)	11(9.9%)
Earned credentials in Fall 2014, Fall 2014 cohort (N=77)		48 (62.3%)	33 (42.9%)	26 (33.8%)	9 (11.7%)
Earned credentials in Spring or Summer 2015, Spring 2015 cohort (N=294)			131(44.6%)	94 (32.0%)	34(11.6%)
Earned credentials in Fall 2015, Fall 2015 cohort (N=167)				125 (74.9%)	66(52.8%)
Earned credentials in Spring or Summer 2016, Spring 2016 cohort (N=311)					95(30.5%)

[27] Note, some of the 48 students may not be the same as the 55 students in fall 2014, but include some credential earners from spring 2014 who dropped out of schools in fall 2014, but then re-enrolled in spring 2015. Nevertheless, the numbers still reflected the general trend that the fall-to-spring retention rate was higher than that for spring-to-fall.

In sum, fall-to-spring retention rates were higher than that of spring-to-fall rates and rates of retention post a credential diminish over time.

Graduation

An important indicator of the success of CHAMP's training programs is the rate of student graduation – and the credentials earned. We begin the analysis with the desired academic goal CHAMP students reported at initial registration. We then examine the credentials students' earned. Note, given time censoring, EERC's analysis only looks at data up to and inclusive of fall 2016. Students who started their program of study during the latter part of the study period may not have had sufficient time to complete their credential. Thus, there may be more students who earned a credential then are reported here.

Declared Academic Goal at Time of Enrollment

Each of the CHAMP schools provides data on the declared credential of interest at the time of registration when students indicated the academic goal or credential for which they enrolled. There were five options for declared certificate/degree goals under CHAMP programs: short-term certificate (less than one-year programs); long-term certificate (between 1 to 2-year programs); associate's degree; bachelor degrees; and students not seeking any credential. Also, some students did not declare any credential at CHAMP enrollment. These students may not have intended to earn a credential, or simply did not declare any goal of study.

The distribution of desired credentials reported by CHAMP students is presented in Table 7. Over half of all CHAMP students stated that they were pursuing associate degrees (51.9 percent). Fifteen percent of students declared a short-term certificate. Fourteen percent of the CHAMP students (all from MSU, the only four-year college in the consortium) were studying for bachelor's degrees. Only a small percent of CHAMP students (4.9 percent) declared a goal of earning a long-term certificate. Six percent of students stated they were not interested in earning any credential. Eight percent of the students failed to report any specific goal for their studies.

Table 7: Academic goal declared at registration

Declared Academic Goal at the Time of Registration	# CHAMP students	% CHAMP students
Associate degree	2260	51.90%
Bachelor's degree	622	14.30%
Short-term certificate	655	15.10%
Long-term certificate	212	4.90%
Not seeking any degree	251	5.80%
Undeclared	354	8.10%
Total	4354	100.00%

Graduation rate

Overall, between spring 2014 and fall 2016, 1,290 out of 4,354 CHAMP students (29.6 percent graduated with at least one credential – certificate or degree. This is better than the overall CCCS three year graduation rate for fall 2012 starters graduating in 2015, which was 22 percent. CHAMP graduation rates have to be understood within the context of the length of time it takes for students to earn them. Thus, colleges that enrolled most students in short-term certificates were more likely to have a higher rate of graduation than MSU, a four-year college where it traditionally takes a minimum of four years to complete a bachelor's degree.

Figure 12 below presents the graduation rates for each of the 9 CHAMP colleges. RRCC had the highest graduation rate, 57 percent. This is likely a result of the systems they put into place to improve credential attainment. See later sections of this report for more information. EGTC and PCC had similar graduation rates, 37.3 percent and 35 percent respectively. The other colleges, except FRCC, evidenced a 30 percent rate of graduation rates. FRCC had the lowest graduation rate at 23 percent. This can be explained by the large percentage of CHAMP FRCC students who were taking non-credit CHAMP courses[28] (280 of 404 students, 69 percent). It also may be a result of doing this analysis prior to the end of the spring 2017 semester.

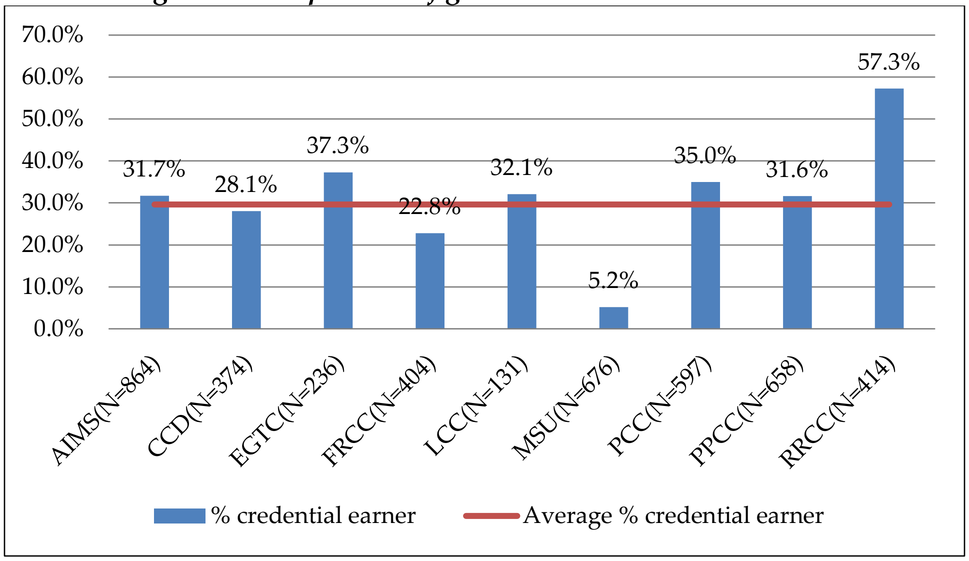
While a significant majority of MSU students stated that they were pursuing a bachelor's degree, [29] the data used for this report showed no bachelor's degrees awarded. This data showed that 5 percent of MSU CHAMP students (N = 35 students) earned a short-term certificate. In later analyses conducted by the evaluation team, MSU students had earned bachelor's degrees. This particular analysis was done too early for those results to emerge.

The graduation rates in Figure 12 represent the proportion of students who earned at least one credential – graduating from one of the CHAMP programs. It does not provide information on the type of credential received. The details of the credentials earned by CHAMP students are presented in Figure 12 below.

[28] However, 4 out of the 280 students taking non-credit courses went on to earn a credential.

[29] Five MSU students stated not interested in any degree, 49 MSU student did not declare any degree of interest. The rest of MSU CHAMP students all striving for bachelor's degrees.

Figure 12. Proportion of graduates/ earned a credential



Highest Credential/Degree

Under CHAMP, the range of credentials offered differed in terms of the credits needed and the length of the program, e.g., a short-term certificate versus a bachelor's degree. We, therefore, chose to analyze credentials students earned by the highest credential attained.

Table 8 presents the highest degree earned by all CHAMP students. Most of the completers earned short-term certificate (19.1 percent) followed by associate's degree (9.3 percent). Very few of the completers earned long-term certificate (1.3 percent). The statistics suggest that, though the completion rate is low at around 30 percent, more students earned short-term credentials than long-term credentials.

Table 8: Highest credential earned

Highest Degree Earned	Number of Students	Proportion
Associate's degree	403	9.3%
Short-term Certificate	831	19.1%
Long-term Certificate	56	1.3%
None	3064	70.4%
Total Students	4354	100.0%

As reflected in the relatively low graduation rates across the CHAMP consortium (30.6 percent), it is clear that many students did not complete their desired credential either because they dropped out or because time censoring precluded earning a credential during the study period.

Further, some students earned a credential, but not the one they had initially declared. And some students who had not declared their intentions at the time of first enrollment, went on to earn a certificate or degree. We, therefore, compared the highest degree achieved with the credential students originally stated was their goal (Figure 13)[30]. We focus on CHAMP students who declared an associate's degree, a long-term certificate, a short-term certificate, and those who did not declare a specific credential.

We begin with the CHAMP students who stated that they had enrolled to earn an associate's degree. Of the 2,260 CHAMP students who had identified the goal of an AS/AA, only 16 percent earned one within the study period. A larger proportion of these students earned short-term certificates (19.0 percent). Some programs, such as the welding program at LCC, use a series of certificates to build towards the associate's degree. But it is not clear to what extent students were using such scaffolding or consciously stacking their credentials along the way to an associate's degree or chose only to pursue a short-term certificate. Note, 1.3 percent of this pool of associate's degree seekers, earned a long-term certificate.

Among the students who wanted to earn a long-term certificate, 8 percent were successful. A larger percent of these students, 26.4 percent, however, earned a short-term degree. At the same time, seven percent of this same group of students exceeded their initial goal by earning an associate's degree.

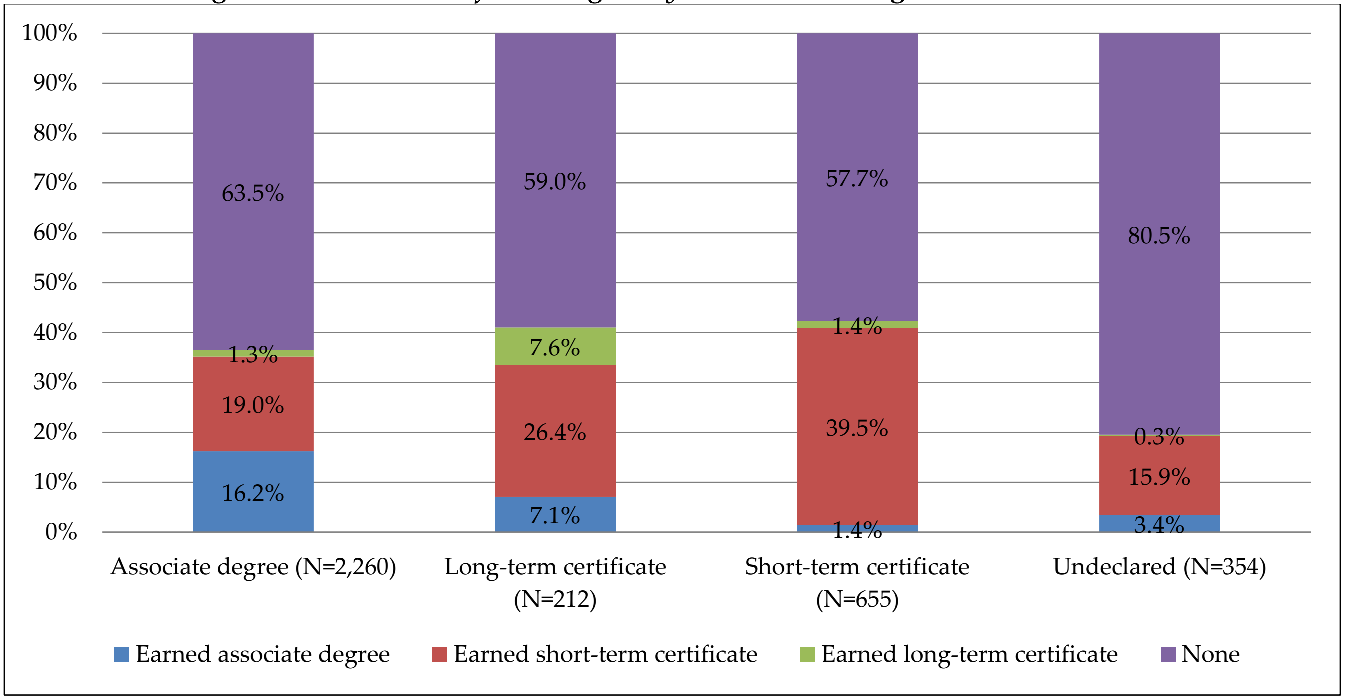
Students pursuing short-term certificates had the highest rate of success earning the credential they set out to earn (39.5 percent). Some short-term certificate seekers, earned a long-term certificate (1.4 percent) and 1.4 percent also earned an associate's degree.

Just under 16 percent of students who had not indicated a target credential earned a short-term certificate; 0.3 percent earned a long-term certificate; and 3.4 percent earned an associate's degree.

Overall, when we look at the rate of completion – with at least one earned credential, the students who enrolled for short and long-term certificates had the best rates of completion, 42.3 percent, and 41 percent respectively. Students who initially declared an associate's degree as their goal had a 36.5 percent rate of completion. Interestingly, the students who had not declared a goal had the lowest rate of completion, only 19.5 percent.

[30] CHAMP students pursuing bachelor degrees (N = 622. All from MSU) are excluded in this figure as none of them had earned a bachelor's degree and there was not any variation in the credentials received. The only credential earned by this group was short-term certificate (N= 28, 4.5 percent). CHAMP students who declared not seeking any credentials were also excluded in this figure (N= 251) as 98.4 percent of them did not earn any credential. Thus, Figure 13 presents the highest credential received for 3,480 CHAMP students.

Figure 13: Earned certificate/degree by the declared target credential



Next, we will examine whether graduation rates vary conditional on students' demographic characteristics, registration status, financial assistantship, and military background. Again, , the reader should be mindful that some of the student characteristics intersect with one another – the student populations varied by college as did the credentials they could earn. Thus, no causal associations should be interpreted from the presented demographic data.

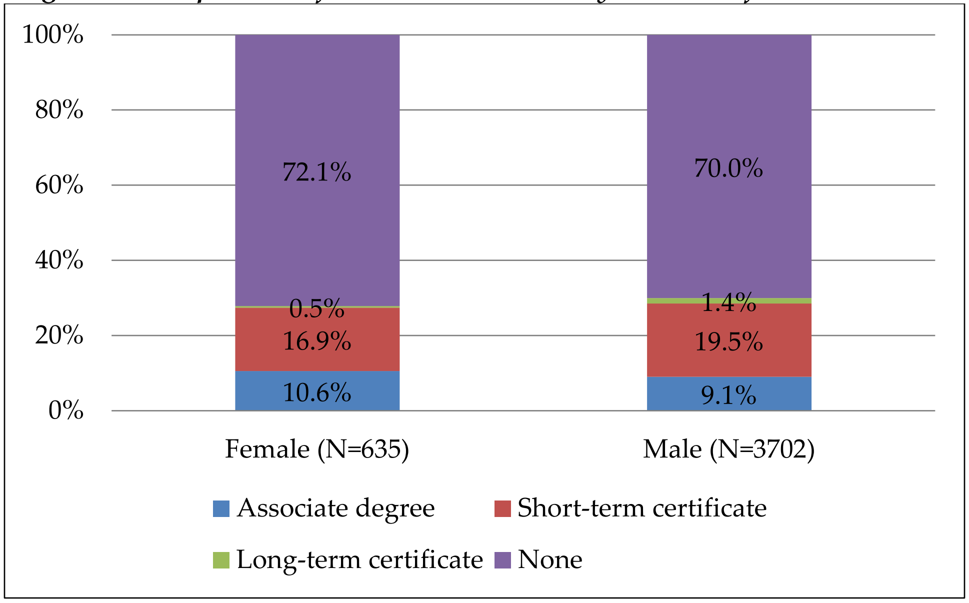
Graduation Rate and Demographics

By Gender

Thirty percent of male CHAMP students and 28 percent of female CHAMP students earned a certificate or degree during the study period.

When EERC examined graduation rates by the type of credential earned (Figure 14), we found that 11 percent of female students earned associate degrees compared to 9 percent of male students; and 20 percent of male CHAMP students earned short-term certificates compared to 17 percent of female students. EERC also found that 1.4 percent of male earned a long-term certificate but only .5 percent of female students.

Figure 14: Proportion of credentials earned by male and female students



By Race/Ethnicity

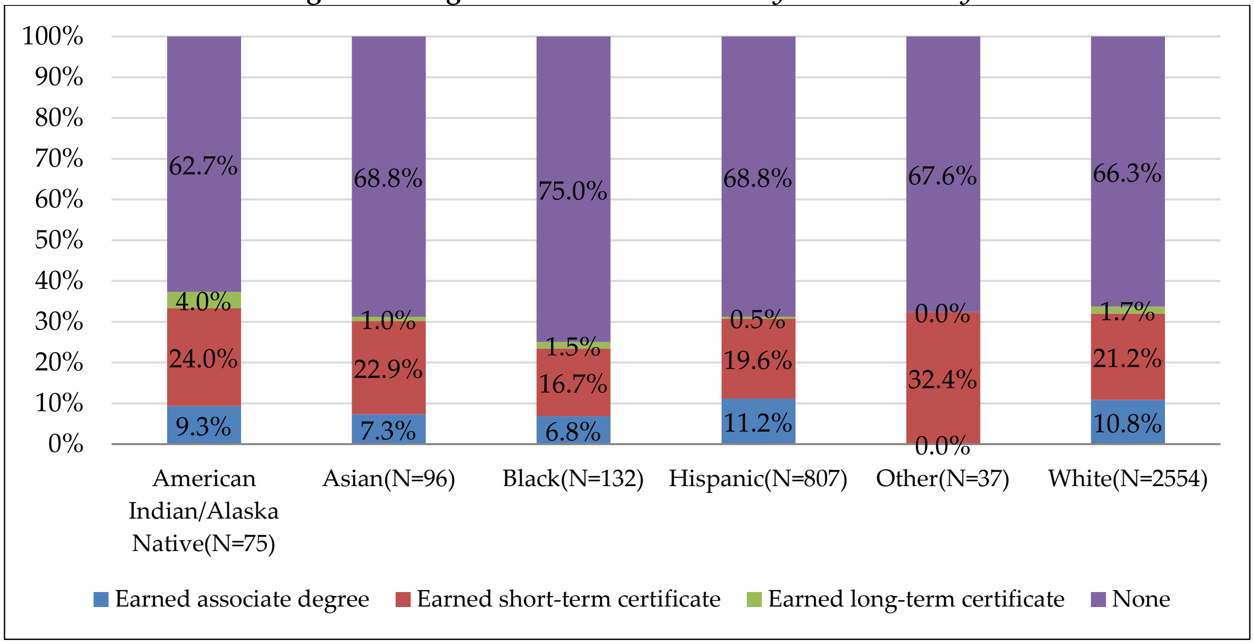
Graduation rates did not vary much by race/ethnicity except for American Indian/Native Alaskan and black CHAMP students (Figure 15). While the number of American Indian/Alaska native students was small at 75, this group had the highest rate of graduation at 37 percent. White students had the next highest rate of graduation 34 percent, followed by students from other racial/ethnic groups (32.4 percent). Asian and Hispanic students had the same graduation rate, 31 percent. Black CHAMP students had the lowest rates of graduation, 25 percent.

When we look at the graduation rates by type of credential, we find that regardless of racial background, the highest credential earned by all racial/ethnic groups was a short-term certificate. In fact, students reporting "other racial group" only earned short-term certificates, 32.4 percent. American Indian/Alaska native students had the next highest rate of short-term certificates, 24.6 percent, followed by Asian and white students earning short-term certificates, 22.9 and 21.2 percent respectively. Hispanic students earned short-term certificates at a rate of 19.6 percent. Blacks had the lowest rate of earning short-term certificates, 16.7 percent.

Eleven percent of Hispanic and 10.8 percent of white students received an associate degree. Nine percent of American Indian/Alaskan natives CHAMP students earned an associate's degree; and 7 percent of Asian and black CHAMP students.

Four percent of the American Indian /Alaskan Natives earned long-term certificates as did 2 percent of white students. Very few Asian, black, and Hispanic students earned long-term certificates as their highest credential.

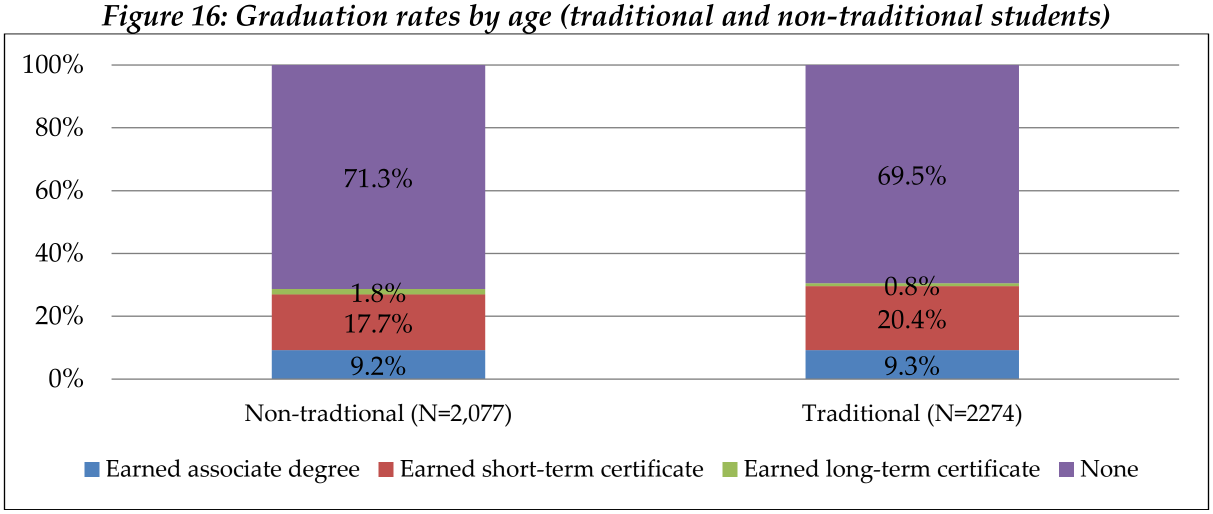
Figure 15: Highest credential earned by race/ethnicity



By Age

The difference in graduation rates between students of non-traditional age and their counterpart traditional-age students was small (Figure 16). About 31 percent of the traditional age CHAMP students earned a credential while the rate was 29 percent for non-traditional students. Among the traditional age degree earners, 20 percent earned short-term certificates, as compared to 18 percent of non-traditional students. The graduation rates for associate's degree earner in both groups was almost identical at 9.2 percent and 9.3 percent. Finally, while the percentages are small, non-traditional students were more likely than traditional students to earn long-term certificates, 1.8 percent compared to 0.8 percent.

Figure 16: Graduation rates by age (traditional and non-traditional students)

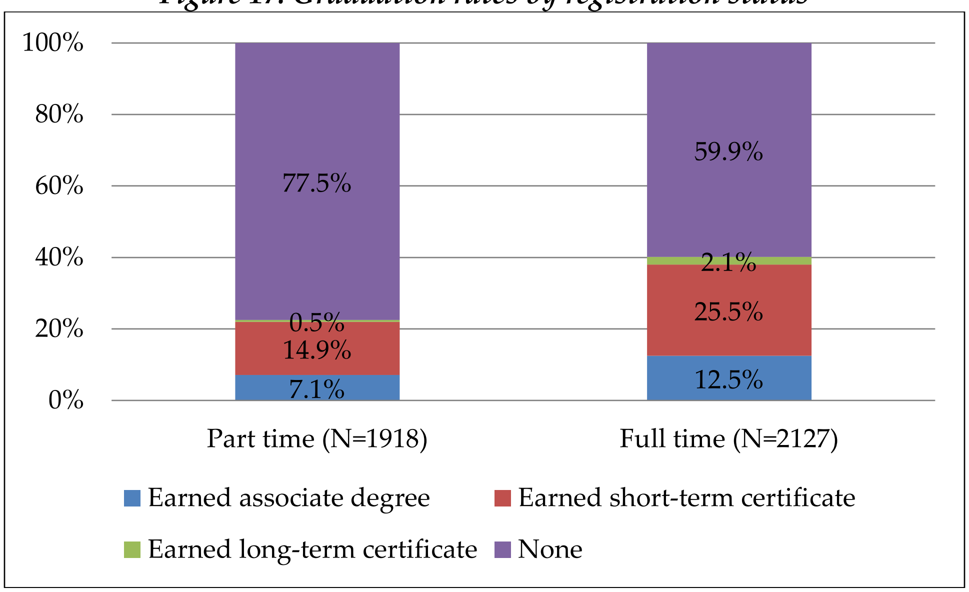


By Registration Status

Graduation rates for full-time CHAMP students were 17 percentage points higher than those of part-time CHAMP students (Figure 17) for all credentials (40 percent for full-time students compared to 23 percent for part-time students). For each of the three credentials of interest – associate's degree, long-term certificate and short-term certificate, full-time students had almost double the rates of graduation as compared to their part-time counterparts.

The largest percentage difference in graduation rates was between full and part-time students who completed a short-term certificate (25.5 percent vs. 14.9 percent). On the other hand, there was only a five percentage point difference between full and part-time students who earned an associate's degree, 12.5 percent vs. 7.1 percent; and less than a two percent difference for students earning long-term certificates, 2.1 percent, and 0.5 percent. These findings are not too surprising given that full times students earned more credits and are more likely to complete their studies in a shorter amount of time than their part-time counterparts.

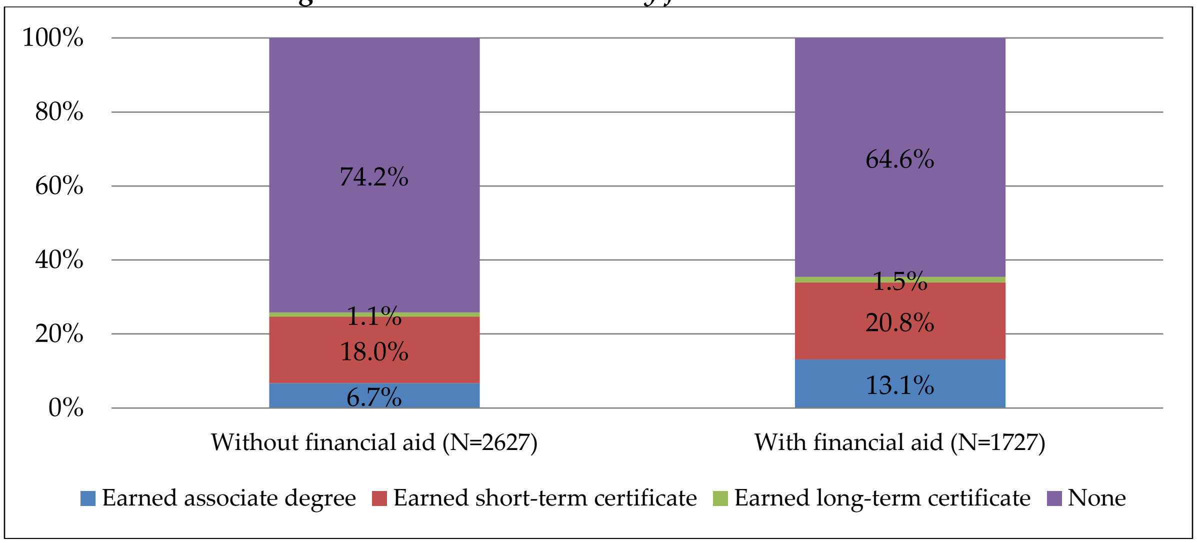
Figure 17: Graduation rates by registration status



By Financial Aid Status

Figure 18 shows the proportions of students earning the three types of credentials in CHAMP by student's financial aid status, receiving a Pell grant. Students with financial aid graduated at higher rates than CHAMP students without financial aid 35.4 percent vs. 25.8 percent. The major difference in graduation rates lies in the proportion of students earning associate degrees. The associate's degree graduation rate among students with financial aid was almost twice as high as the rate for students without financial aid. Students with financial aid also had a two percentage point higher completion rate for short-term certificates than students without financial aid. It is not clear how many of students without financial aid were balancing work and their studies. This would be an important area for future exploration.

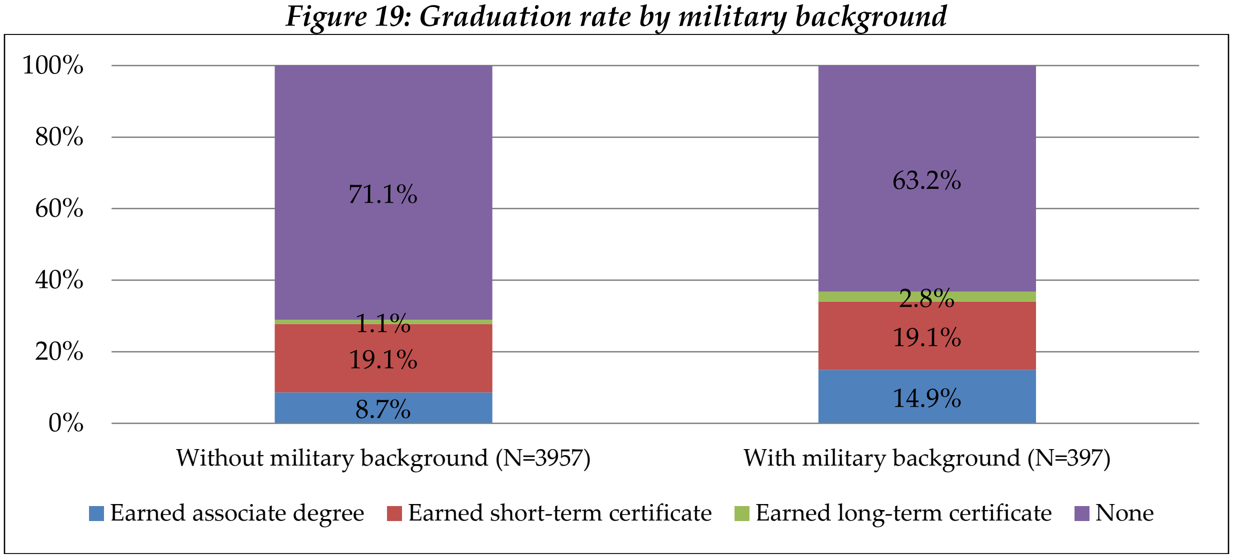
Figure 18: Graduation rate by financial aid status



By Military Background

A higher proportion of CHAMP students with a military background graduated and earned credentials than students without a military background, 37 percent versus 29 percent (Figure 19). Fifteen percent of students with military experiences earned short-term certificates as compared to 9 percent without a military background. The proportion of students completing short-term certificates in both groups was the same. Few students received long-term certificates, but here the difference was 1.7 percent. Those with military background earned long-term certificates at a rate of 2.8 percent versus 1.1 percent for those without a military background.

Figure 19: Graduation rate by military background



In summary, regardless of credential earned, full-time versus part-time student status appears to be strongly associated with rates of graduation, a 17.6 percent difference. Financial aid and military background also seems to be related with completing credentials, but far less at 9.6 and 7.9 percent respectively. Being a black student or being an American Indian/Alaska Native student also seems to be associated with student rates of graduation, 37.3 percent of American Indian/Alaskan Native graduating compared to only 25 percent of black students. Age and gender did not appear to be factors that influenced graduation rates.

Time to Graduation

In this section, we address the question of how many semesters it took for a student to complete his/her first CHAMP certificate or degree. EERC only considered the number of fall and spring semesters between students' first enrollment in CHAMP and completing their first CHAMP credential[31]. Note, if a student earned a short-term certificate in the same semester she/he first registered, that student would be considered as taking one semester to complete a CHAMP program. The results are presented in Table 9 below.

Most CHAMP credential earners completed their program of study – a short-term certificate – in the same semester in which they first registered for CHAMP, 39.4 percent. About 60 percent of all CHAMP completers earned their first credentials within two semesters of enrolling in CHAMP. Moreover, over 90 percent of credential earners finished the program in six semesters or three academic years[32]. These statistics are consistent with EERC's above findings that 83.7 percent[33] (Table 10 below) of CHAMP credential earners received a short-term certificate.

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[31] EGTC follows an 8-month academic calendar rule. Therefore, their spring semester lasts until July. They did not provide registration data for their summer sessions.

[32] The number of semesters to degree also considers the time lapse between first enrollment to first degree. If a student failed to register for courses in any of the semesters in between first enrollment and graduation, EERC still counted the semesters of non-enrollment.

[33]Among the 1,290 credential earners, 64.4 percent earned short-term certificate only, 3.4 percent earned short-term and long-term certificate, 11.6 percent earned short-term and associate degree(s), and 4.3 percent received short-term, long-term certificate and associate degree.

Table 9. Number of fall and spring semesters to first credential

Number of semesters to first credential	Frequency	Percent
1	508	39.4%
2	261	20.2%
3	166	12.9%
4	125	9.7%
5	64	5.0%
6	72	5.6%
7	48	3.7%
8	14	1.1%
9	32	2.5%
Total	1290	100%

Stacking Credentials

One of the goals of the CHAMP grant was to create career pathways in advanced manufacturing through the accumulation of multiple credentials – or *stacking*. As has been discussed, during the grant period, CHAMP students received three types of credentials – short-term certificate, long-term certificate, and associate degrees. Some students earned several certificates, while others earned both certificates and an associate's degree. There were even some students who earned more than one associate's degree during the time of study. Here we take a closer look at how CHAMP students stacked their credentials during the study period.

Between spring 2014 and fall 2016, 1,290 CHAMP students completed a program and earned at least one credential. A large majority of CHAMP students, 80 percent, earned a single credential. For instance, 64 percent of all credential earners earned one or more short-term certificate(s), but no other credential.[34] Fifteen percent of all credential earners received one or more associate degree(s).[35] Very few (only 12 CHAMP students) earned a long-term certificate, and none of these students earned more than one long-term certificate.

Twenty percent of all graduates (N=253) earned multiple types of credentials. Of these students, 3.4 percent (N=44) earned both a short-term certificate and a long-term certificate. A larger number of students earned both a short-term certificate and an associate's degree, 11.6 percent (N=159).). Four CHAMP students earned a long-term certificate and an associate's degree (0.3 percent). And 55 students earned all three credentials (4.3 percent).

[34] Some of them received multiple short-term certificates as shown in Table 12.

[35] Some students earned multiple associate degrees.

Table 10: Type of credentials earned by CHAMP students including stacking

Credential/degree earned	N	%
Short-term certificate(s) only	831	64.4%
Long-term certificate(s) only	12	0.9%
Associate degree(s)	194	15.0%
Short-term and long-term certificates	44	3.4%
Short-term certificate(s) and associate degree(s)	150	11.6%
Long-term certificate and associate degree(s)	4	0.3%
Short-term, long-term certificate, and associate degree(s)	55	4.3%
Total students with credential/degree	1290	100.0%

To better understand stacking and variations across the colleges, we next analyze the number of credentials earned by school and by credential type. In reviewing the following sections, it is important to note that not all colleges offered all credentials and some colleges launched their credentials sequentially, so not all students may have had access to them or time within the study period to complete additional credentials.

Short-term Certificate Only Earners

A large number of students earned only short-term certificates, (831 out of 1290 graduates, 64.4 percent). Table 11 presents the distribution of these students by college. All EGTC and MSU credential earners received short-term certificates. The majority of RRCC students, 90.3 percent only earned short-term certificates. Compared with other schools, a lower proportion of PCC credential earners earned only a short-term certificate (45.5 percent).

Table 11: Degree earners: short-term certificate only by school

CHAMP School	N Earning Short-term Certificate Only	Total N of Degree Earner	% Earning Short-term Certificate Only
AIMS	145	274	52.9%
CCD	63	105	60.0%
EGTC	88	88	100.0%
FRCC	54	92	58.7%
LCC	28	42	66.7%
MSU	35	35	100.0%
PCC	95	209	45.5%
PPCC	109	208	52.4%
RRCC	214	237	90.3%
Total	831	1290	64.4%

When EERC examined the number of certificates earned by students, we found a large number of students earned more than one short-term certificate. In fact, across the CHAMP consortium, 36 percent of students earned multiple short-term certificates (Table 12). Almost half of these multiple short-term certificate earners received two certificates, and quite a few earned up to 3 or 4 short-term certificates. Impressively, one student at Aims, earned 8.

By college there were variations. CHAMP students at LCC, PPCC, and RRCC completed significantly more multiple short-term certificate than at the other colleges. Over half of the students earning only short-term certificate at LCC and PPCC earned more than one. Moreover, 47 percent of students earning only short-term certificate at RRCC earned more than one such credential. Students at Aims and FRCC earned slightly more than the average of multiple short-term certificates, 39.3 percent and 37.0 percent respectively. However, few students at CCD, EGTC, MSU, and PCC earned more than one short-term certificate (Table 12).

Table 12: Stacking degrees: short-term certificates only

CHAMP School	Short-Term Certificate Earners								Total N Earning Short-Term Certificates	N Earning >1 short-term certificates	% Of Short-Term Certificate Earners With >1 Short-Term Certificates
	Single short-term certificate	Dual short-term certificates	3 short-term certificates	4 short-term certificates	5 short-term certificates	6 short-term certificates	7 short-term certificates	8 short-term certificates			
AIMS	88	13	8	17	2	16	-	1	145	57	39.3%
CCD	46	10	6	1	-	-	-	-	63	17	27.0%
EGTC	79	9	-	-	-	-	-	-	88	9	10.2%
FRCC	34	19	1	-	-	-	-	-	54	20	37.0%
LCC	12	9	7	-	-	-	-	-	28	16	57.1%
MSU	25	10	-	-	-	-	-	-	35	10	28.6%
PCC	82	4	6	1	-	2	-	-	95	13	13.7%
PPCC	50	19	27	13	-	-	-	-	109	59	54.1%
RRCC	113	52	19	17	2	10	1	0	214	101	47.2%
Total	529	145	74	49	4	28	1	1	831	302	36%

In sum, the majority, 64.4 percent, of CHAMP credential completers earned only short-term certificates. However, among these students, 36 percent earned multiple short-term certificates.

Associate's Degree Earners[36]

Of the 1,167 degree earners in the seven CHAMP schools that granted associate degrees to CHAMP students, 35 percent (N = 403) earned an associate's degree (Table 13). Again, there were wide variations in the percent of students earning associate degrees by college, ranging from 9 percent at RRCC to 53 percent at PCC. Higher than average proportions of CHAMP degree earners at Aims, PCC, and PPCC also earned associate degrees, 47.1 percent, 53.1 percent and 40.9 percent respectively. Less than 10 percent of degree earners earned associate degrees at FRCC and RRCC (9.8 percent and 9.3 percent respectively).

Table 13: Associate's degree earners by school

CHAMP School	N Earning Associate's Degree	Total N of Credential Earners	% Earning Associate's Degree
AIMS	129	274	47.1%
CCD	35	105	33.3%
FRCC	9	92	9.8%
LCC	12	42	28.6%
PCC	111	209	53.1%
PPCC	85	208	40.9%
RRCC	22	237	9.3%
Total	403	1167	34.5%

Over half (54.8 percent) of CHAMP students who earned an associate's degree also earned a short and/or long-term certificates, and a few even earned a second associate's degree. The distribution of stacking degrees at each CHAMP school is presented in Table 14.

[36] Students in EGTC and MSU only earned short-term certificates. Therefore, they are not included in this part of analysis.

Table 14: Stacking credentials by CHAMP students earning associate degrees

CHAMP School	1 Associate Degree Only	1 Associate's Degree and Short-term Certificate				1 Associate's Degree and Long-term Certificate	1 Associate's Degree and Short-term and 1 Long-term Certificate	N with > 1 Associate's Degrees	Total Earning an Associate's Degree	N Earning an Associate's Degree Plus Additional Credential(s)	% Students Earned > 1 Associate's Degrees
		+ 1 short-Term Certificate	+ 2 Short-Term Certificates	+ 3 Short-Term Certificates	>= 4 Short-Term Certificates						
AIMS	56	18	13	6	26			10	129	73	56.6%
CCD	10	7		2	0	1	15		35	25	71.4%
FRCC	3	1	2		0	1	1	1	9	6	66.7%
LCC	6	1	3	1	0			1	12	6	50.0%
PCC	77	17	4	4	4			5	111	34	30.6%
PPCC	24	7	3	3	5	2	33	8	85	61	71.8%
RRCC	6		3	1	10		1	1	22	16	72.7%
Total	182	51	28	17	45	4	50	26	403	221	54.8%

Looking across the CHAMP consortium, five out of seven community colleges had higher proportions of students earning an associate's degree plus additional credentials, than the average for the consortium, 54.8 percent. The two colleges with a lower proportions of stacking were LCC and PCC. Of note, PCC had a significantly lower percentage of stacking by associate's degree earners (30.6%). At the same time, over 70 percent of associate's degree earners at CCD, PPCC, and RRCC earned an associate's degree and at least one other credential. The high proportion of students at these colleges suggest that many of the CHAMP degree earners may have stacked certificates on their way to earning an associate's degree.

EMPLOYMENT OUTCOMES

A major goal of the CHAMP project was to train incumbent workers and job seekers to better meet the needs of employers in advanced manufacturing. This section explores to what extent the redesign and creation of CHAMP courses and programs resulted in changes in employment status. EERC considered employment status in three ways: employment at program entry (*incumbent worker status*); employment after graduating from a CHAMP program (*non-incumbent employment*); and over the course of the CHAMP program an increase in wages for *incumbent workers*.

Given that CHAMP students did not self-report their employment status at the time of first enrollment in a CHAMP course, EERC used the Unemployment Insurance (UI) dataset as a proxy for employment status.[37] The UI dataset documents individuals' wages on a quarterly basis. For this report, we consider a student *employed* if he or she had over $1,000 income in the year-quarter of interest. Therefore, for this analysis, if a student had wage income in the year-quarter of enrollment, he or she was considered an incumbent worker. If the student earned $1000 or more in the year-quarter after graduation earning his or her first credential, we consider the student employed. If an incumbent worker, experienced a wage increase of over $500 between the time of first enrollment and the end of the study period, we deemed the worker had a wage increase.

UI files include wage data up to the last quarter of 2016. EERC, therefore, was unable to identify current employment conditions for those students who earned their first certificate or associate's degree in fall 2016. As a result, the following employment rate for CHAMP students is underestimated. Moreover, employment status is only considered for credential earners. CHAMP students who started the program early in 2014 or 2015 had a higher probability of getting employed than those who started late in 2016 as the late enrollees may not have completed their programs. Finally, the observational time of wage increase for incumbent workers varies by the amount of time EERC could track them. Thus, students who enrolled in spring 2014 could be followed for three years while their counterparts who enrolled in fall 2016 only have wage data for two-quarters, i.e., third and fourth quarters of 2016. In sum, this section

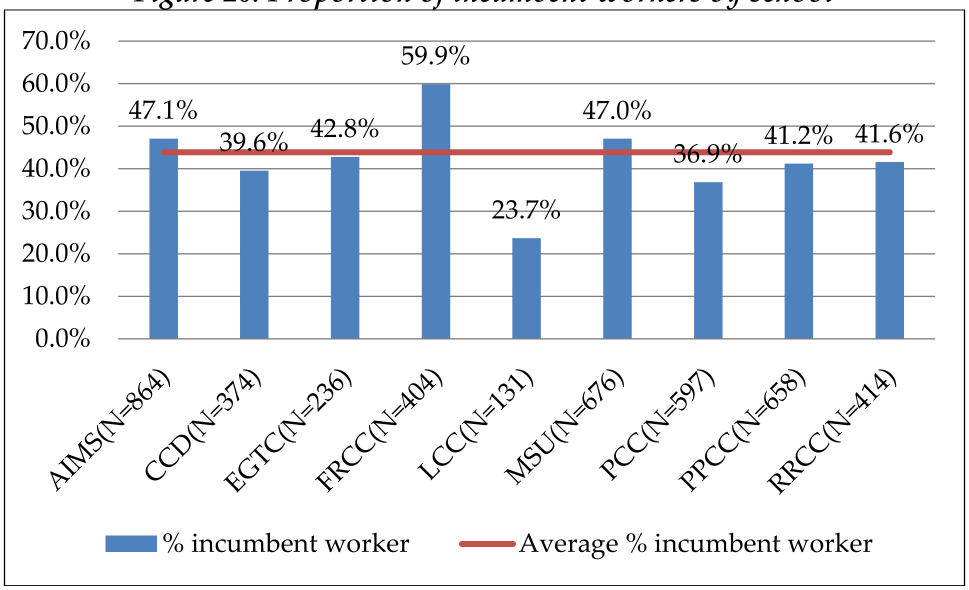
[37] EERC was able to obtain this dataset through a special contract with the Colorado Department of Labor.

only provides a glimpse of the employment experience of CHAMP students, and the statistics may underestimate the impact of CHAMP on employment and wages.

Incumbent Workers

Figure 20 presents students' employment status at the time of their initial enrollment in a CHAMP course. Across the CHAMP consortium, 44 percent of students were employed - incumbent workers (N = 1910). The proportion of incumbent workers in CHAMP programs varied by college, ranging from 24 percent at LCC to 60 percent at FRCC[38]. Aims, FRCC, and MSU had higher-than-average proportions of incumbent workers, around 47 percent. At the same time, CCD, EGTC, PPCC, and RRCC all had slightly lower than average proportions of incumbent workers, 40 to 43 percent of their respective CHAMP students. PCC had the second lowest proportion of incumbent workers, about 37 percent, across CHAMP institutions.

Figure 20: Proportion of incumbent workers by school



Employment Upon Graduation by the First Credential Received

The employment rate is calculated for non-incumbent students who earned a credential. We examine whether a student was able to find employment in the quarter following the year-quarter in which they earned their first credential.

EERC found that about a third (30 percent) of the 773 students who were not employed at time of initial enrollment were employed in the first quarter after they earned their first CHAMP credential (N=228). When we look at the employment rate by the type of first credential earned, those receiving long-term certificate had the highest employment rate, 40 percent (12 students

[38] The higher proportion of incumbent workers in FRCC than in other schools may be due to the large number of students taking non-credit CHAMP courses, most of who were employees.

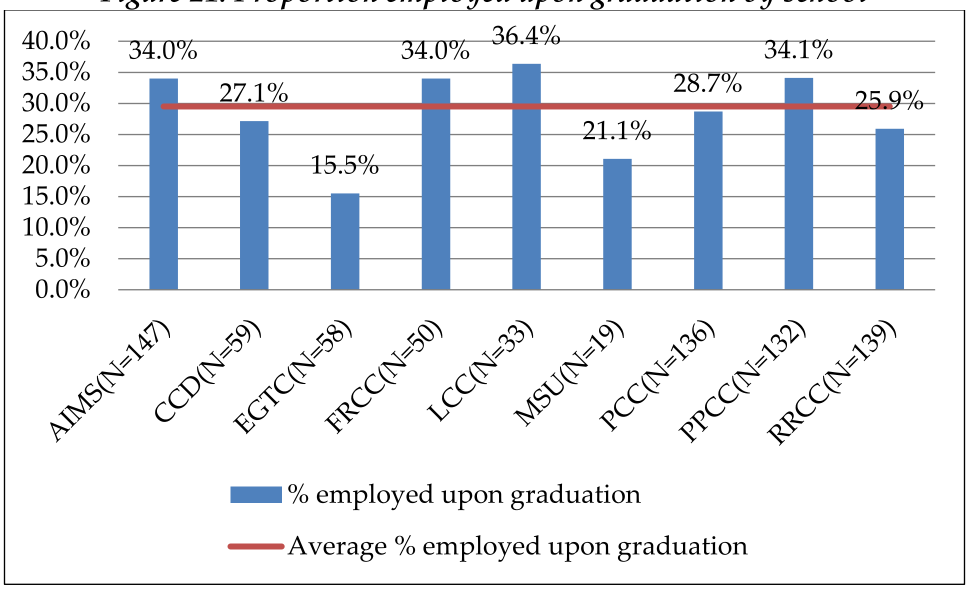
out of 20 long-term certificate earners). Thirty percent of the short-term certificate earners were employed in the year-quarter after receiving the credential, and about 26 percent of those with an associate's degree were employed immediately after earning their degree (Table 15).

Table 15: Employment in first quarter after earning first credential

First Credential Type	Unemployed		Employed		Total
	N	%	N	%	N
Associate's degree	128	74.4%	44	25.6%	172
Short-term Certificate	405	69.7%	176	30.3%	581
Long-term Certificate	12	60.0%	8	40.0%	20

EERC then looked at differences in rates of employment of non-incumbent students by college (Figure 21). With the exceptions of CCD, RRCC, and EGTC, CHAMP institutions had over 34 percent of students employed upon earning their first certificate or degree. In contrast, CCD and RRCC had just over 25 percent of non-incumbent credential earners successfully employed upon graduation; and EGTC had just over a 15 percent rate of employment.

Figure 21. Proportion employed upon graduation by school

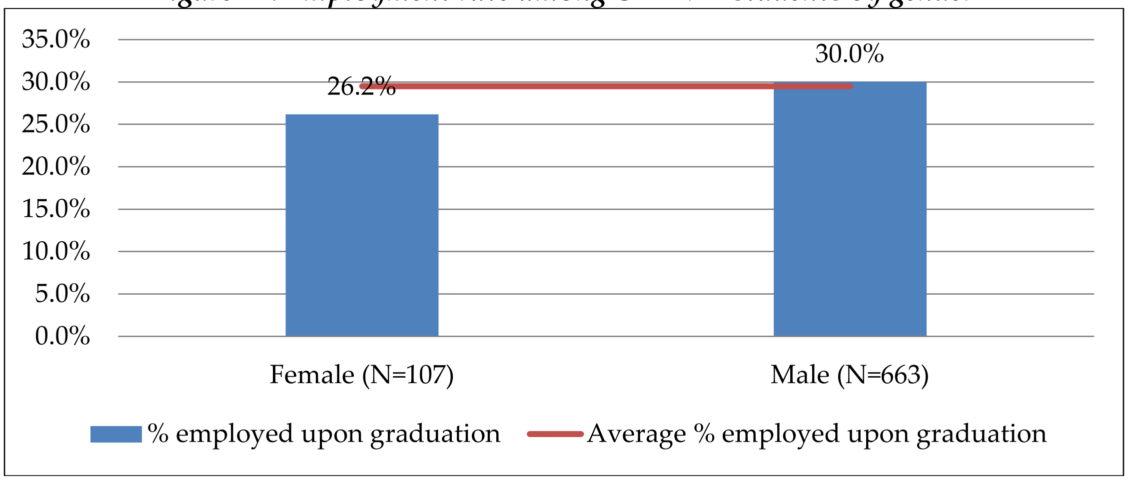


In the following sections, we examine whether the employment rate differed by CHAMP students' demographics, registration status, or military background.

By Gender

As indicated above, there were far fewer female CHAMP students who enrolled in CHAMP programs. However, graduation rates did not differ by gender (28 percent for female and 30 percent for male. See Figure 14). Regarding employment rates after completing their first credential, females had a slightly lower rate of employment than their male counterparts, 26.2 percent of females, and 30 percent of males (Figure 22).

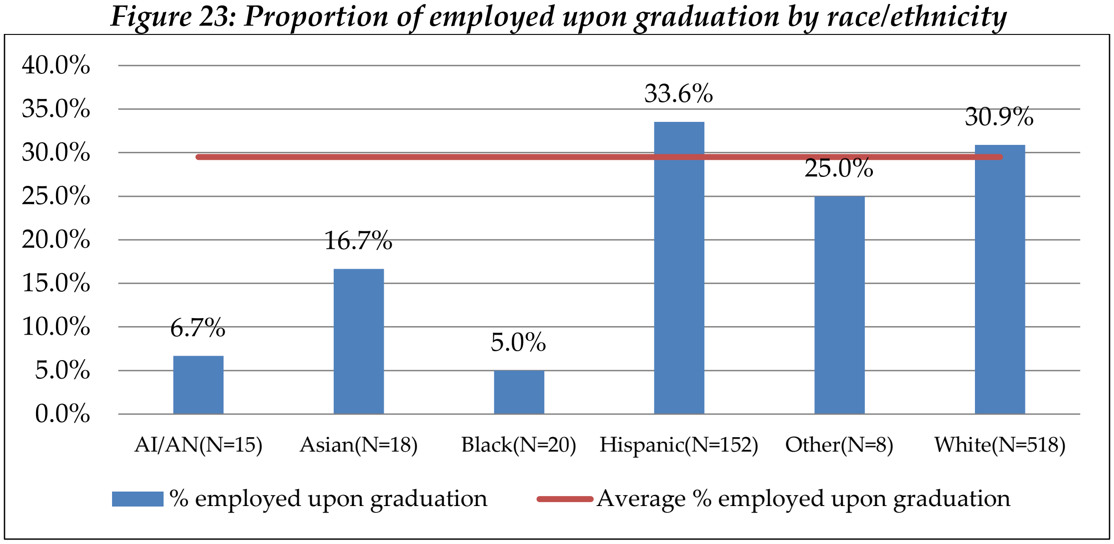
Figure 22: Employment rate among CHAMP students by gender



By Race/Ethnicity

Of the students who reported their race/ethnicity, white and Hispanic students had higher than average rates of employment rates (over 30 percent. The employment rate among the black and American Indian/Alaskan native students were low at 5 and 7 percent respectively. Asian students also had low employment rates at 17 percent (Figure 23).

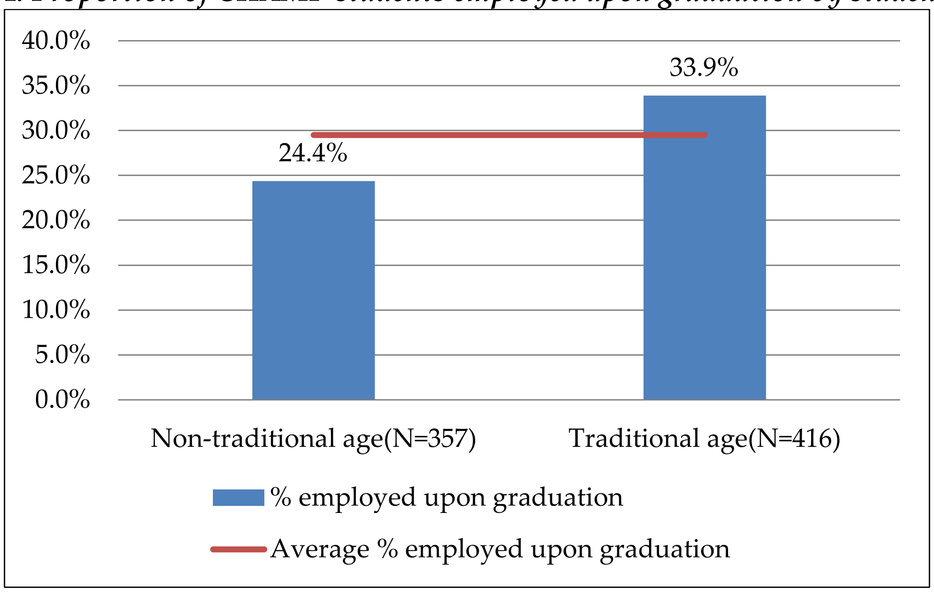
Figure 23: Proportion of employed upon graduation by race/ethnicity



By Age

Figure 24 looks at the rate of employment after completing a first CHAMP credential by age - traditional age student or non-traditional. Traditional students had a 10 percent higher rate of employment than their non-traditional counterparts (34 percent for traditional students compared to 24 percent for non-traditional students). This difference of 10 percentage points suggests that age may be associated with the probability of employment among the CHAMP sample.

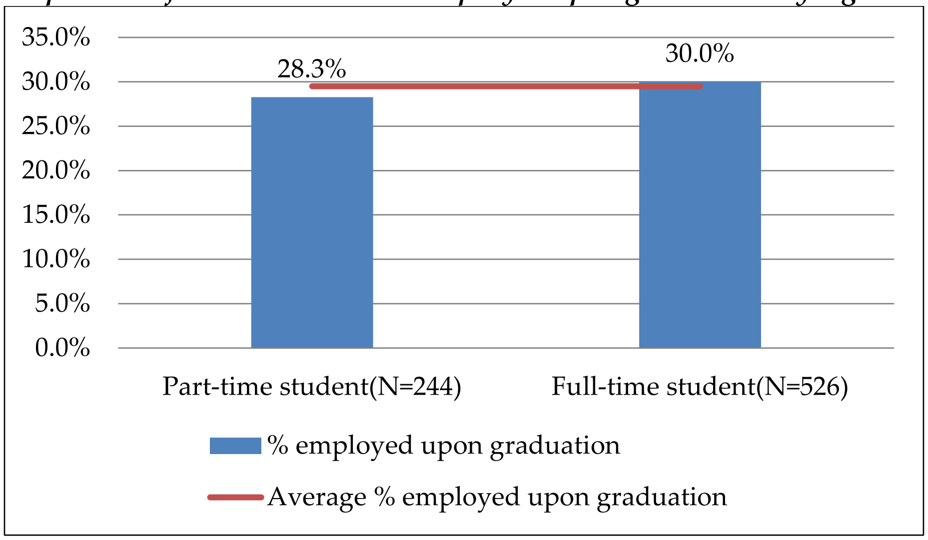
Figure 24: Proportion of CHAMP students employed upon graduation by student status



By Registration Status

Regarding employment, there was no real difference between students who had been full or part-time when they received their first certificate or degree, Figure 25. Full-time students' employment rate was just one percentage point higher than their part-time counterparts.

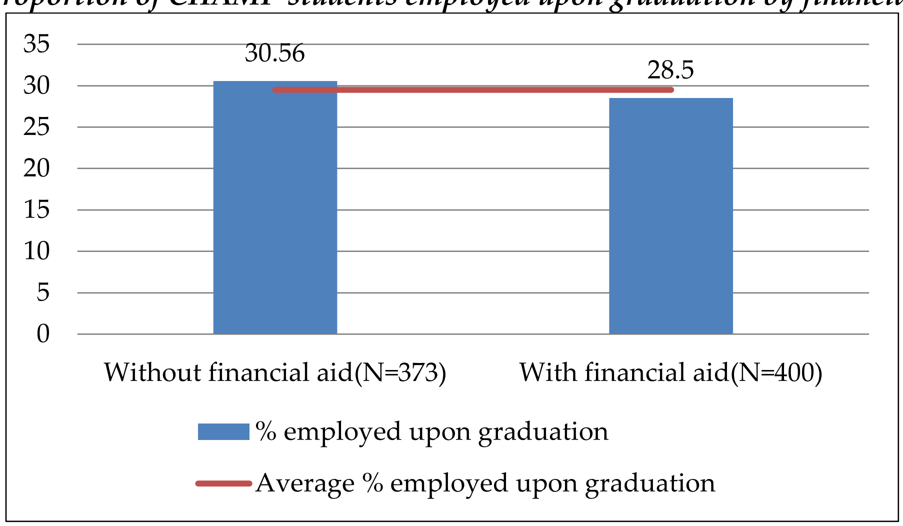
Figure 25: Proportion of CHAMP students employed upon graduation by registration status



By Financial Aid Status

Employment rates among students with or without financial aid were similar. The employment rate of students without any Pell grant was only one percentage point higher than for students who had received a Pell grant (Figure 26).

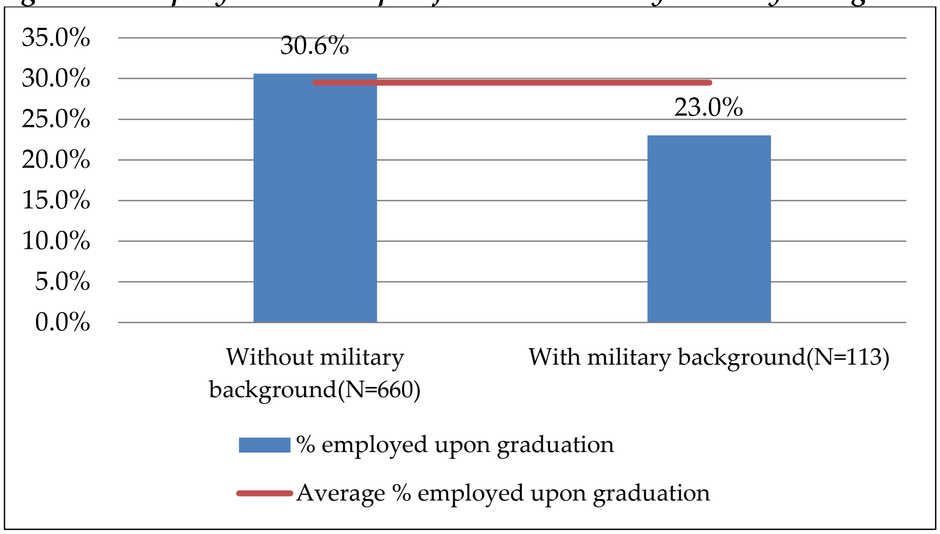
Figure 26: Proportion of CHAMP students employed upon graduation by financial aid status



By Military Background

The employment rate after earning a first credential was higher for students without a military background than their counterparts with a military background (30.6 percent compared to 23.0 percent. Figure 27). The employment rate of degree earners among students with a military background was seven percentage points lower than the consortium average employment, 30 percent.

Figure 27: Employment rate upon first credential by military background



In sum, employment rates stratified by students' demographic characteristics suggest that some demographic characteristics may be associated with the rate by which credential earners were employed. For example, traditional-age students had higher employment than non-traditional students. Moreover, white and Hispanic students were far more likely to be employed after graduation than black and American Indian/Alaskan native students. Also, students with military experience were less likely to be employed after graduation than students without military background.

Wage Increase

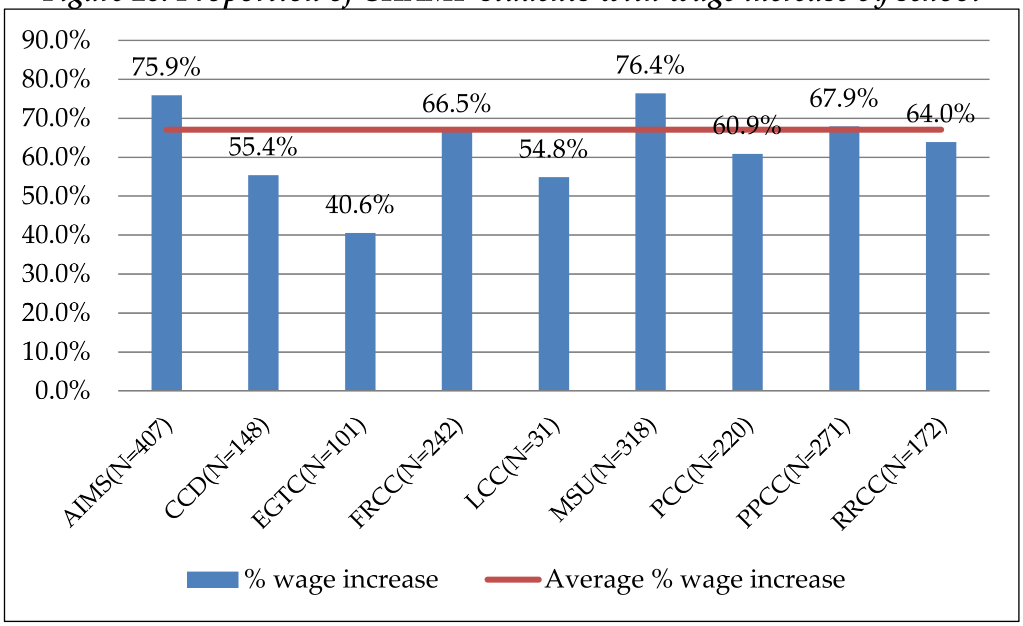
EERC next examined whether CHAMP students who were incumbent workers experienced an increase in earnings over $500 since enrolling in CHAMP program. This analysis focuses on whether learning new technologies and skills through CHAMP helped students find better jobs with a higher income.

When we look at wage increases among all CHAMP students who were employed when enrolling in CHAMP programs, we find that 67.1 percent of them experienced a wage increase of over $500 in quarterly wages. In the following sections, we examine the growth in wages by students' demographic characteristics, registration status, financial aid conditions, and military background. In each of these analyses, the average proportion of students who had a wage gain may differ slightly from the mean of the entire consortium. The mean applies only to the number of students for whom we have data, and that varied due to missing data.

By School

Incumbent workers at CHAMP institutions differed in the rate at which they received a pay increase). The rate ranges from 41 percent at EGTC to 76 percent at Aims and MSU. At FRCC, PPCC, and RRCC the proportion of CHAMP students with an increase in wages was close to the consortium mean of around 66 percent. Students at CCD and LCC had a lower wage increase, about 55 percent (Figure 28).

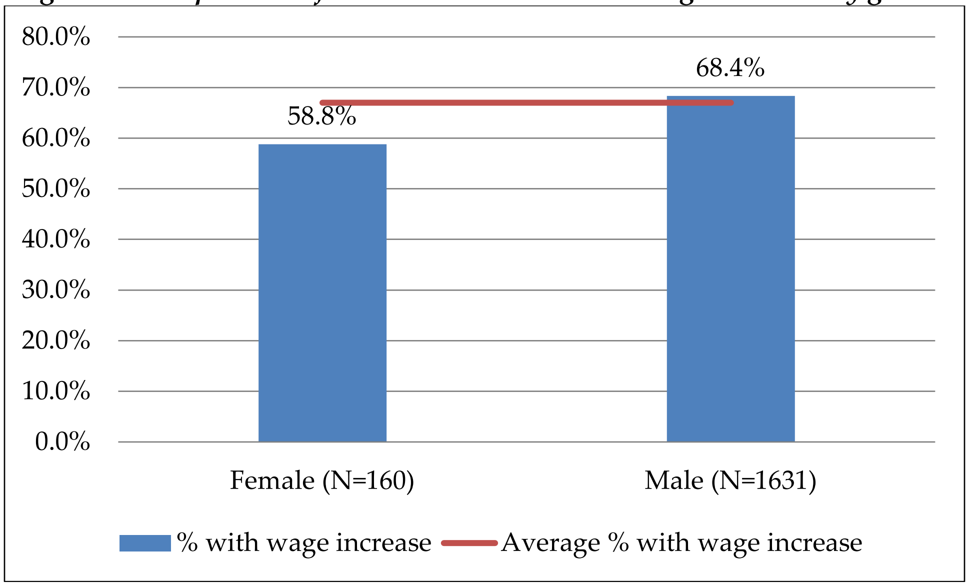
Figure 28: Proportion of CHAMP students with wage increase by school



By Gender

Male incumbent workers experienced a higher rate of wage increase than incumbent female workers, 68.4 percent as compared to 58.8 percent (Figure 29).

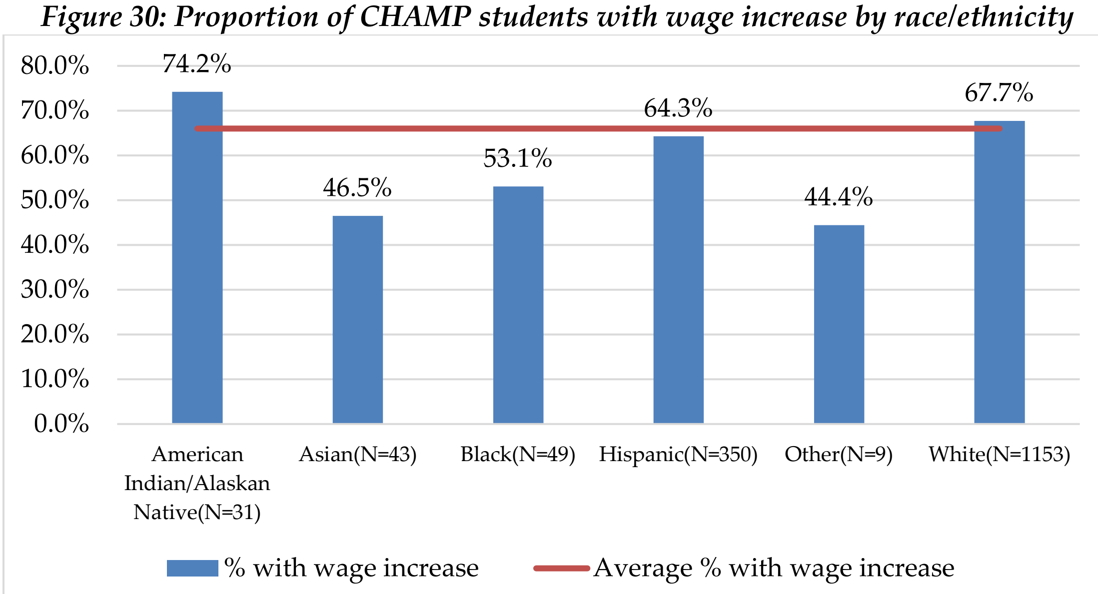
Figure 29: Proportion of CHAMP students with wage increase by gender



By Race/Ethnicity

Incumbent wage increase by race/ethnicity is presented in Figure 30. About 74 percent of American Indian/Alaskan Native students received increases in their wages, the highest rate across all racial/ethnic categories. White students also had a high rate of wage increase, 67.7 percent. The rate of wage increase among Hispanic students was 64.3 percent, just a few percentage points lower than the consortium average. Less than half of incumbent Asian workers experienced a wage gain. Black incumbent workers did slightly better with a 53.3 percent experiencing wage increase. But, this is still at least 13 percent lower than the consortium average.

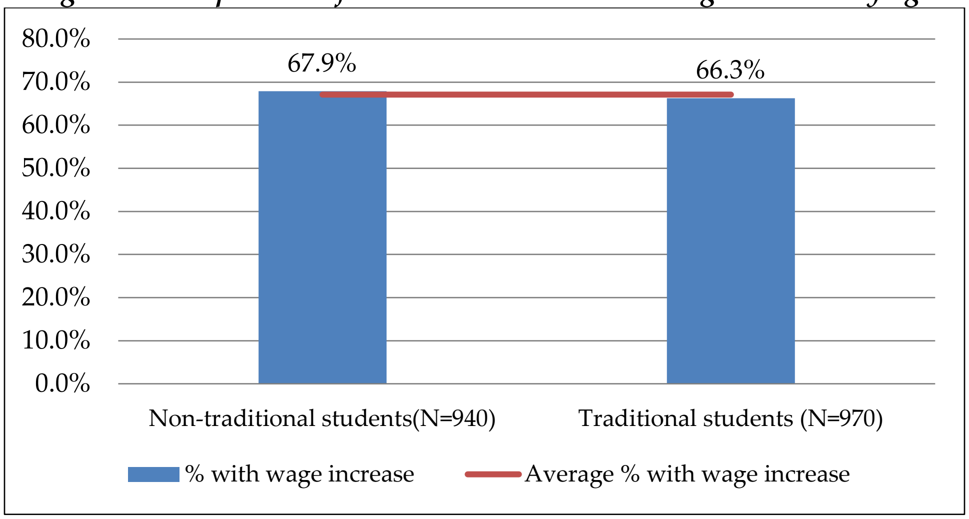
Figure 30: Proportion of CHAMP students with wage increase by race/ethnicity



By Age

There was no real difference between the rates of wage gain for traditional and non-traditional students, 67.9 percent and 66.3 percent respectively (Figure 31). It, therefore, seems that age does not have an impact on the probability of a wage increase.

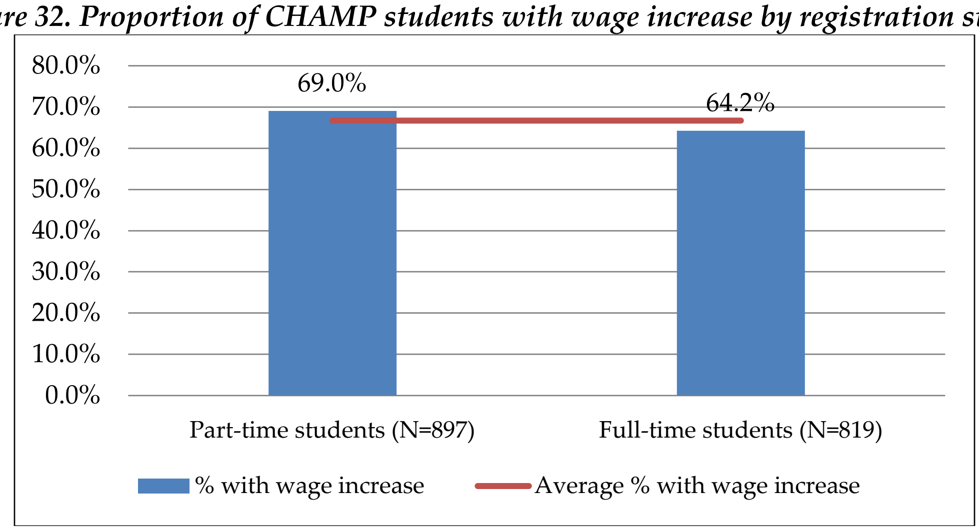
Figure 31: Proportion of CHAMP students with wage increase by age



By Full-Time Status

Comparing wage increases by student registration status, we find that part-time incumbent students had a slightly higher probability of a wage increase than full-time incumbent students, 69 percent vs. 64.2 percent (Figure 32). Without examining other factors such as type of credential and type of jobs in which students were employed, the factors contributing to this difference remain unclear.

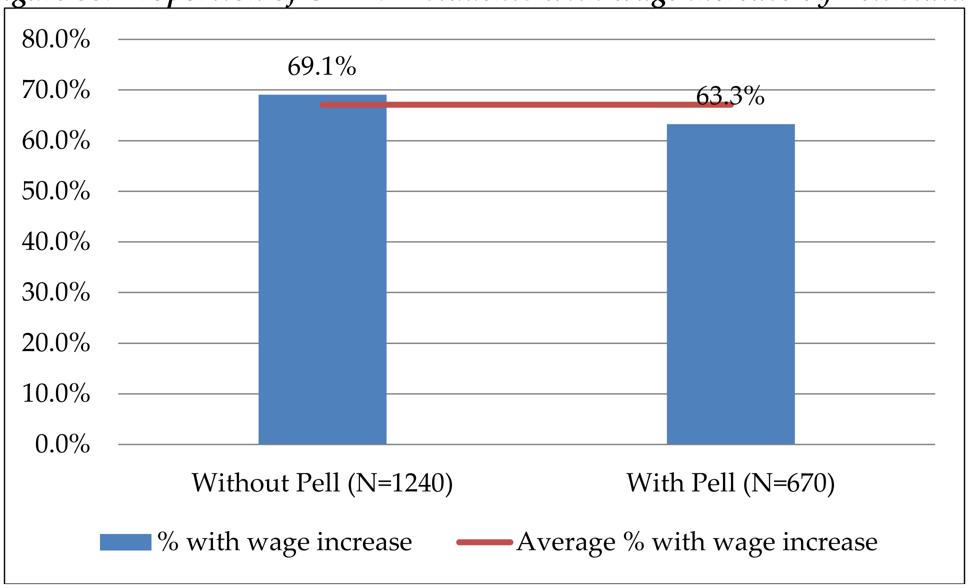
Figure 32. Proportion of CHAMP students with wage increase by registration status



By Financial Aid Status

There is a 6 percent difference in the proportion of CHAMP students with or without financial aid who experienced a wage increase, 63.3 percent vs. 69.1 percent (Figure 33). It is not clear if this reflects that students without aid had better jobs with more potential for promotions and wage increases or other factors.

Figure 33: Proportion of CHAMP students with wage increase by Pell status

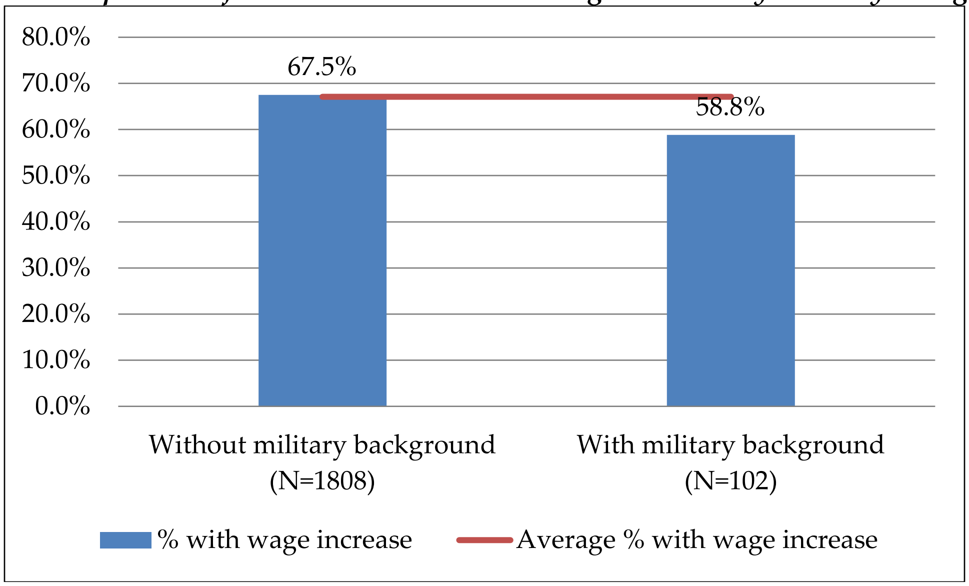


By Military Background

Only 102 students in the entire CHAMP population served in the military and showed up in the UI dataset as employed at the time they enrolled in a CHAMP program.[39] Incumbent students with non-military backgrounds experienced almost nine percentage points more in wage gains than those with military backgrounds, 67.5 percent vs. 58.8 percent (Figure 34). Again, it is unclear what contributed to this difference. It is possible that military incumbent workers started with higher paying jobs, and the wage gain is restricted in the short period of observation.

[39] Students working for the military would not show up in the UI data set.

Figure 34: Proportion of CHAMP students with wage increase by military background



In summary, the rate of wage increase varies by gender, race/ethnicity registration status, military background, and financial aid status. The cross-tab associations presented in this report suggest future analysis should be conducted addressing the differences in the rate of wage increase using these variables.

PART C: PROGRAM ACTIVITIES: IMPLEMENTATION AND IMPACT

CHAPTER 2: NAVIGATORS

Suzanne Michael, Heather McKay, Li Kuang

INTRODUCTION

In addition, to facilitating students' movement into the job market, the CHAMP grant mandated the employment of a "navigator" to provide some or all of the following services:

- Help prospective and registered students to understand the career pathways available to them and identify the credentials they need to complete the pathway they choose,
- Advise and support students to increase their rates of retention and completion,
- Help students to navigate the college's processes, including the awarding of earned certificates,
- Provide referrals and support for nonacademic needs, such as housing or childcare issues, that may impair students' ability to complete their coursework,
- Identify internship and employment opportunities,
- Help students matriculate from associate degree to bachelor's degree programs, and
- Prepare students to engage in employment searches and enter the job market.

This chapter complements our previous report by focusing on the role of the CHAMP navigator at the nine consortium colleges. We begin by examining how navigators have contributed to the achievement of grant goals. We then identify both some promising strategies employed by navigators as well as some of the challenges they have faced. Finally, we end this chapter by making some recommendations for the future.

While this chapter is focused on the work of CHAMP navigators from fall of 2013 through the summer of 2016, our discussion is contextualized, referencing a broader national focus on "intentional or intrusive" student advising (Varney, 2007) to improve retention and completion rates. To illustrate how the work of CHAMP navigators fit within this wider context, we also draw on the experiences of career coaches funded under two prior USDOL TAA grants: the Colorado Online Energy Training Consortium (COETC), which focused on the energy sector; and the Consortium of Health Education Online (CHEO), which focused on the health care sector.[40]

This chapter is divided into three parts. Part I will focus on the role and function of the navigators, and Part II will examine the number of students served by navigators, their demographic characteristics and academic outcomes, and the frequency and nature of their contacts with CHAMP navigators. Part II also provides an analysis of changes in employment status and wages after earning a CHAMP-related credential. Part II: discusses the challenges

[40] See http://smlr.rutgers.edu/content/publications for EERC's reports on these other TAA projects.

faced by the colleges, sustainability, and ends with promising or best practices identified during the grant.

METHODS

Over the course of CHAMP, EERC team members engaged in qualitative and quantitative data collection and analysis to evaluate program development and implementation, and to track and measure program outcomes, successes, and challenges. Data collected for this report includes the following activities and data sources:

- *Phone and on-site interviews* with project leads, navigators, program faculty, and college staff about CHAMP-related activities, challenges, and achievements. Interview tapes and notes were transcribed and analyzed using Nvivo software.
- *Electronic quarterly reports completed by project staff* that provided both numeric and narrative responses about project activities. This information was manually analyzed to identify emergent patterns across the colleges as well as school-specific issues, challenges, and successes.
- *Monthly online surveys of CHAMP navigators* that were designed to capture their activities with regard to student recruitment and engagement; career training; development of internships; and work with regional and local workforce centers and employers. These surveys, which navigators were required to complete, were manually analyzed to identify the nature and frequency of navigator activities.
- *Entries in an online record-keeping system* that navigators maintained to keep track of their engagement with students. These logs included, among other data, demographic information about each student the navigator interacted with; the reason for each contact; and any referrals made during the contact. The records combined both narrative and discrete data and thus were analyzed both qualitatively and quantitatively.
- *Narrative communications from Basecamp*, the project management web portal through which the consortium colleges communicated with one another and with the Colorado Community College System. The discussion threads involving navigators and their posted documents were reviewed and analyzed for this report.
- *Quantitative student data from Banner*, the Colorado Community College System's student data system. Banner data—e.g., student GPA, demographic information, certificate and degree completion dates—was used to analyze student retention and completion rates.

This report is divided into three parts. Part I will focus on the role and function of the navigators, and Part II will examine the number of students served by navigators, their demographic characteristics and academic outcomes, and the frequency and nature of their contacts with CHAMP navigators. Part II also provides an analysis of changes in employment status and wages after earning a CHAMP-related credential. Part II: Discusses the challenges faced by the colleges, sustainability, and ends with promising or best practices identified during the grant.

PART I: THE ROLE AND FUNCTION OF THE NAVIGATORS

Recruitment and Employment of Navigators

To fill the grant-mandated navigator position, colleges required that candidates had, at a minimum, a bachelor's or master's degree. They also sought individuals with prior experience working with students or clients within an educational or workforce setting, and who had worked in "one-on-one situations such as case management, with a diverse clientele." This included having some "experience with nontraditional students (students 25 years and older); students with only adult basic education/GED, and academically underprepared/high school graduates" as well as "experience with at-risk populations" (Colorado Community College System, 2012a). Some colleges indicated a preference for individuals with experience in "career development/counseling, job coaching/placement." Some sought individuals with good organizational skills, strong interpersonal skills, cultural competency, and the ability to build partnerships and collaborate. Some wanted navigators who had the "ability to identify realistic goals/expectations with/for students" and had an "attitude of optimism and the ability to inspire confidence." Teaching and training experience, as well as basic knowledge of data collection methods and program evaluation, were other identified preferences. Finally, some colleges explicitly stated their interest in identifying candidates who had some background in manufacturing.

Between spring and fall 2014, eight navigators were recruited and employed. [41] PPCC hired the first CHAMP navigator in March 2014. Most colleges, however, only hired their navigator after the launch of their CHAMP program (e.g., FRCC, LCC, MSU, and RRCC). EGTC hired someone on their navigator line, but this individual never really engaged in the navigator role. Of note, over the course of the grant, several navigators left[42] and were replaced—including PCC's navigator, who was promoted to the project lead position. Students' access to navigators therefore varied across campuses; that is, some schools experienced short or even long periods of time when their CHAMP programs employed only a part-time navigator—or none at all (Table 1). The inconsistent presence of navigators at some colleges affected the nature of the navigator role on those campuses and may have negatively affected student outcomes.

[41] We restrict the following discussion of navigator characteristics exclusively to this initial cohort of eight navigators.
[42] Aims, PCC, and RRCC experienced at least one change in navigators over the grant period.

Table 1. Navigator presence on campus[43]

	Aims[44]	CCD[45]	EGTC	FRCC[46]	LCC	MSU[47]	PCC	PPCC[48]	RRCC
Spring 2014	No	No	No	No	No	Part Term	FT	FT	No
Summer 2014	FT	FT	No	FT	FT	PT	FT	FT	PT
Fall 2014	FT	FT	No	FT	FT	PT	PT[49]	FT	PT
Spring 2015	FT	FT	No	FT	FT	PT	FT	FT	FT
Summer 2015	FT	FT	No	FT	FT	PT	FT	FT	FT
Fall 2015	No	FT	FT	FT	FT	PT	FT	FT	FT
Spring 2016	FT	FT	FT	FT	FT	PT	PT	FT	FT

Two CHAMP navigators had previously worked as COETC career coaches at their respective colleges (FRCC and RRCC). One navigator had previously worked both as her college's Director of Retention Services and also as the Grant Development Coordinator (PPCC). The other five navigators were external recruits.

All eight navigators had at least a bachelor's degree. Several had master's degrees, and one had a PhD in educational leadership. The navigators came with substantial work experience and, on average, were older than the cohort of career coaches recruited under the COETC grant. Several navigators had taught part or full time at the primary or secondary levels. One navigator had been a high school guidance counselor, and another had been a social worker. One navigator came from manufacturing, a career that began on the line and ended as a plant supervisor/ manager. Another navigator had once been involved in quality control at an electronics factory.

We asked the navigators what special traits, skills, or experiences they brought to their jobs as navigators. One stated that her openness to listening to students' experiences was helpful "so that we don't alienate them in any way." Another navigator explained that she used the parable of the fish when students asked why she did not answer them, but instead showed them where to get information by telling them: "I can give you a fish and feed you for a day or I can teach you to fish and feed you for a lifetime." She explained that she saw her role as

> *…being able to work with students and help them, not only through their education, but help them understand how a business can run and how they can make an impact as an individual within that business.*

[43] Despite the variations in staffing, it is important to note that some colleges assigned other college staff or faculty to some of the "navigator" functions. As a result, some navigators did most everything and others focused on only a few of the "defined" navigator functions.
[44] Aims had both a navigator and a business outreach coordinator.
[45] CCD had both a navigator and an internship coordinator.
[46] FRCC had both a navigator and an employer outreach coordinator.
[47] MSU had both a navigator and an internship coordinator.
[48] PPCC added a military coordinator in February 2016.
[49] As of September 2014, the PCC navigator became the CHAMP project director and then the new navigator became the project lead.

Initially, all but one of the navigators were female, while most of the students and the faculty were men. One navigator spoke directly to the gender issue, sharing that because she had worked with men for the past 30 years, she "speaks their language." She said this helps in her interactions with students.

> *Now, I don't know machining, I don't know welding, I don't know electromechanical, but I know what kind of work that they're leading these students to. So I think it helps me understand their backgrounds. It helps me interact with them because, I don't know, I think there's a difference, it takes a little bit different interaction so that they know I'm—I don't know how to say that. That they can't pull anything over on me.*

Institutional Location and Integration

Under CHAMP, most navigators were assigned to the project team, which was often nested in the college's advanced manufacturing department or division (e.g. PCC, PPCC). This was a change from the earlier COETC grant, under which career coaches were often housed within student services, academic advising, or career services offices. The change of institutional location suggests the multifaceted role of the CHAMP navigator, whose duties extended beyond student advising into the community and the workplace with an intensified focus on employer relations.

At some colleges, navigator functions were bifurcated or shared with another person who usually held an institutional role beyond the CHAMP grant. For example, CCD and MSU both had a navigator and an internship coordinator. At both institutions, however, the internship coordinator was part time in the role. At FRCC, the navigator worked closely with a designated employer outreach coordinator; that person functioned similarly to the business outreach coordinator at Aims, who worked with the navigator at that school. Mid-way through the grant, PPCC employed a military student coordinator to work with its navigator to better facilitate the college's work with students who were active military or veterans and their families. In the discussions to follow, shared navigator functions will be revisited.[50]

Some navigators played a pivotal role in the development and administration of the CHAMP grant. Throughout the course of the grant, navigators worked with faculty and staff from an array of campus offices including student services, academic tutoring, career services, internships, financial aid, and health services. For example, one navigator often worked closely with her dean, the project director, and faculty "trouble-shooting things." At times, this navigator felt she was "at the center of things . . . making sure that everything works well for the students so that we can keep moving them forward." Similarly, PCC's navigator, who was promoted to project lead, was embedded in the Office of the Dean of Business and Advanced Technology and subsequently participated in both the college's PLA committee and the Colorado Community College System's PLA planning committee.

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[50] Note that shared navigator responsibilities will affect the quantitative results about the number of student–navigator interactions as well as the reasons for contacts made on these campuses.

For a few navigators, the physical location of their offices, like those of the career coaches on earlier TAACCCT grants, presented some challenges. Shops and classrooms were often in other buildings (e.g., at LCC and PPCC). This resulted in little informal "drop-in" foot traffic that was enjoyed at FRCC, where the navigator's office was just outside the shop classroom area. Navigators often responded to the challenge of physical distance by embedding themselves in the classroom on a regular basis.[51]

> *Courses are in a couple of different locations, so I did plan on being kind of the warm body at the back of the room, so that I can be there so that if someone has a question, we can make an appointment and get together and that kind of thing. But just so they get to know who I am.*

Overview of Navigator Functions

The CHAMP navigator position was a modification of the career coach position mandated under earlier TAACCCT grants. Paralleling the career coaches, CHAMP navigators were to engage in intensive advising and to help students with both the academic and nonacademic issues that often affect their ability to remain enrolled in their programs, and complete their credentials. Navigators were also to assist students to "utilize credit for prior learning" and "transfer or lattice a program with another institution."[52] Further, while career coaches had at times worked with students on career pathways and employment-related issues, these duties were principal responsibilities for navigators under CHAMP. This shift of emphasis meant that navigators were expected to actively engage with employers and serve as the point person for newly created internship and apprenticeship opportunities at their respective schools. The name change reflected the new emphasis of the position—these new posts were designed to help students *navigate* multiple systems both within and outside the college.[53]

Mirroring experiences under COETC and CHEO, the actual role and function of each navigator was defined within the context of her college's existing student and program resources, and as indicated above, the staffing of related functions. Thus, as we analyzed the navigator's role at each of the nine CHAMP colleges, the diversity and range of navigator activities expanded or contracted to include any number of items from the following list:

- student recruitment
- student orientation
- developing student success skills
- academic and nonacademic advising, including making referrals to campus and community services
- helping students navigate college administrative procedures, including financial aid, adding earned credentials to their transcript, and earning credit for prior learning

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[51] PPCC's navigator was also co-located one day a week at the Colorado Springs WFC.
[52] See CCCS CHAMP proposal, p. 17.
[53] See the EERC report, *TAACCCT Career Coaches: Findings and Observations*, for a more detailed discussion of the career coach title and position. Available at http://smlr.rutgers.edu/content/publications-0.

- explaining career pathways
- attracting internships and apprenticeships
- developing or growing collaborations with workforce centers and employers
- employment preparation
- assistance with job seeking

Outreach and Student Recruitment

A principal focus for many of the navigators was the recruitment of students to new and redesigned advanced manufacturing certificates and degrees. Student recruitment had not been part of the former COETC career coaches' responsibilities, but it had been a function for some CHEO career coaches.

Navigators were expected to reach out to regional employers, workforce centers (WFCs), and community organizations such as veteran groups to disseminate information about their college's CHAMP program. At colleges without an employer or business outreach coordinator (e.g., LCC), the navigator became the campus point person for the array of program opportunities under CHAMP.

In thinking about recruitment, PCC's navigator observed some of the challenges colleges faced.

> *How do we reach individuals that don't know they want to go to school yet, or don't know they want to change careers yet? So I want to get beyond the client list of the workforce center, and I want to get beyond the students who are already here at the college. I want to get that message out to other individuals who are out there, who just don't know yet that that's what they want to do., and don't know that that's what we have available here at PCC.*

Recruitment efforts included navigators going to employment sites to talk about the CHAMP program.

> *We'll often meet [prospective students] at their place of employment to kinda remove that scary barrier that a lot of students believe there is when they haven't been to college ever or haven't been to school in a long time. So we'll do enrollment at their place of employment a lot of times.*

Navigators also tabled at community events, such as the First Annual Aurora Veteran's Expo 2015 (MSU). FRCC's navigator's efforts included going directly into the community—into "coffee shops and churches and things like that [to] post posters"—to market the CHAMP program.

Navigators also invited employers and community organizations to campus events such as job fairs and open houses. Some of these events were collaborations with a local WFC. Navigators also gave tours of their colleges' advanced manufacturing training facilities and encouraged both employers and prospective students to speak with current CHAMP students. The navigator at EGTC reported that once she began to network with community organizations, she was contacted by groups with whom she had had no prior contact, but which had heard about EGTC's program through other avenues.

FRCC's navigator observed that community outreach was a multifaceted process and that her activities built on what had been done in the past. She saw her job as further developing the college's reputation by letting people know about the new opportunities the college had to offer under CHAMP.

The navigators at PCC and RRCC sent mailings to current and past students using marketing brochures created with campus funds; others used social media to showcase their colleges' CHAMP options, including noncredit, certificate, and degree programs. Navigators also used LinkedIn, posted on Craigslist, and created Facebook pages. As one navigator stated:

> *I created a Facebook page for us, so we're hoping that that will help with the younger crowd to kinda see it on there. We do a lot of promotion on there.*

The navigator at Aims who was more involved with marketing and recruitment activities than direct student advisement, developed a number of creative strategies to recruit students and to engage and recognize employer partners. First, she redesigning the school's manufacturing website to make it more interactive. She also developed a video that included bios of alumni – including women - to stimulate interest in the program. Some of these alumni became role models and helped interest new students, as well as help students network when they graduated. Faculty, students and employers were very positive about the video – especially as it showcased the caliber of the program's students, and personalized career pathways. In addition, the CHAMP website showcased some of that employers with whom the CHAMP program was partnering - recognizing their contributions to the program. With company permission, some of these companies were then hot-linked via the website. This provided students with greater access to the regions' business community – helping students become more familiarize with the range of companies, the skill sets these companies desired; as well as job postings. The Aims' navigator also helped to develop a quarterly newsletter which contained articles written by faculty and staff about the college's new programs, and the new state of the art equipment that was now available for training.

The creativity of Aims' navigator went even further. She began to consider the crossing of traditional academic boundaries. She asked faculty and staff how career and technical education (CTE) and the liberal arts and humanities might complement one another. For example, how might engineering and anthropology relate to one another? Her questions stimulated faculty to think about the crossovers. This resulted in some articles on the subject that appeared in the general college newsletter. It is not clear if the navigator's innovative thinking resulted in drawing any students into the CHAMP programs—but it does present an interesting strategy to at least draw students from other fields to explore options under CTE programs.

Some CHAMP navigators, including those at Aims, RRCC, MSU, and EGTC, also developed videos that they posted on their websites and used at recruiting events and technical shows. Aims' navigator summed up the utility of these videos.

> *[A video is] something that we could circulate showing, "Look, we have successful students. This is what this program entails. These are the experiences that students live with." And it's a great marketing tool [to show] our companies because they're like, "Oh, wow, look at that student!" And so instead of reading text, you get to watch someone talk about their experiences, and it's just easier to relate to.*

Although TAACCCT grants do not focus on or serve high school students, some CHAMP navigators encountered high schools in their marketing efforts, opening up a potentially important pipeline into their manufacturing programs. For example, LCC's navigator networked with regional high school counselors and college admissions staff. This resulted in an active dual- or concurrent-enrollment program within LCC's welding program. At PCC, some of the shops were physically located at local high schools, which provided opportunities for high school students to become aware of the college's advanced manufacturing program.

One of the priorities for navigator outreach and recruitment was the expansion of diversity within advanced manufacturing programs—to reach out to women and to nontraditional students, including incumbent workers. To this end, navigators contacted a range of veterans' organizations, including the Disabled Veterans Outreach program, Aurora's Veterans Affairs Commission, and Hero2Hire. Some also attended conferences such as the Denver Veterans Job Fair. Prior to the employment of a dedicated military outreach coordinator at PPCC, the navigator at that school made regular visits to its satellite campuses on the local military bases around Colorado Springs to discuss the CHAMP program with prospective students.

To address the gender imbalance in advanced manufacturing,[54] FRCC's navigator did focused outreach to community organizations serving women, such as the PEO Sisterhood chapter, A Woman's Place and the single moms' group at the Pearl Group.[55] She provided each group with information about the CHAMP program and career opportunities in advanced manufacturing. In addition, the navigator and project lead created a flyer about a new women-only, Intro to Machining course that FRCC had developed. They then sent copies out to a range of community-based organizations, women's groups, the local WFC, and temp/employment agencies, as well as to five hundred employers in the region. The course, which launched in the spring 2016 term, included content thought to be especially meaningful to women: work schedule flexibility to accommodate families, good pay, and creative/challenging work. It was hoped that the course would help women gain confidence, and through comradery might also increase their comfort to pursue a career in manufacturing. Ten women enrolled in the inaugural class, and five enrolled the following semester. FRCC now plans to offer the course once each academic year.

CCD's navigator also reached out to women in a focused attempt to increase the pipeline of female manufacturing students. A CCD administrator said,

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[54] The Bureau of Labor Statistics reported that only 29.1 percent of manufacturing employees were women in 2015.
[55] The Pearl Group is a community-building organization that supports single parents and single-parent families.

[supporting] women in manufacturing has . . . been a real priority, a goal, of ours… Outreach really starts with presence, so we are getting in front of women and girls and really investing in them.

CCD has a "strong institutional support for emphasizing and addressing the exposure gap in advanced manufacturing." The school's CHAMP staff have been connecting with community organizations, industry representatives, and others in manufacturing to work collectively to create awareness of opportunities in the field for women, build interest among young girls, offer internships to women and girls, and offer activities and clubs centered on women in manufacturing. CCD staff are also in the planning stages of creating a club for women in advanced manufacturing at the college.

Another notable outreach strategy CCD has employed is its work with Project "Do it Yourself (DIY)." Project DIY is an advanced manufacturing/STEM camp for Denver-area high school girls that is funded by the Women's Foundation of Colorado and hosted by CCD. In June of 2016, Project DIY graduated 18 area high school girls from its first girls-only manufacturing camp. In our interviews, the CCD staff working on the project felt it was a resounding success and noted that many of the girls who participated in the camp are now interested in pursuing an education—and career—in advanced manufacturing.

Another strategy used by CHAMP colleges to expand the number of women in advanced manufacturing was to seek out women already in the field who might serve as mentors to enrolled students. At Aims, the navigator identified a few women alumni who then opened up a larger network of female graduates. She encouraged these women to act as speakers and as mentors to the women who were considering and/or were enrolled in the school's advanced manufacturing program. In the spring of 2016, the navigator also linked up with the national organization Women in Manufacturing (WIM).[56] Similarly, the navigator at FRCC contacted the Wisconsin chapter of WIM to discuss a program they had created for women mentors in the industry. She also attended the kick-off event for WIM's Denver chapter, where she met a number of women who expressed interest in serving as mentors for FRCC's female students and the chapter's lead offered to speak with FRCC's all-female class.

In addition to her outreach efforts targeting women, FRCC's navigator also attempted to reach out to the Latino/a community by contacting El Comité of Longmont. She discussed FRCC's program with her contact there, and explored strategies to reach Latinos in their local community.

The above outreach efforts fit into a larger context in which researchers have examined the implicit and explicit "cultural" messaging within and outside classrooms. This messaging includes forms of *microaggressions* that have been found to affect student retention—especially among students of color, students with limited means, and women (Caplan & Ford, 2014; Paul, 2015). Under CHAMP, most consortium navigators have attended conferences hosted by the National Alliance for Partnership in Equity (NAPE) that[57] addressed micro-messaging and

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[56] For more information, see http://www.womeninmanufacturing.org/home.

[57] See https://www.napequity.org/stem/

identified strategies to improve the enrollment, retention, and completion rates of historically underserved populations. Navigators have continued to attend NAPE events, conference calls, and webinars, and both PPCC and Aims hosted a NAPE training on their campuses. Navigators have used the NAPE trainings and events as professional development and have actively participated in employing equity practices in CHAMP classrooms as well as in their day-to-day interactions with students.

Intensive Advising: Making Connections Between Academics and Career

The literature on community college students—many of whom are first-generation college students, many of whom are balancing work, family, and school responsibilities, and many of whom are poorly prepared for college work—suggests that advising makes a significant difference. It can facilitate the engagement of students in the college experience and provide a sense that a college cares about and is invested in its students' progress and success (Cuseo, 2003, 2005; Lotkowski, Robbins, & Noeth, 2004; Upcraft & Kramer, 1995; Varney, 2007).

The ad hoc advising that often takes place during the thick of registration is only one of many different forms of advising. In ad hoc advising, the student and the advisor do not take time to get to know one another; the focus is on the student's schedule and little else (Cuseo 2005, 2003). At the opposite end of the continuum is "intentional" or "intrusive" advising, which involves proactive, action-oriented interactions with students (Drake, Jordan, & Miller, 2013; Varney, 2007). During this type of advising the student is aided in identifying and setting academic and career goals and developing strategies to reach these goals (Earl, 1987). In fact, research has found that a career focus as an integrated part of advising increases student academic motivation (Bean & Metzner, 1985; Metzner, 1989). Intentional advising is "systematic and directive" if not, at times, prescriptive and developmental (Upcraft & Kramer, 1995). It involves assisting and supporting student success by identifying both academic and nonacademic issues and facilitating referrals for necessary services or resources. And critically, it frequently involves the adviser connecting with students "before a situation occurs that cannot be fixed" (Varney, 2007).

"Intrusive advising" was identified in the first two TAACCCT grants—COETC and CHEO—as the means by which career coaches would provide "wraparound services to support retention and achievement," career counseling and referrals, academic advisement as it related to career choices, and counseling and referrals for a wide range of social and financial support services (Colorado Community College System, 2011). Early on in these grants, to better reflect the autonomy of students, a decision was made to refer to this kind of advising as "intentional" rather than "intrusive or intensive." In this report, we adhere to that convention by referring to the work that CHAMP navigators do with students as *intentional advising*.

The frequency and nature of CHAMP navigators' advising activities varied across colleges depending on the structure of each college's CHAMP program, its existing student services, and the needs of its student population. Across all colleges, from the employment of the first navigator in March 2014 through the end of our data collection period in March 2016, navigators saw a total of 1,215 unique students who collectively had 5,399 contacts with a navigator. (See Part II for an analysis of student demographics.) Table 2 displays the reasons for which students were in contact with their college's CHAMP navigator according to data collected on the navigator student tracking logs. The description of each category that appears in the table is the same one that appeared in the codebook used by navigators as they completed their logs. We present this information here to provide a context for the discussion of CHAMP navigators' activities that follows. A more detailed analysis of student–navigator interactions appears in Part II of this report.

Table 2. Students' reasons for contacting navigator

Reason for Contact	Proportion of total contacts
Career Advising includes inquiries related to job searches, career planning, internship placements, resume writing, and the like.	26.9%
General check- in[58] includes any meetings with no specific purpose in mind except for an opportunity to "catch up."	25.6%
Academic Advising includes inquiries related to course selection, program of study selection, course success, mentoring and tutoring referrals, and the like.	25.0%
General Info Session includes when a student is referred or makes a general inquiry about program	16.4%
Multiple reasons can be used where there is more than one reason for the visit.	3.6%
Nonacademic includes inquiries related to family-related problems, transportation, financial assistance, social and health related issues of self or family and the like.	2.9%
Credit for Prior Learning includes meeting with a student for portfolio reviews, CLEP advising, etc.	0.2%
Workforce referral includes any meeting with any student who was referred by a WFC.	0.1%

We begin here with the advising navigators provided to prospective students.

Prospective Students

As noted above, many of the CHAMP navigators engaged in marketing and student-recruitment activities; some went further to discuss academic and career options with prospective students; and some were also engaged in admission interviews for their college's

[58] It is not clear how navigators interpreted this category and thus it may include informal contacts within the classroom as well as overlap with more focused meetings on one of the other topics.

CHAMP program. The latter was the case at PCC, where both the navigator and the Division of Business & Technology's academic excellence administrator carried out 1:1 screening of prospective students interested in the school's Fast Track welding certificate, production technician certificate, or other programs in welding, machining, and electro-mechanics. During the screening sessions, the individual's career goals, employment or military background, academic skills (e.g., math proficiencies needed for print reading) were explored as well as his/her ability to commit to the welding Fast Track's intensive one-semester certificate program.

PCC also coordinated pre-semester meetings for students enrolling in the college's Fast Track welding certificate program so students could meet with faculty and get a heads up on program expectations (e.g., attendance, punctuality, etc.). Through these early interactions, students were able to get to know the PCC navigator and the services and support she could provide. These interactions also helped the navigator identify potential challenges for student success:

> *A lot of it was just these guys coming in. We'll sit and talk; we'll talk about what's going on.* [I learned that some students faced some] *pretty significant financial obstacles. So we actually took some of the grant money and put* [together] *a classroom set of some of their tools and supplies that they needed to release some of the financial burden of trying to get everything they needed for welding.*

Enrolled Students

Typically, navigators became involved with students after they were accepted and enrolled in a program of study. MSU was the only college that mandated that all students meet at least once with the navigator. At some other colleges, the navigator went into CHAMP program classrooms to introduce him- or herself and explain the nature of navigator services. Often navigators would schedule regular classroom visits to check in and see how students were doing. This helped the navigators build rapport with students. It also helped to normalize student–navigator interactions. As one navigator observed,

> *They know who I am, and they're more comfortable coming to me*. [. . . I] *let them know we're here for them. No matter how minor they might think that—for example, maybe they need help with food or something. But we can—we have resources—we can help them with that. So don't be embarrassed or afraid to come talk to us—that kind of thing. Because, I mean, yeah, I'm not just here for your career stuff, but if you need to vent or—you just never know what could be going on, but being able to help them with whatever resources they may need in the community, too—not just here on campus, but within our community.*

While nonacademic advising was a component of all navigators' workload, academic advising and career advising were the two most frequent reasons logged for student–navigator contacts. For that reason, we turn our focus first toward these interactions before returning to a wider discussion of nonacademic advising.

Academic Advising

Many community colleges across the nation require students to see an advisor at some point early in their academic career, often during orientation or registration (O'Banion, 2012). Typically, the assigned adviser is from student services or from a general pool of academic advisers. If the student has declared a major or has enrolled in a CTE certificate program, a faculty member from the subject area or discipline is often assigned to the student. Because these academic advisors are helping students during the "hurried and harried period of course registration," they often tend to focus "narrowly, myopically, and episodically on the imminent, deadline-driven task of class scheduling" (Cuseo, 2003).

Frequently, students do not again seek out an adviser until they are doing poorly. But early and preventive or anticipatory advisement—intensive advising—has been found to be important for retention and academic success (Cuseo, 2003). Such advisement can address barriers to student success such as balancing academics with work and family demands that may affect the student's ability to be successful with his or her studies (O'Banion, 2012).

In fact, a secondary aspect of intensive advising is providing the student, through regular interactions with the navigator, a sense that s/he has been "embraced by the college" and that faculty and staff are there to help him/her to be successful. The more a student experiences a sense of belonging at the college, or identifies as a member of the college community, the more he or she will make use of available services as part of his or her college experience—and the greater his or her potential for academic success (Heisserer & Parette, 2002; Bickerstaff, Barragan, & Rucks-Ahidiana, 2012).

The CHAMP navigator position, like the earlier TAACCCT-funded career navigator positons, was specifically designed and instituted to complement more traditional academic advising. Navigators were to provide in-depth advising in which students were asked about both their academic and career goals, as well as any barriers, or 'risk factors,' to achieving these goals. In addition, under CHAMP, navigators were to help students navigate through their college's academic and support system within the context of their advanced manufacturing program. Thus, at CCD, where advising services are provided by generalists, the CHAMP navigator was a "program-specific advisor engaged in traditional 'academic-advisor problem solving' to help students navigate through the system," e.g., helping students with registration and financial aid issues. Similarly, at FRCC, where there are both credit and noncredit CHAMP program options, the navigator helped students identify which option(s) best served their interests and needs and encouraged them, as appropriate, to stack certificates and/or move into a degree program. CHAMP navigators also assisted students with Prior Learning Assessments (PLA) and with the process of applying for earned credentials; these tasks will be discussed in greater detail later in this report, but are mentioned here because both are academic in nature.

Advising models varied by college. One of the more intensive wraparound models was at LCC, where the entire CHAMP team—the navigator and the CHAMP instructors—met weekly to discuss student performance and any concerns. As needed, the navigator brought in other campus staff. For example, after identifying a collective need for academic support, she worked with the director of Learning Support Services "to establish a plan for getting a tutor in the welding shop daily to help with IT and academic needs."

Of note was the way LCC's navigator handled students—especially male students and those who had already been in the workforce or military—who were reluctant to ask for help or let it be known they have a problem.

> *The machismo kind of—you're always supposed to look strong, and you're never supposed to have emotions kind of. It does get in the way of learning, I think. And I think some of them just were—had really bad high school experiences. So they come in, and they expect to be treated badly. And so they're having a different experience.*

The navigator turned this awareness into an opportunity in which students could help one another.

> *I am noticing, though, [a particular student] struggles academically, and I was in there trying to help him. And they get kind of funny about being helped. So I said to him, "You guys can help each other. You can talk each other through things. Actually, it's better if you do because these are the things you would be doing on your job. So-and-so has a body of knowledge and they can share that with you. It's the same here. It's not like you had to get that information from Doug or I had to be your tutor. It's like, you're going to remember it better if they talk you through it because now you're getting it from Doug, you're getting it from Terry, I've talked to you about the academics and what are the best approaches, and now somebody else is saying, hey, if you do this or you look at that . . . "*

At colleges where faculty played a major role in student advisement, navigators had far fewer interactions with students. This was the case at PPCC, where the navigator reported, "when I first started, I thought I would have a steady parade of students coming in and out . . . and that didn't develop." Nonetheless, PPCC's navigator got to know students through her other student-focused activities, including soft skills training (see below).

Regardless of the frequency or intensity of their advising activities, we found that on most campuses (e.g., LCC, MSU, CCD, PPCC), navigators regularly stopped by CHAMP-related classes to remind students of the services they could provide and to remain visible and accessible. And, as appropriate, they facilitated referrals to needed services both within and outside the college.

Career Advising

The category of career advising includes navigator activities around career choice, career readiness and soft skills, job searches, and interview preparation.

Career Pathways

Career pathways involve the formation of partnerships between educational institutions and industry for the purposes of identifying the skill sets employers need and establishing training programs to meet these needs. The career pathway system combines both educational and supportive services to facilitate students' success in earning marketable credentials and embarking on family-supporting careers (US Department of Education, 2015, pp. 1, 6; Strawn, 2016). The TAACCCT grant incorporated this idea.

The functions of the CHAMP navigators reflect multiple facets of the career pathways system: helping students identify industries with expanding job opportunities, and helping them choose the certificate and degree programs that can best prepare them for employment in those industries. Further, encapsulated within the concept of the career pathway is the goal of helping both prospective and enrolled students to explore career opportunities that either match and/or utilize their prior experiences and existent skills and interests. To this end, navigators made some—though, in most cases, limited—use of a career website and related map tool[59] developed by the Council for Adult and Experiential Learning (CAEL) using TAACCCT funding. This website, discussed in EERC's *Colorado Helps Advanced Manufacturing Program Website Brief*,[60] provides information on job types, employers, and certificate and degree programs. It also includes an industry map and industry crosswalk. These tools can help students identify the skills they have acquired in other industries (e.g., energy, construction, or the military) and explore how they overlap with the skills needed in advanced manufacturing.

For example, PPCC's navigator suggested that a female veteran who had fixed Black Hawk helicopters use the career map so she could explore how her experience and skills might be well suited to a career in machining. And the navigator at Aims commented,

> *I think I can use it when students come in and have specific questions about what their trajectories would look like, but I think it's going to be more useful from an advising and tactical standpoint regarding faculty and staff than it is going to be for students because a lot of my students don't really – —they don't want to go in and mess around with it and look at it. They just want to know. They'd rather just come in and talk to someone and have someone tell them and walk them through it versus them doing the legwork.*

However, while some navigators found these web-based tools to be very helpful, other navigators stated that prospective and new students came to them with well-defined plans about what they wanted to do. When dealing with such students, they felt, there was not much need to use these tools.

Navigators also engaged students as they prepared to graduate from their respective programs. Some used the career maps to stimulate students to think about what jobs they would apply for. "It's become a very useful tool," one navigator reported, saying, "It's handy to get on [the website] and show students" different job possibilities.

Some navigators also helped students to think beyond an actual industry or sector of employment and instead to consider the type of work environment they wanted. For example, FRCC's navigator asked students to consider how big a shop they wanted:

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[59] Available at: http://cocareeractiontools.com/

[60] To be posted on EERC's website fall 2017: https://smlr.rutgers.edu/content/publications-0

[I'll ask, "Do you want to work somewhere where] *you're just kinda doing your own thing and nobody's really bothering you and you're just kinda on your own*? *Or a shop which was a really small, intimate shop where you can build friendships and you have a lot of different responsibilities—you might wear different hats or whatever?"*

Most students probably do not have much choice about their first job or worksite—nevertheless, such job reflections provided the framework for them to think more long term, to think about a career trajectory rather than a specific job. The navigator at RRCC went a step further. Recognizing that big and small shops often have different requirements and even different job application procedures, she helped students focus on the skills and application materials each type of shop most often requires.

Soft Skills

Helping students with job readiness was another significant focus for the navigators. Students were gaining advanced manufacturing knowledge and skills in the classroom. However, soft skills often did not receive the same kind of attention. Soft skills have been defined many different ways, but in general they refer to those work-related skills that facilitate communication, problem solving, flexibility, responsibility, leadership, and teamwork. Soft skills can make a significant difference in securing employment as well as in keeping a job and getting promoted (Robles, 2012). In fact, employers increasingly indicate that soft skills are as important, if not at times more important, than hard skills (Davidson, 2016). The development of soft skills has therefore become a focus of CTE programs as well as of post-employment trainings (Mitchell, Skinner, & White, 2010; Bronson, 2007; Houghton & Proscio, 2001).

The navigator at Aims commented during an interview,

> *When I talk to HR [Human Resources], they want people who have those soft skills; they have those—that drive and ambition . . .*

LCC's navigator echoed the need for a variety of soft skills when she worked with students during and after orientation.

> *Being able to follow instructions. Showing up on time. If you can't show up, you're not keeping a job…. Just coming to work ready to work, not giving attitude about anything. Even if you're asked to do something that isn't your job, go do it. Learn a new job.*

Some colleges, like FRCC, integrated soft skills development into one or more of their CHAMP courses. At LCC, the navigator, worked with the welding faculty to integrate soft skills into the classroom. As a result, faculty now use a check-off sheet to grade students on attendance, staying on task, timeline-to-task completion, problem solving, and critical thinking.

Other college created specific trainings or courses, such as student success classes, that focused on soft skills (PPCC). Some of these were taught by the school's navigator (PPCC) or were team-taught by the navigator with other faculty or staff (PCC). In addition, some colleges made use of online resources that focus on soft skills, including the *Employability Skills for Industry* MOOC (Massive Open Online Course) developed by the CHAMP navigators with assistance from CCCS' instructional designer, on professionalism and job readiness that was posted on the Desire to Learn (D2L) interactive website (see the section on MOOCs, below).

Faculty and staff feedback about the self-paced MOOC varied across the campuses—some felt it was too academic, others felt that students needed to have more opportunities to interact with one another as they learned the content, and still others felt that the content needed to be grounded in actual day-to-day classroom interaction. As a result, the MOOC served as a stand-alone resource in addition to being used in conjunction with a required course or training.

At PPCC, students were initially required, as part of their program, to complete an online employability training developed by Goodwill Industries. However, the feedback from students and faculty was that this training was too elementary for PPCC's students, many of whom had experience in the military and/or in the labor force. As a result, the PPCC navigator began to go into classrooms and do her own workshops on employability issues.

In the fall of 2015, PCC's navigator began to conduct "career skills" workshops that integrated elements from the student success course with workforce training. This workshop, conducted in partnership with the Pueblo WFC, was held every other week and was open to current and former students. Topics covered included problem solving, time management, interviewing skills, decision-making, and work relationships.

Resumes and Interview Preparation

In addition to navigators' engagement in the development of soft skills content, they also helped students with resume writing, interview preparation, and conducting effective job searches. These are real skills that can be taught and nurtured and are important for students' sense of self (Wang & Yorks, 2012). They can increase students' access to a range of job sources, can increase their visibility, and can ultimately increase their chance of success in the job market (Hansen, Oliphant, Oliphant, & Hansen, 2009).

One of PCC's several navigators developed a flip booklet called *Quick Guide to Success*. This booklet provides guidance on the basics of writing a resume, preparing for an interview, questions to ask at a job interview, and appropriate dress for an interview.

CHAMP navigators created resume templates (e.g., EGTC), conducted workshops on resumes and cover letters (e.g., CCD, LCC, PCC, PPCC), and/or met with students one-on-one to review their resumes (e.g., EGTC, FRCC, MSU, PPCC). Some navigators also conducted mock interviews with students.

LCC's navigator went a step further. In the spring of 2016 she invited the director of HR from one of the college's industry partners, Oliver Manufacturing, to come to campus and work with the welding students. Prior to the visit, students prepared their resumes, and each completed a job application. The HR director then conducted one-on-one interviews with every student, which was followed by individual feedback that identified the areas in which the student did well, along with those on which he or she needed to work. Students found the exercise extremely helpful.

Identification of Employment Opportunities

Many navigators worked with their local WFCs and reached out to industry partners to identify current and anticipated job opportunities. At both Aims and FRCC, the navigators worked closely with the college's business/employer outreach coordinators. Navigators also worked with campus career service offices at schools where such offices existed.

PPCC's navigator developed annual manufacturing mixes, informal socials which brought regional employers to the college to meet with faculty and students. In preparation for each mixer, students developed a brief "elevator" speech to showcase their interests and skills.

During the mixer, students interacted with potential employers, asking them questions about their companies and discussing the training experiences at PPCC.

Navigators referred students to regional WFCs, various online job websites including Connecting Colorado and search engines, and directly to employers who posted jobs. For example, the navigator at MSU presented to students in 19 advanced manufacturing classes a short video about WFCs in Colorado and the services they offer. This navigator also continuously updated students via e-mail about new jobs and financial aid opportunities, including WIOA funds.

Nonacademic Advising and Support

Table 2 revealed that only 2.9 percent of student–navigator interactions were logged by the navigators under the category "nonacademic advising." However, in our interviews with navigators, it was clear that nonacademic issues often came up in their interactions with students. It is possible that some navigators included nonacademic issues within other categories such as "general check-in" or "multiple issues." The recorded percent therefore may not fully reflect the frequency at which nonacademic issues arose.

Financial aid was cited by navigators as a common problem for students. Colleges provide students on financial aid with some financial planning assistance, but many students both on and off financial aid, needed more help. In response, EGTC's navigator brought to campus a representative from Western Credit Union to discuss financial planning. She also scheduled the Financial Health Institute to deliver a workshop on managing debt. Other navigators helped students with financial aid applications and referred them to the WFC for WIOA funds. The MSU navigator commented, *I have been working with a student who is attempting to navigate the system in an effort to receive the WIOA training dollars to assist with payment for his additive manufacturing engineering certificate. It is indeed an arduous process!*

The navigator at PPCC similarly reflected on her work with veterans and how challenging it was for some of them to secure student aid.[61] Negotiating multilayered systems was therefore another important function of the navigators.

Several navigators worked with students who were experiencing homelessness and/or food insecurity. In these situations, the navigators helped students connect with other campus offices (e.g., Student Life at CCD) and/or identified community resources such food banks, Hunger Free Colorado, and United Way 211.

Prior Learning Assessment (PLA)

Studies suggest that PLA has a positive impact on students' academic success in terms of leading to higher graduation rates, increased student retention, and saving students both money and time. Specifically, studies have shown that, compared with non-PLA students, students earning PLA credits are more likely to persist through their program with higher retention rates, higher grade point averages, and higher graduation rates (Snyder, 1990; Hoffmann, LeMaster, & Flickinger, 1996; Klein-Collins, 2010). Moreover, earning PLA credits reduces tuition costs and helps students—especially adult students— graduate faster (Klein-Collins, 2010; Travers, 2011).

In 2015, EERC released a report on the impact of PLA credits on persistence and graduation rates across 13 community colleges in Colorado between the fall of 2007 and the summer of 2010 (Kuang & McKay, 2015).[62] This CHAMP funded study showed that PLA students had better academic outcomes—specifically, higher rates of both retention and completion as well as shorter time to degree—than students who did not receive PLA credits.

One of the major components of the CHAMP grant was the redesign of Prior Learning Assessment (PLA) policy, practice, and implementation across all of Colorado's public community colleges. During the first two years of the CHAMP grant, CCCS and participating colleges developed policy and practice recommendations for PLA. Navigators were initially identified as key actors in the roll out of the redesigned PLA. The plan was for navigators to help students identify skills gained in prior employment or through the military and then help those students apply for academic credits through the redesigned PLA procedures. However, by the third year of the grant, most navigators were still not actively involved in working with prospective and enrolled students on potential PLA credits. Instead, as each colleges' PLA steering committee (most of which did not include the college's navigator) engaged in the implementation of standardized PLA practices, a member of the campus committee worked

[61] Mid-grant, PPCC added a military liaison.

[62] See EERC's website for a copy:
https://smlr.rutgers.edu/sites/default/files/documents/PLA%20Baseline%20Report%20FINAL%202-4-16.pdf

directly with students on PLA matters. Over time, some navigators were trained in the system-wide PLA procedures and/or taking the PLA MOOC developed by CCCS.

The significant exception to the above pattern was the navigator at PCC, who eventually moved into the CHAMP project lead position. This navigator/project lead participated in the state's Prior Learning Assessment Revision committee, which helped identify student needs and worked to offer amendments to the existing policy. After the policies were amended, she was asked to develop a matrix of equivalencies for advanced manufacturing. In addition, she was an active member of PCC's campus PLA steering committee, and in this capacity was excited about the potential use of videos in portfolios to document students' skills.

As their respective colleges began to implement the amended PLA policies, other navigators became more involved in PLA. This occurred at LCC, where the navigator spoke about the college's growing interest in the use of portfolios for PLA. Referring to discussions that were taking place on campus, she observed that portfolios might provide

> *. . . a better overall understanding of their [students'] ability and whether—it would prove that they actually have that body of knowledge rather than just let them test out.*

Navigation of the Credentialing Process

One of the goals of the TAA series of grants was to increase the number of stackable credentials students earned. The hope was that additional credentials would positively impact future employment opportunities and wages. During the COETC grant, career navigators discovered that students often completed the requirements for a certificate, or even a degree, but then never actually filed the necessary administrative papers to be awarded the earned credential. For example, during the COETC grant, RRCC's career coach reviewed the transcripts of all the water quality management students and identified many students who were eligible for one or more certificates, but had not been awarded them. In response, the career coach notified each student and worked with him or her to get the earned credential(s). As a result, 76 water quality management students were awarded an additional 160 credentials (McKay, Michael, & Khudododov, 2016). [63]

Similarly, under CHAMP, several navigators engaged in transcript reviews and then assisted students within the filing of necessary paperwork for so they could be awarded their earned credential. Most often this was a certificate.

At LCC, for example, where the CHAMP welding program was structured as a series of stackable certificates. Students needed encouragement and assistance to submit the needed paperwork to receive those credentials. At CCD, RRCC and PPCC, the navigators assisted

[63] See report on EERC website:
https://smlr.rutgers.edu/sites/default/files/images/DE%20Executive%20Summary%202-29-16%20FINAL.pdf

students with the certificate award request process. PPCC's navigator observed this was a challenge not only for the student but also for her.

> *You have to fill out the paperwork. You have to get the student to sign it. You have to pull their unofficial transcript, print that out. So there's—it can be tedious, and it can be time-consuming. So kind of staying on the ball with that with our students to ensure they get their actual paper certificates in case they have to show that, yeah, they are certified, or they did get that training. So just kind of staying on top of that.*

Development of Internships

Internships provide students not only with an opportunity to learn a new skill, or even to network; for many individuals they also provide an opportunity to "try out" a trade or profession. Conversely, employers who sponsor internships can learn from students about new theories and processes taught on campus, groom the next generation of workers, and identify the most qualified individuals to employ.

CHAMP colleges were not required to establish internships as part of their programs. However, they were strongly encouraged to do so. The extent to which internships existed prior to CHAMP, and the creation of new internships opportunities varied from one college to the next.

At some CHAMP colleges, navigators had responsibility for developing internship opportunities for their students, e.g. PPCC. However, a few colleges either already had an internship coordinator or established one during the grant period. For example, the navigator at Aims initially had the dual role of navigator and "business outreach and internship coordinator." By the second grant year, however, these functions had been separated into two, sometimes-overlapping positions—navigator and internship coordinator.

MSU has a dedicated internship center housed at its Denver campus which serves the entire university; however, under CHAMP MSU's engineering technology program has had its own dedicated internship coordinator. This individual works with companies to develop credited student internships as well as to identify job opportunities. The coordinator also helps prepare students for internship placements by working with them to develop soft skills, such as professional attitude and behaviors. MSU's navigator has worked closely with the college's internship staff to identify potential internship sites and CHAMP students who might be interested in an internship experience. One of MSU's cited successes is its relationship with Ball Aerospace, where over the past two years MSU interns have been placed. At the end of their internship, many of these students have been offered full-time positions.

At EGTC, apprenticeships predated the CHAMP grant, but they were not housed within the College of Trades and Industry, where the CHAMP programs are located. As a result, the navigator was initially not involved with internships. This changed with the January 2016 launch of the college's revised advanced manufacturing certificate program, which now includes internships as part of the program of study. EGTC's navigator worked with the college’s School of Business to learn about their internship models and then promoted internships through the college’s Manufacturing Technology Advisory Board.

Under CHAMP, CCD decided to bifurcate the internship function from other navigator functions, employing a CHAMP-funded internship coordinator who built “from scratch” the internship program for advanced manufacturing. With the help of an ad hoc team, the internship coordinator developed the conceptual frame for workplace-based learning (WBL); developed student learning objectives; and developed unpaid internship agreements with industry partners. The navigator then worked with students to fill out their WBL applications as a first step toward being placed in internships lasting one to four weeks.

At FRCC, the workforce liaison, in collaboration with the college wide director of workforce solutions and the CHAMP navigator, has had responsibility for internship development. At the beginning of the grant, employers indicated little interest in internships. Over time, however, employers have come to recognize internships as a good pipeline from which to identify potential employees. As a result, the navigator has been able to place students in a number of different internships.

Over the course of CHAMP, PPCC experienced changes in both its project leadership and the college’s senior administration. The navigator therefore became heavily involved in coordinating internship-related activities. She attended the first meeting of internship coordinators from around the state, sitting in on their informal discussion of their offices’ best practices. She also surveyed the existing paid and for-credit internships at PPCC, and worked with the college’s new coordinator for paid internships. In addition, she attended manufacturing forums, the Electronics and CAD/Machining Advisory Board meetings, and visited local employers to identify potential sites of internships. In August 2015, the navigator worked on revising an internship handbook for advanced manufacturing. She also helped to put together two very successful networking events at PPCC, held in March and October 2016. These events were designed to bring students and employers together with the hope that students could learn more about special industry opportunities and showcase their skills, and employers could meet and single out students they might consider for internship and employment opportunities.

PPCC’s navigator observed that there was no real consistency in how paid and for-credit internships were structured at the college. In response, she suggested that PPCC consider creating a new position, post-CHAMP, focused specifically on internships related to advanced manufacturing programs. The navigator further suggested that, once successful, this pilot model could be replicated to develop more structured internships for all other programs at PPCC, such as culinary arts, business, etc.

PCC consistently reported very successful experiences with internships. In fact, the navigator stated that employers themselves sometimes took the initiative to contact the college seeking interns—a reverse of the usual roles in that interaction. It appears that as employers learn about CHAMP and/or have special projects or particularly busy seasons, they envision the benefits of having interns. The college, however, has taken a cautious approach to such unsolicited requests; it is their view that internships do not involve simply working at a company. Rather, students must gain work experience that directly "supports their program of study."

To this end the PCC navigator and the project lead have worked closely with some employers to shape students' internship experience. The result has been that many of the PCC's internships are now four- to six-week *apprenticeships* that occur at the end of the students' studies. Apprentices are paid employees, so the employer does not face the challenges of internships with regard to liability. This is especially important in welding and machining—two fields where internships have been difficult to establish given shop-floor risks and employers' concerns about the waste of valuable materials. The feedback from employers involved in the apprenticeship program has been good. They are impressed with the skills and knowledge of their PCC apprentices, and are hiring some graduates subsequent to their apprenticeship.

In fall 2016 a PCC team, including the manufacturing department chair, CHAMP navigator, CPL specialist, and CHAMP program lead, began to explore the possibility of networking among a number of small companies to create a rotational apprenticeship program. Such a program would expose students to different job sites and skill sets. It would also reduce costs for individual companies, expanding the number and viability of apprenticeships.

At the beginning of the CHAMP grant, RRCC's navigator worked with the college's internship department to develop an internship program for machining students. The navigator was successful in developing a number of internships on her own before a new adjunct faculty position was established to serve as a part-time navigator and internship coordinator. The two individuals then worked together on the task. The assignment for the internship coordinator was to engage industry and work with the full-time navigator to further develop RRCC's internships. The coordinator also monitored and graded internships and ensured credit allocation—something she was able to do because of her adjunct faculty position. In addition, the full-time navigator helped the internship coordinator to develop internship procedures and policies RRCC could use after the CHAMP grant sunsets September 2017. According to the navigator, "previously, no procedures were firmly in place." During fall 2015 the navigator helped to create a strategic plan for creating and implementing internships, including some that occurred during spring break and over the summer.

Although RRCC still offers internships, a lack of student interest in them has led to low enrollment. Many students are already incumbent workers, have temporary jobs lined up over school breaks, or simply take employment instead of completing internships. RRCC's part-time navigator has since left the position, and RRCC has replaced her with a new part-time navigator whose duties do not include internship coordination to the same extent as the previous part-time navigator. Instead, the colleges' internship department has subsumed internship strategies, and the program's machining instructor is now responsible for grading and credit allocation.

LCC's navigator engaged in considerable outreach to regional employers to identify internship sites for welding students. As part of this effort, she fielded an employer survey, worked with the local WFC, and worked with members of the advisory board. However, she was unable to create traditional internships. Instead, she arranged field trips for welding students to visit a number of local and regional factories. In addition, a local business, Oliver Manufacturing, extended an invitation to LCC's advanced manufacturing students to use its shops on a day when the company is closed. The idea is to give students the opportunity to work on a project from start to finish—reading blueprints, learning about the processing of the components, and manufacturing something small from beginning to end—in a real-world environment. This offsite workshop had not been scheduled at the time of this writing.

Development of MOOCs

Three Massive Open Online Courses (MOOCs) were originally proposed during the grant application process: one on employability skills for students entering the manufacturing industry, one focused on math skills, and one focused on credit for prior learning. A fourth MOOC was added later, focused on web accessibility for educators. Of the four MOOCs, navigators were only focused on the creation and implementation of the employability MOOC. The other MOOCs were to be developed by other TAACCCT staff, faculty, or external organizations.

Manufacturing employers across the country report that their employees often lack the fundamental employability skills necessary to be successful. In response, CHAMP leadership envisioned the employability MOOC as a way for navigators to help teach soft skills to students. The MOOC was to include "an openly licensed rubric that instructors can use to assess students' mastery of basic employability skills, e.g., professionalism, initiative, and teamwork (Colorado Community College System, 2012b, p. 17)."

To assist the navigators with the development of the MOOC, CCCS provided them with access to an instructional design coordinator, a program online curriculum specialist, and other members of CAEL and CCCS staff.

As one of their first steps, the navigators met in a workshop format to identify content for the MOOC and discuss how they would proceed with its development. They then divided the work regionally. In turn, these regional navigator groups divided the MOOC content into modules. The MOOC was planned as a course that would run once a week for five weeks, but navigators designed the curriculum such that faculty and students could use single or multiple modules independently. MOOC topics included: employment expectations, workplace math, reading and writing, workplace courtesy, time management and deadlines, communication and cooperation, teamwork, leadership and management, and critical thinking.

Navigators worked collaboratively on specific modules with their regional counterparts. When asked if she thought the MOOC-development process was a positive one, MSU's navigator stated that the most positive aspect of the process was the collaboration with other navigators.

> *It brought us closer as a group. We have monthly meetings, and we're on Basecamp [interactive project management software designed for process collaboration], so [we] interact a lot with each other. But this was an actual working relationship, so we brainstormed together, we supported*

> *each other. In fact, I learned a lot about my teammates, stuff that I would not have known had we not had that working relationship.*

Other navigators echoed the MSU navigator's sentiments. Regional collaboration on the MOOC brought the navigators together, fostering relationships that continued after the completion of the MOOC and persisting through the rest of the grant period. (Networking among navigators will be further discussed in the next section.)

Navigators' reactions to the development of the MOOC itself and to the finished product was not generally positive, and some navigators questioned the quality of the finished product. When asked about the process, one navigator observed that the development of the MOOC felt "very rushed," and she had felt "out of place" creating the course. In fact, she commented, few navigators had training or experience in either curriculum development or teaching. Another navigator echoed this navigator, saying she found the task "difficult" without prior training or knowledge in course design.

While most navigators felt that including soft skills in the curriculum was important, some felt the platform of the MOOC was not conducive for teaching such content to manufacturing students. One navigator commented that students in her colleges' machining courses preferred to learn "hands-on," and completing online modules or classroom work that addressed soft skills was not the best pedagogy for them.

> *The students are here because they're hands-on. They wanna be out on the floor. They are not classroom students. That's why they're not going to a four-year degree, or four-year school. And they're not in the classroom taking electrical engineering or mechanical engineering. They wanna be on the floor.*

Most navigators discussed implementation of the finished MOOC with their CHAMP program team and departmental faculty. Instructors at some schools chose to utilize only some of the modules rather than the entire MOOC, assigning the selected modules as part of the D2L curriculum. Other schools chose to incorporate the learning objectives of the MOOC modules directly into the classroom, teaching those elements as part of the face-to-face course rather than making use of the actual MOOC.

Faculty and staff indicated that because not all students had ready access to computers, offering the MOOC as it was intended—online—was not helpful. A number of navigators spoke about the benefits of classroom discussion versus an online format. They noted that most classes contained a "mix" of students—those new to the career, and incumbent workers re-tooling or adding additional skills. In a classroom setting these students could discuss soft skills topics amongst themselves, and incumbent workers could share their experiences with students who were new to the field.

One navigator reported that soft skills were discussed in the classroom under the rubric of a series of questions: "What is your experience behaviorally in the shop? How do you see your skills as a student being portable in ways in the workforce?" She noted that "when they all start talking, I just feel that they're actually learning from each other." Some navigators felt this was the most beneficial part of the learning experience and something students were unlikely to get from completing the MOOC online.

Although navigators were involved to varying degrees in deciding on MOOC utilization, members of each college's CHAMP advisory board and faculty made the ultimate decision about how and when the MOOC would be used within CHAMP programs. Aims' navigator, for example, was very involved in facilitating the MOOC on campus, making sure all departmental faculty made the MOOC available to their students, posting t on their own soft-skills syllabi or D2L shells, or both. This navigator also discussed the MOOC with her schools' AAA department and made sure they were aware of the resource.

At most colleges, employers were also involved in making the decision about how much—and which—soft skills to include in program courses. Schools' advisory boards were generally used as a platform for employers to voice their input. At one school, the advisory board was "split down the middle," with some employers feeling students needed the additional soft skills training, and others feeling soft skills were not "something you could train on—you either have it or you don't." Staff and employers at some schools felt soft skills were already embedded in the program coursework, and very few additions needed to be made.

Navigators felt that for the most part students responded positively to learning soft skills, especially if they were seamlessly embedded within their courses. One navigator commented that the same skills that make someone a good employee—the ability to focus, to complete tasks on time, to show up on time and be dependable—also make someone a good student. Therefore, the challenge was reaching those students who lacked "good student" skills. Navigators who worked one-on-one or in small groups with students felt using the MOOC modules in the online format was beneficial. This allowed students to progress through the MOOC at their own pace while at the same time allowing an opportunity for group discussions to take place.

By winter 2017, most schools had chosen to embed elements of the MOOC into program courses, so few CHAMP students were taking the MOOC online. Overall, navigators seemed to feel the most beneficial element of the MOOC creation and implementation was the collaborative process leading to its development.

Intercollege Networking Among the Navigators

The development of the employability skills MOOC was one of the early opportunities for navigators to collaborate with one another and with other CHAMP staff. Many other opportunities to collaborate arose over the course of the grant. In fact, more intercollegiate collaboration among navigators took place during the CHAMP project than among similarly-situated staff during any other round of the state's TAACCCT grants. Some navigators point to the creation of the consortium-wide CHAMP advisory board as a reason for this. Through this board, navigators had monthly phone calls in which they worked together discussing issues related to industry needs and student employment. As one navigator observed about these collaborative phone calls, which began very early in the grant,

> *I think a lot of it has to do with the CHAMP advisory board. For example, the navigators, from day one—even when there were just two of us and then three, and then there were four, talking on the phone—we have always talked together.*

Regular meetings among the navigators also helped cement relationships which had started with the MOOC workshop and continued during phone calls. Meetings were held at different colleges, so rural college navigators did not always have to travel the farthest. One navigator said: "We're like a team. The navigators are like a team…. We're sharing information. We're learning. We're being educated."

Another navigator echoed this sentiment, stating that learning what other navigators were doing and what was successful helped all the navigators to identify the best strategies for their own college. When asked if the meetings and trainings were useful, one navigator replied,

> *The interaction with those folks, absolutely. Just strategies. Like [a CHAMP staff member from her college] came because I went to a training session up at Aims. I met [another college's staff member and] I thought "Man, I really liked her marketing strategy." She said, "You know what I do, I go in for an internship site meeting, and then I say 'Well how about your existing employees, what would you like them to know?'" So she said she's very undercover about how she sells customized trainings. So I put [the two staff members] together, we had coffee. After we did that she sent us some employers. One of those employers turned out to be a good candidate to be on [our] advisory committee.*

She further noted that "Sometimes it's almost the informal connections rather than the formal connections."

These "informal" connections also proved beneficial among navigators relative to students transferring to/continuing their education at other schools, including MSU. The project lead at MSU stated while formal articulation agreements were established, it was the informal network among navigators that was instrumental in helping students make decisions about transferring:

> *They've kind of set up a network among themselves so that when they meet with the students, they can kind of analyze what their goals are and let them know about the opportunities with MSU—Denver, since we are making the articulation agreements. And if it's something they are interested in, then it's more so, like, the navigator's putting the student in contact with the other navigator. So they would make sure that [our navigator] is able to contact their students at their school that are interested.*

Although all navigators participated in networking, navigators from specific colleges tended to work closely with navigators from colleges geographically close to them. For example, the navigator at Aims tended to work most often with FRCC's navigator because they were both located in northern Colorado. The Aims' navigator also worked occasionally with the navigators from RRCC and CCD, and she participated in the "manufacturing mixers" held at

PPCC. All of these colleges are located in the more northern regions of Colorado and North Denver. Other navigators in regionally similar areas also tended to work closely together.

Networking relationships among navigators have extended to employer relationships as well. The navigator at Aims, for example, once coordinated a manufacturing tour of local employers during which she led a group of "tourists"—including high school students, prospective manufacturing students, and chaperones—through the manufacturing plants of various local employers. The navigator hoped to include one specific local employer, but her contacts at the employer told her "that is just not going to happen" because of the plant's concerns about liability relative to visitors. Luckily, however, the navigator at FRCC had a contact at the same company, and through this other contact Aims was able to secure the plant's agreement for the site tour. In sum, the sharing of successes and challenges enabled the navigators to help one another, thereby extending the range of their activities and contacts, and the doors that were opened to them. In turn, this active networking and support increased and improved the opportunities navigators could offer their students.

Navigators across the consortium also participated in other, more formal and structured activities that fostered collaboration. As previously mentioned, these included CCCS leadership convened regular navigator meetings—including trainings and professional development workshops.

In addition, while career couches under other TAA grants occasionally used Basecamp, CHAMP navigators used the platform regularly to communicate with one another. Communications on the site included: inviting fellow navigators to events, discussing upcoming state or regional events, sharing tools that they found useful in working with students, posting videos created for or by the navigators' home institution, and informing one another about scholarship opportunities they had identified.

EERC tracked 173 different navigator threads on Basecamp between October 2013 and December 2016. The analysis of Basecamp activity clearly indicates the significance of this medium for the navigators – and how it facilitated their open sharing of helpful techniques, practices, and tools, and how it enabled them to reach out and encourage one another through challenges and to also celebrate each other's successes.

PART II: OUTCOMES ANALYSIS

Part I discussed the diverse functions of the navigator across the CHAMP consortium colleges. We also described their location within their respective colleges and their interactions with one another. We now turn to an examination of the demographic and other characteristics of the CHAMP students who interacted with the navigators; the frequency of navigator-student interactions; and the identified reason for these interactions. We then move on to analyze any differences between students served by a navigator and their academic outcomes including credential completion and the stacking of credentials and; finally, their employment and post CHAMP wages.

Research Questions

EERC began its analysis of the role and impact of CHAMP navigators with five research questions.

> *Question 1*: Who were the students who contacted their colleges' CHAMP navigators? How did they compare to students who did not contact their navigator in terms of their age, gender, ethnicity/race, economic background (measured as Pell financial aid eligibility), military background, and work experience?
>
> Question 2: What was the frequency of students' contact with their CHAMP navigators?
>
> Question 3: What was the means by which students interacted with their navigators?
>
> Question 4: Did students served by navigators complete their certificates and/or degrees at higher rates than those who were not served by navigators?
>
> Question 5: Did students served by navigators have higher rates of employment and higher wages subsequent to earning a credential than those who had not been served by navigators?

Methods

Eight of the nine CHAMP colleges[64] are included in this section of the study: Aims, CCD, FRCC, LCC, PCC, PPCC, RRCC, and MSU.[65] With the exception of MSU, which is a 4-year university offering bachelor's degrees, the schools are community colleges conferring long-term and short-term certificates as well as associate degrees.

Data was obtained from the colleges'/universities' administrative data sets (referred to as *Banner*). Data was also collected from EERC's online activity tracking logs on which navigators were required to record information related to their interactions with students. The tracking logs asked for a student's name, demographic characteristics (e.g., age, race, gender), the date of contact, the reason for contact, and how the student had heard about the CHAMP program. In addition, navigators were asked to record students' targeted degree/credential, as well as their employment status, internship status, military background, and Pell grant eligibility. In the case of missing data on the online tracking form, EERC attempted to retrieve the data from Banner, which contains student data recorded at the time of a student's registration. Student graduation outcomes were also retrieved from Banner

Our population of interest includes all CHAMP students enrolled between spring 2014 and spring 2016 at the eight CHAMP schools included in the analysis. We identified a total of 3,346

[64] The navigator at EGTC did not complete the tracking logs as required under the grant. As a result, we did not have information about the mode and frequency of student contacts at that school, nor information about the students with whom the EGTC navigator interacted. Due to the volume of missing data, we have omitted EGTC from the current analysis.

[65] We are not including EGTC which was a technical school, not a community college.

students as CHAMP enrollees during this period. The navigator activity tracking logs included data on 1,759 unique students who had interacted with a CHAMP navigator during the study period. However, because some records contained incomplete, incorrect, or missing information, we were only able to identify 1,215 of these students as being enrolled in a CHAMP program. We therefore excluded 544 students who could not be linked to a CHAMP school administrator data set. These 544 students are not included in our analysis of student demographics. However, these students have been included in our analysis of navigator activities, including the number of students served.

In the sections to follow, for each research question, we report our findings at both the CHAMP consortium level and at the individual college level.

Study Limitations

Our analyses of navigator activities are based on the activity tracking logs that were completed by the CHAMP navigators at each school. Data quality varied from one school to another. Some schools kept detailed information on students' demographic characteristics along with their reason for contact, contact dates, and methods of contact. Other schools' data lacked any number of details. Missing data was commonly related to students' academic goals, work experiences, and reason for contacting the navigator. We were able to cross-verify some of the missing information—including goal of study, demographic characteristics, military background, and economic hardship—using school administrative data, which track these pieces of information upon students' registration each semester. However, we were unable to triangulate details about students' work experience from any other datasets available to us. Further, our review of the patterns of missing data suggests that some program navigators failed to record every contact with students. The current analysis, therefore, provides a conservative picture of the number of students actually served and may provide an incomplete picture of the intensity and range of focus of the interactions between CHAMP navigators and students.

It is important to note that, given missing and incomplete data, the information presented in the following tables and figures is affected by the base population of CHAMP students on each campus and the subset of these students who were both served by the navigators and for whom we have specific data.

The number of unique CHAMP students served by the navigators varied widely across the colleges, from a low of 21 students at Aims to a high of 344 at MSU. Readers are therefore cautioned about interpreting some of the consortium-level results, since one or two college's experiences may distort general patterns. Further, time censoring occurred with respect to data collection about students' completing one or more credentials[66].

[66] Unlike students enrolled in CHAMP early, students enrolled in CHAMP in 2016 may not have completed their studies because we do not follow them up in 2017.

Finally, this report focuses only on students who contacted CHAMP navigators during a specific timeframe, their characteristics, and the frequency and focus of their interactions with those navigators. However, given the differences in navigator functions and types of CHAMP programs across the consortium colleges, plus the wide variety of program and institutional factors at play, we cannot assess the specific impact of navigators on student outcomes. Future work is needed to investigate the associations between navigator-student interactions and students' academic and employment outcomes.

DEMOGRAPHICS

CHAMP Students Served by Program Navigators

From the start of CHAMP in fall 2013 to spring 2016, 3,346 unique students were enrolled in one or more CHAMP programs across the eight study colleges. Thirty-six percent of these CHAMP students (n=1,215) had at least one verified contact with a program navigator. Several factors account for the variance in the number and proportion of CHAMP students served by navigators across CHAMP institutions. First, the size of the CHAMP program at each participating school was different. While some schools only offered one CHAMP program, others offered several different credentials and programs that were in high demand in Colorado—such as PCC, which offered both machining and welding. Second, across the colleges, policies and requirements varied with regard to whether and how often CHAMP students were required to meet with their navigator. Third, the primary focus of the navigator—whether on student–navigator advising, recruitment, and/or employer relations—varied according to the needs of the college. Finally, some colleges experienced staffing changes that affected the availability of a navigator at some point(s) during the study period.

Figure 1 presents the proportion of CHAMP students from each college who interacted with their college's navigator during the observation period. All of MSU's CHAMP students were served by navigators, as were over three quarters of those at FRCC (80 percent) and LCC (78 percent). About 44 percent of CHAMP students at CCD were served by a navigator, followed by about one third of students at both PPCC (31 percent) and RRCC (29 percent). PCC reported that only about 14 percent of its CHAMP students had contact with a navigator. Finally, of all the colleges, Aims college had the lowest rate of student–navigator contact—just under 3 percent of students contacted the Aims' navigator. Again, it needs to be noted that navigator functions varied considerably by college,[67] and that navigators were not always available at all times at each consortium school; in fact, there were long stretches of time during which Aims had no navigator. [68] Looking at this distribution, it seems clear that these factors affected student–navigator contact rates at the college level.

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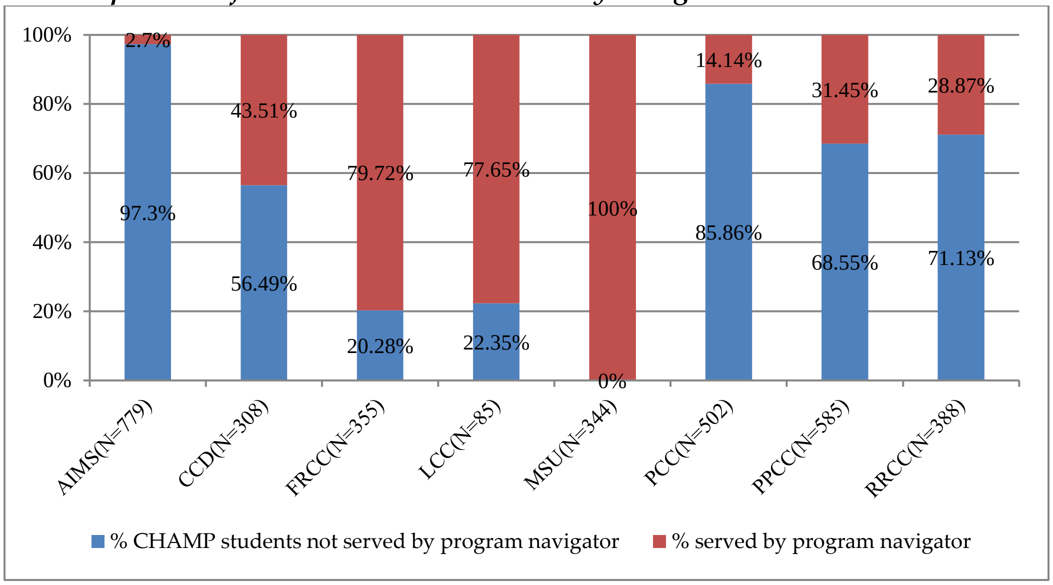
[67] The navigator at Aims was more involved in marketing and recruitment than in student advisement,

[68] See Part I. Some colleges, such as Aims, had long periods without a navigator, which may have contributed to the low rate of student–navigator contact.

Figure 1. Proportion of CHAMP students served by navigators at each consortium school



Besides the variation in the distribution of students served at the CHAMP institutions, we also examine, both at the consortium and college level, the extent by which students served by navigators varied according to a set of demographic characteristics—gender, race/ethnicity, and age—and life experiences—work history (TAA status), financial hardship (Pell eligibility), and military background.

Gender

The CHAMP population consisted of a much higher proportion of male students than female students (85 percent male vs. 15 percent female).

Figure 2. Gender of the CHAMP student population and the navigator-served population

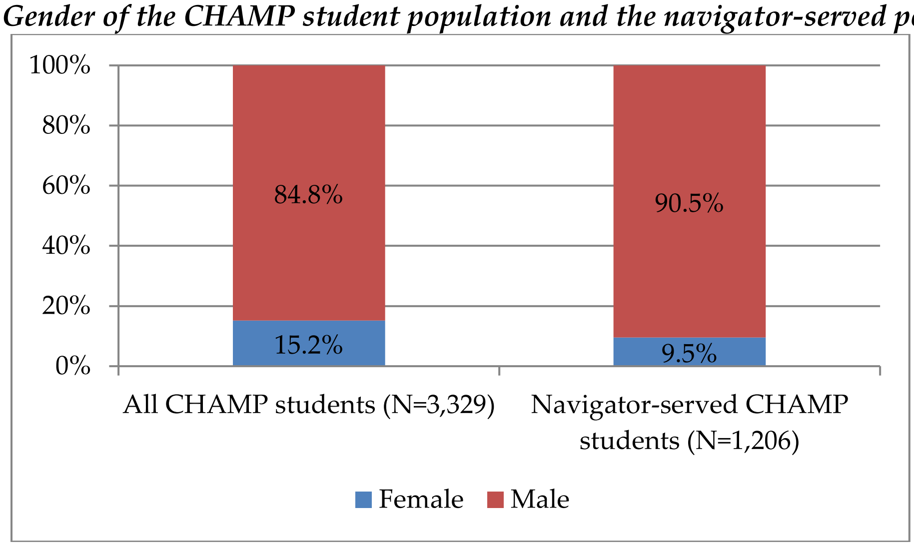


Figure 2 shows a slightly higher proportion of male students among the population served by the navigator than among the CHAMP population in general (91 percent vs. 85 percent). This reveals that male students were more likely than their female counterparts to seek the counsel of a navigator. Figure 3 gives us a more detailed look at this finding.

Figure 3. Navigator-served CHAMP students as a percentage of all CHAMP students by gender.

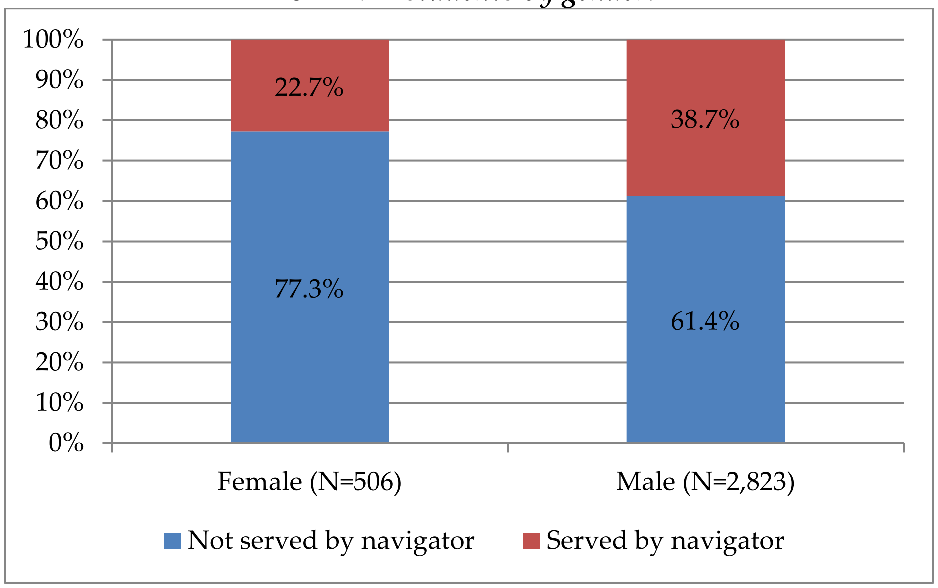


Figure 3, which breaks down the CHAMP population by gender, shows that only around 23 percent—less than one quarter—of female CHAMP students were served by their CHAMP navigator. This is a full 15 percentage points fewer than their male counterparts, who met with their navigators at a rate of 39 percent. This gender disparity in navigator-student interaction is worthy of further investigation, especially given the significant gender disparity of the field as a whole.

At the college level, when we examine CHAMP students' contact with their navigators by gender, we find considerable variation across the institutions. The results of this analysis are presented in Table 3. At MSU, where all students were required to meet at least once with the navigator, female and male students were served at the same rate - 100 percent. Otherwise, the findings at most schools were consistent with the consortium-level analysis. A larger proportion of male CHAMP students were served by navigators than were female CHAMP students. For example, at CCD and FRCC, male students were served by navigators at a rate that was 7 and 8 percentage points higher than the rate female CHAMP students who were served. A greater disparity—15 percentage points—was observed at PPCC. And even a greater disparity was found at LCC, where 80 percent of male CHAMP students, but only 57 percent of female CHAMP students were served by a navigator—a difference of 23 percentage points.

This relationship was reversed at only two schools, and in both cases, the differences were relatively small. At PCC, the difference between female and male CHAMP students served was 3 percentage points (17 percent vs. 14 percent), with proportionally more female students seeing a navigator than males. At RRCC, the difference was slightly larger at 6 percentage points: 34 percent of female CHAMP students were served by a navigator compared to 28 percent of male students.

Table 3. CHAMP students served by the navigator by gender and school

	Male			Female		
CHAMP school	**Total (N)**	**Navigator Served (n)**	**% Navigator Served**	**Total (N)**	**Navigator Served (n)**	**% Navigator Served**
AIMS	526	17	3.2	246	4	1.6
CCD	271	120	44.3	37	14	37.8
FRCC	312	250	80.1	36	26	72.2
LCC	77	61	79.2	7	4	57.1
MSU	312	312	100.0	32	32	100.0
PCC	459	64	13.9	42	7	16.7
PPCC	534	174	32.6	50	9	18.0
RRCC	332	93	28.0	56	19	33.9
Total	2823	1091	38.6	506	115	22.7

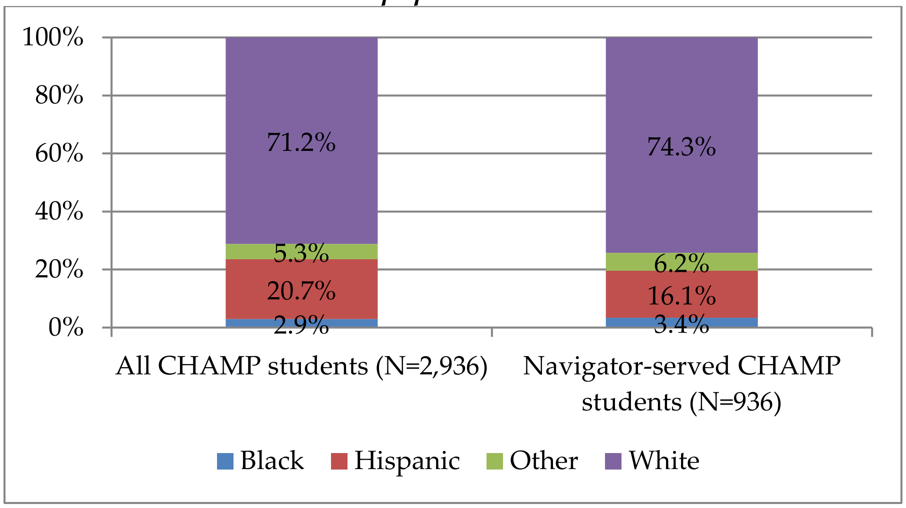
Race / Ethnicity[69]

Although our full sample contains 3,346 CHAMP students, we were only able to obtain information about race/ethnicity for 2,936 students. As a consequence, only 2,936 students are used the following analysis. Two factors account for the missing data: CHAMP students did not always indicate their racial/ethnic background at registration, and navigators did not always report it on their tracking forms. It should also be noted that when navigators did record race/ethnicity data, it is not clear whether that information was self-reported by the student or "assumed by observation" by the navigator.

Figure 4 shows that the majority of CHAMP students in our sample were white (71 percent). Hispanics comprised the next-largest racial/ethnic group (21 percent), followed by students of other race/ethnicity (5 percent), and black students (3 percent).

[69] The Census and some CHAMP colleges use Black Non-Hispanic, White Non-Hispanic, and Hispanic as race/ethnicity categories in their data files. However, some colleges only use the categories Black, White, and Hispanic. EERC has used White, Black, Hispanic, Other. The number of students of Hispanic origin thus might be underreported in our data.

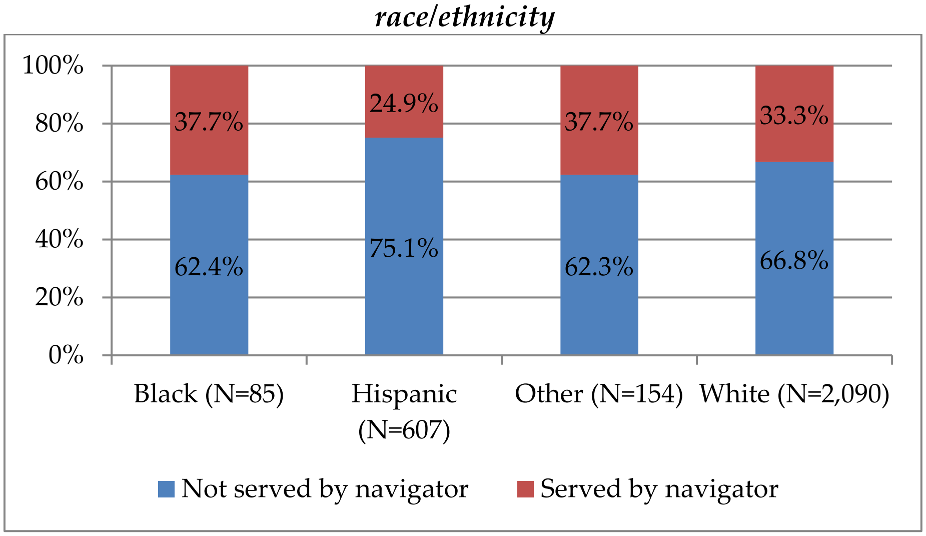
Figure 4. Race/ethnicity of the CHAMP student population and the navigator-served population



About 32 percent (n=936)[70] of the 2,936 students[71] for whom we were able to obtain race/ethnicity data had contact with CHAMP navigators. Compared with the racial distribution of the observed set of CHAMP students, slightly higher proportions of white, black, and students of other racial/ethnic backgrounds had contact with navigators. However, the differences were small, all falling within the range of 1 to 3 percentage points (Figure 4).

Conversely, Hispanic students were underrepresented in the population of students served by navigators. Whereas Hispanic students made up about 21 percent of the overall CHAMP population, they made up only about 16 percent of those served by CHAMP navigators.

Figure 5. Navigator-served CHAMP students as a percentage of all CHAMP students by race/ethnicity



When we break down the population of CHAMP students by race (Figure 5), we observe that only about 25 percent of Hispanic CHAMP students interacted with a program navigator,

[70] Out of the 1,215 students who had contact with the navigator, we only have race/ethnicity data for 936.

[71] Out of the 3,346 CHAMP students in our sample, we only have race/ethnicity data for 2,936 students.

making them the least likely racial/ethnic group to do so. Black students and those with “other” racial/ethnic backgrounds were the most likely to meet with a navigator—about 38 percent of these students did so. About 33 percent of white students interacted with a navigator.

We next examined interactions with CHAMP navigators at each college to look at variations in the racial/ethnic background of students served at each school. These results are shown on Table 4.

As noted previously, all CHAMP students at MSU had contact with navigator, so there was no difference in percent contact across categories of race/ethnicity.

At FRCC, across racial/ethnic backgrounds, the majority of CHAMP students had some contact with the college’s program navigator—rates of contact ranged from 74 to 100 percent. As was the case at many schools, however, the number of both nonwhite and non-Hispanic students was relatively small: for example, while 100 percent of black CHAMP students at FRCC interacted with the navigator, that number reflects interactions with only two students.

LCC also had high rates of student–navigator contact across all categories of race/ethnicity. The exception is the interaction rate among students in the “other” category, which shows a relatively low 25 percent. This rate is likely a reflection of the very small number of observations in that category (n=4), however. Looking across the remaining groups, 80 percent of white students (n=47), 78 percent of Hispanic students (n=14), and 100 percent of black students (n=2) met with the CHAMP navigator. Once again, the rates among Hispanic and black students were likely affected in part by the small numbers of students in those racial/ethnic groups.

Thirteen of the 18 black students (72 percent) enrolled in CHAMP at CCD met with a navigator, as did almost half (47 percent) of the college’s white CHAMP students. Just under 37 percent of Hispanic CHAMP students and 35 percent of students in other racial/ethnic groups were served by the navigator.

At PPCC, 20 percent of black students interacted with the CHAMP navigator, along with about 27 percent of Hispanic students and students in the “other” racial/ethnic group. About a third of white students contacted the PPCC navigator, making them the most likely to do so.

About thirty percent of white, Hispanic, and students in “other” racial/ethnic groups had contact with a navigator at RRCC. The single black student enrolled in CHAMP, however, did not have any recorded contact.

As noted above, the proportion of CHAMP students served by the Aims’ navigators was small. The rate was especially low for white students: Only 2 percent (n=8) of the 496 white students enrolled in CHAMP were served by a navigator. Among the 14 black students, the rate was higher at 14 percent (n=2), but both rates are affected by the small number of students. Finally, of Aims’ large Hispanic CHAMP student population (n=239) students, only 4 percent contacted program navigators.

The proportion of CHAMP students at PCC who had some contact with the navigator was also low. Only 12 percent of PCC’s 291 white CHAMP students (n=34) were served by navigators, though a slightly higher proportion—around 20 percent—of the black (n=3) and Hispanic (n=27) CHAMP populations at the school contacted a navigator.

In sum, the proportion of students served by racial/ethnicity background varied across the CHAMP colleges. However, given the disproportional sizes of the different groups affecting rates at both the consortium and college levels, we are not able to discern any patterns of note.

Table 4. CHAMP students served by a navigator by race/ethnicity and school

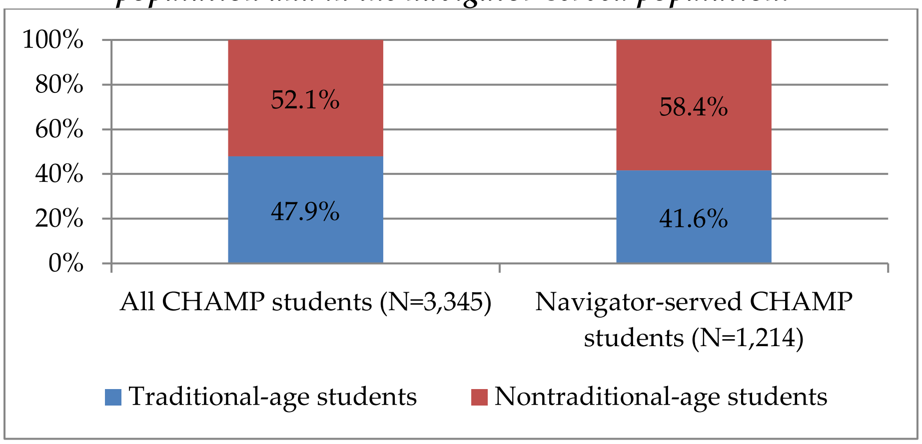
CHAMP School	Black			Hispanic			Other[72]			White		
	CHAMP enrollees (N)	Served by navigator (n)	% Served by navigator	CHAMP enrollees (N)	Served by navigator (n)	% Served by navigator	CHAMP enrollees (N)	Served by navigator (n)	% Served by navigator	CHAMP enrollees (N)	Served by navigator (n)	% Served by navigator
AIMS	14	2	14.3	239	10	4.2	12	1	8.3	496	8	1.6
CCD	18	13	72.2	41	15	36.6	17	6	35.3	196	93	47.4
FRCC	2	2	100.0	32	28	87.5	27	20	74.1	250	200	80.0
LCC	2	2	100.0	18	14	77.8	4	1	25.0	59	47	79.7
MSU	4	4	100.0	24	24	100.0	13	13	100.0	91	91	100.0
PCC	14	3	21.4	137	27	19.7	31	2	6.5	291	34	11.7
PPCC	30	6	20.0	63	17	27.0	29	8	27.6	421	137	32.5
RRCC	1	0	0.0	53	16	30.2	21	7	33.3	286	85	29.7
Total	85	32	37.6	607	151	24.9	154	58	37.7	2090	695	33.3

[72] Other includes American Indian/Alaska Native, Asian, and any other category included in CCCS Banner data sets.

Age

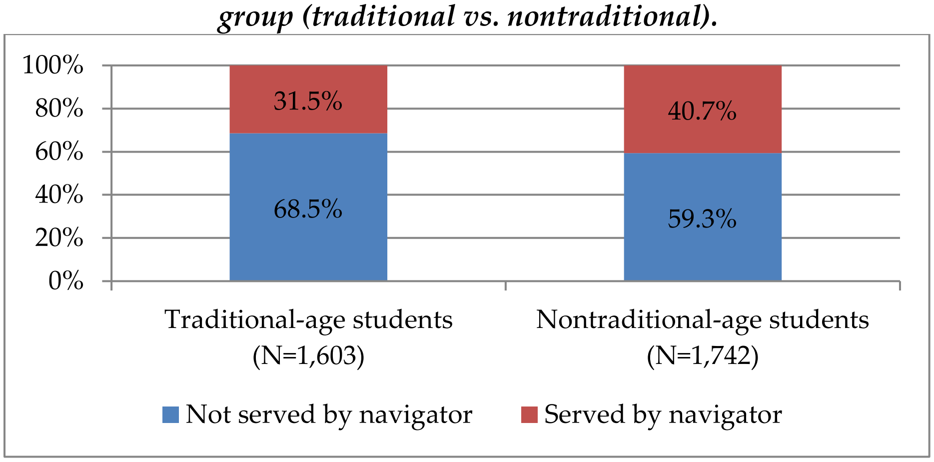
Many CHAMP students had previously been in the labor force or in the military, and were now returning to college to earn CTE certificates, associate degrees, and/or bachelor's degrees. Many of these nontraditional-age students wanted to enhance their skills or change their career paths. Given their life experience, it was not surprising to find that older students were more likely than their younger counterparts to seek the services of a navigator. As Figure 6 shows, 58 percent of nontraditional-age CHAMP students contacted a navigator versus only 42 percent of traditional-age students.

Figure 6. Proportion of nontraditional students (age 25 or older) in the CHAMP student population and in the navigator-served population.[73]



Whereas Figure 6 revealed that nontraditional-age students were more likely than traditional-age students to be served by a navigator, Figure 7 reveals the size of that disparity. Nontraditional-age CHAMP students were served by navigators at a rate of 41 percent, which is 9 percentage points higher than that of traditional-age CHAMP students (32 percent).

Figure 7. Navigator-served CHAMP students as a percentage of all CHAMP students by age group (traditional vs. nontraditional).



[73] One student's age data was missing, thus N=3,345.

The college-level distributions of traditional- and nontraditional-age students, shown on Table 5, varied. Colleges that offered certificates (e.g., FRCC and PPCC) tended to have more nontraditional-age students than did those that offered associate and bachelor's degree programs.

Given the comparisons described in Figures 6 and 7, some interesting findings emerge at the college level. We find that at several consortium colleges the proportions of traditional-age and nontraditional-age students served by navigators were similarly distributed. At three of the eight schools—Aims, LCC, and PPCC—the two populations differed by 2 percentage points or less. Moreover, the one-percentage-point difference at LCC was tipped in favor of traditional-aged students contacting navigators more often than nontraditional-age students.

The differences observed in Figures 6 and 7 can be attributed to only three schools: CCD, PCC, and RRCC. At CCD, 20 percent more nontraditional-age CHAMP students than younger students had contact with navigators (52 percent vs. 32 percent). At RRCC the rate of nontraditional students served was more than double that of traditional-age students (50 percent vs. 20 percent), and nontraditional students at PCC were served three times more often than younger students (21 percent vs. 7 percent).

Table 5. Proportion of CHAMP students served by a navigator by age group (traditional vs. nontraditional) and school

CHAMP School	Traditional-Age Students			Nontraditional-Age Students		
	Total (N)	Served by navigator (n)	% Served by navigator	Total (N)	Served by navigator (n)	% Served by navigator
AIMS	400	9	2.3	379	12	3.2
CCD	134	43	32.1	174	91	52.3
FRCC	93	82	88.2	261	200	76.6
LCC	68	53	77.9	17	13	76.5
MSU	182	182	100.0	162	162	100.0
PCC	238	17	7.1	264	54	20.5
PPCC	217	65	30.0	368	119	32.3
RRCC	271	54	19.9	117	58	49.6
Total	1603	505	31.5	1742	709	40.7

TAA Status

TAA status refers to a federal program serving workers who have been laid off or will be laid off due to foreign trade or the off-shoring of jobs. Once a group of workers has been designated "TAA eligible," members of that group can apply for TAA services and benefits—which include a number of funded educational and retraining opportunities—through their state's Workforce

Centers (WFCs).[74] In our analysis, we use the term "TAA-like" to describe individuals who are unemployed or low income and who are seeking to further their education or retrain. The TAA-like status was provided in the data sets the navigators filled out.

Navigators were asked to indicate if any of the students they served had TAA status or were TAA-like. Navigators, however, were not consistent in recording this information in the log. As a result, we cannot compare the rates of TAA eligibility among CHAMP students served by navigators against that of the entire population of CHAMP students. We can only state that of the 1,759 students who had contact with a navigator, 19 were identified as being TAA-eligible, and 445 students were identified as being TAA-like

Financial Aid Eligibility

We used Pell eligibility as the surrogate/proxy indicator of financial hardship. Figure 8 shows that Pell-eligible students made up 36 percent of all CHAMP students, but only about 28 percent of those served by a navigator.

Figure 8. Pell eligibility of the CHAMP student population and the navigator-served population[75]

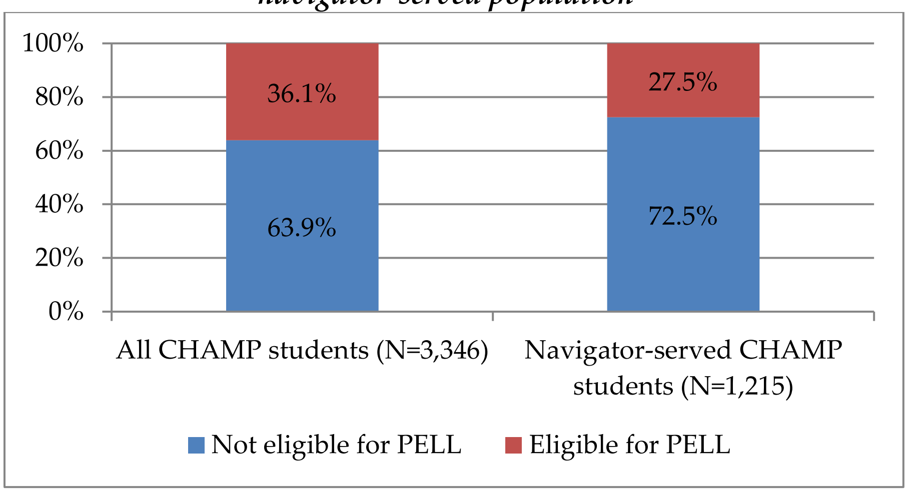


Figure 9 supports this finding. When we break down the CHAMP population by Pell eligibility, we see that a lower percentage of students who were eligible for Pell grants (28 percent) had contact with a navigator than did students who were not eligible for Pell grants (41 percent). This finding implies that students facing financial hardship may be less likely than those who are not struggling financially to reach out for assistance in their programs. This counter-intuitive finding is concerning and suggest the need for more outreach to students who have financial need.

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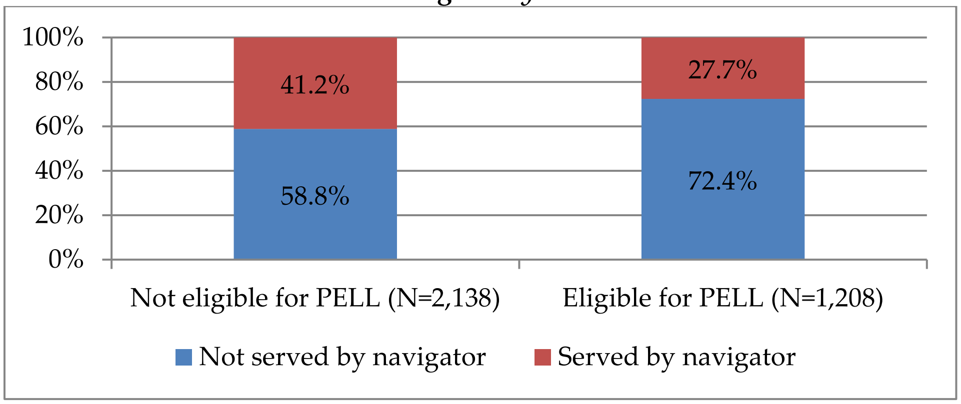
[74] See https://www.doleta.gov/tradeact/factsheet.cfm.

[75] Only includes the 1,215 out of 1,758 CHAMP students served for whom we have PELL-eligibility data.

Figure 9. Navigator-served CHAMP students as a percentage of all CHAMP students by Pell eligibility[76]



In Table 6 we compare the rates by which navigators served students with and without Pell eligibility at each consortium college. Overall the rate of navigator contact was similar between 28 percent of the overall Pell-eligible population were served by navigators, as were 30 percent of all Pell-ineligible students. However, at FRCC, CCD, PCC, and RRCC, Pell-eligible students were more likely than their non-eligible counterparts to contact a navigator. The greatest difference was observed at RRCC, where 49 percent of Pell-eligible students had contact with the navigator versus only 25 percent of the ineligible students at the school—a difference of 24 percentage points. Only at PPCC were these roles reversed; there, slightly more Pell-ineligible students (33 percent) than Pell-eligible students (30 percent) were served by a navigator. Again, it is important to note that differences in school population sizes affect these rates, as does each navigator's uniquely defined role at the college. Further, colleges varied in the range of support resources available to their CHAMP students.

Table 6. Proportion of CHAMP students served by a navigator by Pell grant eligibility and school

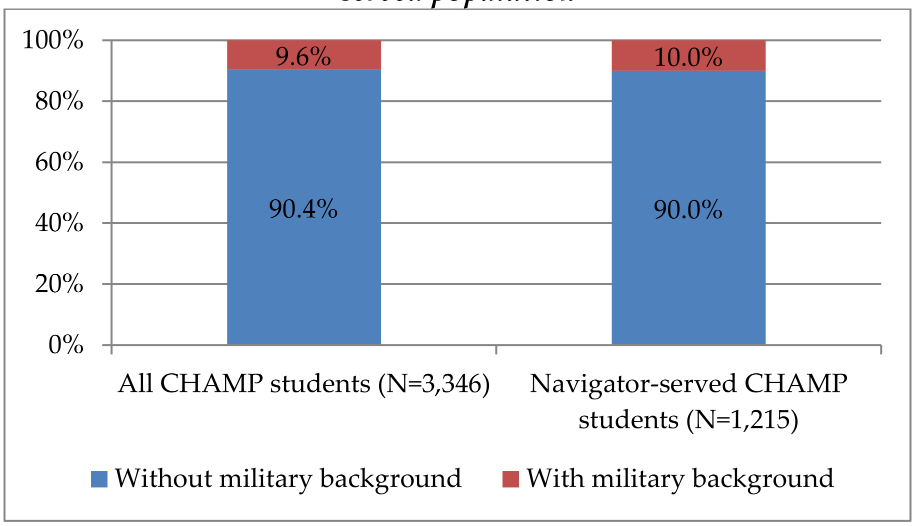
CHAMP School	Pell-eligible students			Pell-ineligible students		
	Total (N)	Served by navigator (n)	% served by navigator	Total (N)	Served by navigator (n)	% Served by navigator
AIMS	319	11	3.4	460	10	2.2
CCD	143	77	53.8	165	57	34.5
FRCC	37	33	89.2	318	250	78.6
LCC	59	47	79.7	26	19	73.1
PCC	316	54	17.1	186	17	9.1
PPCC	275	83	30.2	310	101	32.6
RRCC	59	29	49.2	329	83	25.2
Total	1208	334	27.6	1794	537	29.9

[76] Only includes the 2,138 CHAMP students for whom we had PELL-eligibility data and the 1,208 students served for whom PELL eligibility data was recorded. Further, MSU CHAMP data is not included in this analysis.

Military Background

Just under 10 percent of CHAMP students had a military background. That proportion was slightly higher among students served by navigators, but the difference was less than a single percentage point.

Figure 10. Military service background of the CHAMP student population and the navigator-served population



Across the CHAMP consortium, over a third of students with a history of military service were seen by a navigator (38 percent). This rate was comparable to the rate of nonmilitary who had contact with a navigator (36 percent), as shown in Figure 11.

Figure 11. Navigator-served CHAMP students as a percentage of all CHAMP students by military service background

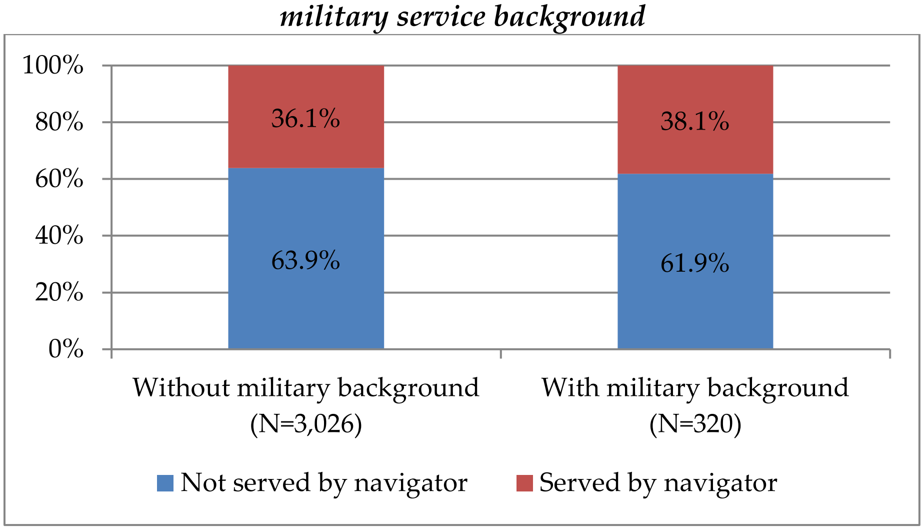
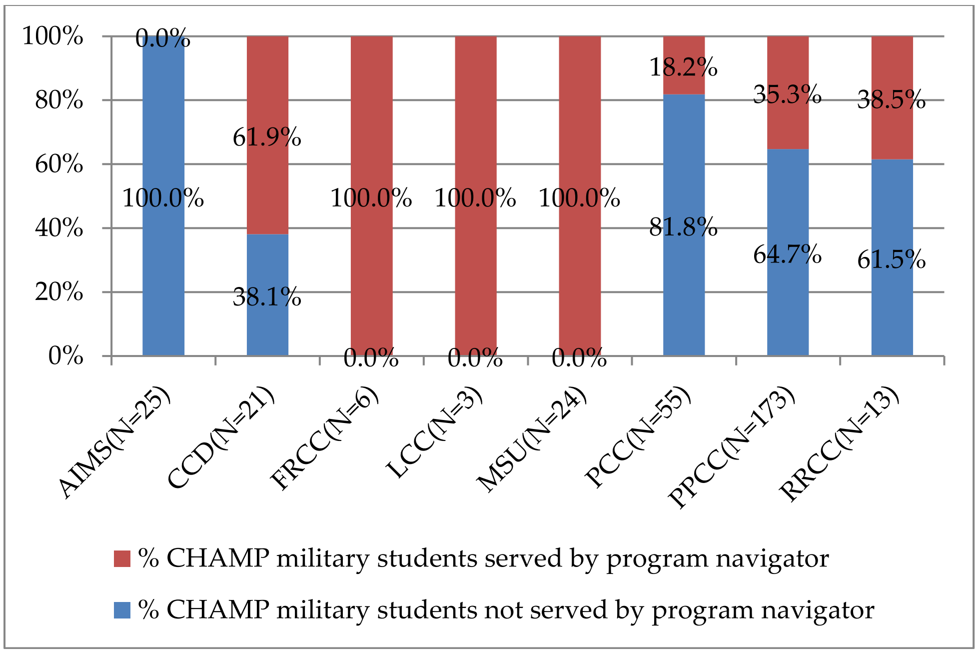


Figure 12 shows that military students at FRCC, LCC, and MSU, though small in number, were all served by program navigators. None of the 25 military students at Aims had contact with their program navigators; this is in keeping with the low number of CHAMP students at Aims who had any navigator contact.

At CCD, 62 percent of the 21 military students were served by navigators, and over a third of the 13 military students at RRCC had contact with navigators. Though our data indicate that only 35 percent of the military students met with the navigator at PPCC, it is likely that this number underreports the amount of military students served at the school. By the middle of the CHAMP grant, PPCC had hired a military liaison who worked with CHAMP students, so it is likely that more students with a military background met with a CHAMP-funded person than is indicated here.

Figure 12. Proportion of CHAMP students contacting navigator by military service background and school.



Navigator Activities

As discussed in Part I, one of the defined functions of the navigators was to work directly with CHAMP students, providing academic and career advising and preparing them for job searches and interviews. The degree to which advising was a primary function of the navigators varied by college as did the CHAMP program's policy about mandating student–navigator interactions. Other school-specific factors also influenced the data reported in this section, including the availability of navigators; the role of faculty as advisers; the CHAMP programs offered by the school; the related credentials offered (certificates, associate degrees, or bachelor's degrees), and the duration of those programs; and finally, the regional job market for CHAMP-related fields. While some of these factors were discussed in Part I, the navigator tracking log and other available data sets did not track this contextual information. It was therefore not possible to analyze their influence quantitatively. Still, all these factors must be kept in mind with respect to the analyses that follow.

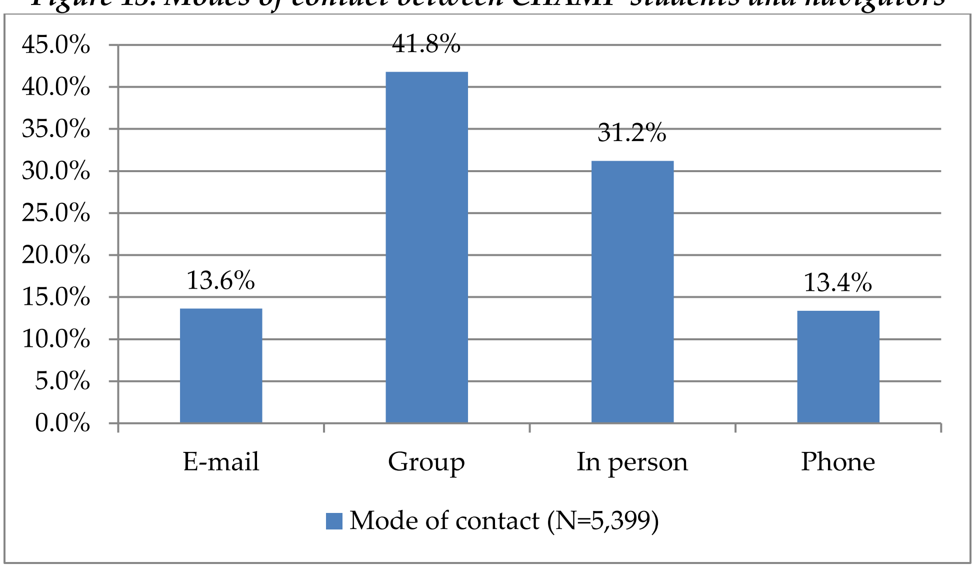
The data for this section comes directly from the activity tracking logs that the navigators were asked to keep. We report here on the mode and frequency of contacts, and the reason for recorded interactions between CHAMP students and navigators.

Mode of Contact

For the study period, navigators' activity tracking logs documented 5,399 contacts with CHAMP students.[77] This number is greater than the number of unique students served by navigators, as it takes into account multiple contacts with individual students.

There were four major channels through which CHAMP students and navigators communicated—e-mail, phone calls, group-lessons, and in-person visits. Figure 18 indicates that the majority of interactions between CHAMP students and program navigators were made through group sessions[78]; these accounted for 42 percent of all student–navigator contacts. In-person or face-to-face (in most cases one-to-one) interactions were also common, accounting for over 31 percent of contacts. Across all eight CHAMP schools included in the analysis, e-mail and telephone contacts each accounted for about 13 percent of student–navigator interactions.

Figure 13. Modes of contact between CHAMP students and navigators



Though group lessons were the most frequently used mode of contact at the consortium level, differences emerge when we examine modes of contact at the individual college level; this

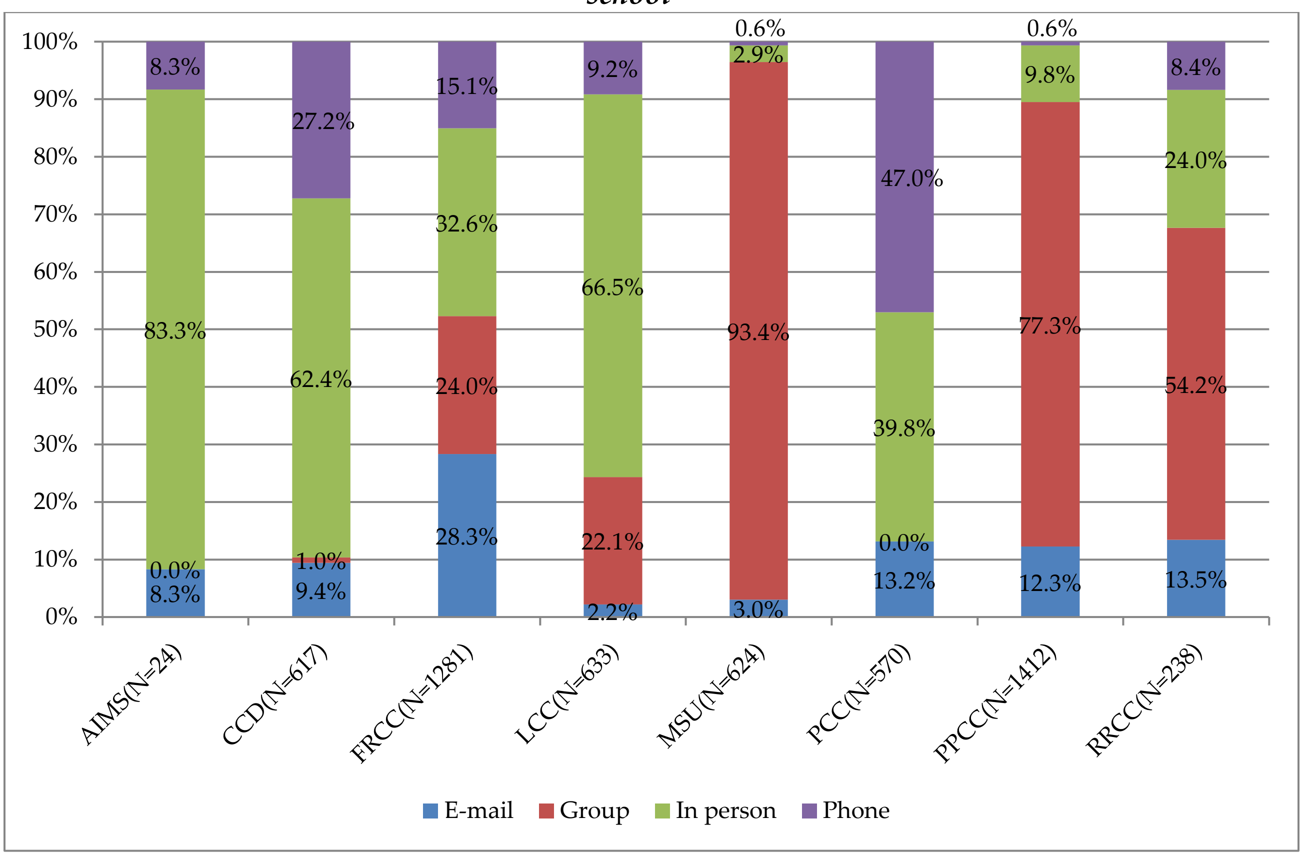
[77] Records that lacked a date of interaction were eliminated from the analyses of the intensity and frequency of contact later in this section.

[78] We should be careful when interpreting the frequency of group interactions, as it is unclear how individual navigators interpreted this category when entering data into the log; some may have entered the number of students participating in the group interactions, while others may have entered the number of defined group sessions.

analysis is shown in Figure 14. As expected, most student—navigator contacts at MSU (93 percent), PPCC (77 percent), and RRCC (65 percent)) were group sessions. (At these three colleges, group sessions mostly focused on soft skills and job preparation.) In-person visits were the most commonly used mode of interaction at Aims (83 percent), CCD (63 percent), and LCC (66 percent). This is somewhat consistent with the consortium-level results, which showed that mode of contact to be relatively popular among CHAMP students as well.

Interestingly, however, the navigator at PCC logged no group interactions at all; the vast majority of contacts at that college were made by phone. Another anomaly appears at FRCC, where e-mail contacts account for 28 percent of student–navigator interactions. This makes e-mail contact (more common at FRCC than group interactions (24 percent), second only to in-person contact in frequency (33 percent).

Figure 14: Modes of contact between CHAMP students and navigators at each consortium school



In general, we found that e-mail and phone use varied widely at the college level. At the consortium level, we observed that each accounted for about 13 percent of student–navigator interactions. By college we found e-mail use varied from as low as 3 percent at MSU to the 28 percent previously discussed at FRCC. Similarly, phone contacts at the college level ranged from no use at all at MSU to being used for nearly half of all communications at PCC.

Frequency of Contact

Between spring 2014 and spring 2016, CHAMP navigators documented 5,352[79] contacts with students in their online activity tracking logs. The number of contacts made at each consortium college varied widely based on several factors. First, navigators' hiring dates and tenures of employment differed by college (see Part I). Second, CHAMP programs were launched at different time points during the study period. Third, programs varied in the number of students enrolled at each college. Fourth, the length of the programs varied such that some students were only enrolled for one or two semesters. And fifth, as discussed, the navigator role varied across the colleges such that some were primarily focused on student advisement—and thus were more available to engage with students—while others were more focused on recruitment and marketing or on employer relations.

We broke down the 5,352 contacts to identify the number of unique students represented therein, and then we examined the frequency of recorded contacts with a navigator for each of these students. During the study period, 1,740 unique CHAMP students had at least one contact with their college's navigator.[80] We found that some students had a single recorded contact and a number had more than 30 contacts over two years. The number of times students interacted with their school's CHAMP navigator reflected, to some extent, that navigator's function and campus presence.

Table 7 presents the number of unique students at each school who contacted a CHAMP navigator alongside a breakdown of how often navigators met with individual students. We see that CHAMP students at Aims contacted their navigator only once, as did the majority of students at CCD (67 percent), MSU (78 percent), and RRCC (66 percent). To some extent this parallels for MSU and RRC the significant use of group contacts.

On the other end of the spectrum, most CHAMP students at LCC—49 out of 75, or over 65 percent—met with their navigator five or more times. Many students at FRCC (25 percent), PCC (42 percent), and PPCC (36 percent) also had more than five contacts with program navigators.

Table 7. Number of navigator contacts per CHAMP student by school

CHAMP School	Total Unique Students	Number of Contacts								
		1	%	2	%	3–4	%	5 or more	%	Median
AIMS	25	25	100.0	0	0.0	0	0.0	0	0.0	1
CCD	282	189	67.0	58	20.6	30	10.6	5	1.8	1
FRCC	380	125	32.9	91	23.9	68	17.9	96	25.3	2
LCC	75	12	16.0	7	9.3	7	9.3	49	65.3	7
MSU	476	369	77.5	83	17.4	21	4.4	3	0.6	1
PCC	124	29	23.4	18	14.5	25	20.2	52	41.9	3

[79] We only focus on the contacts that have dates available. The 437 contacts that did not indicate date of contact were excluded from this part of analysis.

[80] Some students who contacted the Navigator were not CHAMP students. They have been excluded.

PPCC	262	52	19.8	29	11.1	86	32.8	95	36.3	3
RRCC	116	77	66.4	14	12.1	10	8.6	15	12.9	1
Total	1740	878	50.5	300	17.2	247	14.2	315	18.1	1

***Number of Contacts and Number of Students Served Each Month*[81]**

Given differences in the hiring dates for navigators and the start dates of the various CHAMP-funded programs, we were interested in tracking the number of contacts and number of unique students served in each month during the study period, spring 2014 to spring 2016. These data appear in Table 8.

We found that the number of contacts varied by month from a low of 20 to a high of 546 contacts, and the number of unique students served varied by month from a low of 18 and to a high of 392. The large range of number of contacts and number of unique students served in each month reflects to some extent the academic calendar and the availability of navigators.

At the beginning of the CHAMP grant spring 2014, as colleges were developing or enhancing their programs, few students were enrolled, and fewer still were served by a navigator. As the program developed, the number of students contacting navigators increased from a low of 18 in January 2014 to that year's high of 258 unique students in August. High numbers of unique contacts and frequency of contacts is seen in August and September 2015. These high numbers line up with the beginning of the fall term and no doubt reflect the waves of incoming students seeking information and guidance about CHAMP programs.

The large number of unique students and the peak in the frequency of contacts in March and April 2015 suggest that students also tend to seek the guidance of navigators as they prepare to graduate and look for jobs—in other words, when they need employment assistance or help with credentialing processes. However, these data are incomplete as not all colleges reported navigator activities for April and May 2016.[82]

Small numbers of unique students annually each December and from May through July reflect winter recess on most campuses, and lower rates of enrollment for summer programs.

See Appendix B for the complete set of college-level data showing the numbers of unique students served each month by CHAMP navigators. Again, the prior contextual caveats need to be taken into consideration when viewing the differences across the colleges.[83]

[81] The frequency of contacts in each month should be interpreted with caution as each school may have put their navigators in place at different points in time. As Appendix A–B shows, navigators at Aims started working with students in 2016, while their counterparts at FRCC and MSU started contacting students from the beginning of 2014. Navigators at CCD and LCC, on the other hand, started to serve students in fall 2014.

[82] In some cases, this was because of staffing changes and the absence of any navigator.

[83] For example, some schools, such as FRCC and MSU, employed navigators early in the grant period, while other colleges experienced long delays in hiring navigators or had gaps between navigators.

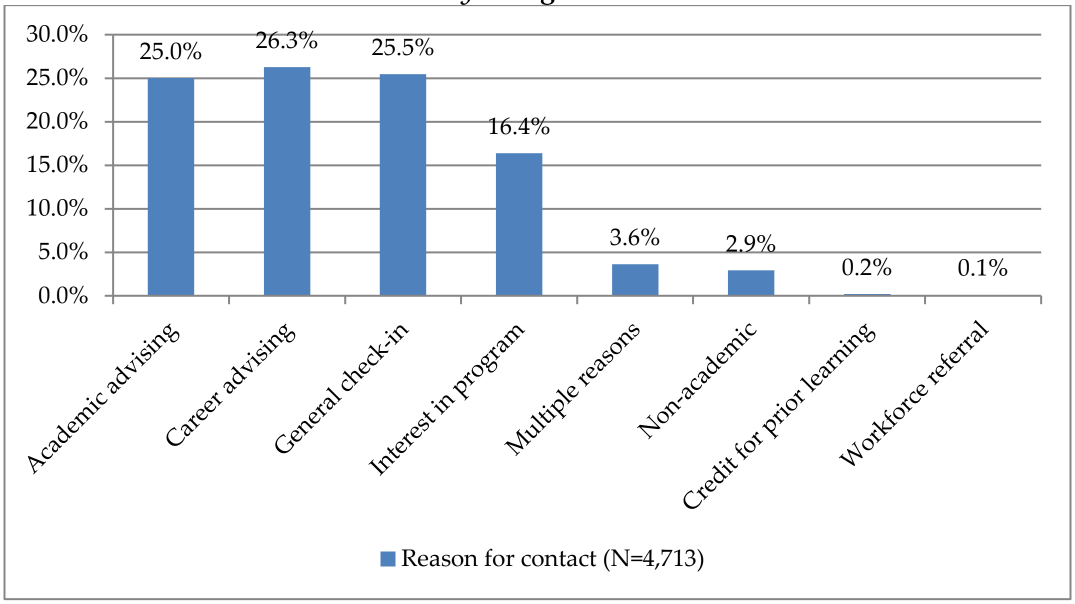
Table 8. Total contacts made and number of unique CHAMP students served by navigators each month, January 2014–May 2016

Month	2014		2015		2016	
	# Contacts by month	# Unique students by month	# Contacts by month	# Unique students by month	# Contact by month	# Unique students by month
January	20	18	370	161	296	211
February	112	97	251	188	302	156
March	53	36	272	214	356	211
April	33	26	277	203	103	82
May	29	24	94	78	5	5
June	98	67	36	25	NA	NA
July	117	76	38	34	NA	NA
August	343	258	231	198	NA	NA
September	140	110	546	392	NA	NA
October	193	122	283	216	NA	NA
November	201	143	290	225	NA	NA
December	78	65	185	142	NA	NA
Total	1417	1042	2873	2076	1062	665

Reasons for Contact

Out of the total number of recorded student–navigator contacts (N=5,352), 88 percent (n=4,713) included the reason for the contact. Figure 15 identifies the reason(s) navigators listed for their interactions with a CHAMP student. According to navigators, each of the following three reasons accounted for around 25 percent of the interactions they had with students: career advising, academic advising, or general check-ins. Another 16 percent of student–navigator contacts had to do with students' inquiries about the CHAMP program. Very few of the navigators' students contacted them for workforce referrals, with questions regarding credit for prior learning, or with nonacademic concerns. The lack of contact on PLA was probably a result of delays in the implementation of the roll out of the redesigned PLA policies and procedures. Note, the percentages in Figure 15 reflect one or more contacts per student about the identified reason.

Figure 15: Student–navigator contacts[84] categorized by the reason for the contact, as identified by navigators.



In Table 9 we examine reasons for contact in terms of unique students rather than by frequency of contact. We found that most CHAMP students contacted their navigators for help with career advising. This category, which includes career mapping, job preparation, and employment searches, stimulated nearly one third of the students who contacted a navigator to take that action. Just over 24 percent of unique students contacted a navigator to learn about the CHAMP program. Academic advising accounted for another 21 percent of students seeking navigator guidance, and around 14 percent of navigator-served students contacted their navigator for the purpose of a general check-in. Only three students got in touch with a navigator with an inquiry about PLA, and another five made contact regarding a workforce referral. Combined, these students accounted for less than 1 percent of all navigator-served students.

[84] Navigators used a codebook for each of the categories. Complete descriptions of each category appear in Table 2 of this report.

Table 9. Unique students served by navigators by the reason for the contact, as identified by navigator

Reason for contact	# of unique students	Percent
Academic advising	508	21.2
Career advising	753	31.5
General check-in	332	13.9
Interest in program	584	24.4
Multiple reasons	117	4.9
Nonacademic	90	3.8
Credit for prior learning	3	0.1
Workforce referral	5	0.2
TOTALS	2392	100

Next we examine the reasons students contacted a navigator at each individual school. (See Table 10.) Again, we see differences by college.

The majority of CHAMP student–navigator contacts at CCD, LCC, and PCC were related to academic issues. For example, at CCD, almost two thirds (65 percent) of student–navigator contents students were for the purposes of academic advising, as were over half of all contacts made by students at LCC (52 percent) and PCC (54 percent).

In contrast, the reason for nearly all of MSU students' contacts with their CHAMP navigator was for career advising—those meetings accounted for 95 percent of student–navigator interactions at the school. Two thirds of Aims students (67 percent) and the proportional majority of FRCC's students (44 percent) also consulted their navigators for career advising.

The majority of student–navigator contacts at PPCC and RRCC were identified as general check-ins (77 percent and 60 percent respectively). It is not clear from the logs what these entries referred to—they may have been informal contacts or brief interactions in which navigators met a student in a classroom or lab and asked how he or she was doing.

Students seeking information about the CHAMP programs at their schools accounted for about 20 percent of reported contacts at CCD, FRCC, PCC, and PPCC.

Of interest was that nonacademic issues—e.g., financial aid, housing, family needs, etc.—did not emerge as a common impetus for student–navigator interaction. This is quite different from the experience of career coaches under both COETC and (to a lesser extent) CHEO. There were also few contacts related to workforce referrals or for information on how to receive credit for prior learning experience. During CHAMP, PCC was very active with credit for prior learning/prior learning assessment activities which may be why they were the only college which reported activity for this purpose.

Table 10. Reasons for contacting navigators, by school

CHAMP College	Interest in program		Academic advising		Credit for prior learning		Career advising		Nonacademic		Workforce referral		General check-in		Multiple reasons	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
AIMS (N = 24)			3	12.5			16	66.7	3	12.5			1	4.2	1	4.2
CCD (N = 467)	129	27.6	302	64.7					4	0.9			1	0.2	31	6.6
FRCC (N = 952)	211	22.2	215	22.6			422	44.3	91	9.6					13	1.4
LCC (N = 637)	8	1.3	333	52.3			109	17.1	13	2.0	2	0.3	110	17.3	62	9.7
MSU (N = 618)	20	3.2	9	1.5			586	94.8	3	5.0						
PCC (N = 561)	127	22.6	300	53.5	10	1.8	92	16.4	20	3.6	1	0.2			11	2.0
PPCC (N = 1270)	274	21.6	9	0.7			8	0.6			2	0.0	977	76.9		
RRCC (N = 184)	3	1.6	8	4.3			6	3.3	3	1.6			111	60.3	53	28.8

STUDENT OUTCOMES

CHAMP project goals included improving rates of retention and completion, expanding the number of credentials students earned, and increasing both the rates of employment and wages of students earning one or more CHAMP credentials. CHAMP-funded navigators were to facilitate and enhance the success of students in these areas.

The third and final section of our analysis examines CHAMP students' academic and career outcomes by comparing the outcomes of students who were served by a navigator to students not served. Given the wide variation in navigator functions, contextual issues at each of the colleges, and differences in the industries upon which the various CHAMP programs were focused, our analysis can only suggest the impact of student–navigator interactions on outcomes. More research is needed to move from associative to causal explanations.

ACADEMIC OUTCOMES

Degree Completion by Target Credentials

In this section we examine differences in credential completion rates between the CHAMP students who were served by navigators and those who were not. We begin our analysis by presenting the credentials CHAMP students reported as their desired goal. We then examine students' graduation rates. Note that, our analysis only looks at data up to and including spring 2016. Students who started their program of study during the latter part of the study period may not have had sufficient time to complete their credential. Thus, there may be more students who earned a credential than are reported here.

Each time students register, they are asked to indicate the credential they intend to pursue. The data set for the following analysis, however, includes only the target credential declared by students at the time of their initial registration for one or more CHAMP courses.

Our target credential variable contained five categories: short-term certificate (programs taking less than one year to complete); long-term certificate (one- to two-year programs); associate degree; bachelor's degree; and no credential (used for students who did not declare a target credential at the time of their initial CHAMP enrollment).[85] Because MSU is the only four-year college in the CHAMP program, and almost all of the school's 311 CHAMP students were pursuing bachelor's degrees, we left them out of this portion of the analysis in favor of focusing on the seven CHAMP community colleges.[86] What remained for analysis was a sample of 2,780 CHAMP students.

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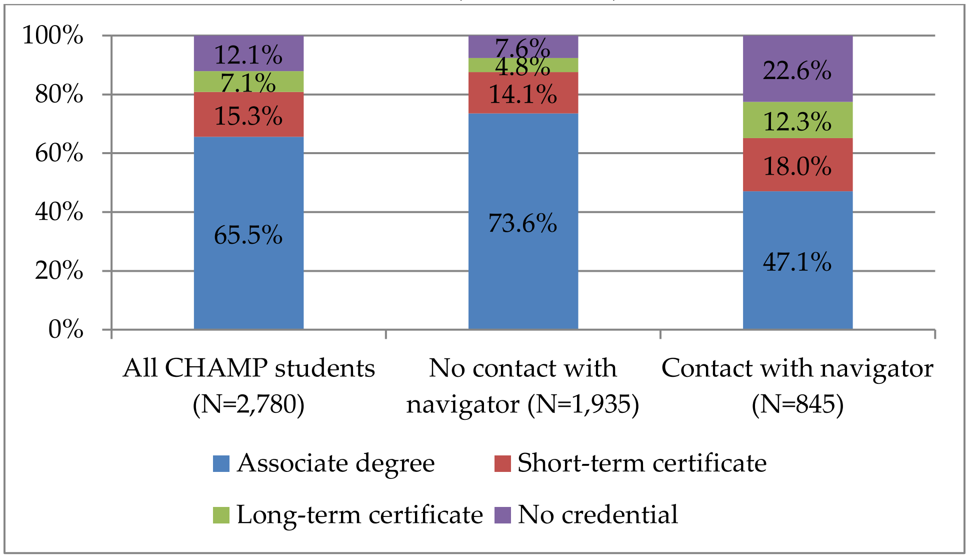
[85] It is unclear whether these students were enrolled in noncredit courses and did not intend to earn a credential or simply failed to report their academic goal on the form.

[86] Because none of the colleges that remained in the analysis granted four-year degrees, bachelor's degree is not included as a category of the target credential variable.

Figure 15 shows the breakdown of credential goals for the above defined sample of CHAMP students, and for students who were and who were not served by program navigators.

Figure 15: CHAMP students' target credentials within categories of navigator interaction (all CHAMP students, no contact, contact)



Associate degrees were the most popular target credential indicated by CHAMP students, pursued by about two thirds (66 percent; n=1,822) of the enrollees. (See Figure 15 and Table 11.) The next most frequently sought-after credential for CHAMP students was short-term certificates (15 percent; n=425). Long-term certificates were the least popular targets (7 percent; n=196). About 12 percent (n=337) of students did not declare a target credential when they initially enrolled in a CHAMP course.[87] This distribution of target credentials reflects, to some extent, the distribution of the credentials offered under CHAMP at the various consortium colleges; the history of such credentials at the colleges (for example, more established programs enjoyed greater market knowledge); as well as the anticipated job market of the industries represented by each of the programs.

CHAMP students pursuing an associate degree accounted for a much larger proportion of students who did not have contact with a navigator, than of those who did—74 percent versus 47 percent, respectively. In contrast, students pursuing both short- and long-term credentials were more likely than not to have had at least one contact with a navigator. This was also the case with students enrolled in noncredit courses/programs or who had not yet identified a

[87] Many of the students in this cohort were incumbent workers who enrolled in one or more CHAMP-related courses but were not initially pursuing a CTE certificate or associate degree. For example, many students at FRCC were incumbent workers taking noncredit CHAMP-related welding courses to enhance their technical skills while on the job.

credential target, 22.6 percent versus 7.6 percent (N=337). This large difference was most likely driven by the relatively high rate of student–navigator interaction at FRCC (75 percent; n=252).

As shown on Table 11, CHAMP students' target credentials varied by college in a way that reflected, in part, the nature of the CHAMP program(s) offered by the college. The proportion of students served by navigators also varied by school and by the type(s) of credential(s) offered.

Despite the large numbers of CHAMP students at Aims, PCC, and PPCC pursuing associate degrees (540, 361, and 476 respectively), the rates at which students at these schools contacted their navigators were relatively low, ranging from 3 percent at Aims to 32 percent at PPCC. Again, the different functions of the navigators at these colleges, as well as gaps in the availability of navigator services, may have contributed to the low rates at Aims.

Over 90 percent of students pursuing short- or long-term certificates at FRCC and LCC had some contact with their CHAMP navigator, and over 60 percent of CCD's certificate students had contact with a CHAMP navigator. However, the proportions of students served by navigators at PCC, PPCC, and RRCC were far lower, ranging from 23 to 38 percent of students seeking short-term certificates; and from 13 to 27 percent of those seeking long-term certificates.

As noted above, many of the students at FRCC (n=252) were enrolled in a noncredit course or had not yet identified a credential. Eighty students at Aims also were either noncredit students or did not initially specify a target credential. While roughly three quarters of the FRCC students in this cohort met with their navigator, less than 3 percent of those at Aims did so, which again may reflect the periods during which no CHAMP navigator was available at Aims.

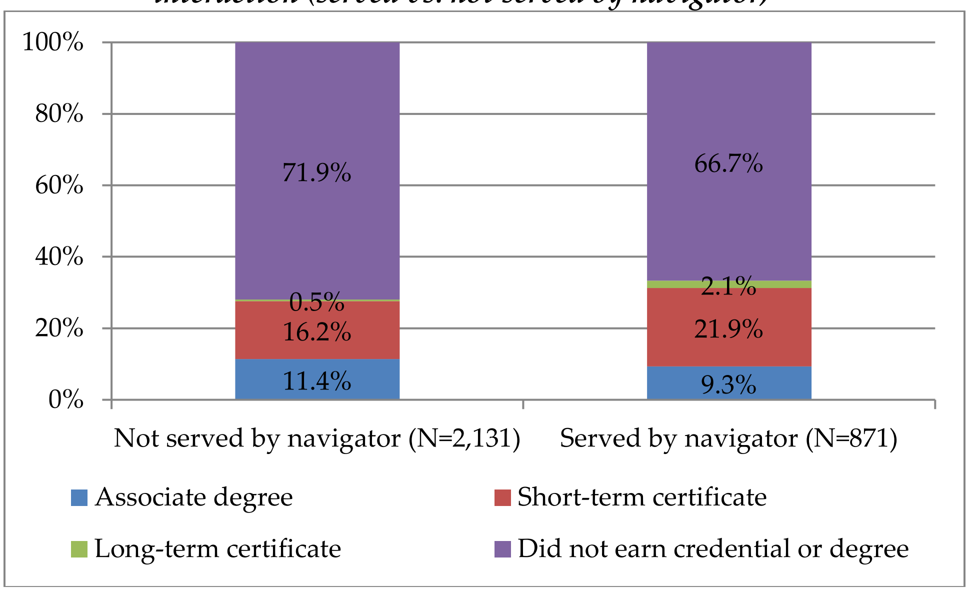
Table 11. Proportion of CHAMP students who contacted a navigator, by declared credential and school

CHAMP school	Short-term certificate			Long-term certificate			Associate degree			No credential declared at registration		
	Total (N)	Contacted navigator (n)	% Contacted navigator	Total (N)	Contacted navigator (n)	% Contacted navigator	Total (N)	Contacted navigator (n)	% Contacted navigator	Total (N)	Contacted navigator (n)	% Contacted navigator
AIMS	77	1	1.3				540	17	3.1	80	2	2.5
CCD	74	46	62.2	27	17	63.0	175	68	38.9	2	1	50.0
FRCC	28	25	89.3	40	40	100.0	26	22	84.6	252	187	74.2
LCC	16	15	93.8	31	29	93.5	38	22	57.9			
PCC	29	11	37.9	72	13	18.1	361	46	12.7			
PPCC	64	19	29.7	11	3	27.3	476	153	32.1	2	1	50.0
RRCC	132	30	22.7	15	2	13.3	206	70	34.0	1	0	0.0
Total	420	147	35.0	196	104	53.1	1822	398	21.8	337	191	56.7

Program Completers

An important question for this report was if CHAMP students served by navigators earned credentials at a higher rate than those who had not been served by a navigator. Figure 16 shows that overall, regardless of their target credential, students who contacted a navigator had a completion rate 5 percentage points higher than those who did not contact a navigator—33 percent versus 28 percent. This difference was significant. [88] At the individual credential level, the credential completion rate among students in short-term certificate programs who interacted with a navigator (22 percent) was 6 percentage points higher than that of those in who had not (16 percent). However, navigator contact was not related to higher completion rates for all target credential groups. Among students enrolled in associate degree programs, those who had not seen a navigator had a higher rate of completion (11 percent) than those who had seen a navigator (9 percent). [89, 90]

Figure 16. Degree completion rates among all CHAMP students within categories of navigator interaction (served vs. not served by navigator)[91, 92]

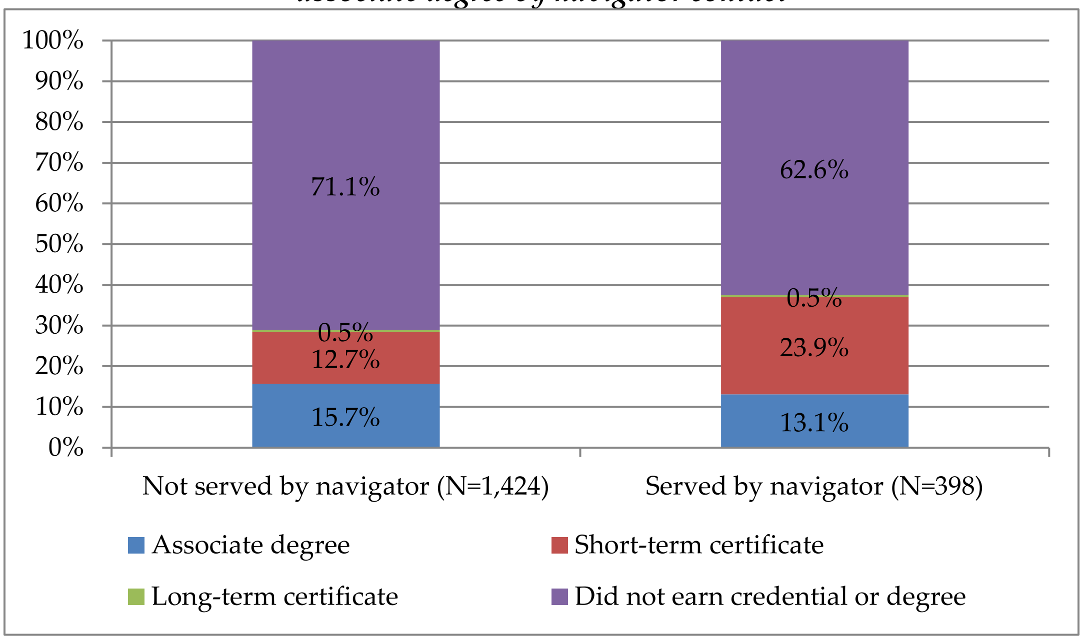


In Figure 17 we present the rate at which CHAMP students completed, during the period under study, the credential they had declared as their target when they first enrolled in a CHAMP course. In this model, the cohort who did not earn a credential includes students who were in progress to a credential but had not yet completed a credential; those in noncredit/non-credential programs; and those who simply did not declare a target credential upon their initial registration. Among students pursuing an associate degree, those who did not interact with a

[88] Chi-square with one degree of freedom = 8.129, p = 0.004
[89] The numbers were too small here for a significance test.
[90] It not known in these cases if students received advising from faculty or from another campus service.
[91] Figure 16 looks at all students regardless of whether they declared a credential as their goal at registration.
[92] This excludes 344 MSU students as they did not earn any credentials.

navigator had a slightly higher associate degree completion rate than those who did—16 percent versus 13 percent—but this three-percentage-point difference was not statistically significant. There was, however, a significant difference in the rates of completion for students pursuing a short-term certificate. Students who interacted with a navigator had a completion rate of 24 percent as compared to a completion rate of 13 percent for those who had not been served.

Figure 17. Credential completion for students who declared goal of earning an associate degree by navigator contact



We next examined the rate by which students earned a credential with and without navigator contact, at each CHAMP college. This analysis is shown in Table 12.

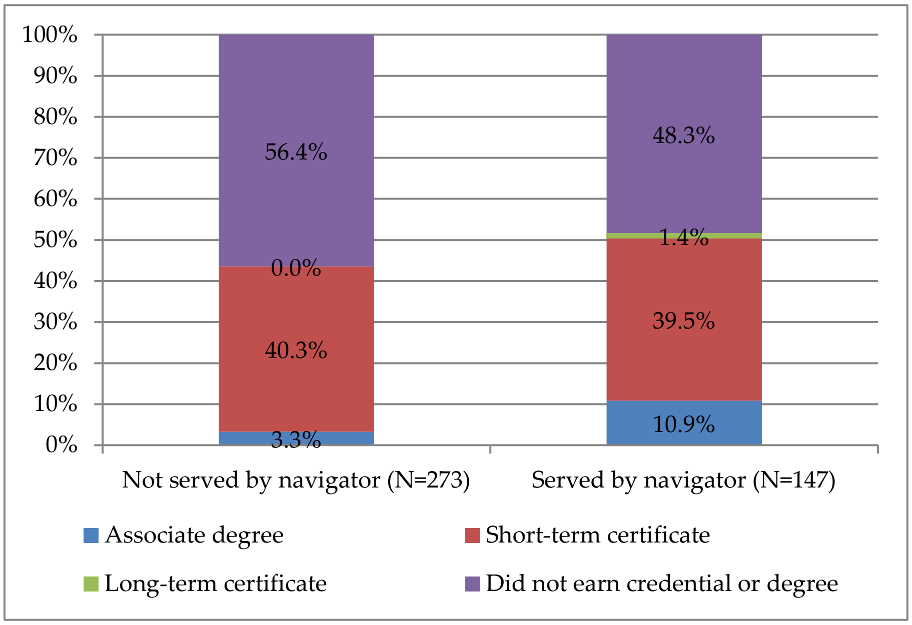
At FRCC, all CHAMP students who earned a credential met with a CHAMP navigator, as did three quarters of those who did not earn a credential. At all other schools, navigator contact seemed to vary by the credential earned. At PCC, for example, 57 percent of CHAMP students earning short-term certificates had been served by navigators, but only 14 percent of those who earned associate degrees had navigator contact. At both PPCC and RRCC, the rate of navigator contact was similar among students receiving short-term certificates and associate degrees—just over 30 percent—but very few students earning long-term certificates interacted with a navigator. At PPCC, only one of eight students (13 percent) who earned a long-term certificate contacted a navigator; and at RRCC, the only student who graduated with a long-term certificate did so without having contact with the navigator. A similar pattern was observed at LCC.

Table 12. Earned credentials of CHAMP students served by a navigator by school

CHAMP School	Short-term certificate			Long-term certificate			Associate degree			No credential earned		
	Total (N)	Served by navigator (n)	% Served by navigator	Total (N)	Served by navigator (n)	% Served by navigator	Total (N)	Served by navigator (n)	% Served by navigator	Total (N)	Served by navigator (n)	% Served by navigator
AIMS	136	0	0.0				111	7	6.3	532	14	2.6
CCD	34	26	76.5	2	2	100.0	30	21	70.0	242	85	35.1
FRCC	34	34	100.0	14	14	100.0	8	8	100.0	299	227	75.9
LCC	17	14	82.4	2	1	50.0	10	9	90.0	56	42	75.0
PCC	53	30	56.6	1	0	0.0	87	12	13.8	361	29	8.0
PPCC	71	24	33.8	8	1	12.5	62	19	30.6	444	140	31.5
RRCC	192	63	32.8	1	0	0.0	15	5	33.3	180	44	24.4
Total	537	191	35.6	28	18	64.3	323	81	25.1	2114	581	27.5

Figure 18 provides a more in-depth look at CHAMP students who initially declared their goal to be a short-term certificate, but who went on to earn other credentials. For short term certificates, there was little difference in students' rates for completion in relation to navigator contact. Completion rates were approximately 40 percent for both students with contact and students without contact. However, we found that 11 percent of CHAMP students served by navigators exceeded their initial goal and went on to earn an associate degree during the study period compared to only about 3 percent of students not served by navigators.

Figure 18. Credentials earned by CHAMP students initially registered in short-term certificate programs within categories of navigator interaction (served vs. not served by navigator)



Stacking Credentials

One of the goals of the CHAMP project was to facilitate students' ability to stack credentials—i.e., for students to accumulate more than one credential. Credential stacking may involve earning more than one certificate or, upon completing an initial credential, transferring earned credits into an associate degree or even a four-year bachelor's degree program. Navigators at some of the consortium colleges played an active role in guiding and assisting students with the stacking of credentials. This included, as discussed in Part I, helping students complete and file any related documentation that must be submitted prior to a certificate being issued. In this section we examine credential stacking.

Our analysis includes an examination of differences by navigator contact. As one reads this section, it is important to note that not all colleges offered the same opportunities to earn more than one short-term certificate (i.e., schools may have offered only one short-term certificate).

We looked at the 537 CHAMP students who earned one or more short-term certificates (Table 13). We found that 40 percent of those students earned two or more certificates. The highest proportions of students earning more than one short-term certificate were found at FRCC (47 percent), LCC (77 percent), PPCC (47 percent), and RRCC (47 percent). In fact, ten students from RRCC earned six short-term certificates. In addition, 12 students from Aims earned six short-term certificates, and another Aims student earned eight.

Table 13: Credential stacking by short-term certificate earners at each CHAMP school

CHAMP School	Short-term certificate earners							Total (N) earning short-term certificates	Earned >1 short-term certificates (n)	% Earned >1 short-term certificates
	Single short-term certificate	2 short-term certificates	3 short-term certificates	4 short-term certificates	5 short-term certificates	6 short-term certificates	8 short-term certificates			
AIMS	84	11	8	17	3	12	1	136	52	38.2
CCD	26	6	2	0	0	0	0	34	8	23.5
FRCC	18	14	2	0	0	0	0	34	16	47.1
LCC	4	9	4	0	0	0	0	17	13	76.5
PCC	49	1	1	1	0	1	0	53	4	7.5
PPCC	38	12	14	7	0	0	0	71	33	46.5
RRCC	102	43	16	20	1	10	0	192	90	46.9
Total	321	96	47	45	4	23	1	537	216	40.2

On Tables 14 and 15, we compare the number of students earning short-term certificates who had navigator contact with those without navigator contact. Of the 346 CHAMP students who had no navigator contact, 44 percent (n=153) earned two or more certificates. Of the 191 students who earned short-term certificates and interacted with a navigator, however, 33 percent earned two or more certificates. When interpreting this result, it is important to note that the vast majority (78%) of students who earned multiple certificates without interacting with a navigator were at Aims and RRCC. At Aims there was an inconsistent navigator presence and both schools had several strong CHAMP short-term certificate programs.

Table 14. Credential stacking by short-term certificate earners not served by navigators at each CHAMP school

CHAMP School	Short-term certificate earners							Total (N) earning short-term certificates	Earned >1 short-term certificates (n)	% Earned >1 short-term certificates
	Single short-term certificate	2 short-term certificates	3 short-term certificates	4 short-term certificates	5 short-term certificates	6 short-term certificates	8 short-term certificates			
AIMS	84	11	8	17	3	12	1	136	52	38.2
CCD	6	0	2	0	0	0	0	8	2	25.0
LCC	2	1	0	0	0	0	0	3	1	33.3
PCC	20	0	1	1	0	1	0	23	3	13.0
PPCC	20	9	11	7	0	0	0	47	27	57.4
RRCC	61	30	14	16	0	8	0	129	68	52.7
Total	193	51	36	41	3	21	1	346	153	44.2

Table 15. Credential stacking by short-term certificate earners served by navigators at each CHAMP school

CHAMP School	Short-term certificate earners						Total (N) earning short-term certificates	Earned >1 short-term certificates (n)	% Earned >1 short-term certificates
	Single short-term certificate	2 short-term certificates	3 short-term certificates	4 short-term certificates	5 short-term certificates	6 short-term certificates			
CCD	20	6	0	0	0	0	26	6	23.1
FRCC	18	14	2	0	0	0	34	16	47.1
LCC	2	8	4	0	0	0	14	12	85.7
PCC	29	1	0	0	0	0	30	1	3.3
PPCC	18	3	3	0	0	0	24	6	25.0
RRCC	41	13	2	4	1	2	63	22	34.9
Total	128	45	11	4	1	2	191	63	32.9

Table 16 indicates that 266 CHAMP students earned an associate degree, and 39 percent of these students (n=104) also earned one or more certificates. Nineteen of these students (16 whom were from Aims) earned an associate degree plus 6 or more short-term certificates.

Half of the associate degree earners at Aims, CCD, and LCC earned short-term certificates along with their associate degrees, and that proportion was exceeded at RRCC, where almost two thirds—62%—of associate degree earners stacked credentials.

Table 16: Credential stacking by CHAMP associate degree earners at each consortium school

CHAMP School	Earned 1 associate degree only	Short-term certificate earners							Earned 1 associate degree plus ≥1 short-term certificate	Total earned 1 associate degree	% of Associate degree earners who also earned at least one short-term certificate
		+ 1 short-term certificate	+ 2 short-term certificates	+ 3 short-term certificates	+ 4 short-term certificates	+ 5 short-term certificates	+ 6 short-term certificates	+ 7 short-term certificates			
AIMS	52	14	9	6	5	2	16	0	52	104	50.0
CCD	8	7	0	1	0	0	0	0	8	16	50.0
FRCC	3	1	1	0	0	0	0	0	2	5	40.0
LCC	5	1	3	1	0	0	0	0	5	10	50.0
PCC	67	7	3	3	0	0	2	1	16	83	19.3
PPCC	22	4	5	2	1	1	0	0	13	35	37.1
RRCC	5	0	3	0	3	2	0	0	8	13	61.5
Total	162	34	24	13	9	5	18	1	104	266	39.1

While there was a considerable difference in the number of CHAMP associate degree earners who went on to earn short-term certificates across the consortium colleges overall, we found that, in general, a higher percent of students with dual credentials had contact with a navigator, than had not. (See Tables 17 and 18.) Whereas 51 percent of students who had contact with a navigator managed to earn at least one additional credential, only 36 percent of those who had no navigator contact were able to do so. The higher rate of navigator-served students stacking credentials suggests the positive impact of CHAMP navigators on students' academic outcomes.

Table 17. Credential stacking by CHAMP associate degree earners not served by navigators at each consortium school

CHAMP School	Earned 1 associate degree only	Short-term certificate earners							Earned 1 associate degree plus ≥1 short-term certificate	Total earned 1 associate degree	% of Associate degree earners who also earned at least one short-term certificate
		+ 1 short-term certificate	+ 2 short-term certificates	+ 3 short-term certificates	+ 4 short-term certificates	+ 5 short-term certificates	+ 6 short-term certificates	+ 7 short-term certificates			
AIMS	51	13	8	5	3	2	16	0	47	98	47.9
CCD	4	3	0	1	0	0	0	0	4	8	50.0
LCC	1	0	0	0	0	0	0	0	0	1	0.0
PCC	59	3	3	3	0	0	2	1	12	71	16.9
PPCC	15	1	3	1	1	0	0	0	6	21	28.6
RRCC	3	0	2	0	1	2	0	0	5	8	62.5
Total	133	20	16	10	5	4	18	1	74	207	35.7

Table 18. Credential stacking by CHAMP associate degree earners served by navigators at each consortium school

CHAMP School	Earned 1 associate degree only	Short-term certificate earners					Earned 1 associate degree plus ≥1 short-term certificate	Total earned 1 associate degree	% of Associate degree earners who also earned at least one short-term certificate
		+ 1 short-term certificate	+ 2 short-term certificates	+ 3 short-term certificates	+ 4 short-term certificates	+ 5 short-term certificates			
AIMS	1	1	1	1	2	0	5	6	83.3
CCD	4	4	0	0	0	0	4	8	50.0
FRCC	3	1	1	0	0	0	2	5	40.0
LCC	4	1	3	1	0	0	5	9	55.5
PCC	8	4	0	0	0	0	4	12	33.3
PPCC	7	3	2	1	0	1	7	14	50.0
RRCC	2	0	1	0	2	0	3	5	60.0
Total	29	14	8	3	4	1	30	59	50.8

Retention Rates

Another of the CHAMP project outcomes that was to be facilitated by student–navigator interactions were student retention. Over the study period we compared the retention rates of CHAMP students who had contact with a navigator to those of CHAMP students who had not. The results are presented in Tables 19 and 20. CHAMP programs began to be rolled out in spring 2014; we therefore begin with the spring 2014 consortium cohort and track these 767 students through spring 2016, comparing students with and without contact with a navigator. The 228 navigator-served students enrolled in CHAMP programs as of spring 2014 had a retention rate of 77 percent entering the fall 2014 term; the retention rate of students who were not served by navigators was only 50 percent. While the rates of retention diminish over time—in part given the time needed to complete various short- and long-term certificates and associate degrees—navigator-served students continued to have higher retention rates than their counterparts.

We then looked at the spring 2015 cohort. We found the same pattern: better retention rates among navigator-served students. This time, however, the differences in the rates were not as large—perhaps because CHAMP programs may have been better established in the second year of the grant and therefore easier for students to navigate on their own.

Table 19. Retention rates for spring CHAMP cohorts by navigator interaction category (contact vs. no contact)

Spring 2014 CHAMP cohort (N=767)	**No navigator contact (n=539)**	**Navigator contact (n=228)**	**Spring 2015 CHAMP cohort (N=581)**	**No navigator contact (n=343)**	**Navigator contact (n=238)**
Spring 2014–Fall 2014	49.9%	76.8%	Spring 2015–Fall 2015	47.2%	53.8%
Spring 2014–Spring 2015	42.7%	69.3%	Spring 2015–Spring 2016	42.6%	50.0%
Spring 2014–Fall 2015	25.8%	57.0%			
Spring 2015–Spring 2016	18.6%	43.4%			

The same pattern was observed among the fall 2014 cohort: Those served by navigators experienced higher retention rates than those not served by navigators. (See Table 20.) However, the differences for this cohort were not as large as that observed among the spring 2014 cohort. Further, we did not observe any retention-rate advantage for students who had contact with a navigator in the fall 2015 cohort. Both those with and without navigator contact had retention rates just below 70 percent entering the spring 2016 term.

Table 20. Retention rates for fall CHAMP cohorts by navigator interaction category (contact vs. no contact)

Fall 2014 CHAMP cohort (N=531)	No navigator contact (n=299)	Navigator contact (n=232)	Fall 2015 CHAMP cohort (N=619)	No navigator contact (n=329)	Navigator contact (n=290)
Fall 2014–Spring 2015	69.9	75	Fall 2015–Spring 2016	69.0	68.3
Fall 2014– Fall 2015	44.8	49.1			
Fall 2014–Spring 2016	37.8	39.7			

In sum, the differences in retention rates between navigator-served and non-navigator-served CHAMP students were more pronounced in the early stages of the CHAMP program. It is not clear to what degree this reflects changes in the definition of navigator functions and their activities over time; a tendency for interventions to occur only early in the students' academic career; or some other factor.

EMPLOYMENT AND WAGE OUTCOMES

In our sample of 3,002 CHAMP students, 1,323 students were incumbent workers, and 1,679 were non-incumbent workers—students without any income in the quarter of their first CHAMP-course enrollment. In this section, we examine whether non-incumbent-worker students were working[93] after they earned a credential through the CHAMP program, and compare the rates of employment for those who had navigator contact with those who had not. We then examine if students who were incumbent workers experienced wage gains of more than $500 after completing their CHAMP credentials. Again, we compare those with and without navigator contact. Finally, we look at employment rates and wage gains according to the type of CHAMP credential earned. In this final analysis we compare the rate for three credential categories—students with an associate degree only, with associate degree(s) and certificate(s), and with certificate(s) only.

Employment

Among the non-incumbent workers, 539 students earned credentials between spring 2014 and spring 2016. We compare the rate of employment by credential types for students with

[93] In this analysis, we define employment as earning > $1,000 in the quarter during which a student earned his or her final credential or the quarter immediately after credentialing occurred.

navigator contact (N = 176) vs. students without navigator contact (N = 363). The results are presented in Table 21.

Overall, the rates of employment upon graduation were similar for both group of non-incumbent workers, 34 percent for those with contact and 37 percent without contact. However, variations in employment rates were observed when we examined the non-incumbent-worker population according to the type of credential received. Certificate earners[94] served by program navigators had a slightly higher employment rate than their counterparts not served by program navigators—38 percent versus 33 percent. However, of note, navigator-served students earning associate degrees had a significantly lower rate of employment than associate degree earners not served by program navigators (5 percent vs. 41 percent). We also looked at students who had earned an associate degree and one or more certificates – the pattern continued but the difference was smaller. Thus, navigator served students with associate degrees plus certificates had a rate of employment of 38 percent compared to those not served who had a rate of 50 percent.

Table 21. Post-graduation employment rates for non-incumbent-worker CHAMP students by navigator interaction category (not served vs. Served) and credential(s) earned

	Not served by navigator			Served by navigator		
Type of earned credentials	**Total (N)**	**Employed upon graduation (n)**	**Employed upon graduation**	**Total (N)**	**Employed upon graduation (n)**	**employed upon graduation**
Associate degree only	76	31	40.8%	20	1	5.0%
Associate degree + certificates	48	24	50.0%	16	6	37.5%
Certificate only	239	78	32.6%	140	53	37.9%
All credential earners	363	133	36.6%	176	60	34.1%

Wage Increases

Finally, we examine whether contacting a program navigator is associated with an increase in wage (over $500) for the incumbent workers in our study, and we examine that relationship by the type of credentials earned. Among the 349 CHAMP students identified as incumbent workers who earned credentials, 114 students had contact with navigators. Their wage increase results are presented in the Table 22. Comparing all credential-earning incumbent workers served by navigators with their counterparts who were not served by navigators, we do not find any difference in wage increase—roughly 40 percent of both groups experienced post-graduation wage increases greater than $500. As in the previous analysis, variations were observed when the population was broken down by the credential(s) earned. A higher proportion of students who only earned certificate(s) and were served by program navigators

[94] Since few students earned long-term certificates, we do not distinguish short- vs. long-term certificate in this session.

experienced post-graduation wage increases as compared to their counterparts not served by navigator (46 percent vs. 40 percent). However, the relationship was reversed in the case of incumbent workers who earned associate degrees—whether alone or in combination with one or more certificates. Here we found that only 27 percent of associate-degree-only students who interacted with navigators experienced a wage gain as compared to 43 percent who had not navigator contact. For the students who earned both an associate degree and one or more certificates, the rates for wage gain were 14 percent and 32 percent, respectively.

Table 22. Post-graduation wage increases of incumbent-worker CHAMP students by navigator interaction category (not served vs. served) and credential(s) earned

Type of earned credentials	Not served by navigator			Served by navigator		
	Total (N)	Experienced wage increase of >$500 upon graduation (n)	with wage increase of >$500 upon graduation	Total (N)	Experienced wage increase of >$500 upon graduation (n)	wage increase of >$500 upon graduation
Associate degree only	65	28	43.1	11	3	27.3
Associate degree + certificates	31	10	32.3	14	2	14.3
Certificate(s) only	139	55	39.6	89	41	46.1
Total credential earners	235	93	39.6	114	46	40.4

PART III: CONCLUSION

In this final section, EERC discusses the challenges identified by the navigators themselves, and by staff and faculty colleagues in respect to the role and functions of CHAMP navigators at their respective colleges. We then talk about the significant challenges colleges are facing sustaining either the navigator position and/or navigator functions. We end the report with the promising or best practices that have emerged over the course of the past four years. We hope these identified activities will provide insight and stimulus to the colleges as they work to improve student recruitment, and strive to increase rates of retention and completion of credentials in advanced manufacturing.

Challenges

Echoing the experiences of career coaches under earlier TAACCCT grants, CHAMP navigators have experienced a number of acute and chronic issues. These issue not only challenged the navigators' ability to carry out their defined functions during the grant, but also reduced the possibility that their functions would be integrated into their college's infrastructure post grant. Addressing these challenges, then, are key to ensuring that the promising practices and lessons learned under the grant will be sustained beyond the grant. We turn now to the often-overlapping challenges that affected navigators' program contributions, our assessment of their impact, and their potential to affect post-grant sustainability.

Definition of the Navigator Role

The generality of the CHAMP proposal's job description enabled each college to define the position to meet its own needs. However, the diversity of those needs, and the varying array of resources each college had available, diluted clarity about the focus and activities of the navigator. For some colleges, this meant traversing a difficult, if not steep, learning curve in defining its navigator's role and functions under the grant.

Some navigators continued very much in the career coach mode, while others focused more on industry partnerships. This division of focus made it difficult for EERC to assess navigator impact across the nine colleges, especially with respect to student–navigator interactions (see Part II).

The generalist nature of the role also created challenges for some navigators. Most navigators (like the career coaches before them) came to their positions with a wide array of skills including academic or vocational advising or workforce, teaching, or social work experience, but none came with all the skills required to fulfill their assignments. While learning new skills is an important part of professional growth, some navigators felt concerned that they were being given responsibility for activities beyond their current capacities: The development of the employability MOOC was a good example of this. Similarly, though student recruitment and outreach/marketing were not part of the incoming skill set of many navigators, they were nonetheless expected to hit the ground running in those competencies.

Several navigators felt they did not have sufficient background to advise students, especially in their CHAMP-industry fields. This belief was rooted in their lack of knowledge about industry skill sets, career trajectories, and industry terminology. The lack of industry knowledge initially limited the ability of some navigators to provide in-depth guidance to prospective and enrolled students. It also affected the navigators' interactions with industry employers with respect to jobs and internships.

> *I came in not really knowing the fields of engineering graphics and welding and [the] machining industry. I've had to really get up to speed with that . . . had to learn a lot about the industry there. There's a lot to learn; it's huge.*

At several CHAMP colleges, some of activities that had been defined under the CHAMP navigator role (e.g., employer outreach, internship coordination, student advisement) were already the responsibility of preexisting faculty or program staff. In some of these cases, the navigators had to identify supplementary activities and/or create their own primary focus. For example, PPCC's faculty advise students, and other staff interact with employers. The navigator therefore immersed herself in soft skills training and in helping students to process their paperwork for credentials.

In contrast to the navigators who struggled to define their roles, navigators at other colleges felt stretched in multiple directions, uncertain how to attend to all their assigned tasks. For example, in addition to their defined advising responsibilities, several navigators felt that faculty relied too heavily on them to monitor students' progress and well-being on a regular basis. One navigator expressed feeling burdened,

> *. . . to do 'check-in' calls with students. I feel that needs to come from the instructor. Almost like an employee/employer relationship; if you cannot show up to work, you would call your boss.*

Multi-Campus Colleges and Student Access

Navigators were more valuable to students who could easily reach out to them. Several navigators served multiple campuses, however, and in these situations, it was often not possible to set up offices at each campus. This reduced the navigators' visibility and created barriers to building strong connections not only to students but to other campus services. CCD's navigator, for example, related problems he experienced with the referral process to the CHAMP program's satellite location from CCD's main campus. Many supports services are on the main campus and thus it was a challenge for students to get to them. Similarly, students at EGTC and RRCC faced difficulties accessing other needed college services through their navigators. The CHAMP program at EGTC was located at the college's Trades' campus, about two miles from the main campus—and RRCC's CHAMP program was located at a satellite location, Warren Tech. Off-site locations away from the main campus also affected navigators' student outreach and recruitment efforts.

Finally, many of the colleges held evening classes. This meant navigators had to straddle daytime activities in the field with prospective students and employers alongside late-afternoon and evening meetings with enrolled students.

Space and Privacy

Many of Colorado's community college campuses have significant space constraints. As a result, another challenge was literally finding office space for the navigators. At times, navigator offices were located at a considerable distance from CHAMP classrooms and labs even if they were basically part of the same department, as was the case at PCC. This distance affected student–navigator interaction. Further, some navigators either had no regular office and thus were forced to meet with students in their classrooms or find other temporary space (CCD) or shared offices with other workers, which curtailed their ability to engage in conversations that were sensitive or private in nature (e.g., PCC, RRCC).

Students' Use of Navigators

In the discussion above it was noted that students are often reluctant to seek out advice or help until they are faced with a major roadblock to their studies. Even then some would rather disappear than acknowledge they need help and support. To respond to this "reluctance/

resistance," MSU mandated one or more student–navigator meetings to "normalize" these interactions. Navigators at many colleges regularly visited CHAMP classrooms to allow students to get to know them, perform a general check-in, and identify any students who may be struggling. Despite these efforts, navigators continued to observe that a good number of students have a hard time seeking out advice or help. (See Part II for our analysis of navigator contacts by college and the reasons those contacts were made.)

Staffing and Sustainability

Table I presented details about navigator staffing over the course of the CHAMP grant. As indicated, most colleges did not employ a navigator until the summer of 2014, almost one year into the grant. Three colleges experienced navigator turnover because the navigator left the college, took another non-grant-funded positon, or was promoted to the project lead (PCC).

In some cases, navigators worked part time for all or part of a semester. While staff changes are common in most fields, such changes during a time-limited grant impact the visibility of the program and the capacity to maintain consistency of activities. They also can affect efforts to sustain and integrate the navigator position into the college network or to justify the need for a dedicated navigator for advanced manufacturing.

This seems to be happening at PCC, which has had a very successful CHAMP program but has experienced changes in navigator staffing, in fact in the final grant year, PCC only had a part-time navigator. Given the existing advising resources at the college level—including dedicated academic excellence advisers—already available within PCC's division of business and technology, senior administrators in the department wonder if they will be able to justify the need for a navigator, and/or find resources to sustain such a position, beyond the grant period.

At FRCC, the navigator left during the spring 2016 term and was not replaced. While the project lead sees this as a real loss for the college's machining program, the college's administration expressed some reservations about the wisdom of having a dedicated adviser for a specific program like machining. Such an advising structure may isolate students, they argued, and could contribute to their lack of integration into the wider college. In this context, it is important to note that FRCC is currently transforming its academic advising services into more of a mentoring model. Under this new model, program maps will be used to help students become more aware of pathway options. The college is also planning for a college-wide student success course.

MSU's navigator was told when he was hired that his position was time limited. As of mid-fall 2016, this navigator was unsure whether any of his functions, especially student outreach and education, would be maintained post-grant, reassigned to other college staff.

LCC's navigator observed that after the grant there would probably be some "turning point" at which a decision would be made with respect to navigator functions. For example, if "all of a sudden, the welding program isn't doing as well," the career counselor/educational case manager functions might be continued through other college or new grant resources. However, if the welding program does well post-grant, there will be no incentive to fund a dedicated adviser for the program. While the college has not yet decided if, and how it will sustain navigator functions, it has decided to continue the employment of the individual come campus capacity.

As indicated above, PPCC's navigator focused much of her time on helping student's process paperwork for their earned credentials and providing soft skills training, and was minimally involved in internship development. However, over time she had observed that the college did not have any college-wide policy or procedure with regard to translating internships into academic credit. She therefore suggested that the college consider creating a new position focused on coordinating and centralizing all PPCC credit and noncredit internships and apprenticeships.

At colleges such as Aims, where the navigator role was bifurcated into a student advising position and an internship- or employer-outreach coordinator, even more questions arise in terms of charting a path forward after the grant sunsets. It is unclear which if any of these positions is most likely to be continued, which functions would be retained by whom, or even—given the diverse functions of each role—whether the positions could be recombined to serve the advanced manufacturing program or the student body college-wide.

Student Recruitment and Marketing

Marketing and recruitment was a significant challenge for many navigators for several reasons. First, some had no experience with recruitment and therefore learned as they engaged. Second, the grant did not include a budget line for marketing, thus the colleges had to identify other resources with which to develop their marketing materials. This was not always easy. For example, Aims' navigator struggled to get her department to fund the development of banners and marketing material. Third, some colleges emphasized degree programs over certificate programs—thus, several navigators (e.g., PCC) received limited support for their efforts from other advisers and found their programs had a lower profile during campus-wide recruitment activities. Fourth, colleges needed to be on an approved provider list in order for individuals receiving WIOA benefits to enroll. As colleges established their programs, they needed to apply for this status. That application process was delayed at some colleges (e.g., PPCC), affecting recruitment efforts. Similarly, veterans cannot receive their "living stipend" if they take only hybrid courses; this policy, which is a real contradiction between the federal push for program hybridization and financial support of veterans, also affected recruitment efforts.

The relatively low unemployment rate in the region—2.9 percent, the second-lowest in the nation in 2016[95]—posed a significant problem for some colleges in that there was less of an incentive for TAA-like individuals to return to school for additional training, especially if the program ran during the day. The navigator at RRCC observed,

> *. . . now with the economy being so good, it's hard to find new students. Because how do you lure them into a daytime program that's pretty full-time, either the morning or the evening? Then with the incumbent-worker piece is—we've heard that, "Well, my employer's not going to pay for it. I'm not going to do it." Or "I already work full time. I have a family, and you want me to—?" So the motivation might not be there. So [we're] really trying to work with industry, saying, "You wanted us to have these classes. Can you meet us halfway and help us recruit students?"*

Entry-level salaries were also not sufficiently attractive to recruit students into programs that would require both money and time.

Given all these factors, navigators struggled to locate and identify prospective students. Some navigators initially piggybacked on other student-recruitment activities but found that too often, few students showed up, or there was limited interest in advanced manufacturing among those who attended. Under prior grants, local WFCs often sent prospective students to the colleges for training or retraining—however, over the course of the grant were far fewer WFC referrals, as, according to one navigator, "potential students are getting placed in jobs." So the navigators were challenged: If not from the WFCs, through campus networking, or through employers, where does one find prospective students? What are the venues and networks "geared more toward a manufacturing industry or folks who would be interested in that"? Identifying this audience was not always easy.

Internships

Despite a CHAMP-project goal to develop and expand internship opportunities, navigators faced a number of challenges. Given students' other work and family demands, there was often not much student interest in internship positions. Navigators also found that most employers were more interested in employing graduates than hosting interns. Safety and liability issues were the most frequently cited reasons for this preference, but another issue was that the small manufacturing companies that are common in Colorado generally lack the resources to offer internships. Finally, while some colleges, such as CCD and MSU, had well established internship offices with which the navigator collaborated, some colleges lacked clear policies

[95] "Over the year, construction is up by 10,900 payroll jobs, leisure and hospitality by 24,200, and educational and health services by 11,000 jobs. Mining and logging, which includes oil and gas activities, is down by 6,800 payroll jobs from March 2015, according to seasonally adjusted data" (Wallace, 2016).

with respect to credit and noncredit internships, which limited the development of new internships.

College–Workforce Center Partnerships

The structure and intensity of college–WFC relationships varied across the CHAMP consortium. As indicated above, some colleges have enjoyed good partnerships, many of which were established by career navigators under earlier TAACCCT grants. An ongoing problem, however, has been that partnerships between the colleges and WFCs are often more personal relationships than positional ones. As a result, when staff turns over at a WFC or at the college, the connections weaken, if not end entirely, and the collaborative gains previously made just "[fall] off the radar."

Of note, during the CHAMP period, Denver-area WFCs were in transition, outsourcing their services in response to the Workforce Innovation and Opportunity Act (WIOA). This affected EGTC's work with them. It is unclear if this was also the cause of CCD's difficulty in establishing structured or continuous relationships with any of the three WFCs in their service area. CCD's navigator initially tried using e-mail and phone calls to the three centers but got no response, so in the end he just "dropped in" on them if he needed something.

In Colorado there is no formalized statewide data collection mechanism through which WFCs keep track of their referrals. Each WFC is independent, deciding if and how it wants to share data. An issue that arose during the earlier COETC and CHEO grants was securing follow-up information about any grant-touched students who career navigators referred to a WFC. Again, while CHAMP navigators, like career coaches, recorded who they referred, they were unable to find out what took place at the WFC unless the student returned and self-reported. This hampered the identification of any issues students faced getting the services the needed. It also limited the navigators' ability to track successful referrals and to track to what extent additional services and/or the receipt of financial aid enabled students to successfully complete their certificate or degree programs.

Documentation and Record-Keeping

Assessing the impact of the CHAMP navigators on student progress and completion was complicated by the navigators' wide range of focus and array of activities. Although we did set up mechanisms for navigators to track their work with students and document their other activities, completion of these monthly summaries was variable over the course of the grant. This further limited our ability to assess navigator impact (see Part II). Finally, we could not secure UI data for the noncredit students, many of whom were incumbent workers, because their social security numbers had not been recorded. It was therefore impossible for us to analyze these students' post-program employment outcomes.

Sustainability

Sustainability of the navigator position and/or navigator functions are in and of themselves challenges faced by the CHAMP colleges. However, given the importance of sustainability we have separated it out and given it a separate section here.

EERC researchers have observed that the position of career coaches established under earlier rounds of TAACCCT grants (COETC and CHEO), were mostly discontinued after the respective grant ended. This was even the case when the individual filling the position continued his or her employment at the college. It appears that most colleges in the CHAMP consortium also will not sustain their navigator positions when CHAMP sunsets on September 30, 2017. We therefore recommend that **s**ustainability should focus on the specific navigator functions which appear to have had the most positive effects on program and student outcomes. These include the association between contact with a navigator and students' higher rates of retention and stacking credentials.

To this end, some CHAMP colleges are reviewing the specific navigator functions and activities which have most benefited their own students and determining how best to sustain them through other staff and offices. For example, FRCC plans to maintain its college Outreach Coordinator, adding some navigator functions to her responsibilities. Similarly, RRCC's CHAMP staff have identified campus offices which and staff/faculty who will add navigator functions to their routines after CHAMP sunsets. In fact, during the final grant year RRCC had some of these individuals "shadow" the navigator to learn the "what" and "how" of the work she has done. We believe this is a good model for other consortium schools to consider adopting.

Promising/Best Practices

In this report, we discussed multiple ways the navigators, and their CHAMP colleagues, have worked to achieve project goals. In this section, we highlight the strategies and practices we believe are most promising in terms of their effects on program and student success. We suggest colleges consider the use and expansion of these strategies as they move forward post-grant.

Marketing and Recruitment Strategies

Navigators have successfully used **s**ocial media platforms—e.g., Craigslist, LinkedIn, and Facebook—as a recruitment strategy to showcase CHAMP program options.

Marketing materials that included success stories profiling students in ways that highlight how participation in a CHAMP "program of study benefited their career" have been effective in attracting new students. Targeted recruitment and education efforts geared specifically toward traditionally underrepresented populations—such as women and racial/ethnic minority groups in manufacturing—in forums, courses, media, and through direct community outreach, have helped some colleges attract students from these populations.

The development of a mentor and advisory network of women in manufacturing helped FRCC's CHAMP program increase the numbers of women enrolling in its certificate programs.

Thinking out of the box, Aims' navigator stimulated conversations among program staff about the crossover potential for CTE and the liberal arts and humanities. Formal and informal bridges can expand students' exploration of new fields that can enhance their work in their home subject. For example, anthropology students might compare more traditional modes of manufacturing with current advanced manufacturing and its effect on workplace culture. Or a welding student might learn in a history course about early craft guilds. Faculty from engineering, history, and business might share materials introducing business ethics, new ways to view technology, and innovative management techniques.

Creating a Pipeline into Manufacturing

A number of navigators noted the importance of stimulating interest among high school students in careers in advanced manufacturing as important to maintaining and expanding the workforce—and the field as a whole. While not part of the grant, some programs had contact with high school students, e.g., hosting career fairs, or utilizing shop facilities at high schools, and through the college's dual-enrollment programs. In fact, as a means to reflect changes in the industry and to attract the next generation of workers, PPCC's faculty began, referring to the college's electronics technology programs as "robotics."

Program-Focused Student Orientation

PCC expanded its pre-semester orientation from one that was focused on general guidance about the college and its procedures to one in which students met program faculty and discussed program expectations. The college found that this change enhanced student engagement in the program.

Normalization of Intensive Advising

Navigators found it extremely helpful to regularly visit and spend time in program classrooms and labs. Maintaining a regular and active presence in these neutral settings helped establish mutual rapport—students got to know the navigators and the navigators got to know students—and created opportunities for emerging issues to be identified and addressed more quickly. It also helped students feel "embraced by the college."

Mandated student–advisor/navigator meetings during the course of study helped "normalize" the use of an adviser to discuss progress, deal with problems and challenges, and plan for next steps. At a minimum, three meetings—one at the beginning of a program, one at the mid-point, and a third near the end—have been found to be helpful.

Transcript Review and Follow Up

Building on the work done under COETC, many navigators now review student transcripts to identify credentials students may have earned but have not been awarded. Navigators then help students with the applications and procedures necessary to be granted a credential. Transcript review and follow up has increased the number of credentials awarded, which carries dual benefits. It helps students with their job searches and helps colleges build their retention and completion rates.

Local Employers as Resources

By hot-linking potential employers' websites on her CHAMP program's website, Aims' navigator enabled students to quickly access information about different subfields within their industry. This helped student to identify companies with job openings, and helped them prepare for job interviews.

LCC's decision to invite HR staff to conduct mock interviews on campus was found to be a highly effective strategy. Students were able to practice their interview skills with a potential employer, and receive immediate and helpful feedback prior to going out on an actual job interview.

PR as an Incentive in Employer Relations

Public recognition of the businesses and community organizations that work with the consortium colleges—e.g., online and print news articles, mention on websites, awards, etc.—does not occur often. However, such recognition can be an important strategy to enhance and maintain the involvement of these partners and may bring new partners to the table.

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CHAPTER 3: PRIOR LEARNING ASSESSMENT

Renee Edwards and Li Kuang

INTRODUCTION

The focus of this brief is the redesign of the policy, practice, and implementation of prior learning assessment at the six CHAMP colleges within the CCCS system, one four-year non-system CHAMP college (Metro State University), and other non-CHAMP schools, such as Arapahoe Community College. Early outcomes are also presented. These colleges were chosen for discussion in this brief because each had a representative present on the CHAMP prior learning assessment subcommittee. Colorado colleges have used prior learning assessment as an alternative means for awarding academic credits for over 40 years, but historically its use lacked uniformity within the system. Institutions varied in the extent to which students had knowledge about prior learning assessment, in students' access to assessment, cost of assessment, and in how prior learning assessment was administered. During the first two years of the CHAMP grant, CCCS and participating colleges developed policy and practice recommendations for prior learning assessment use through the prior learning assessment subcommittee. During year three of the grant, these changes were beginning to be implemented at colleges. This brief looks at the development, implementation, and dissemination of these redesigns by the consortium-level prior learning assessment subcommittee, and discusses early implementation efforts and outcomes at nine state colleges.

BACKGROUND

A primary goal of CHAMP was to redesign the credit for prior learning policies and use within the system and state. Credit for prior learning protocols recognize and grant academic credit for the skills and knowledge that individuals have gained outside the classroom. Credits for prior learning are especially helpful for returning students who left school without graduating but have gained significant experience in the workplace since then. Additionally, credit for prior learning can be awarded for certain types of specialty training, such as military schooling. Receiving credits for prior learning can shorten the time that it takes to complete a certificate or degree program. A diversity of students come to Colorado community colleges at various stages of their lives and careers. Prior learning assessment is a way for students to validate the significant learning they bring with them, accelerating the process of reaching their academic and professional goals.

Legislation/Policy

In 2001, a higher education student bill of rights was passed in the Colorado legislature. The law stipulated, among other things, the establishment of a process for students to test out of core classes by successfully sitting for a challenge exam. In 2012, this directive was amended to provide for credit to be awarded for prior learning. These higher education policies reflect the state's recognition of students' real-life experience. Since 2009, CCCS has awarded over 120,000 credits through assessment methods such as challenge exams and portfolios. Through the CHAMP grant, CCCS is working to revise and improve upon this policy and the use and acceptance of prior learning assessment in the state.

SUBCOMMITTEE

To review and revise the prior learning assessment policy, grant administrators established the prior learning assessment subcommittee, composed of representatives from the consortium colleges, affiliates from CAEL, and industry representatives. The subcommittee was created early in 2014 and first met in February 2014. It was tasked with reviewing existing Colorado prior learning assessment policies and developing potential revisions to suggest to policymakers. The subcommittee ensured that all suggested policy revisions were aligned with the Colorado Students' Bill of Rights[96] and reviewed existing policies to ensure that they were aligned with it as well. Their work was informed by research; in cooperation with CAEL, the SC spent a great deal of time examining the prior learning assessment policies and practices of other states and institutions. In one of its first actions, the subcommittee created a vision statement about a proposed approach to prior learning assessment. The statement was meant to help define a purpose for the subcommittee going forward and to serve as a guidepost for the members' actions and policy revisions.[97]

Because of discussion at the subcommittee meetings and online collaboration, the subcommittee recommended several changes to the Colorado policies (System President's Procedure 9-42 and State Board Procedure 9-42). The recommendations were aimed at revising the Board policies in alignment with the vision statement of the subcommittee. Overall, the recommendations sought to improve the experience that students have with prior learning assessment and the process of assessment review. They included changes to the wording of the policy to ensure that the language focused on the students' learning and "learning experiences" and that learning is related to the student's program of study. The changes further reiterated the statements of principle in the Students' Bill of Rights and made clearer the guidelines that institutions could potentially use to determine a student's prior learning. The subcommittee also drafted an outline for a revision of the Prior Learning Assessment Handbook—renamed the Prior Learning Assessment Manual—for faculty and staff at the participating schools. The revised manual contained information on what prior learning assessment is, standards for implementation, and

[96] House bill number (HB01-1263)

[97] Subcommittee vision statement: "A diversity of students can come to Colorado community colleges at various stages of their lives and careers and are able to validate the significant learning they bring with them, accelerating the process of reaching their academic and professional goals. College level prior learning is validated by academically sound and rigorous prior learning assessment methods."

an explanation of how students can benefit from credit for prior learning. The manual was completed and finalized in fall of 2014 and updated in spring of 2017.

Subcommittee Goal/Purpose

The subcommittee's primary goals were to review existing policies at each college relative to prior learning assessment and to develop a prior learning assessment manual. Before the efforts by the state to create more uniform prior learning assessment procedures, colleges had been using American Council on Education (ACE) credit review to provide their students with credits for prior learning. However, the review was costly, and some schools did not use it. Other schools' faculty wanted to do reviews themselves, rather than accept competencies they did not review. Implementation differed between the system and non-system schools and with respect to College-Level Examination Program (CLEP) credit, as well as between some two-year and four-year institutions. Moreover, the subcommittee found that many colleges were not making the availability of prior learning assessment options clear to their students. During the first year of the CHAMP grant, the subcommittee assessed the existing policies, looked at how those options could be made more available to students and tried to identify the barriers in the institutions that kept those policies from working.

In the second year of the grant, the subcommittee began to formally meet to develop the prior learning assessment manual. Also, guidelines were developed for a portfolio process in which participating institutions would conduct a complete assessment of a student's knowledge of specific courses or student needs. During the second year, the subcommittee also discussed discrepancies between what two-year and four-year colleges accepted for CLEP tests and scores and used this to encourage schools to expand their prior learning assessment offerings and to standardize what institutions accepted relative to CLEP and other tests

Subcommittee Formation

In forming the subcommittee, CCCS leadership chose representatives from colleges across the state, including both CHAMP and non-CHAMP schools, system and non-system schools, industry, community colleges and one four-year college. Each school's representative was the person who historically worked with prior learning assessment at that respective school. This was someone from the school's testing center, a registrar, or someone holding a specialized role specifically for prior learning assessment, such as a "PLA Specialist." Each representative had something to offer the subcommittee regarding his or her respective knowledge about prior learning assessment. For example, Arapahoe Community College's testing center coordinator was included in the subcommittee because of her background and involvement with students testing out of classes and converting knowledge to credits through CLEP and DSST (formerly Dantes Subject Standardized Tests) tests. Her knowledge of typical costs associated with testing, the testing process, and how ACT/SAT placement scores are evaluated and translated to cut scores was beneficial to the subcommittee. MSU's PLA specialist was part of the subcommittee to offer the perspective of a four-year university. She described her involvement in the subcommittee:

> We looked at the handbook that the community colleges had been using and all their policies and broke everything down, and it was really a lot to go over, like word, by word, by word. My role was just to, I guess, talk as the transfer school, the view from the faculty from our school, just to kinda say, "Well that's cool. That might work for you, but I don't think that's going to work for us because of the culture of a four-year school. So you might want to think about this instead of just this."

Pike's Peak Community Colleges' subcommittee representative was chosen because of his involvement with the schools' military population relative to prior learning assessment. The colleges' huge military and veteran population gives him a unique perspective on how this specific population's needs relative to prior learning assessment can be served.

All subcommittee representatives brought with them a unique and specific experience that helped increase the understanding of the subcommittee as a whole regarding various aspects of prior learning assessment. The goal of the subcommittee was to create one manual appropriate for all schools across the state—including two- and four-year schools. Throughout the process, subcommittee members agreed that they ended up with a much better understanding of prior learning assessment than they had previously. One member summed this up when she stated: "I think we broadened our PLA understanding by leaps and bounds."

Process/Collaboration

The subcommittee met in person about once a month. Subcommittee representatives broke into individual workgroups, with each group working on a specific element of prior learning assessment, such as creating uniform matrices and developing shared cut scores. During each meeting, workgroups presented on their progress to the subcommittee. A major theme throughout the process was collaboration. One member stated that:

> Everybody that was there and engaged in this respected each other. So very thoughtful conversations, good strategies put in place. People wanted to come to agreement. So it wasn't a matter – we didn't have division, in my opinion, there, of, "Oh, no, you can't do it that way." …There was no contention in the group.

Another said: "The committee itself… worked very well together. …Everybody respected each other's opinions. …There was good communication, and I don't want to say urgency, but focus on hitting our target of having this put together in a timely manner." Another representative commented that the mutual respect of the subcommittee group really helped everyone bring their own skills to the table: "It was easy to work together. I mean, because of that respect, we knew that, "Hey, you're great with this data," and they would bring it to the table."

Aside from the monthly meetings, the subcommittee also collaborated and communicated via a Basecamp site. The website allowed subcommittee members to post questions and view others' comments. One subcommittee member stated:

> Basecamp was hugely successful for posting questions. A lot of work got done there. And I think everybody loved that piece of it. …It was the way to easily get things fixed. So you could look at people's comments immediately. And the people that had questions about it, they could address it immediately and it didn't slow anybody else down. If you didn't have questions, you just, "Oh, great, that's good to know, move onto the next thing." So I think, to me, that was a tremendous asset for the group. It helped tremendously in cutting down the number of meetings [we had] to have. So much of the discussion could happen right there.

Challenges

The subcommittee's goal of coming up with prior learning assessment protocols that work for schools across Colorado was certainly challenging. There was a considerable amount of communication among the workgroups to discuss variation across the schools and how to address it. For example, one subcommittee representative discussed how CLEP exams were accepted by some schools and not others. Some schools had challenge exams that other schools did not honor. And likewise, some schools accepted cut scores that others did not. These issues became challenges for students if they decided to transfer to another school after receiving credit for prior learning. Workgroups tackled these issues, developing compromises and coming to a consensus about each.

Several subcommittee members stated that the most challenging issue for the group was the inability of the members to make real change. The purpose of the group was to suggest change, rather than make it. In many cases, subcommittee members mentioned to EERC team members that they were frustrated they were not able to make changes at the subcommittee level. All suggested changes were turned over to the Department of Higher Education and were also "ran by" four-year schools for comment after the subcommittee work was completed. Because some members felt the prior learning assessment process historically has been complicated by some four-year schools in the state, this concerned many members.

COLLEGES

After meeting as part of the subcommittee, representatives and CCCS leadership were tasked with introducing the variations in policy to the respective colleges. Once the manual was finished and approved, it was handed down to the colleges for use in aligning college practices with the manual's suggestions. This was no small task, as much training was needed for college staff, faculty, and advisors, and many colleges had to shift their past practices to align them with the new suggested practices.

Variance in Prior Learning Assessment Before Redesign

For the past 40 years, Colorado schools have been offering credit for prior learning without central agreed-upon processes. This has meant that schools have developed their own protocol, processes, and procedures for how prior learning assessment is done. Because of this, there was significant variation between colleges in how prior learning assessment was approached prior to the state efforts to redesign and standardize the process. For example, some schools predominantly offered CLEP or DSST tests. Some allowed students to submit portfolios, while others did not. Some schools would offer credit for cut scores of 4 on a test, while others would offer credit for cut scores above 5. Schools also varied in what they would charge students for prior learning assessment. Arapahoe, for example, changed $35.00 per credit for a student to test for an Arabic class, where Community College of Denver charged $62.00 per credit. Red Rocks Community College charged $13.00 per credit for students to challenge courses. Schools also varied considerably in the numbers of students who received credit for prior learning, as well as the populations they served through prior learning assessment. For example, Pike's Peak, located near a military base, has historically served as many as three or four times as many students receiving credit for prior learning as other schools; most of them from military backgrounds. The subcommittee helped bring these differences to light. One representative commented on this, saying "The one thing that we did find when we were working with this committee is that we are doing so many things differently across the system." Another said, "I think that we started to see that there were different processes being used by different colleges and that there was a need for us to come together."

As the subcommittee worked to identify variances and offer new standardized practices, most schools adopted a model where the subcommittee member became that schools' prior learning assessment "expert." Students with questions about prior learning assessment would be funneled to the resident subcommittee member or equivalent expert on campus. This became the primary model as schools started to assess how prior learning assessment would be implemented on their respective campus as standardization began.

The process of creating the manual and suggesting standardized practices for prior learning assessment moved slowly, but by the end of year two, the subcommittee had submitted suggested changes. By fall of 2014, the Prior Learning Assessment Manual and changes suggested by the subcommittee had been approved.

Implementation and Changes

Although implementation at individual colleges was still in its early stages when this brief was written (summer of 2017), most CHAMP consortium colleges had established a plan for moving forward and had begun to make changes. One of the biggest first steps was to introduce the concept to faculty, advisors, and other staff who may have been previously unaware of prior learning assessment. CAEL helped with this process by offering trainings and webinars, and subcommittee members also brought back important information from their workgroups. Most schools focused on educating faculty and advisors and giving general information sessions to staff. One subcommittee member stated that the change in awareness relative to prior learning assessment at her school was noticeable: "The awareness has changed for sure among everyone, among advisors, faculty, department chairs. …I think it's becoming more incorporated just in the language of the campus and faculty meetings. People are starting to understand what it is."

Several subcommittee members told EERC staff that having school leadership on board with changes was the most important factor in faculty and staff embracing the efforts. Many felt that some faculty were unwilling to make changes unless direction came from leadership. Interviewees told EERC staff that major contributors to progress within individual schools were institutional buy-in and third-party credibility. The more college leadership were on board with the changes, the faster the changes took place at the individual school. In addition, some schools brought in CAEL representatives, system leadership, or representatives from the American Council of Education to meet with faculty and staff and give trainings on prior learning assessment. These schools, such as MSU, found that external credibility lent an expertise that couldn't come from within the college and increased the acceptance of change, especially among faculty.

The first change most schools were making was to develop a plan for informing students of the option to receive credits for prior learning. Most schools did not advertise prior learning assessment as an option for students prior to the state's efforts to standardize it. Statewide, most schools reported developing marketing plans including informing general advisors of available prior learning assessment options, creating brochures and posters, and adding information to school websites. Most school staff members felt that informing students of their options to receive credit for prior learning would help boost enrollment. One staff member said:

> It allows us to say, here, you can see yourself as a college student because of this. …We have one more tool to help our non-traditional students see themselves doing college. And that's the most impactful thing to me. I want to have an arsenal of ways to show people [how] to get their education.

Another subcommittee member spoke of marketing as the first step in rolling out the PLA changes at her college: "It's in process. We talked about presenting it at student orientation. It will be on the website. There'll be a poster campaign, a brochure campaign, just to increase awareness of it."

Red Rocks Community College found that an increase in marketing had already made a difference in the number of students attempting prior learning assessment: "PLA has always been around, and we've always done several thousand dollars a year doing PLAs. But there has been an increase, and I think it's more the marketing and the specific targeting that we're trying to do…"

One of the biggest changes across colleges in the state has been adherence to the state-wide statute that institutions must allow students to challenge any Guaranteed Transfer (GT) course, a challenge testing rule. All colleges across the state are required to allow students to offer a challenge option to students—where students can take a learning assessment in lieu of taking classes for GT credit. While there are several options for how a student could challenge a course, schools are most comfortable with challenge testing. If a student passes the challenge test, they are granted credit for that course without completing the course material. Challenge testing, however, requires each school to have a test in place for its general education classes. While many schools had challenge tests, most did not have them for every general education class, and some schools had very few at all. Initially, a change suggested by the subcommittee was to create a test bank of challenge tests that schools across the system would use. This would not only create more available tests for students without faculty having to create challenge tests for every subject, but would also standardize challenge tests across the state. A student challenging English 101 at Pike's Peak would then be taking the same test as one challenging the same class at Pueblo.

However, faculty pushback halted creation of the test bank. Faculty pushback largely centered on concern over tests not being rigorous enough. Faculty creating a challenge test for the test bank were theoretically vulnerable to negative input by other faculty members once the test was part of the bank. Peers at other colleges could "judge" whether they considered the test valid. There was also disagreement about where the test bank would be located. Disagreement over the test bank is likely partly attributed to the fact that even though the colleges are all part of the same state (and most are part of the system), they are also individual, independent colleges, and a tension exists between cooperation and competition.

Instead of a central testing bank, schools decided to create their own challenge tests. In many cases, schools choose to informally share challenge tests between them and an informal network has emerged. However, since the choice is theirs and the process is informal, faculty are more comfortable with this.

Similarly, a suggestion at the consortium level to create and publish crosswalks for faculty-evaluated workplace training such as ACE recommendations and joint services transcript information was met with faculty pushback. Faculty were willing to compile the information but did not want it published. Instead, samples of past credit crosswalks are being compiled voluntarily and will be posted on the PLA website by the end of the grant period.

Legislation passed this year (2017) is heralding another change consortium-wide. Each institution in the state is now required to develop its own policy in which ACE credit will be cross-walked for students in the military. This will prevent institutions from granting military credits as elective credits only. It will require institutions to grant credits for knowledge gained while in the military as counting toward a specific course required for a degree, such as a general education course, rather than elective credits. Institutions are required by the legislation to review ACE credit carefully. Once this step is complete, it should open the door for more far-reaching and careful review of prior learning-to-credit crosswalks rather than the simple assigning of credit as counting toward electives.

Another change some schools had begun to implement was a more widespread and standardized acceptance of portfolios. Many schools never accepted portfolios prior to the efforts of the subcommittee to standardize the process. Staff at one system school—PCC—told

EERC they were moving more toward encouraging students to create robust portfolios now than to take standardized tests.

Collaboration

Early implementation at individual colleges required a significant amount of collaboration within each school. In most cases, the subcommittee representative brought back information and helped educate administrators, faculty, and staff at the college, but lacked decision-making capacity. Subcommittee members thus acted as conduits of information at their respective schools and suggested internal changes, but did not actually make changes. In most cases, they collaborated extensively with others to figure out the best plan for implementation at their individual school. For example, one subcommittee member described her meeting with leadership and staff at the school to decide how "to set this up so that the information is communicated effectively out to our three campuses." Others stressed their work with faculty Chairs as being incredibly important relative to implementation. This was mostly because of buy-in. She noted that "even if I can get one-third of our Chairs to buy-in, then they can help me with the other two-thirds." Most subcommittee representatives said the implementation process at the individual colleges started "very slow and frustrating," but eventually, through collaboration, faculty and staff began to "open up more" to the changes.

As schools began to implement changes and offer more/various forms of prior learning assessment (depending on the school), collaboration also occurred between colleges. For example, at CCD, one student needed two credits to finish her Associate of General Studies degree, and she wanted to use Arabic for those two credits—a language she already knew and spoke. CCD had the course in its catalog but had not offered it for five years or more. To allow the student to challenge the class, staff at CCD had to find a school that was currently offering the course. Arapahoe Community College was currently offering the class, so staff at both colleges worked together to create a challenge exam for the student. CCD's subcommittee member described the intense collaboration required to make the situation work for the student:

> So we had to bring in HR. We had to bring in the Dean over Arts and Humanities. We had to bring in the Chair. We all had to come together so that we could get this challenge exam created so that this student could have these two credits satisfied with her PLA experience.

The adherence to prior learning assessment policies and procedures has translated to a significant amount of up-front work for each of the Colorado schools. This is especially true relative to creating challenge tests and allowing students more latitude to apply prior learning in areas individual schools may not have previously allowed. One staff member described this process:

> So sometimes we have to bend over backwards, be very creative in what we have to do, but it is here to say, and we have to make this work for the students. It's not a simple question as "Do I have to do this?" It's more or less "How do I do this to make it work for the student? Where does it begin?" They're very serious about this across the system.

Through collaboration, schools could share the workload and develop ways to work together for the benefit of students.

Faculty Reception

Faculty reception of the changes in prior learning assessment varied across the system. It also varied considerably within colleges, as faculty in some departments seemed more willing to accept prior learning assessment than others. Some faculty was reticent to encourage prior learning assessment because they felt it would detract from full-time enrollment, numbers of students enrolling, and tuition dollars for the school. Others also felt that academic rigor would suffer, and the school would simply become a "diploma factory," handing out diplomas for students that were not doing their learning at the school.

Other faculty members were 'on board' with offering prior learning credits through CLEP and DSST tests—standardized tests—but were hesitant to accept portfolios as a method of prior learning assessment. Faculty who were not evaluating portfolios were often reticent to accept the credit, since they were unsure of the process and rigor, while faculty who were asked to review portfolios felt the time required was often too much for their workload. Some faculty also felt that learning "on the job" was different than learning in the classroom, and that prior learning should not be translated to credits unless it is rigorously tested and proven equivalent.

Another challenge some schools had in terms of faculty acceptance of prior learning assessment had to do with multiple people being involved in the teaching process. At some schools, concurrent or dual-enrollment was common, and in effect, high school teachers were teaching college-level classes. When students apply for prior learning assessment, they are tested on their "mastery of the material" whether through standardized tests, challenge tests, or portfolios. Some faculty feel dual-enrollment students cannot have a full mastery of the material if they have been taught by high school teachers. Likewise, some faculty members at four-year universities feel the same if students are taught by community college instructors. The best way to counter this reticence, most interviewees thought, was to "bring [the concept] in slowly with the right people to make sure that it's done well." And to make sure that "as this rolls out, faculty are comfortable with what's happening and how it's gonna happen on their campus," as well as "what the rules of engagement are."

Most schools started with faculty that were excited about the concept of prior learning assessment and let these faculty members talk to others who were perhaps less accepting. One subcommittee member said it was easier to "let [the excitement] ripple out" and occur more naturally than it was to "push too hard with faculty." Another said:

> We're trying to create – we have a model here with our faculty of what I call the vanguard model. We get faculty to volunteer as a vanguard, and then they disseminate that positive experience. And you can get most faculty on board in that way.

Most leadership and staff at individual colleges felt that faculty reaction to prior learning assessment was 'all over the board' at their respective schools. One representative described this at her school:

> There are some faculty members who are completely on board. They are excited about it and just ready to do whatever needs to happen, which is great. There are some faculty members who don't care. We'll just call it that. It doesn't affect them, and they're not interested in even thinking about it. There are some [faculty] Chairs who—it makes them nervous. They are worried that yes, it might be good for the students. It might be good for the college as a whole. But it lowers their program numbers.

Even though implementation was still in its early phases at most schools at the time this brief was written, there were already some shifting opinions among faculty members. Many faculty members were beginning to see the benefit of prior learning assessment and some of those who were previously skeptical were beginning to embrace the concept. When asked what they thought perpetuated these shifts, most subcommittee representatives and other school staff members felt the education about prior learning assessment at each of the colleges had played a large role in perpetuating the change. One staff member said:

> I think the exposure has changed their opinion. So, so much talking about it, so much of having steps. So that does definitely help. Having information about how it actually is different and how it will – really does improve graduation rates. I think that information has changed that opinion more than anything else. Because at the end of the day, they just want to do the right thing for students, too. But we need to have good solid data to back that up that this is the right thing for students. Now that we have that most faculty are – they're getting there, if they're not already there.

Some schools also chose to contract with external contractors to take the burden off faculty, especially relative to portfolio assessments. A staff member at CCD spoke to this:

> We contracted with Learning Counts to do portfolios assessment at least for this year. I think that will continue for the next few years. It just takes a while to get up to speed, and we didn't want to delay student's access because we're still getting up to speed on how portfolio assessment should work.

Student Impact

When asked what benefit there was to changing the prior learning assessment process, most staff interviewed agreed that it was a benefit to the students. One said:

> Mostly it's good for our students. Actually, that is the only reason. It's good for our students because it gives them credit which gives them – it improves their retention. It improves their graduation, and that's good for our students which means it's good for us.

Another said:

> I see a good thing happening as a result of PLA and more people signing on for it when they know that it's less expensive than actually paying the tuition. They can get it done and finish up their education a lot quicker for a lot less money.

Although implementation was still early, some schools were already seeing a gradual increase in students aware of and applying for, prior learning assessment. One staff member commented that she had hoped to see more students applying for prior learning assessment and that she was hoping students would spread the information through word-of-mouth: "We didn't think that the floodgates would open. My experience with these things is that there was a trickle and it's not until students are talking to students that we'll really see it take off."

On the other hand, most schools were not yet prepared to have a huge influx of students interested in credit for prior learning. At most schools, general advisors were still being trained on how to approach prior learning assessment and did not fully understand how to advise on it. In addition, discussing options with students and fully understanding their prior learning experience(s) required a significant amount of time and discussion; something general advisors do not always have time to do, especially during high-priority registration periods. Most schools had one or two people in charge of prior learning assessment at their respective school, and students with questions about prior learning credits or with extensive work histories were funneled to these "resident experts" for help. While this was working for small numbers of students inquiring about prior learning credits, it was widely acknowledged that this system would not work for larger quantities of interested students. At most schools, training for advisors and registration staff was underway at the time this brief was written. In addition, an online tool called PLACredit.com tool will help schools become more efficient with the process once training for the tool is complete. CCCS is planning to roll out training shortly. One school, RRCC, was effectively using the tool at the time this brief was written.

While adult learners of all backgrounds can theoretically benefit from prior learning assessment, the population most impacted is likely to be students with a military background. As previously mentioned, Pike's Peak—located near a military base—has historically had a high population of military students, and has a rich history of granting prior learning credits to students with military training. After the subcommittee met and the manual was created, more schools began to offer—and advertise—credit for prior learning for students with military backgrounds. Military training can often translate directly to college-level coursework, and thus military students can be great candidates for prior learning assessment. Because military transcripts are different than college transcripts, however, the translation process can be tedious and require specialized knowledge on behalf of the college representative. Education and training about the process had already increased the ability of Colorado colleges to assess students with military backgrounds.

EARLY STUDENT OUTCOMES

To assess early outcomes of the changes to prior learning assessment and implementation efforts by institutions, EERC analyzed student data for CCCS schools in the state of Colorado. While the above narrative has focused on CHAMP schools, prior learning assessment outcomes data analysis was completed for all 13 schools in the system. Using data provided by CCCS on its students' registration history and academic profiles, we focus on students enrolled in CCCS colleges between spring 2014 and spring 2017. Outcomes data is based on a study sample of 251,417 unique students in CCCS schools during this timeframe. Among them, a little over three percent (N= 7,809) had earned prior learning credit in one of the CCCS institutions. We refer to students receiving prior learning assessment credit as PLA students and students who did not earn PLA credit as non-PLA students.

This report uses student data from the following thirteen CCCS colleges, which vary in school size, student population served, and the number of programs offered. The colleges are:

- Arapahoe Community College (ACC)
- Colorado Northwestern Community College (CNCC)
- Community College of Aurora (CCA)
- Community College of Denver (CCD)
- Front Range Community College (FRCC)
- Lamar Community College (LCC)
- Morgan Community College (MCC)
- Northeastern Junior College (NJC)
- Otero Junior College (OJC)
- Pikes Peak Community College (PPCC)
- Pueblo Community College (PCC)
- Red Rocks Community College (RRCC)
- Trinidad State Junior College (TSJC)

Outcomes are divided into three sections: 1) prior learning assessment methods offered by each school, 2) student enrollment information for students who received an assessment for prior learning, and 3) a focused look at students who graduated with prior learning assessment credit versus those without.

Prior Learning Assessment Methods

Credit for prior learning experiences were assessed and awarded through four major methods; each of which could be fulfilled by several assessment instruments.

Methods and Assessment Instruments:

- ***Portfolios***

- Credit is awarded through the development of a portfolio
- Evaluation is performed by a subject-matter expert or panel of experts

➢ ***Published Guides***

- The American Council on Education (ACE) non-collegiate guide for industrial and corporate training programs
- ACE credit recommendations as published in *The Guide to the Evaluation of Educational Experiences in the Armed Services*, used to evaluate military training and learning experiences
- Other published guides developed by nationally recognized organizations

➢ ***Challenge Exams*** developed by institutions

- Equivalent to a comprehensive final exam,
- May be written, oral, demonstration-based, or a combination of all three
- Evaluated by an area dean or a designated subject-matter expert

➢ ***Standardized Exams***

- College-level Examination Program (CLEP)
- Excelsior College exams—formerly the American College Testing Proficiency Program (ACT-PEP/RCE/EXCELSIOR),
- Defense Activity for Nontraditional Educational Support (DANTES)
- Advanced Placement (AP)
- International Baccalaureate (IB)

Assessment methods offered in each CCCS college differed as some schools used only one while others used a combination of assessments. Table 1 presents the methods used by each of the 13 CCCS institutions. Eight out of the thirteen colleges used all four methods (ACC, CCA, CCD, FRCC, PCC, PPCC, RRCC, and TSJC). Standardized exams were well-accepted among CCCS colleges: all 13 schools used some form of standardized exam for prior learning assessment. One school, NJC, used standardized exams as its only method of assessing prior learning credit. OJC used a combination of standardized exams and challenge exams—these methods were also used by most of the colleges. NJC was the only institution that did not use challenge exams as a means for awarding prior learning credit to students in the study sample. Small colleges such as CNCC, NJC and OJC did not use published guides to award prior learning credit. Portfolios were the least commonly offered method among all CCCS schools. Still, nine out of the thirteen colleges in the consortium assessed prior learning using this method.

Table 1. PLA methods offered in CCCS, by school

CCCS College	Challenge exams	Portfolios	Published guides	Standardized exams	Number of PLA methods offered
ACC	X	X	X	X	4
CCA	X	X	X	X	4
CCD	X	X	X	X	4
CNCC	X	X		X	3
FRCC	X	X	X	X	4
LCC	X		X	X	3
MCC	X		X	X	3
NJC				X	1
OJC	X			X	2
PCC	X	X	X	X	4
PPCC	X	X	X	X	4
RRCC	X	X	X	X	4
TSJC	X	X	X	X	4

PLA assessments by method

Between spring 2014 and spring 2017, CCCS had carried out 22,800 prior learning assessments, of which almost half were conducted via published guides (47.9 percent).[98] 38 percent of the prior learning credit evaluations were done by standardized tests, and 12 percent by portfolios. Although almost all consortium schools offered challenge exams, only two percent of all PLA credits earned in the past three years were conducted via this route.

Table 2. PLA assessments, by method

PLA method	Number of assessment	Proportion of assessment via PLA method
Challenge exams	461	2.0%
Portfolios	2812	12.3%
Published guides	10931	47.9%
Standardized tests	8596	37.7%

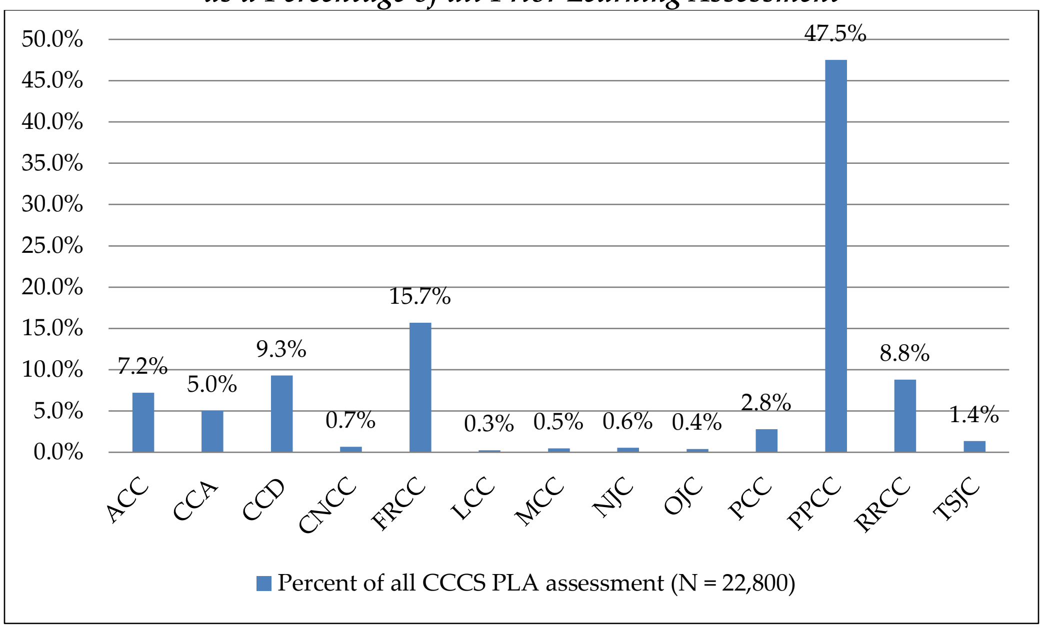
[98] PPCC represents a majority of this data; the school has a large population of military students that it assesses for prior learning through published guides.

Total	22800	100.0%

PRIOR LEARNING ASSESSMENT BY INSTITUTION

The number of PLA assessments completed varied among CCCS schools. Some institutions carried out more assessments than others. PPCC conducted almost half of all the prior learning assessments in the system (47 percent, see Figure 1). This is due to a large population of military students at the school. PPCC was followed by FRCC, which conducted around 16 percent. Between 5 to 10 percent of all prior learning assessments were carried out in ACC, CCA, CCD, and RRCC. Other small schools, such as CNCC, LCC, MCC, NJC, OJC, and TSJC, had few assessments, likely due to the small size of enrolled student populations and low demand compared with larger schools such as PPCC and FRCC.

Figure 1. Prior Learning Assessments by CCCS Institution as a Percentage of all Prior Learning Assessment



Although most CCCS colleges offered multiple methods of PLA, schools varied in how often they used each PLA method. PLA tools were not equally likely to be used across the schools at which they were offered. On the contrary, each school had a preferred choice of PLA tool—one that was used substantially more often than all other available options.[99] Nine CCCS colleges used standardized exams as their primary method for assessing prior learning credits. The frequency of use ranges from 54 percent (ACC) to 100 percent (the sole PLA method of assessment at NJC). Although almost half of CCCS prior learning assessments were conducted via published guides, the method is not widely adopted across CCCS schools but rather focused

[99] These frequencies were calculated by the number of times each method was used divided by the total number of PLA assessments in each school. A student can earn prior learning credits using multiple methods.

at a few. PPCC served a large student population with military experiences and background which likely results in the 73 percent of the PLA evaluations conducted by published guides.

CNCC and PCC focused more on portfolio assessments. Over half of their PLA evaluations were done through this method (61.5% and 54.6% respectively). Thirty-seven percent of prior learning assessments were also done with portfolios at TSJC; however, the school also used standardized exams and published guides. Of all available prior learning assessment methods, Challenge exams were used least often in CCCS colleges, accounting for only two percent of all PLAs in CCCS schools. This may change over time, as schools are still in the process of conforming to the state-wide rule that each general education subject should have a challenge exam associated with it so students can easily challenge the course. It is feasible that with more challenge exams available, schools will increase the number of assessments conducted with challenge exams.

Table 3. PLA assessments by PLA method, by school

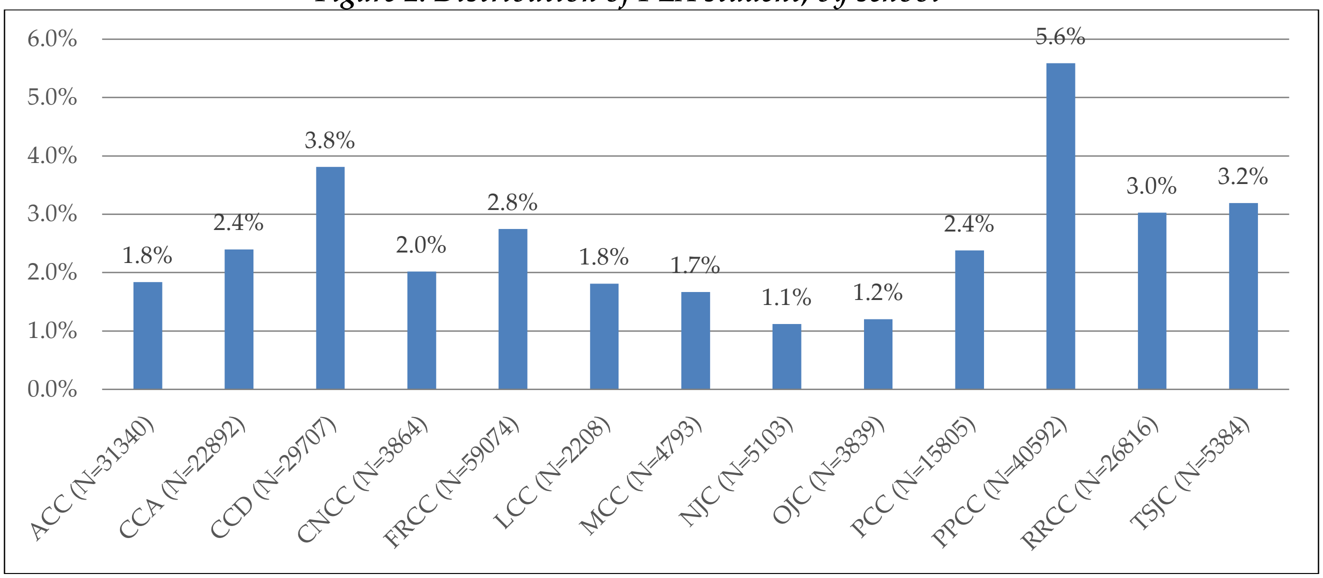
CCCS College	Challenge exams		Portfolios		Published guides		Standardized exams		Total N of assessments
	N assessments by college	% total assessment in school	N assessments by college	% total assessment in school	N assessments by college	% total assessment in school	N assessments by college	% total assessment in school	
ACC	48	2.9%	57	3.5%	649	39.6%	885	***54.0%***	1639
CCA	20	1.8%	95	8.3%	227	19.8%	804	***70.2%***	1146
CCD	35	1.7%	46	2.2%	269	12.7%	1769	***83.5%***	2119
CNCC	14	9.5%	91	***61.5%***	-	-	43	29.1%	148
FRCC	120	3.4%	35	1.0%	1401	39.2%	2021	***56.5%***	3577
LCC	6	10.3%	-	-	5	8.6%	47	***81.0%***	58
MCC	2	1.8%	-	-	2	1.8%	106	***96.4%***	110
NJC	-	-	-	-	-	-	127	***100.0%***	127
OJC	3	3.3%	-	-	-	-	89	***96.7%***	92
PCC	147	23.0%	349	***54.6%***	42	6.6%	101	15.8%	639
PPCC	9	0.1%	1486	13.7%	7940	***73.3%***	1397	12.9%	10832
RRCC	54	2.7%	538	26.9%	292	14.6%	1119	***55.9%***	2003
TSJC	3	1.0%	115	***37.1%***	104	33.6%	88	28.4%	310
Total	461	2.0%	2812	12.3%	10931	47.9%	8596	37.7%	22800

ENROLLMENT OF STUDENTS RECEIVING PRIOR LEARNING CREDITS

Demographic characteristics by school

As shown in Figure 2, the percentage of students earning prior learning credits varied across schools. In general, larger CCCS colleges—such as ACC, CCA, CCD, FRCC, PCC, PPCC, and RRCC—had higher percentages of students assessed for prior learning credit (of these larger schools, only ACC assessed fewer than 2 percent of students for prior learning credit.) In contrast, most of the smaller colleges—CNCC, LCC, MCC, NJC, OJC, and TSJC—had fewer than 2 percent of students assessed for prior learning credit. Of the smaller colleges in our study, only at CNCC and TSJC did students assessed for prior learning credit make up more than 2 percent of the student population. The school that had the lowest proportion of students assessed for prior learning was NJC (1.1 percent), where standardized testing was the only method of assessment offered. The college with the highest proportion of PLA students (5.6 percent), was PPCC, which offered three different assessment options. This indicates that a broader array of assessment options may result in more students being assessed for prior learning, as different options may appeal to students in different situations.

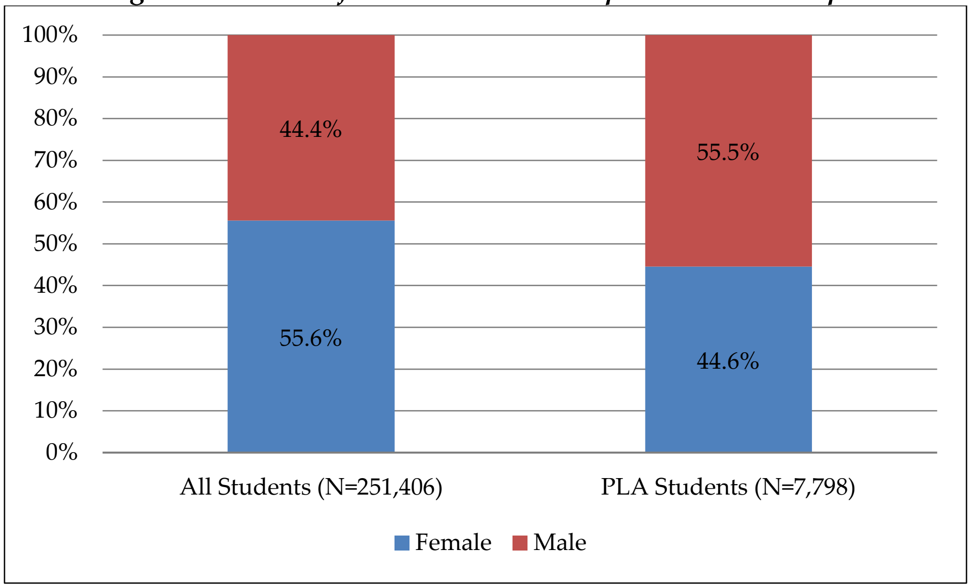
Figure 2. Distribution of PLA student, by school



Gender

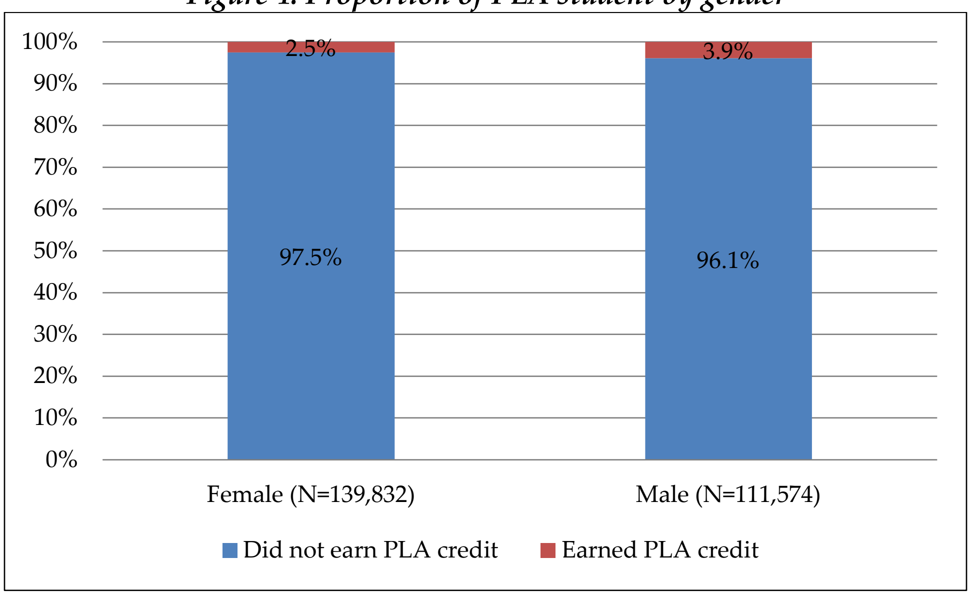
Figure 3 compares the gender distribution of the full sample with that of the population of PLA students. While 56 percent of CCCS students were female, females made up a smaller percentage—only about 45 percent—of PLA students. Thus, female students were underrepresented in the PLA population.

Figure 3. Gender of students in all sample and PLA sample



Although the proportion of students earning PLA credit was low, male students were more likely to have earned PLA credit (3.9 percent) compared with female counterparts (2.5 percent) (Figure 4).

Figure 4. Proportion of PLA student by gender



Race/Ethnicity

The majority—about 60 percent—of CCCS students in our sample were white (non-Hispanic). About 18 percent were Hispanic, 6 percent were black (non-Hispanic), just over 3 percent were

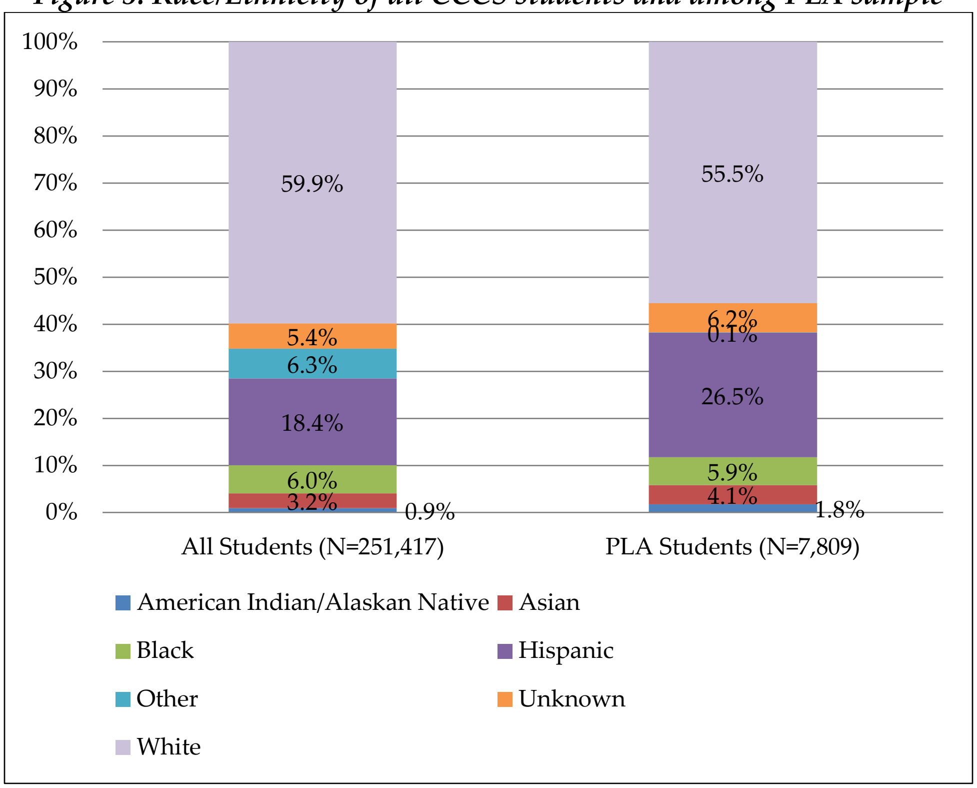
Asian, and almost 1 percent were American Indian/Alaskan Native[100] (Figure 5). These groups were not proportionally represented in the PLA sample.

The distribution of PLA students shows that the percentage of white PLA students (55.5 percent) was slightly lower than the percentage of white students in the full student population. Students of other race/ethnicity were less represented in the PLA sample than in the full student population (1 percent vs. 6.3 percent).

Conversely, a disproportionately higher proportion of Hispanic students (about 27 percent in the PLA sample compared to 18 percent in the full sample) and American Indian/Alaskan Native students (0.9 percent of the full population vs. 1.8 percent in the PLA sample) were found in the PLA sample. The proportion of black students was about the same in the PLA sample as in the full sample (about 6 percent in both samples). The proportion of Asian students was slightly higher than that for the full population (4.1 percent in the PLA sample vs. 3.2 percent in the full sample).

Comparing the racial distribution of the full sample and the PLA sample, Hispanic, Asian, and American Indian/Alaskan Native students were over-represented in the PLA sample compared to the CCCS student population. The proportion of black students in the PLA sample aligns with their distribution in CCCS. Students in other racial groups were much less represented in the PLA population.

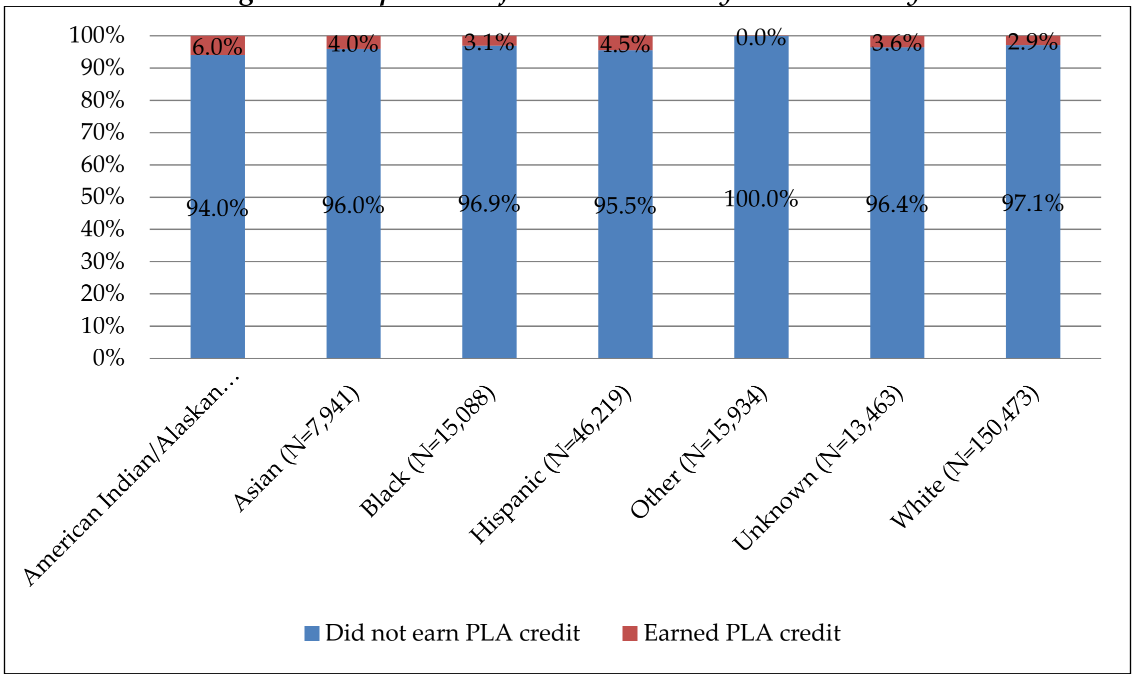
Figure 5. Race/Ethnicity of all CCCS students and among PLA sample



[100] This is the term used in the data set.

Among all CCCS students, 3.1 percent earned credit for prior learning. Comparing different racial/ethnicity groups, American Indian/Alaskan Native, Asian, and Hispanic students had a higher than average rate of PLA earning (over 4 percent). Black students and white students respectively earned credit for prior learning at a rate that is close to the average for the entire student population (3.1 percent and 2.9 percent respectively, Figure 6).

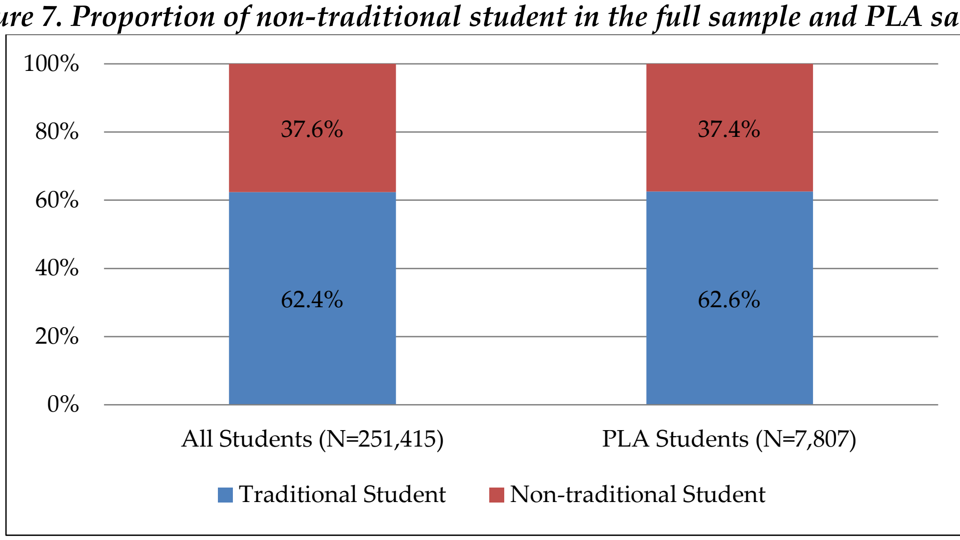
Figure 6. Proportion of PLA students by race/ethnicity



Nontraditional Adult Students

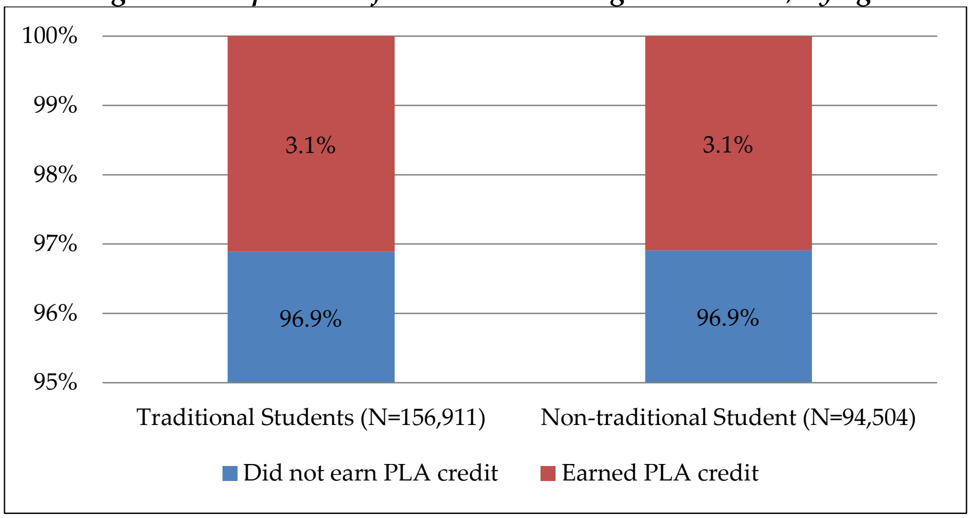
The age distributions of students in the overall CCCS and PLA samples are similar. The average age of CCCS and PLA students were both 25. Like the CCCS full sample, around 37.5 percent of the PLA sample were non-traditional students (age 25 or older, Figure 7).

Figure 7. Proportion of non-traditional student in the full sample and PLA sample



Around three percent of both the traditional and non-traditional students received PLA credits. Therefore, the likelihood of earning PLA credits was similar for both the adult students and their younger counterparts (Figure 8).

Figure 8. Proportion of students receiving PLA credits, by age



Financial Aid Status

As shown in Figure 9, about 32 percent of CCCS students were eligible for financial aid. In the PLA sample, however, we find that a lower proportion of students (about 19.5%) reported being eligible for financial aid. Moreover, when we compare the PLA rate of students who were eligible for financial aid against the PLA rate of those who were not eligible for financial aid—as illustrated in Figure 10—we find that economically disadvantaged students were less likely to be assessed for prior learning credits than those who were better off financially (1.9 percent vs. 3.7 percent, respectively).

Figure 9. Proportion of financial aid recipients in the full and PLA sample

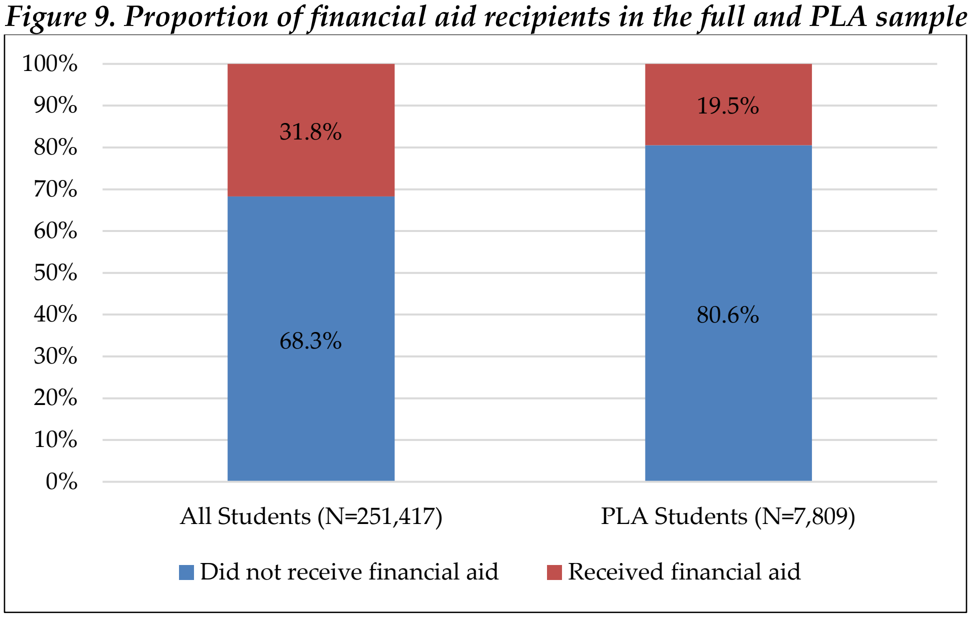
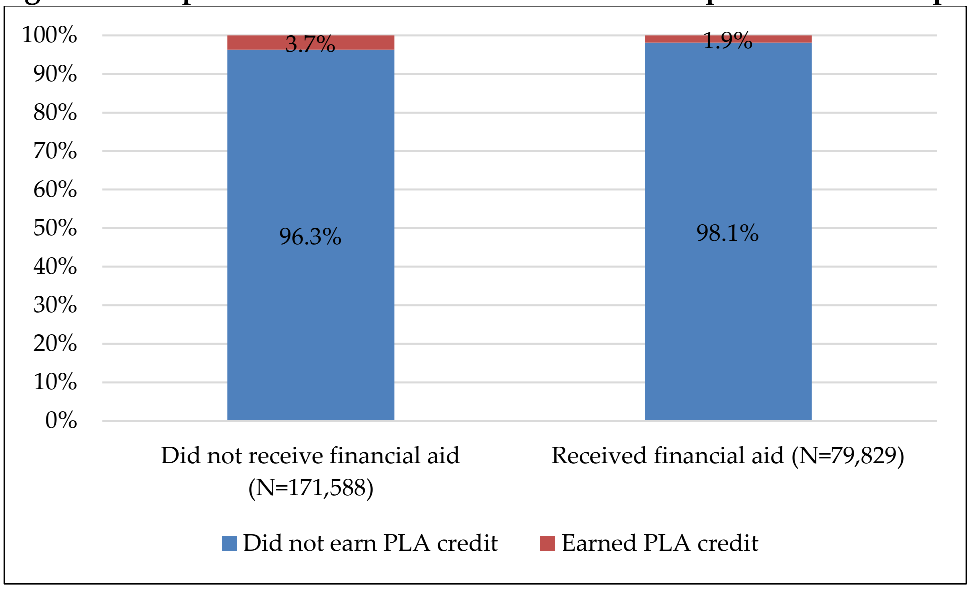


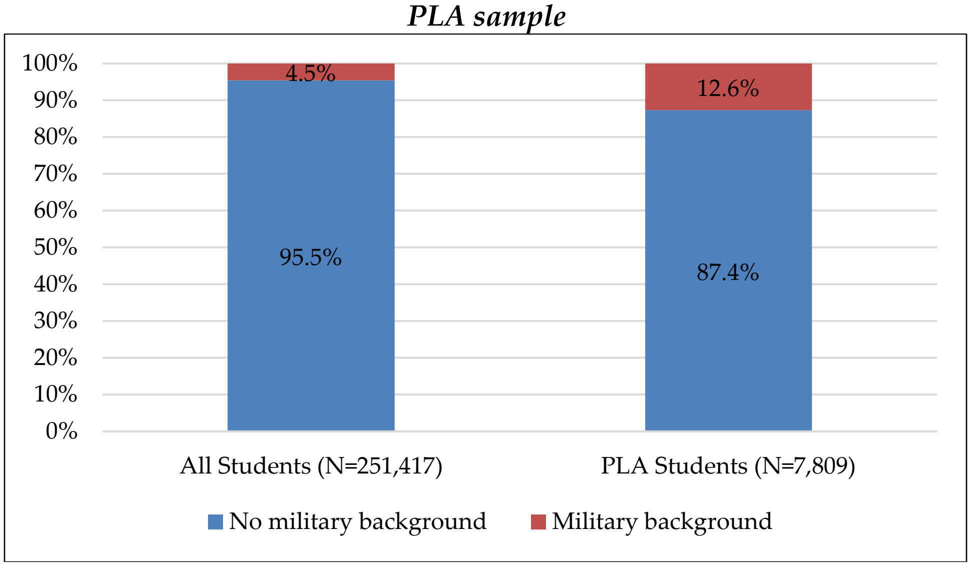
Figure 10. Proportion of PLA students in the full sample and PLA sample



Military background

Since CCCS datasets did not differentiate students who failed to report military background from those who did not have a military background, we assumed students without an indicator for military services did not have a military background. Of the CCCS full sample, around 5 percent had a military background. The rate was much higher in the PLA sample—around 13 percent of PLA students had military background/experience (Figure 11).

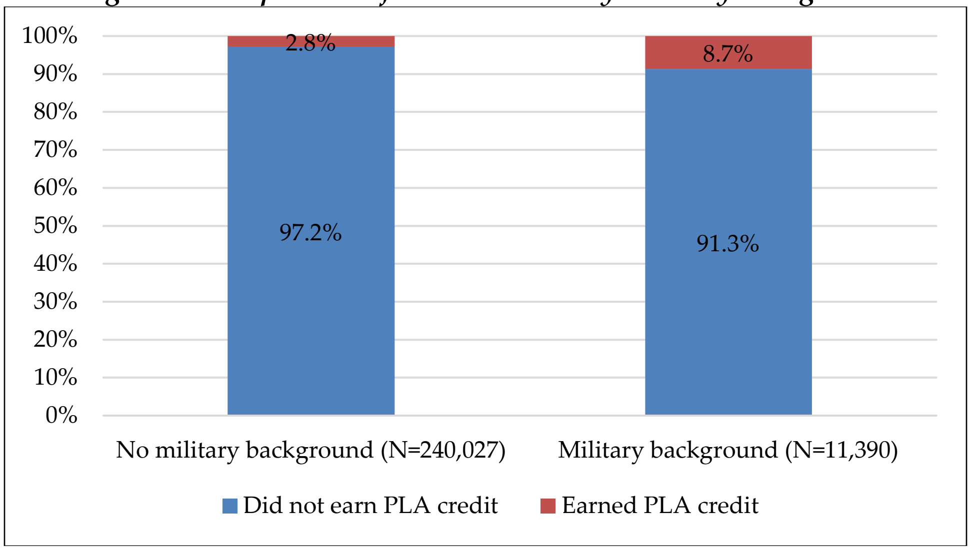
Figure 11. Proportion of students with military background/experience in the full sample and PLA sample



Only about three percent of students without military background/experience earned PLA credit compared with almost nine percent of students who had military background/experience.

Most of the students with military experience were from PPCC, which is located close to several military bases in Colorado.

Figure 12. Proportion of PLA students by military background

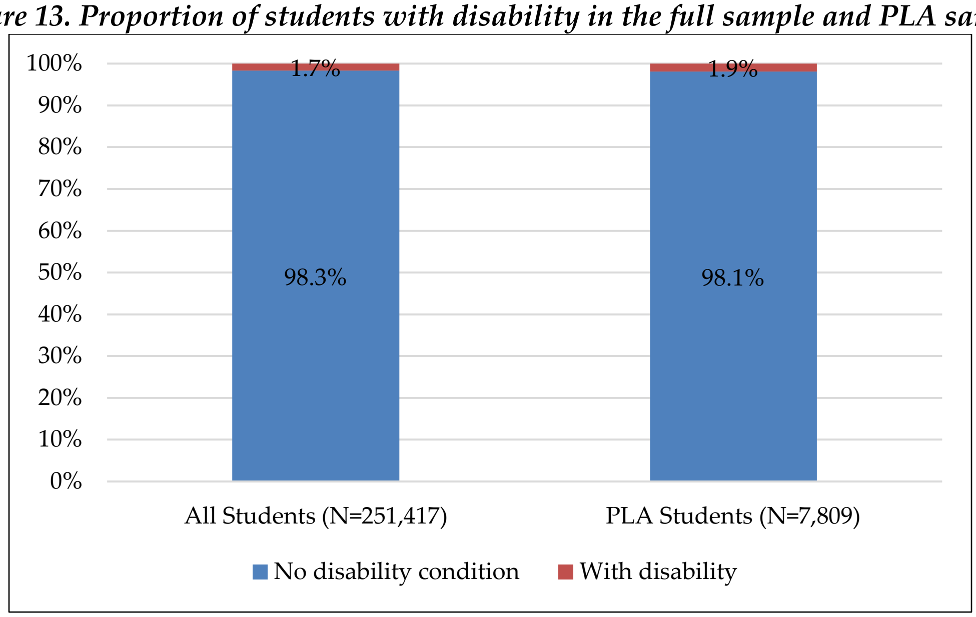


Disability status

Information on disability status was self-reported by students at registration. Any student who reported a disability condition at any time during the study period were considered as a student with disability status.

In the CCCS full sample, less than two percent of students reported a disability condition. The distribution of students with disability conditions among the PLA sample was similar to that in the full sample at 1.9 percent (Figure 13).

Figure 13. Proportion of students with disability in the full sample and PLA sample



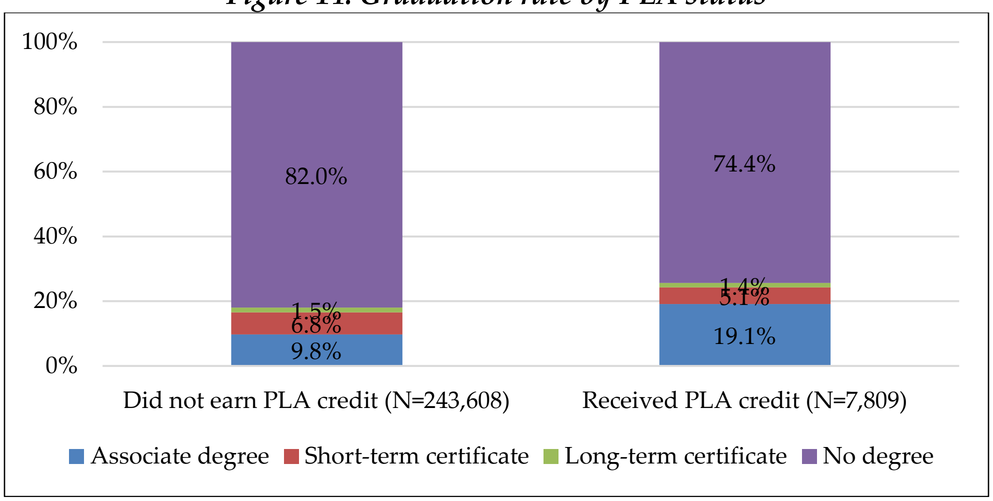
PRIOR LEARNING ASSESSMENT AND PROGRAM COMPLETION

An important question for this study is whether earning PLA credits improves a students' graduation rate. Are PLA students more likely to graduate than non-PLA students? For graduation outcomes, we considered three types of credentials awarded in CCCS: 1) associate's degrees, 2) long-term certificates, which require 1-2 years to finish, and 3) short-term certificates, which usually take less than 1 year to complete. Analysis of student graduation outcomes and prior learning assessment status confirms the positive relationship between prior learning credits and program completion.

Graduation rates of PLA and non-PLA students

Figure 14 presents credential completion rates for PLA students and non-PLA students.[101] Graduation rates for PLA students were considerably higher for non-PLA earners. The overall graduation rate (regardless of the type of credential) for PLA students was around 26 percent while that of the non-PLA students was around 18 percent. Considering graduation rates by the type of credential, a larger proportion of PLA students received associate's degrees than non-PLA students: over nineteen percent of PLA earners completed associate's degrees compared to 9.8 percent of non-PLA students. The rate of graduation for students earning a long-term certificate was similar regardless of PLA status. About 1.5 percent of non-PLA students and 1.4 percent of PLA students received a long-term certificate (if they did not earn an associate's degree). Finally, about seven percent of non-PLA students earned a short-term certificate, compared with five percent of the PLA earners. The difference in earning a short-term certificate by PLA status is small.

Figure 14. Graduation rate by PLA status



[101] Many CCCS students earned multiple credentials. Students may have earned both an associate's degree and one or more short-term or long-term certificates during the study period. For this part of the study, we prioritized the credentials with more credit requirements and length in the order of associate degree, long-term certificate, and short-term certificate. For each completer, we only considered one credential.

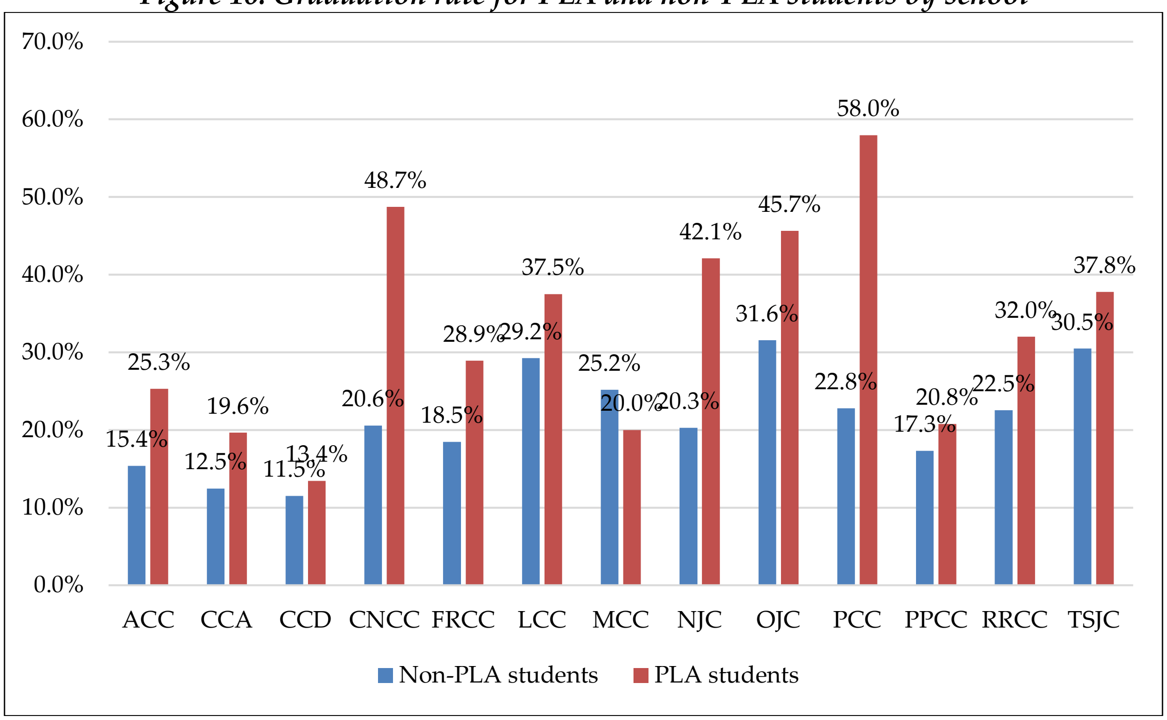
Graduation rate of non-PLA and PLA students by school

In the CCCS population, PLA earners graduated at a much higher rate than non-PLA earners. Here we examine whether the strong association between PLA credit-earning and students' graduation rates differed by college.

Figure 16 presents the graduation rate of non-PLA and PLA students in each CCCS institution. Except for MCC, PLA students in each of the 13 CCCS colleges had a higher completion rate than their counterpart non-PLA earners. Nevertheless, the impact of PLA credit on program completion differed by school. At CNCC, NJC, and PCC, we found graduation rates among PLA students were twice as high as those for non-PLA students. Graduation rates of PLA students were over 10 percentage points higher compared to their counterpart non-PLA students at ACC, FRCC, OJC, and RRCC. The difference in graduation rates between PLA and non-PLA students was small at CCA, CCD, LCC, PPCC, and TSJC, ranging from 2 to 8 percentage points. Graduation rates of PLA students at MCC were 5 percentage points lower compared to non-PLA students (20 percent vs. 25.2 percent).

The influence of PLA credits in promoting graduation varied by CCCS school, suggesting that variations in assessing, applying, and implementing PLA may result in different graduation rates at CCCS colleges.

Figure 16. Graduation rate for PLA and non-PLA students by school



Prior Learning Assessment and graduation rate by student demographics

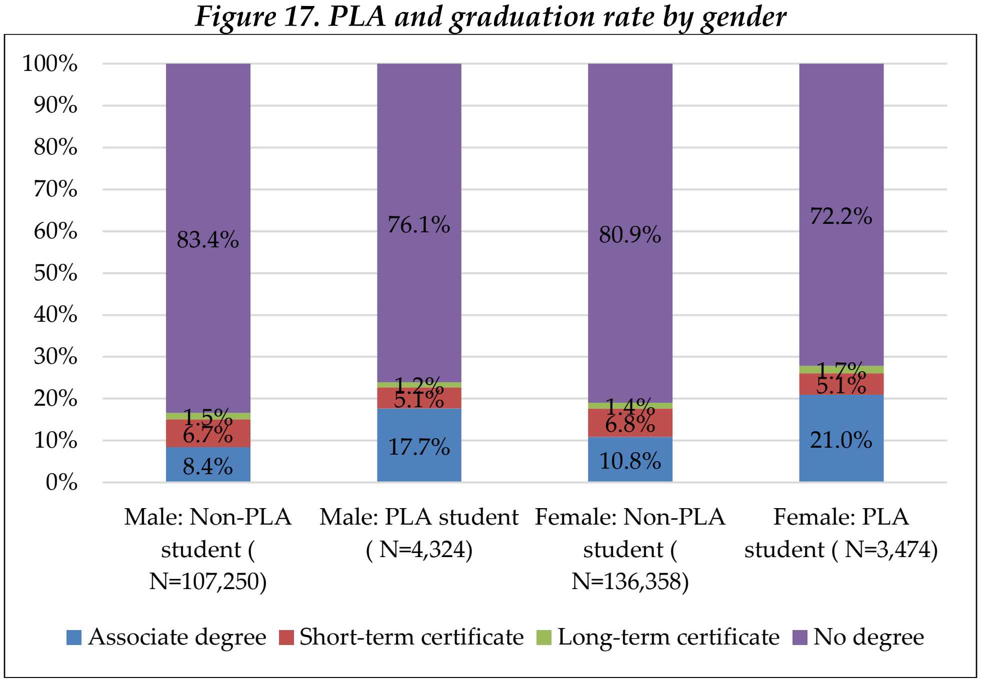
We also examined how the positive relationship between earning credit for prior learning and graduation rate may vary by a student's demographic background. Addressing this question may help influence future prior learning assessment regulations and policies targeting students from various backgrounds such as minorities and the economically disadvantaged.

Gender

The positive association between earning credits for prior learning and graduation rate was observed and consistent for both male and female students. Prior learning credit earners of both sexes graduated at a rate that was 7 percentage points higher than the rate of non-PLA earners. Figure 17 shows that among male prior learning credit earners, 24 percent earned a credential compared with only 17 percent of male non-PLA earners. Female PLA earners had an even higher graduation rate: 28 percent graduated compared with only 19 percent of their non-PLA-earning counterparts.

The difference in graduation rates between PLA- and non-PLA-earning students was due in large part to the difference in associate's degree completion rates. PLA earners had a much higher associate's degree completion rates than non-PLA students. Both male and female PLA students received associate's degrees at a rate that was more than twice as high as that of their non-PLA counterparts: almost 18 percent of male PLA students received associate's degrees, whereas only 8 percent of male non-PLA earners did so. Female PLA earners had an even higher graduation rate among students pursuing associate's degrees: Nearly 21 percent earned associate's degrees while only about 11 percent of non-PLA-earning females did so. However, graduation rates for certificate programs, especially 2-year certificate programs, were more similar among male and female students regardless of whether they earned PLA credits (for 2-year certificates: 1.5 percent vs. 1.2 percent for male non-PLA and PLA students, and 1.4 percent vs. 1.7 percent for female non-PLA and PLA students). Around seven percent of non-PLA earners, regardless of gender, graduated with a short-term certificate while the rate was around 5 percent for PLA students regardless of gender.

Figure 17. PLA and graduation rate by gender



Race/Ethnicity

When examining the graduation rates of PLA earners and non-PLA earners by race/ethnicity, we found that for each race/ethnic group, graduation rates for PLA earners were higher than those of non-PLA earners (See Figure 18a and Figure 18b). The biggest differences between the PLA and non-PLA groups within categories of race/ethnicity were found in the graduation rates of students who received associate's degrees. The graduation rates of white, black, and Asian PLA earners were approximately two times as high as those of their non-PLA counterparts. The difference between Hispanic PLA and non-PLA students was only slightly less dramatic as that of white, black and Asian groups—around 14 percent of Hispanic PLA earners graduated with associate's degrees, a rate that was about 5 percentage points higher than that of non-PLA-earners (8.6 percent).

Figure 18a. PLA and graduation rate, by race/ethnicity

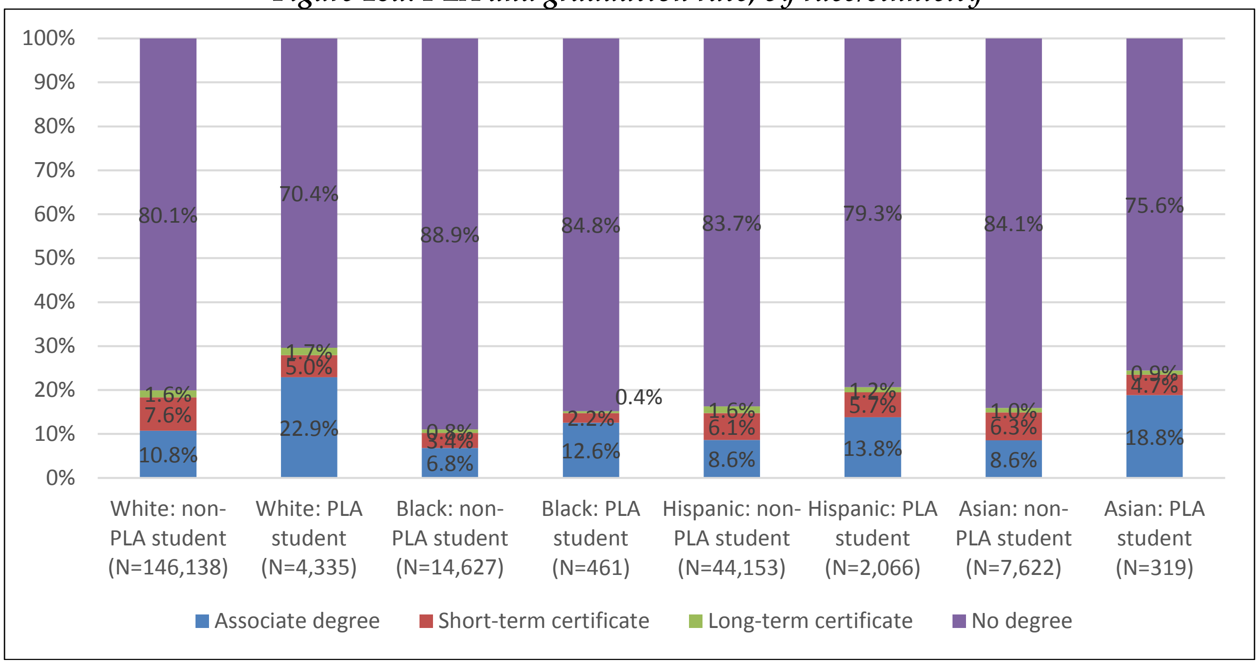
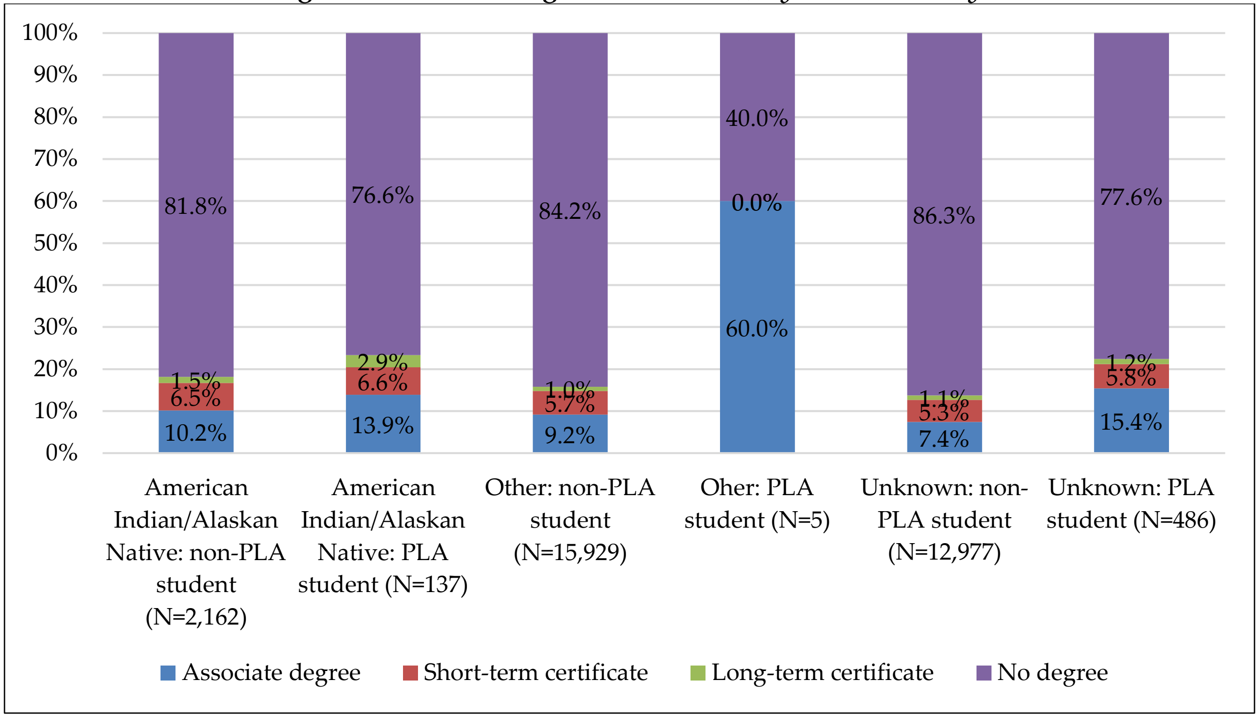


Figure 18b. PLA and graduation rate, by race/ethnicity

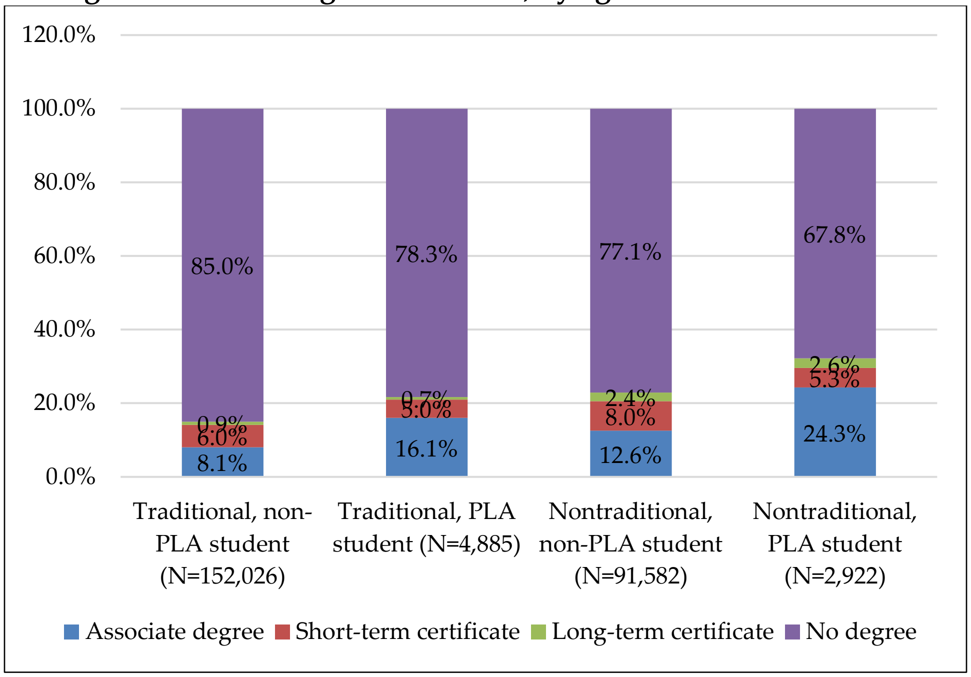


Non-traditional adult students

When evaluating the relationship between PLA and graduation rates by students' age, we found students who earned PLA credit had higher graduation rates than non-PLA earners regardless of their age (Figure 19). The proportion of students graduating among traditional students with PLA credits was about 8 percentage points higher than that of the non-PLA counterparts. Non-traditional PLA students had even higher graduation rates of around 32 percent which was over 10 percentage points higher than that of the non-traditional non-PLA students.

Much of the difference in graduation rates can be attributed to the difference in the associate's degree completion rates between PLA and non-PLA students. For both traditional and non-traditional students, graduation rates for associate's degrees among PLA students were twice as high as those of their non-PLA counterparts. The differences between graduation rates for students of different age groups pursuing certificates were minimal.

Figure 19. PLA and graduation rate, by age/non-traditional adult

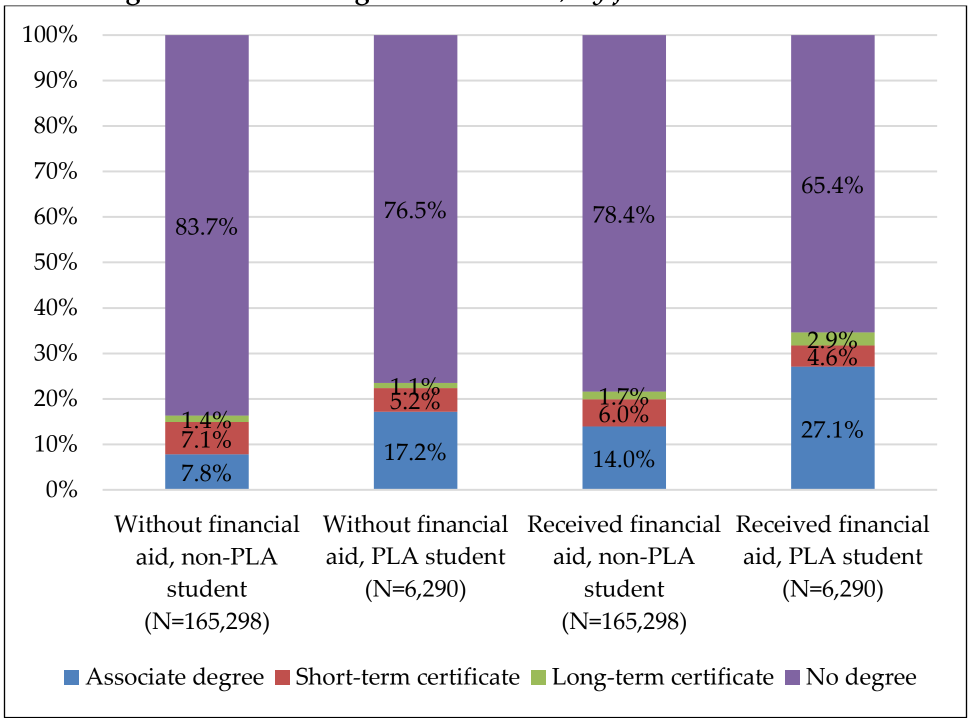


Financial aid status

As shown in Figure 20, among students who qualified for financial aid under the Federal Pell Grant program, PLA earners had higher graduation rates than non-PLA earners (35 percent compared to 22 percent). Among students who were ineligible for financial aid, PLA earners also graduated at higher rates than non-PLA earners (23 percent of PLA earners graduated compared to around 16 percent of non-PLA earners).

Graduation rates were higher among students who were eligible for financial aid than they were among those who were ineligible for assistance. Prior learning credit earners eligible for financial aid graduated with associate's degrees at a rate of 27.1 percent on average compared to 17.2 percent of PLA earners ineligible for financial aid. Among non-PLA earners, economically disadvantaged students also had higher graduation rates than their more financially secure counterparts across all degree types. For example, nearly 14 percent of non-PLA-earners who were eligible for financial aid received associate's degrees, whereas only about 8 percent of those who were ineligible for financial aid did so. Such associations were also discovered among students earning long-term certificates. Overall, we found that prior learning credit earners who were eligible for financial aid had higher graduation rates than those who were not.

Figure 20. PLA and graduation rate, by financial aid status

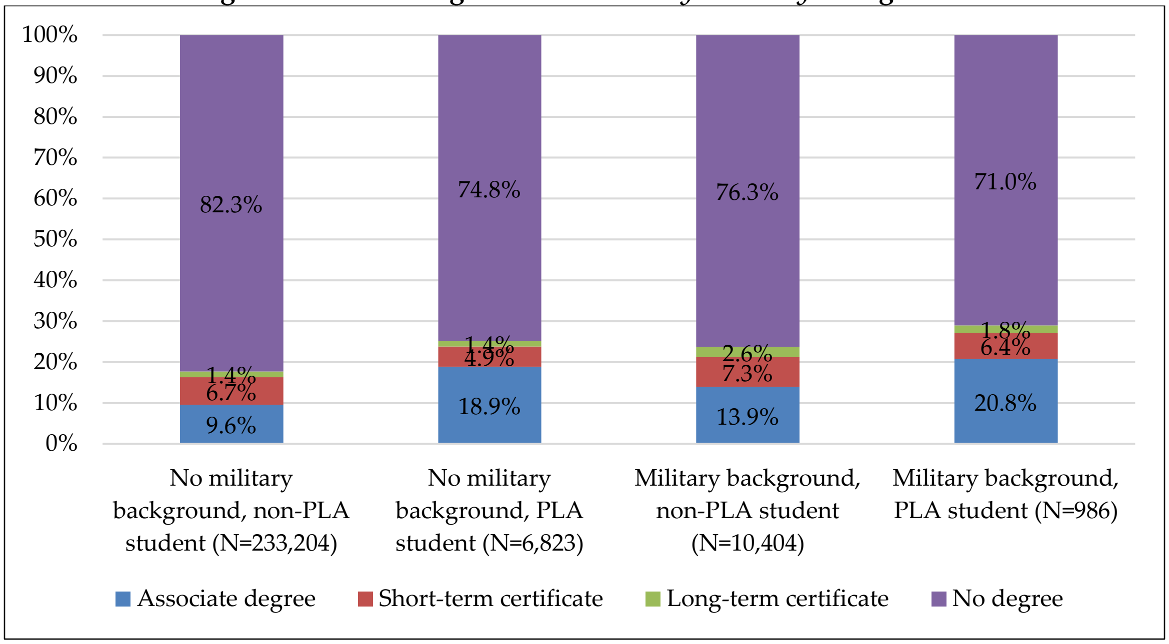


Military background

We also examine the association between PLA credit-earning and graduation rates by students' military service experience. Our data show that regardless of military background, students who earned PLA credit graduated at a higher rate as compared to students who did not earn PLA credit (Figure 21).

Among students who did not report any military experience, 25 percent of PLA earners successfully earned a credential as compared to only 18 percent of non-PLA students who did so. However, as shown in Figure 21, the difference in graduation rates between PLA earners and non-PLA earners who had military experience was less noticeable. Among students, with a military background graduation rates were higher for PLA earners than for non-PLA earners (29 percent vs. 24 percent). Most of the difference in graduation rates between students who earned prior learning credit and those who did not can be attributed to the difference in graduation rates of associate's degree programs. The difference in gradution rates between PLA-earning and non-PLA-earning students with no history of military service was significant (18.9 percent vs. 9.6 percent, respectively). The difference in graduation rates among students who had some military background was also large; about 21 percent of prior learning credit earners vs. around 14 percent of non-PLA-earners. PLA credits thus had a slightly stronger association with graduation rates among non-military-affilliated students.

Figure 21. PLA and graduation rate by military background

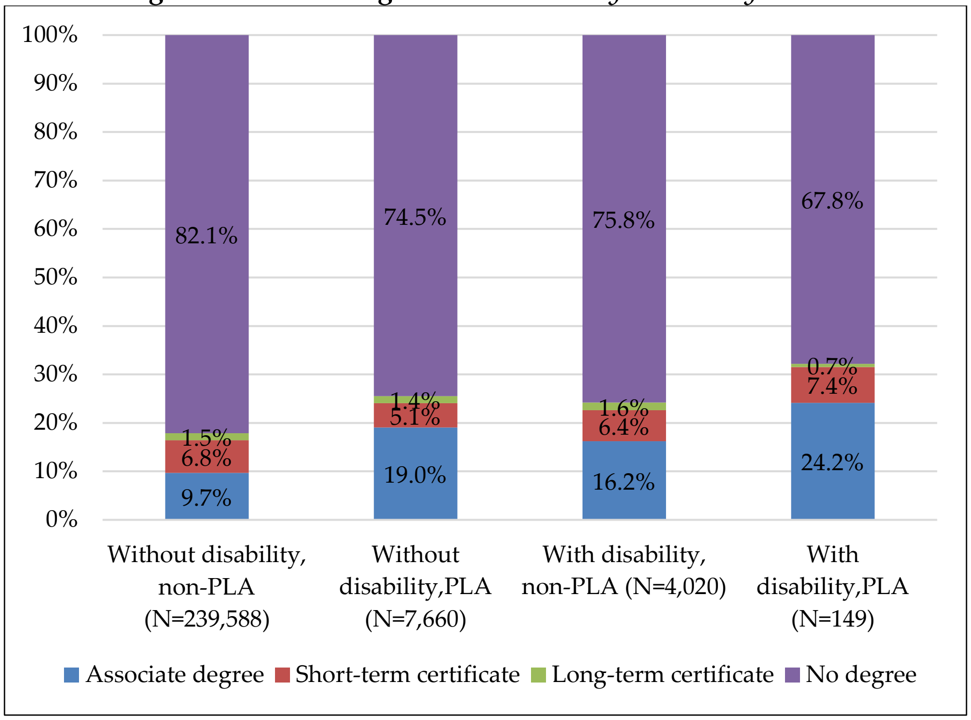


Disability

Students who self-reported a disability condition graduated at a slightly higher rate than students who did not report a disability condition (Figure 22). Comparing students by their prior learning credit status, we found that the rate of graduation of non-PLA students who reported a disability was about 8 percentage points higher (24 percent) than their counterpart non-PLA students who did not report a disability (18 percent). Graduation rates of PLA students with a reported disability were also higher than those of PLA students without a reported disability (32.2 percent vs. 25.5 percent respectively).

Regardless of disability condition, students with PLA credits graduated at a higher rate than their counterpart non-PLA students. The association was especially pronounced for graduation rates for associate's degrees.

Figure 22. PLA and graduation rate by disability status



Summary

Although schools have just begun implementation of the improved prior learning assessment policy at the institutional level, it is evident that prior learning assessment is beneficial to students. Both qualitative and quantitative data indicate that prior learning assessment helps students achieve higher graduation rates. At this point, it is difficult to tell if more students are using prior learning assessment than previously, but those that are using it are achieving associate's degrees at a higher rate than their counterparts without prior learning credits.

NEXT STEPS

For most colleges, early implementation was focused on faculty/staff/advisor training, plans for marketing to/recruiting students, and solidifying detailed plans for roll-out at each respective school. Some schools had begun a "pilot" of the changes to prior learning assessment by having one or two "experts" handle all prior learning credit inquiries and applications. Next steps for most schools involve continued training for faculty and advising staff, rolling out marketing, and beginning to spread the duties of prior learning assessment to other staff and advisors.

Other next steps include several at the consortium level. Now that individual institutions have implemented the redesigned prior learning assessment policy and some time has elapsed, system staff have recognized that there is still some variance in how schools have aligned with the improved policy. While all schools have implemented the changes, some are doing a better job of adhering to the changes than others. For example, some schools have done a better job at reporting data than others, and most are not using the tools created during the grant period, such as the PLACredit.com tool. Additionally, some schools are doing a better job of awarding meaningful credits through prior learning assessment than others. By pulling data at the system-level, staff can see that some institutions have higher rates of completion among those with PLA credits than others—an indication that some schools are not awarding general education credits rather than elective credits for prior learning assessment. Next steps for both of these issues include better communication from the system to individual institutions. Representatives from the system plan to visit each institution again to work on adherence issues and to further educate staff about data entry tool usage, credit crosswalks, and etcetera. The visits will help to clarify what institutions need to do to adhere to the policy and help increase compliance.

In addition, the system has received a Colorado Department of Labor and Employment (CDLE) grant to help increase enrollments in credit programs in advanced manufacturing in the state. One strategy of the grant will involve prior learning assessment. A goal of the grant is to ensure that each college that sponsors or provides non-credit training opportunities has an individual to interact with those training participants about what a CCCS college can offer them—including prior learning assessment. As a course of the grant, the CCCS PLA director will provide additional training to colleges and employers. Training for colleges will ensure that each college has staff who can have conversations with students about past training they have received and how that may convert to credit. Training for employers will ensure that employers fully understand the benefits of prior learning assessment and how training can be adapted to credit. This grant will scaffold some of the work of the TAACCCT grant relative to prior learning assessment.

In terms of research and evaluation, next steps include a more detailed prior learning assessment report in fall of 2017. This report will include more detailed outcomes from a quasi-experimental design on prior learning assessment. It will also analyze additional outcomes such as retention and time to completion for students receiving prior learning assessment credits. Delays in data pulls as well as the need to wait until after the summer semester for enough completers meant the prior learning assessment report could not be completed in time for inclusion in this version of the final report.

CHAPTER 4: BADGING

Suzanne Michael

INTRODUCTION

The CHAMP grant has facilitated the further development of CCCS' policies and procedures for awarding credits under Prior Learning Assessments (PLAs), which recognize students' prior experiences and skill sets gained in industry and the military. It is within this context that CCCS has led an initiative to develop and launch digital badges as an additional form of credentialing. These digital badges provide a "verifiable, portable" digital credential "with embedded metadata about skills and achievements" and are "shareable across the web" (Mozilla Foundation, n.d.).

This brief discusses the development and implementation of digital badges under the CHAMP grant. It has been prepared by Rutgers University's Education and Employment Research Center (EERC), the third-party evaluator for the CHAMP project.

Part I describes methodology and data sources. Part II provides a brief overview of the history of digital badges. Part III focuses on CCCS and its activities related to the development of digital badges in advanced machining. Part IV presents early feedback from industry and faculty on the badges and their use. Part V discusses plans for sustaining and scaling badges subsequent to the end of the CHAMP grant.

PART I: METHODOLOGY

EERC used qualitative methods to explore the development, implementation, and use of digital badges. EERC team members engaged in phone and in-person interviews with faculty and staff at consortium colleges as well as with senior staff at the CCCS office.

Most interviews were taped and transcribed; non-taped interviews involved extensive note taking. Transcriptions and notes were coded using NVivo qualitative data management software and were analyzed by EERC team members.

In addition, the EERC team reviewed relevant literature and conducted a content review of badging-related materials developed by CCCS and/or individual colleges. EERC also examined data posted to the Credly website. Credly is the digital badge vendor and portal CCCS is using to track the awarding of badges and to observe how they are used and discussed in social media.

PART II: FROM THE LITERATURE

Digital badges are mechanisms for assessment and credentialing that are housed online. The intent of digital badges is to serve as an assurance of the acquisition of skills or knowledge through either formal or informal learning. Badges provide a more granular or tailored view of a student's skills than typical academic credentials, as they can include measures of "experience, competency, and quality" (Casilli and Hickey, 2016). Ahn, Pellicone, and Butler (2014) argue that badges act as "signifiers of what knowledge and skills are valued, [as] guideposts to help learners plan and chart a path, and as status mechanisms in the learning process." Finkelstein, Knight, and Manning (2013) add that badges can serve as milestones for students, increasing motivation and retention. They also note that badges make the new skills students acquire more "visible."

Badges can also expand the concept of where learning can happen and how it can be validated, capturing skills developed from in the field in both formal and informal settings – e.g., practicums, apprenticeships, and employment – using industry or professional standards for skill assessment.

Some argue that employers, especially those in technology, education, and healthcare (Beals, et. al, 2015; Erickson, 2015), have found badges helpful in matching applicants' knowledge and skills to job requirements (Bradley, 2016). Badges can also be helpful to industry in recognizing new knowledge and skills incumbent workers acquire through additional on- and off-the-job training opportunities. Employers, however, have not unconditionally embraced the movement toward badges. Bradley (2016) reported that hiring professionals still primarily rely on college degrees, certificates, or licenses to judge candidates. In fact, in that study, representatives from only about half of the companies reported that they would accept a badge as a supplement to previous work history or a traditional degree.

Nonetheless, badging – specifically online digital badging – is gaining attention with industry, and academic institutions are investing in its further development and use.

PART III: THE COLORADO COMMUNITY COLLEGE SYSTEM AND DIGITAL BADGING

In Colorado, CCCS oversees both community colleges and vocational education. This dual role means that CCCS is invested in developing programs and mechanisms to facilitate the preparation of students for both higher education as well as for the workforce.

As part of this investment, CCCS recently refined the policies and procedures surrounding Prior Learning Assessments (PLA), which recognize skills and knowledge acquired in industry, the military, or through other experiences by translating them into college credit. The PLA refinement process, partially funded by the TAA CHAMP grant, was launched in February 2015.

In May 2015, the Colorado Governor issued a directive to increase stackable certificates and micro-credentialing (Personal communication, B. Perea, February 24, 2017). This directive reflected the State's recognition of the growing number of jobs in Colorado's advanced manufacturing sector that went unfilled despite local colleges graduating students with certificates and degrees in a variety of manufacturing fields. In part, these unfilled jobs reflected employers' needs for specific skills and knowledge sets that were not being reflected in academic certificates and degrees, nor from employers' reviews of courses on applicants' transcripts (Perea, Chieppo, and Woodmansee, n.d.). In response, in the summer of 2015, the CCCS president directed the system to create digital badges in advanced manufacturing. This initiative arose out of the above-cited work done on both competency-based education and PLA refinement.

Funded by CHAMP, the digital badging initiative was launched in 2015 and continues to date. CCCS facilitated the project, with its chief instructional designer taking a lead role. The project involved educating both faculty and employers about the potential of digital badges as well as guiding the actual work of developing the badges. To this end, a series of collaborative and intersecting industry-sector summits, business advisory groups, task forces, and work groups were convened for actual and potential stakeholders. Working together, these groups identified the competencies most needed by industry, reviewed badging projects, and explored accessible platforms and standards.

A white paper on digital badging was then produced (Personal communication, B. Perea, February 24, 2017). This white paper situated the development of digital badging within CCCS' 10-year strategic plan (2015–2025) and included a framework or "ecosystem for issuers, earners, [and] consumers/receivers" (Perea, n.d., pp. 3–4).

The project adopted the 2012 Open Badges Standard developed by the MacArthur Foundation, Mozilla, and the Peer2Peer University. Under this standard, the issuing institution attaches "verification data and evidence of skill attainment to the badge image file, hard-coding the metadata" (Perea, Chieppo, and Woodmansee, n.d.). This enables verification of skills and mastery and ensures future access and outside review.

In addition to using the Open Badge model, CCCS decided to establish a hierarchy for its badges. Initially, CCCS identified four tiers: *Excellence, Mastery, Expert,* and *Proficient.* However, after some discussion, industry requested that *Proficient* (equivalent to a grade of C) be dropped so that badge earners were "either excellent, expert, or masters of specific skill sets."

Badging Implementation Process

Given input from industry that included specific details about the competencies they needed, CCCS along with MSU began to create a series of badges in technical math, engineering graphics, and machining.

To develop the badges, work groups for the above three fields were convened. These work groups included faculty and instructors, department heads, members of CHAMP business advisory groups, and instructional designers. The Technical Math badge series was developed by using CCCS 's MAT 108–Technical Math Competencies course as well as input from employers who identified the math skills needed "on the floor" of their manufacturing shops. Existent NIMS certifications were used as a blueprint for the specification of Machining Level 1 skills.

In addition, the work groups engaged in "backward design." They took the skills industry had identified and then "organized the identified skills into groups of competencies and then proceeded to determine levels of mastery – differentiating between proficiency and mastery" *(*Personal communication, college staff, spring 2017*).* They then reviewed program and course curriculum to identify where such competencies were being taught – and mastered. This included attention to the types of evidence that could verify competency; the assessments program courses used to measure skill acquisition; and the means to ensure that evaluation methods and standards would be consistent across all CCCS schools. The work groups also made decisions about the "shelf life" of a badge: an expiration date at which time the badge holder would need to be re-assessed to ensure continued mastery.

The next step was the graphic design of the badges. A decision was made for a system-wide template of a basic coin with concentric bands and a ribbon for the badge name. Again, CCCS' chief instructional designer played a lead role in the development of the badge design

All CCCS badges have the words "*Colorado Community College System*" around the outer rim of the coin. In some cases, a badge may also include a symbol representing the badge's field. The badge template enables the inclusion of additional information as relevant – e.g., in a multilevel badging series, where a specific badge fits.

Badge Platform: Credly

After an RFP process involving a number of different potential platform vendors, the CCCS Task Force chose Credly (https://credly.com) to host CCCS' badges. The Task Force decided that Credly provided the "best vision" and economics for the system's digital badging. Credly, one of the leaders in the digital badging movement, is an open-badge-compliant platform that both issues and imports digital badges.[102] The CHAMP grant provided initial funding for the platform's use.

Once a student has qualified for a badge, the information is forward to CCCS's chief instructional designer who inputs it into the Credly platform. An email notice is then generated

[102] For more information on the Credly platform, see https://credly.com/faq.

to the student to claim the badge. If the student accepts, a badge is issued and posted on the student's profile in Credly. The badge with its unique URL specifies the competencies required to earn the badge; the issuing agency; and the evidence of mastery and method of assessment used to ensure competency. As each badge has its own URL, the earner can include an active link on her resume or export the badge to other sites such as a Mozilla backpack or LinkedIn profile.

CCCS plans to fund the Credly site for two years after the CHAMP grant sunsets, September 2017, thus until October 1, 2019. Of note, regardless of CCCS's continued use of Credly after 2019, all existent badges will continue to be accessible on the site.

CCCS Badges

In advisory board meetings, industry representatives spoke of the widespread lack of applied math skills among incumbent workers and job seekers. These skill gaps included units of measure; geometric dimensions; and ratios, proportions, and percentages. They stated that workers were unable to calculate the amount of materials they needed for a project or task or configure the dimensions or determine the tolerance of the item they were manufacturing. This led to waste and slowed down production activities. In response, CCCS decided to develop and pilot Technical Math as its first digital badge series. Concurrently, CCCS began work on badges in machining, some of which were based upon NIMS' certifications. In addition, CCCS also began to develop the engineering graphics series of badges. Further, CCCS also developed a number of badges that were inspired by CHAMP activities but were not funded by CHAMP, including badges in Faculty Development,[103] 21st-Century Healthcare,[104] and Colorado First and Existing Industry noncredit training.[105]

In the sections below the CHAMP-funded badges will be discussed in more detail.

Technical Math Badges

Technical math is needed in most advanced manufacturing fields; traditional credentials, however, provide employers little indication of a job applicant's math skills. Several years ago, in response to broad industry need, CCCS developed an online course (specifically, a Massive Open Online Course, or MOOC) called Technical Math for Industry. This MOOC contextualized math skills for industry and had built-in "concept mastery" assessments that could be transformed into digital badges. Under the digital badging system, students were only allowed to take the MOOC's topic and subtopic randomized math assessment once. If they earned a grade of 80 percent or higher, they would automatically be awarded a digital badge.

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[103] Ten Faculty Development badges were developed and launched in late summer 2016.

[104] Six 21st-Century Healthcare Skills badges were created to be used both with high school and college students.

[105] See https://www.cccs.edu/partnering-for-success/training-funds/ for information on this series of badges.

The pilot program provided CCCS with a means to introduce both the MOOC and digital badging to employers – often through the CHAMP advisory committees. Table 1 shows the number of badges awarded in technical math in 2016. It should be noted that the Technical Math MOOC was open to anyone in the world with access to the Internet. The numbers in Table 1 therefore include both CCCS students as well as non-CCCS students.

Table 1. Technical Math Badges Awarded Between January 27th and November 3rd 2016[106]

Badge	# Awards
Essential Geometry Mastery	15
Essential Statistics Mastery	11
Systems of Equations Skills	23
Math- Angles & Triangle and Geometric Concepts Skills Badge	14
Math- Essential Trigonometry Mastery	9
Formulas and Variation Skills	18
Math-Algebraic Functions Skills Badge	17
Math-Circles & Polygons Perimeter & Circumference and Area Skills Badge	15
Equations and Formulas Skills	17
Math-Essential Finance Mastery	12
Essential Math Mastery	32
Math-Exponential and Logarithmic Functions Skills Badge	13
Math-Exponents, Roots, Powers of 10 & Scientific Notation Skills Badge	32
Math-Finance, Simple and Compound Interest Skills Badge	13
Math-Fundamental Concepts and Operations of Algebra Mastery	27
Graphing Skills	11
Ratio, Proportion & Percent Mastery	2
Ratio, Proportions, and Percent Skills	44
Solving Quadratic Equations Skills	17
Statistics Mean, Median, Mode and Probabilities Skills	14
Math-Trig Functions, Sine, Cosine & Tangent Skills Badge	11
Math-Units & Systems of Measurement Skills Badge	36
Vectors Skills	11
Math-Volume of Geometric Solids Skills Badge	16
TOTAL	430

Note. Data retrieved May 22, 2017, from Credly database.

[106] Because the Math MOOC was not offered during the 2016–2017 academic year, no badges were awarded after November 2016.

Machining Level I

The members of the Machining Task Force used the certification criteria set forth by the National Institute of Metalworking Skills (NIMS) as the basis for the series of badges they were charged with creating. As NIMS has well-established industry standards, the identification of competencies for these badges did not involve the same level of consultation with industry employers as did the other badge series developed by CCCS (Perea, n.d.)

To earn a digital badge in machining, students had to receive a recommendation from their instructor and successfully complete the associated NIMS test or an equivalent project. Given the use of NIMS' standards, machining students can concurrently earn two credentials—a CCCS badge and a NIMS certification.

One of the benefits of linking a CCCS badge to NIMS certification is that it expands the visibility of students' skill mastery. The digital, open-source CCCS badges enable employers who are not familiar with NIMS or are not part of the NIMS system to use common platforms such as LinkedIn to search for skilled workers (Personal communication, B. Perea, February 24, 2017).

The series of 11 Machining Level 1 badges were launched during the spring 2016 semester (see Table 2).

Table 2. Machining Level 1 Badges Awarded Between May 28th, 2015 and April 23rd 2017[107]

Badge	# **Awards**
CNC Milling: Operations Mastery	40
CNC Milling: Programming Setup & Operations Mastery	4
CNC Turning: Operations Mastery	38
CNC Turning: Programming Setup & Operations Mastery	6
Drill Press Skills 1 Mastery	10
Grinding Skills 1 Mastery	3
Job Planning, Benchwork & Layout Mastery	10
Manual Milling Skills 1 Mastery	5
Measurement, Materials & Safety Mastery	39
Turning Between Centers Mastery	6
Turning Operations: Chucking Skills Mastery	6
TOTAL	158

Note. Data retrieved May 22, 2017, from Credly database.

Due to the overlap between NIMS certification and digital badges in machining, CCCS allowed students who had already received NIMS certification prior to 2016 to also earn a digital badge. Thus, the navigator at FRCC contacted current and prior machining students to ask them if they were interested in getting a digital badge. If they were, she sent their information to CCCS'

[107] 2015 totals include the students, mostly from FRCC, who retroactively earned a digital badge based on their NIMS certifications.

instructional designer, who then entered the necessary information on the Credly site. Once the student accepted the badge, that action was posted on Credly.

Engineering Graphics Badges

CCCS collaborated with its CHAMP four-year institutional partner, Metro State University (MSU), to develop a set of Engineering Graphics badges. MSU began working on its badges first; however, these badges were unique to MSU as they were grounded on competency modules within the university's curriculum. When MSU's badges were complete, their metadata were passed along to the Additive and Subtractive Manufacturing faculty at CCCS to be revised and transformed into that program's two- to four-year Engineering Graphics badges. The CCCS badges were designed to align closely with trainings in specific software needed in manufacturing as well as in the emerging field of 3D printing. At both institutions, CHAMP advisory board members were active in reviewing and developing the badges. The CCCS badges were made available in August 2016; the first badges were awarded in November 2016. MSU's badges were ready for rollout in July 2016 but were not made available until the fall 2017 term, when the courses with which the badges were aligned were launched.

The CCCS versions of the Engineering Graphics badges were developed by a design task force primarily made up of faculty from FRCC, PPCC, RRCC, CCA, and PCC – including the state discipline chair for CAD. The involvement of the state chair helped to ensure that the badges corresponded to the current Colorado system-wide CAD curriculum.

Given distances, the CCCS team met remotely for six months. First, they reviewed the identified competencies developed for the MSU engineering graphic badges. Then, they considered potential content areas for their badges based on the software that is central to current graphics curriculums. They also engaged in some backward design, comparing two-year college curriculums with MSU's four-year curriculum and the badges that were being designed to support that program.

The CCCS team identified a series of badges that paralleled the competencies covered in a typical two- year college CAD curriculum. This series of Engineering Graphics badges were then reviewed by PPCC's and FRCC's CAD Advisory Board to ensure that each badge's competencies matched what industry required for each badge to be meaningful in the workforce.

Six Engineering Graphics badges were presented at the CAD discipline state meeting in September 2016, then launched. This first batch did not include the SketchUp Mastery badge. That badge was developed and rolled out during the fall 2016 semester, when the task force recognized that SketchUp had the highest enrollment rates of all CAD courses across CCCS colleges.

As part of its 2016 launch, CCCS decided it would review all its Engineering Graphics badges over the summer of 2017. This review will involve employer feedback about each badge. It will also examine to what extent the badges continue to align with specific competencies and signify the degree of mastery. Adjustments and modifications will then take place for the next generation of Graphics Engineering badges.

Currently, depending on the specific badge, most Engineering Graphics badges roughly equate to a student completing one or two courses. To be awarded a badge, a student must complete the related coursework with a grade of 80 percent or higher, or have a project portfolio reviewed by faculty to determine mastery of specific competencies. However, badges are not awarded automatically for course completion; instead, students must explicitly request a review of their transcript or portfolio. CAD faculty have begun advertising the availability of the badges in emails to students enrolled in courses associated with them, letting students know there are opportunities to stack a number of badges as they pursue a certificate or associates degree.

To date, the vast majority of badges have been awarded for AutoCad 2D, followed by AutoCad 3D mastery (see Table 3). FRCC reports that the majority of their badge recipients are CAD program students, though they have awarded some badges to interior design and architecture students.

As described above with regard to machining, CCCS permitted the colleges to notify students who had taken the relevant coursework within the prior year to invite them to earn a digital badge. Interested students were then assessed for one or more badges, which were awarded to those who demonstrated mastery.

The distribution of the Engineering Graphic badges developed by both CCCS and MSU, and the number of each badge awarded to date, can be seen in Table 3.

Table 3. Number of Engineering Graphics Badges Awarded, By Awarding Institution

MSU-Denver		**CCCS (7/5/2016 – 5/1/2017)**	
Badge	**# Awards**	**Badge**	**# Awards**
Foundations of Composite Materials Mastery	2	3D Printing & Additive Manufacturing Mastery	1
3D Scanning Mastery	0	3D Scanning Mastery	1
Design for Metal Additive Manufacture Mastery	0	AutoCAD 2D Mastery	55
Metal Additive Manufacturing Post Processing Mastery	0	AutoCAD 3D Mastery	11
Composite Repair Skills Mastery	0	Revit Basics Mastery	1
Composite Testing Skills Mastery	0	SketchUp Mastery	2
		Solidworks Mastery	0
TOTALS	2		71

Note. Data on awards made to CCCS students retrieved May 22, 2017, from Credly database.

The Use of Badges

To date a total of 72 badges have been created by CCCS and MSU, and a total of 535 badges have been awarded to 202 unique individuals. As of July 25, 2017, the badges have had over 91,200 views "either by direct URL to the participants' specific badge or through social media (13 percent shared through Facebook, 78 percent shared through LinkedIn, and 9 percent shared through Twitter)" (Personal communication, B. Perea, July 2017).

As noted above, digital badges can increase the visibility of students and the specific skills they have mastered – thereby increasing their marketability. Digital badges can also increase employers' ability to identify individuals who have the blend of skills needed to thrive in the workforce. In addition, digital badges can help incumbent workers add to their qualifications by showcasing professional development that has taken place since being hired (CCCS, n.d.).

In addition to benefits related to employment, digital badging has been found to be helpful within academic institutions. Through their codification of competencies and mastery, digital badges make explicit the skills contained in a course or program of study. This transparency in the awarding of credits can help students transition from certificate to degree programs. Badging also simplifies credit granting for courses students take at other CCCS colleges if their home institution does not offer a specific course. For example, PPCC does not have a CNC lathe course, so students needing that course must enroll in another consortium college and then transfer those credits back to PPCC. Further, digital badges can facilitate the transfer of students to other colleges.

Badges, like PLA credits, can provide students with a sense of achievement and motivate them to continue their studies, thereby affecting retention (CAEL, 2010). Further, given industry's recognition of badges, they can also be useful for employment before, or even instead of, completing a certificate or degree.

PART IV: EARLY FEEDBACK

Reception to Badges

Faculty

Digital badges have been conceived by participating CHAMP colleges as supplements to, rather than replacements for, existing certificate programs. However, faculty at some colleges were concerned that digital badging may eventually be transformed into an independent credentialing process. These faculty members worried about how the expansion of digital badging would affect enrollment in their certificate and degree programs.

A number of faculty observed that not all curriculum can be segmented into skill sets conducive to badging. The stacking of certificates in these courses or programs (e.g., LCC's welding program) were thought to be far more valuable for students and industry.

Despite these reservations, most of the staff and faculty involved with badging were optimistic about the future potential for badges in the advanced manufacturing industry.

> *It's very simple for them to go onto LinkedIn and see somebody's profile. And then click on a badge they have a discipline in (sic).*

Students

During site visits to CHAMP colleges conducted in fall 2016, we found that the majority of students we spoke with were not yet aware of the availability of digital badges or how best to utilize their earned badges as they seek employment.

Information about badging is often only presented after a student has enrolled in a course associated with a badge. For example, at FRCC, the CAD instructor sends an email every semester to students enrolled in CAD courses to make them aware of the Engineering Graphics badges and the process of earning them.

As the initial development phase of badge creation concludes, some colleges, such as FRCC, are beginning to sponsor training programs or workshops about digital badges so students understand better what digital badges are, how badges can help them with their job searches, and how they can use badges to expand their portfolio.

As is clear from the number of badges earned to date, CCCS students have begun to participate in the badging process. Unfortunately, EERC did not have the opportunity to interview any badge recipients about their experiences with earning and using digital badges.

Employers

Despite some industries' and employers' increased use of badges to recognize professional development or to manage their talent pool – e.g., IBM, Fossil, Home Depot, Bank of America, Hunter Douglas, Walmart, Google, Microsoft, Time Warner Cable (Perea, Chieppo, and Woodmansee, n.d. p. 5) – reception to the new CHAMP-created digital badges has been mixed.

Indeed, when we interviewed several employers already associated with the CHAMP grant during the spring of 2017, we found that most were not aware of the colleges' digital badging efforts. As a result, this section focuses on interviews with faculty and staff and their views on the interest and awareness of badges among their industry partners.

In interviews with EERC, some faculty and staff shared that from their perspective the push to develop digital badges came much more from the academy than from industry. One project lead stated,

> *We just don't have a lot of industry push for it right now. They really don't care. They want somebody to go through this. . . class. Right now, it's still the certificate that we get. And so we just haven't crossed over on that wake yet. . . [,] we haven't heard back from our advisory organizations yet, and our industry experts, to say we need this badge in this area. They just want the training in this area.*

Another interviewee noted that there may be a mismatch in nomenclature – a failure to communicate:

> *We call them something [badges], but industry doesn't understand what we're calling them. Even though it might be the same thing they're looking for. They might – it's not in their lingo, [so it] needs to be changed.*

One project lead summed up the challenge that they are facing with rolling out badges to industry:

> *Many of the businesses [don't have an appreciation] as to how badging works, and how it can work for them, and how they can use this to verify their [applicants' or employees'] credentials in their skill sets.*

Another commented, "the skills and applicability of the credential must be immediately apparent or some of their value is lost."

Like anything new, colleges are recognizing the need to commit to an ongoing educational process that explains to employers what digital badging is and how it can benefit them. To facilitate this educational process, CCCS has created pamphlets, videos, and a website with an FAQ about digital badges.

The CHAMP colleges say they are beginning to see these educational efforts gaining traction as employers are expressing more interest. For example, PPCC's project lead noted that members of that college's advisory board, such as Lockheed Martin and Sythes, "really like the idea."

Another project lead made the link between digital badges and the current interest in competency-based education:

> *Eventually badging will have a greater meaning for the employer, based on competencies. So I think it really goes strongly with the trend of competency-based education. And it will be a more concrete format for an employer to understand competencies.*

In fact, despite some industry employers stating a continued preference for traditional credentialing – i.e., the pursuit of certificates and degrees – digital badging has opened up new possibilities on the noncredit side. The CHAMP project lead at Aims reflected,

> *When I first started under the TAA grants, somebody had mentioned badges and those type of things. That was coming from educators . . . trying to push it down on employers and stuff. Now we are hearing from manufacturers that they might want those badges because they want quicker turnaround for training and stuff.*

It is not clear to what extent industry has begun to move to a tipping point where badging is more acceptable if not encouraged. Nonetheless, to meet their industry partners' interest in accelerated credentialing, Aims is currently working with them to develop digital badges for the college's noncredit offerings.

Four-year colleges are also beginning to award badges in their noncredit training (Personal communication, B. Perea, June 15, 2017) in response to industry's interest in skill upgrades for incumbent workers and to identify new workers capable of operating new technologies. As noted above, these endeavors have also raised concern about the effect of badging on credit and noncredit program enrollments at both four- and two-year colleges.

PART V: THE FUTURE OF BADGING

CCCS staff have expressed some concern that they are "in a bubble" with regard to digital badging. They believe that if there is not a sustained, systematic effort to create a system of badging across and between the various system colleges, the gap will be filled by for-profit educational opportunities – and community colleges will potentially be disadvantaged in the emerging competition. CCCS therefore wants to grow and support the digital badging "*ecosystem*" after CHAMP ends in September 2017.

To that end, CCCS secured funding for the Credly platform through September 2019 and recently established a new position: Director of Workforce Development. This individual will have overall responsibility for the digital badging project, including the employment of an instructional designer who will directly oversee badging activities within the system (Personal communication C, Perea, June 15, 2017). In this way, CCCS staff will maintain the centralizing and guiding functions they carry out under CHAMP, including their work to prevent the creation of duplicative badges (Personal communication A, Perea). Several CCCS colleges that are not part of this study are also developing new sets of digital badges. For example, Trinidad State Community College is working on badges in gunsmithing, drone analytics/GIS and agribusiness. Colorado Northwestern Community College is developing badges in heavy equipment and civil engineering with the help of three diverse industries: excavation, power plant, and construction. Arapahoe Community College is developing badges in LEAN manufacturing.

Further, FRCC's Fort Collins campus has begun to credential their co-enrolled high school students with badges. The college is also discussing the development of a "professionalism" badge to reflect the (CHAMP-developed) addition of soft skills to their advanced manufacturing curriculum.

In addition to these activities, colleges continue to work with their industry partners to refine their badges. For example, they are examining the advantages and liabilities of assessment processes (e.g., exams, projects) and are considering whether and how to evaluate individual performance in group projects. They are also exploring how the stacking of badges might create new types of certificates.

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CHAPTER 5: ADDRESSING INDUSTRY NEEDS IN THE CTE CLASSROOM

Renee Edwards

INTRODUCTION

This brief discusses implementation methods and strategies used by CHAMP schools, explores challenges institutions encountered, and discusses the resulting impact of hands-on learning on the institutions. It also briefly discusses next steps and sustainability issues relative to hands-on learning as implemented through the grant.

IMPLEMENTATION METHODS AND STRATEGIES

Several themes emerged from the data relative to implementation methods and strategies throughout the course of the CHAMP project. Methods and strategies used include: 1) the assertion of strong consortium goals expressed early in the project, 2) institutional alignment of these goals with goals of individual schools, 3) shared curriculum across the consortium which can save time and resources, and 4) an industry-centric framework which involved employers throughout every step of implementation and included industry representatives in important decisions, such as what equipment to purchase. Each section below considers these themes in detail.

Strong Consortium Goals

The CHAMP grant was written primarily to redesign/restructure participating colleges' advanced manufacturing programs by integrating hands-on learning, adding industry-specific equipment, and creating curricula more responsive to the current job market. Consortium colleges planned to adjust courses by adding content and equipment identified by employers. A central goal of the program was to increase the amount of exposure students had to industry-specific machinery allowing students to become competent with each machine and increasing the quality of learning experienced by students. Attention was also paid to the needs of local employers and incumbent workers; therefore, specialized training material was added to some courses and classes were to be offered during evenings and weekends as well as via a "hybrid" format—with course material offered online and hands-on learning occurring during scheduled lab times.

Hands-on learning was to be focused primarily on types of equipment expected in a manufacturing setting, such as machining equipment, manual and computer numerical controlled mills and lathes, other metal-working machines, 5-axis milling machines and related software, Swiss screw machines, 3D printers and scanners, virtual welding simulators, coordinate measurement machines, mechatronic (the combination of mechanical and electrical systems) modules and advanced soldering stations. Under the CHAMP funding, the consortium envisioned a total re-vamp of participating schools' advanced manufacturing programs, including extensive integration of hands-on learning.

Institutional Alignment of Consortium Goals

Consortium goals matched well with those of the nine individual institutions. While schools were given latitude to purchase equipment that fit with institutional goals and local employer needs, most schools chose to implement within a similar vein: to create a technology-enabled learning environment that mimicked a manufacturing shop floor. College staff at all nine schools reported a common institutional goal, which aligned well with the consortium's goals: implement hands-on learning with equipment that employers expect potential employees to be knowledgeable about, thus increasing students' career options. Most of the nine colleges already had plans for restructuring their programs underway, but lacked the resources for equipment purchases and space renovation. A staff member at Aims said: "We were in the process of developing the program when the grant came along. It would've happened either way, but it was certainly fortuitous." Another staff member at CCD stated "to be able to meet the needs of the community, we needed these pieces of equipment."

Shared Curriculum

CCCS led consortium colleges in a process to develop open access courses that could be used across colleges making use of the new equipment purchased under the grant. Most schools chose similar equipment, although there was some variation between colleges. The idea behind sharing curriculum was that 1) it would foster faster implementation, 2) individual schools would not have to hire subject matter experts or instructional designers, and 3) there would be increased collaboration between consortium faculty members. CCCS provided a team of instructional designers to help instructors develop courses, put them online, and make sure they were open access. Since many instructors had never developed or taught material online, this was greatly appreciated, especially for those schools that did not employ instructional designers. While these instructional designers were available, some colleges chose to hire their own, including Aims and FRCC. These schools felt that although time consuming, the process of developing the courses was highly beneficial since the end product was so good. However, the use of shared curriculum between schools seemed to be less common. Also, some college staff felt the exercise of creating open source material was unnecessary and time-consuming.

Industry-Led Equipment Purchasing

Staff at some consortium schools involved industry partners in deciding what equipment to purchase at their institution. Most employers gave input during regularly scheduled advisory board meetings. Some schools had one or two local employers who acted as 'spokespeople' for other employers in the community. Staff at PPCC had such a spokesperson, who told them: "You need to purchase equipment that will work for all the employers here in town." Staff members said, "he was wise enough to recognize that we needed to train a core or critical mass for all of Colorado Springs so buy generic equipment, buy generic CNC equipment, and buy things that are readily used by all companies." FRCC also had an employer who served as a voice for other employers. He discussed what he told staff at the college:

> *We told them what we were using in our shops…what the industry's using for machines that [are] affordable. We [want students to] come out of the program with some experience on machines that folks are going to have in their business[es].*

At PCC, staff asked advisory board members to provide input, but also made calls to local employers to directly solicit input. They also toured the facilities of local employers to "look at their shops, see what kind of equipment they're on [employees are using] and see what kind of tools they're using, that kind of stuff." A staff member commented that this process was "a little less formal, but gave us a good insight as to what kind of equipment we should buy."

One employer described the process to EERC as something they enjoyed:

> *That was great fun. 'We'd like one of these and one of these and oh, six of those.' Yeah, we had a couple of meetings. Several of us were not so much, I guess, going around shopping in places, but we would go to one facility or the other. …We'd get together and talk about what machines, what brands were ones that they could get for – that were good enough, but not so expensive they couldn't afford them. That kind of thing.*

Staff and instructors at several colleges mentioned their reliance on industry representatives at program advisory board meetings. One staff member said:

> *They do help out. For instance, [I ask:] "Do I need to teach this?" and they say "No, you don't" or "Yes". So, they are helpful. They have driven a lot of the purchasing too. "Do we need to have this?", "Yes, you have to have this.*

At another school, other staff echoed this by describing a similar process through their advisory meetings:

> *We pitched ideas of what we thought would be interesting to teach at advisory meetings. And then as we went through it, industry actually selected all of our equipment. So, we went through, said "Hey, what do you want to see here?" And then when we got bids in and everything else. [We said] "What do you want? What do you think is the most valuable for us to teach?" And so, there's machines that maybe I thought would be more interesting that ultimately don't have as much as a representation in the market. So, it was important to me to make sure that they had the buy-in and we were picking equipment that was for them. Because ultimately, this is to support them.*

A staff member at FRCC also discussed receiving advice from an employer that staff chose not to heed. Some employers advised against the college purchasing 3D printing equipment because employers were not using it yet. Staff chose to purchase the equipment anyway, to stay 'ahead of the curve' and to train students on equipment that they envisioned would eventually be part of the workforce.

Having students trained on advanced equipment also means that employers have the option to purchase newer equipment because they have access to potential employees that can run it. An instructor at CCD who used to be in the industry discussed what this means for employers:

> *It means that our employers now can purchase these machines because they have a place to get people trained to run them. Before I was with the college I was in industry. Someone would come in and say, "Hey, I have this great machine. It's a $300,000 machine. I've got an extra one on the floor. I'll give it to you for $200,000." My answer would be "If you could sell me somebody who can run it, fine. If you can't, it's just a $200,000 boat anchor. I don't need it."*

Most CHAMP schools were forward-thinking relative to skills that students may need to prepare for the future of advanced manufacturing, in addition to skills they need for the current state of the industry. For example, most of the CHAMP schools were teaching some level of automation, regardless if local employers were using automation yet or not. Staying ahead of changes to the industry would help students stay relevant into the future.

CHALLENGES

The nine CHAMP colleges encountered some challenges during implementation of the newly designed courses. Most challenges centered on curriculum development for the courses and incorporating the new, technologically advanced, equipment effectively into curriculum. Finding instructors able to run—and teach—the new equipment was also challenging for some schools. Several schools also had to renovate space or find new space for the new equipment. This next section details challenges schools faced and how they overcame them.

Curriculum development

While some schools chose to use the shared curriculum developed by the consortium, there were still some challenges integrating it. Staff at RRCC, for example, discussed how difficult it was for instructors to integrate the new curriculum. One faculty member said:

> *I feel like I'm running a lot more than I have in years past. It's been a lot more interesting for me because it's – all of it's new. So, it's like being a new teacher all of a sudden again. All the curriculum is new. All the equipment is new. But it's made the job a lot more fun again.*

Some schools chose to purchase equipment beyond what the shared curriculum had been created for, which meant curriculum had to be developed outside of what was done at the consortium level. Faculty at these schools were tasked with developing this additional course material. This was sometimes time consuming and meant instructors had to take on additional duties outside their normal teaching load.

Some schools did not purchase all the equipment the shared curricula were developed for. This meant shared course material taught students about equipment they did not have access to. Faculty members had to remove such material and replace it with relevant information.

Instructors at LCC noted that they had run their program several times and were still finding things in the coursework that referenced equipment they did not have. Each time the course ran faculty had to make changes to the curriculum. Faculty members were optimistic, knowing that eventually they would no longer need to make changes. LCC's instructors felt that the shared curriculum saved them time, regardless of the changes they had to make along the way.

CCD chose to write their own curriculum, which meant instructors had to take on designing over 50 courses on top of their regular work load. Although the school hired a team of instructional designers to work with the instructors, it was a slow process.

Finding Instructors

Purchasing technologically advanced equipment comes with its own challenge; some of the schools lacked someone to run the equipment and teach it. Some of the technology was so advanced that only a few people in a schools' area could use it and bringing them in was cost-prohibitive for the college. School staff wanted to hire instructors who were experts in their fields, and preferably still working in or recently retired from it. One staff member discussed how finding staff with the right qualifications can be difficult because industry pays so much more than teaching. But hiring instructors who had been out of the field for a period came with other issues—some began to "lose skill" he said, or were an expert at one piece of equipment but not others. Nonetheless, staff felt "it was very important that our instructors all have recent machining experience, and hopefully, ongoing machining experience." Most CHAMP staff members across the consortium noted the perfect balance seemed to be instructors who worked part-time in the field and taught either full- or part-time.

Another challenge related to finding instructors who are experts at certain types of equipment was staff size. Since most of the schools purchased multiple pieces of specialized equipment, they needed to find multiple instructors. Most instructors were not experts at multiple pieces of machinery. One staff member noted:

> *For our 5-axis mill class, it wasn't enough just to have somebody who knew three and 4-axis, and who could figure out 5-axis mill. We needed to find somebody who was an expert at 5-axis. And same with the Swiss turning center, same with Mastercam, and so, eventually what you find out is you have 10 instructors. And so, it's hard to keep all of them going.*

Additionally, some experts were great at running the machinery, but not teaching courses. Across the consortium staff discussed challenges with instructors who did not have pedagogical backgrounds—they were not trained instructors. This especially became an issue when courses were transitioned to hybrid formats—instructors had to rely on pedagogical knowledge to effectively transition course material including lectures, assignments, quizzes and simulations to an online format so students could spend class time working with the machinery. In several cases this was so foreign to instructors that they had to rely heavily on their schools' or the systems' instructional designers as well as other faculty and staff who regularly used their schools' online learning platform. At some schools, keeping instructors on staff was difficult for this reason. One staff member discussed challenges he had had keeping instructors:

> *We find that some come in and after a semester they just can't cut it. They're just not built for instruction. Their expectations, perhaps, are not realistic. And so after a semester or two they say, that's enough. So that's been an ongoing challenge, and will continue to be.*

Across the consortium finding and keeping qualified instructors was challenging. However, having qualified experts teaching industry-specific courses and equipment was a benefit that most staff felt far outweighed the challenges.

Space Renovations

All nine schools renovated space to some degree to accommodate new equipment. Four schools, however, underwent major renovations: Aims, CCD, RRCC, and LCC. As is often the case, major renovations mean significant delays. And delays were often exacerbated due to federal purchasing requirements for the equipment and federal approval processes for the remodeling of facilities. In some cases, equipment purchases were approved before renovations were, creating situations where equipment was ready to be delivered with no place to put it. Likewise, renovation approval sometimes came during the regular school year, when students were using the facilities and renovations represented a safety hazard until school breaks when buildings were vacant. Timing, thus, represented a major challenge to some schools. There were also instances where renovations were completed, but when equipment arrived it became clear the renovations were incompatible with the equipment. Further renovations/modifications were then needed to make the equipment work as planned.

IMPACT

Impact of hands-on learning reverberated across the consortium. Several common themes emerged relative to positive changes. First, most schools experienced major changes in classroom pedagogy and structure of the classroom. How students learned also changed; hands-on learning increased shop time and decreased classroom—textbook—time. Students learned theory on their own time outside of the classroom. Second, hands-on learning improved the skill sets of students and the confidence students experienced. It also increased the earnings potential for students. Hands-on learning throughout the consortium had an impact on industry as well; it encouraged industry representatives to keep pace with the colleges in terms of highly technical equipment purchases and development of skill sets. Colleges were also able to use this leverage to develop specialized training opportunities for incumbent workers. Overall, a common benefit of hands-on learning throughout the consortium was also the increased ability for students to learn and apply their learning to employment. Each is discussed in detail below.

Classroom Structure/Pedagogical Changes

The purchasing of equipment created a change to the basic structure of classrooms at most of the consortium schools. Simply adding several large pieces of equipment in practice meant classrooms—shop space—needed to be expanded or moved to a new location. Some schools, such as CCD, moved to a completely new facility. Others re-appropriated space on campus or expanded existing space by moving out other programs that were sharing space. In the cases where schools vastly renovated or moved into new facilities, faculty and staff were unanimous in stating that the change had inspired better learning for their students. A staff member at CCD stated:

> *In more ways than just the equipment, but [also] the building itself—the atmosphere—helps with education, and it also helps with the mentality and learning environment that encourages people to say: "Hey, look! I can do better at a shop here. I can learn this."*

Adding new equipment also meant changes to curriculum. For most schools CHAMP meant a major shift to hands-on learning as well as a shift to a hybrid learning format. Some schools employed hands-on learning prior to CHAMP, but the addition of more equipment meant students could learn on their own equipment rather than share, and can spend more time learning hands-on. Most schools transitioned their classes from "watching" classes to "doing" classes. One staff member recounted what the change had meant for his students:

> *We used to have just the lecture and give the students an idea of what this does. But now since we got these equipment, now we have a lab component associated with these where students could do the hands-on experience since our program is more on applied engineering rather than theory-based. So, this equipment gave us very good opportunity to do more practical applications – how this really applies in real world.*

A couple of schools employed procedures where students put the new equipment together as part of their class, since equipment was delivered just prior to classes starting. Since it needed to be assembled and students needed to learn it seemed like a perfect situation to have the students involved in the assembly process. Staff at those schools that did this ended up so happy with the instructional benefit that they made the process a permanent part of the class. Students assembled, used, and then took apart the equipment as part of their class, where it was then ready for incoming students to do the same. Instructors at PCC and RRCC, two schools who adopted the assembly teaching method, found students learned better and faster when they understood how the machinery went together and could learn from their mistakes—when something wasn't assembled properly it didn't work. Instructors regularly told EERC they could teach more practical applications since acquiring the new equipment, rather than only theory-based lessons. Instructors at LCC noted that adding new equipment and changing courses to a hybrid format forced them to restructure their welding program into a "strong set of courses" they will have long into the future, which "strengthens the program a tremendous amount."

Other pedagogical changes across the consortium included developing cross-educational classes. PCC, for example, developed classrooms where students from programs such as machining, HVAC, electronics and CAD all shared classroom space for foundation-level courses such as blueprint reading. This allowed students from different backgrounds and with different interests and insight to learn together. This also closely mimics how some shops operate in the "real world" and better prepares students for a career.

Employing a hybrid format for courses, a goal of the CHAMP project, also created a pedagogical change. This change allowed incumbent workers and students with family and care responsibilities to take classes because lab times—where hands-on learning occurred—were often scheduled for nights and/or weekends. Although not all faculty and staff consortium-wide were positive about transitioning to hybrid courses, many students embraced the change because it allowed them to spend more time "on the shop floor"; learning hands-on.

Improved Student Skills/Confidence

Hands-on learning and improved curriculum has given students the ability to learn more skills than previously. Students can operate machinery, understand manual and technologically advanced processes, and use soft skills. One instructor also said that the renovated facilities gave students the confidence they needed to secure jobs in advanced machine shops:

Employers also noted that students who were trained through the improved programs had improved skills sets and were more employable because of them. One employer stated:

> *A kid coming out of that school or an adult taking the classes, they have a good skill set when they come in. They know what a mill is. They know what a lathe is. They know how to use a micrometer. They know how to read a print. So I can teach them very specific things, the way I want them to learn my machine, but they have a base knowledge and I think that's what's critical for me.*

Improved Earnings Potential

In general, improved skills lead to improved earnings potential. Therefore, improving students' skills through CHAMP programs should allow students to not only get a job but to find employment with good pay. Faculty also mentioned that a primary goal is to help students find employment with a career ladder—jobs with increased earnings potential and upward mobility over time. A major component of that is latticed credentials and the ability for students to work with multiple types of machinery. Some machining students, for example, were training in engineering graphics, which was giving them the skills set to develop a project from start to finish. These students hoped that not only would this give them an edge in employability as well as increased earnings potential, it would also give them flexibility—so they could look for more than one type of job or fill multiple positions for one employer. Some employers were sending employees through CHAMP programs to have them cross-trained on multiple pieces of machinery. This would theoretically give them the ability to hire fewer people, off-setting the cost of paying more salary for the cross-trained employee.

Impact on the Industry

College staff felt by creating industry-specific programs with high-tech equipment they were creating an impact on local industry, as well. A staff member at FRCC also noted that "the manufacturing industry in the state right now is…trying to decide…how [to] become more cohesive." Local employers must continue to acquire advanced manufacturing equipment, and to re-organize the manufacturing industry within the state. He believes the colleges have been able to "help lead that charge." By purchasing specific equipment and mimicking a real-world work environment—a standard set by industry-- colleges have proven to industry partners a "commitment to trying to solve a need for them," especially in terms of providing quality potential employees, and that we were going to do it on a very quality level for them." This in turn has mobilized industry support and community awareness. Staff at FRCC, where major renovations and re-structuring created a training center-style manufacturing center to mimic real-world work environments, discussed how the facility had impacted local employers and the community: "When they [industry partners] came and saw our open house and saw what was there, more and more have jumped on the bandwagon to help support it…and the community as well, [is] so impressed."

Staff at Aims also noted that many employers do not yet have some of the high-tech equipment that the colleges recently purchased. Because of that, the staff member feels the colleges are "raising the bar pretty heavily within [the] industry." An employer-partner with FRCC echoed this when he said, "the folks that are coming out of trade schools these days, they're learning on these new machines so it's trying to stay up with technology because that's what they're teaching at the schools." Because of this, quality hands-on learning on state-of-the art equipment, such as that provided in CHAMP-funded programs, is having an impact on industry and driving innovation in the field.

Specialized Training Opportunities

Another impact hands-on learning has had for the CHAMP colleges relates to specialized training opportunities for incumbent workers. Several schools have been able to develop new specialized training curriculum focused on specific machines to target incumbent workers. Employers at local machine shops send current employees to get training on very specialized equipment, such as the 5-axis mill and the Swiss Turn machine. Because of this, several schools have been able to expand enrollment/recruitment opportunities to include more incumbent workers and diversify the student population. Allowing for more types of students has also increased the sustainability for programs at several schools, since employers will often pay for employees to receive specific training.

Student Learning

One of the biggest impacts the grant-funded equipment has had on participating schools throughout the grant period has been on student learning. Prior to this change, those schools that had pre-existing programs focused more on theory, predominantly relying on lecture and textbooks to teach technique. Some had manual machines donated by industry or previously purchased by the college that were outdated but functional; instructors used them to teach students foundational principles. Some colleges had one or two pieces of machinery that were more current—but not enough for each student to use. Students either took turns operating the machinery while the rest of the class watched, or instructors operated the machinery while students watched. Some colleges ran 3-D printing classes, but without individual machines for students to learn on. Those that had a 3-printer were generally using older, slower technology that could only print demonstration pieces rather than projects each student developed. The purchase of grant-funded equipment has changed the student experience by allowing them to learn hands-on—operating equipment they otherwise wouldn't have been exposed to.

Throughout the course of the grant period, EERC interviewed students across the consortium. Overwhelmingly, students were highly favorable of hands-on learning and felt their instruction was preparing them for the workplace. For a detailed reporting of students taking courses during 2016 and their perspectives on the impact of the grant, see the "student voices" section of this report. The section below briefly outlines students' perspectives of hands-on learning relative to the impact equipment purchases have had on student learning.

All students interviewed appreciated hands-on learning more than the alternative—theory-based knowledge. Most students stated they learned better hands-on than from books or lecture. This is not surprising since most students self-selecting for machining, welding, drafting, or other technical programs are less likely to enjoy theory-centric classes than those who might pursue, say, a liberal arts education. One student said he enjoyed working with the equipment because he was "getting to do something instead of taking notes all day. I'm learning a skill instead of writing and reading all the time." Another described how easy it was for him to learn while doing, and how impressed he was that he was learning from the very first day of classes:

> *When I first got here I had no idea of what I was getting into. But I was impressed the first day because it was all hands-on. I was in Motors Control, it was my first class. We actually went out and…put the parts in there and made sure that they were – the wiring was screwed in, and then, boom, the motor came on.*

Another student said: "I like the hands-on part. I am not good at focusing but when I have to do something with my hands, I can do that." Another echoed this sentiment, saying that he learns easier if the concepts are applied in a hands-on manner:

> *It's so much more valuable, at least to me, than book learning. I feel like I can grasp a concept much easier if I'm actually doing it and I can see it and be like "Oh, yeah, well we blew that circuit." It makes a lot more sense if I'm actually doing it and I'm watching the sparks fly. And I go "Oh, yeah, that's because it shorted right here." Reading things in a book it seems like – it seems more like regurgitation. It's like, okay, I memorize it, take the test, and a week later I'm not gonna remember it. Whereas hands-on learning I feel like I still remember the lessons that I learned a year ago with that type of learning. So, it's more valuable.*

A student in a drafting course discussed the difference having 3-D printers has made in his class:

> *I like the 3D printers because it helps with your designing even and the – because you can see – you're able to print out what you make and see it, hold it, and see how it works, and make changes, and you can adapt your designing to how they're gonna actually work in the real world as opposed to having it here and then having it shipped off somewhere else where it's got to be printed and then shipping it back. And it cuts out a lot of time on it and it's a huge help to actually be able to see it, see it work. And like you said, with the hands-on stuff, it's really, really good.*

Likewise, an instructor for this course also discussed the benefits the equipment has brought to the class:

> *The 3D printer has really helped us out. It shows the students not only what they're building, but they make mistakes and they get into what we do in real life. You build something and it doesn't work out. We used to have to do it in metal and when it didn't work out, we used to say, "Come pick up your boat anchor." But now with the 3D printing, the students make the mistakes, turn around and reprint.*

Some schools purchased both manual and high-tech versions of equipment, giving students the ability to learn the foundations of a skill before moving to more automated machinery. Many students interviewed by EERC appreciated learning in this manner and felt it was the only way to truly learn skills applicable to employment. One student said:

> *I kind of compare it to math like with math you can't do calculus without knowing how to add. You can't work on a CNC lathe without knowing what it takes to do it manually at first because that can only enrich your experience and enrich your knowledge as to what you want. So, I really enjoy it.*

Marketing/Recruitment/Enrollment

Another impact equipment purchases have had on participating colleges has been increased enrollment due to exposure. A staff member at CCD told EERC that the equipment…

> *…brings us more students because of all this exposure. It has brought us more incumbent workers to get training. It's had an impact in that way. Students didn't know we were here [before]. I'm still surprised by the number of students and employers who don't know we're here because we don't have a marketing budget for the programs. It has impacted the school because it has brought them tremendous exposure.*

Another at FRCC said:

> *You just walk out and go "Wow!" And we have held several events here. The very first one an information session that had 150 people attend when machining was considered icky and nobody knew what it was and we had 150 people attend.*

Similarly, a staff member at EGTC said:

> *When you come in and you see the guys on the floor and sparks are flying and they just look really cool and they've got all this awesome gear on, I think it peaks a lot of interest. And it's like, "Wow, what is that?!" And "I think I can do that." And "I want to try that." So, I think, yeah, there's a demand and there's a need for it, but people like seeing it. It looks cool.*

At LCC, instructors set up a welding simulator during the open house for the program, which has garnered a lot of attention and interest in the program. An instructor spoke about how the open house has increased enrollments in the program due to the "wow factor" with the simulator: "We bring in the welding simulator. And that's probably been our biggest recruiting marketing piece right there. There's a line throughout the whole thing to try out the welding simulator, and then students sign up for the program right there."

Marketing the programs though open houses and demonstration days has proven an important student recruitment tool for CHAMP colleges. But it has also increased the awareness of the programs to community members and industry partners. By holding open houses and demonstrations and allowing local employers to see the quality of instruction students can receive, these events have put programs "on the map" and have become an important piece for sustainability.

Staff at CCD have especially focused on using their new space to increase awareness among employers. A staff member noted the practice has been working:

> *We're seeing that evidence now with the increase growth in machining and the welding programs and the ever-increasing awareness and demand we have out in the community. So that exists and it just an issue of us keeping that moving forward as we go on to the future. That's all predicated on ensuring that the community and manufacturers in particular know that were here. So, anything we can do to let manufacturers know that we're here, we do that. National Manufacturing Week, National Apprenticeship Week which is coming up, [etc.].*

FUTURE PLANS

When asked about future plans relative to hands-on learning, staff at most of the consortium schools mentioned plans to add additional pieces of equipment in the future. Some also have plans for additional expansion of facilities. FRCC, for example, had already convened 30 manufacturers from the area to discuss plans for a center for integrated manufacturing. The discussion involved outlining what the center could look like and gaining insight from manufacturers about what it would need to include. From that meeting, a steering committee of local manufacturers was developed to further outline plans.

Colleges were also seriously considering what the future of manufacturing looked like relative to automation. As a staff member at FRCC noted,

> *Now we're looking at: "What is automation going to mean to manufacturing? How is that going to impact those occupations?" And "What are additional needs that are not being met out there?" ...Both non-credit customized, and then also with – certainly the* machining program is

really doing well, very successful – both our credit, non-credit side. But what else do we need to do? Because we know we just don't want to put all our eggs in one basket.

Employers interviewed by EERC staff were somewhat mixed in their views on automation. Some felt automation was already an important part of their operations, while others felt it was unnecessary or at the very least something they did not need to worry about for the near future. Regardless, college staff across the consortium were considering next steps in preparing students for a future involving automation.

SUSTAINABILITY

Part of consideration of the future of CHAMP-funded programs across the consortium is certainly sustainability planning. Chapter 19 of this report is devoted to the discussion of sustainability. However, a brief discussion here will consider sustainability relative to hands-on learning and equipment purchases. Most schools were considering maintenance costs relative to the equipment purchased, some of which are considerable. Instructors at some schools were taking special courses to be able to perform maintenance on the grant-purchased equipment. Others were training assistants to help with maintenance, and some were building maintenance into courses and teaching students how to maintain the equipment. This had the added benefit of built-in maintenance of the machinery every semester. Many schools had put policies in place to ensure daily and weekly upkeep, as well as end-of the-semester maintenance. This can be challenging to make sure the tasks are being completed. A staff member at one school spoke of this relative to new policies in place for the schools' machining programs:

Making sure that instructors and students follow those policies is my biggest challenge—for example – cleaning the machines, daily oiling. These sound small, but they are very important. When they [students] are in real jobs they will be expected to take really good care of the equipment… because they need to keep [the] machines working.

For all colleges considering hands-on learning involving highly technological or cutting-edge equipment, sustainability also means staying current. Some schools' staff were concerned about their ability to stay current, especially considering the cost of some of the high-tech equipment purchased under the grant. Without grant funds it would be impossible to make similar future purchases. Most staff felt the equipment had a "long life"—many mentioned still using equipment purchased in the 1970s—but were still aware of the possibility of falling behind the technology curve relative to industry.

CHAPTER 6: AUTOMATION

Sara Haviland

AUTOMATION IN THE COLORADO MANUFACTURING INDUSTRY

Today's manufacturing shops are evolving toward higher skilled tasks for workers, a process that will continue as automation removes the more repetitive or physically demanding processes from human hands. To ascertain the role that automation may play in the near term in the Colorado manufacturing sector, the CHAMP program undertook a pilot study on the state of the industry and workforce from the perspective of manufacturing employers. These findings are derived from interviews with employers involved with the CHAMP program (N=15) and a pilot survey with employers attending a regional meeting of Colorado manufacturers (N=10). All data were collected between May and August of 2017. Given the small number of survey respondents these results should be seen as exploratory, but they point to important trends that may affect demand for the manufacturing workforce and inform directions for future research.

Employers are generally interested in increasing automation and some have already implemented automation processes of varying scope and scale. However, multiple interview respondents noted that the process of automation was not as simple as it appeared, and implementation could be time and resource intensive. We discuss employers' views on the manufacturing workforce and motivations for automation, as well as some of their challenges and concerns related to automation.

AUTOMATION AND THE WORKFORCE OUTLOOK

The fates of the manufacturing workforce and of automation are intertwined, as automation addresses tasks previously performed by workers and changes the nature of the jobs held by workers in any operation. For this reason, automation is often described as a threat to the manufacturing workforce, as it has the potential to ultimately cause the number of jobs in manufacturing to dwindle to a small number of specialists running computers and robotics rather than a larger number of workers carrying out manual tasks. However, employers report that they already face challenges in finding enough skilled workers to fill their jobs, and that automation is a tool that can help them to address these shortages.

As seen by employers, the manufacturing in Colorado is a stable growth industry. Survey respondents were optimistic about the future growth of their firms; 7 out of 10 expected to increase employment over the next 6-12 months, and 6 out of 8 responded that they expected the number of manufacturing positions in their organization would expand (the remaining two expected the number to stay the same; no one expected the number to contract). However, they were less optimistic about the available workforce to fill these positions. We asked survey respondents whether they had issues in finding qualified workers when hiring; 9 out of 10 responded yes. We presented those 9 employers who faced challenges six common reasons why they might be facing challenges, and asked them to select all that applied. Ranked in order of agreement, these reasons were:

Table 1. Employers' perceptions of challenges to finding qualified workers

	N of respondents
Lack of technical competencies (hard skills)	7
Lack of workplace competencies (soft skills)	4
Lack of experience	4
Lack of available applicants/no applicants	4
Inability to pass a drug test and/or background check	3
Looking for more pay than is offered	2
Total respondents	9

Skills and experience, specifically the lack thereof, were cited most often as challenges to filling positions. Technical competence was the biggest challenge.

Given that there may be difficulties in filling jobs, we asked the respondents about alternative strategies they may have considered to address gaps in their workforce, with respondents again selecting all that applied from a list of 6 strategies. Automation was the most popular strategy, as demonstrated below:

Table 2: Strategies employers considered to address challenges in staffing jobs

	N of respondents
Introducing automation to some components of your operations	6
Training incumbent workers to fill different jobs	4
Outsourcing some components of your operations to (sub)contractors	3
Bringing in labor from abroad	3
Relocating your manufacturing facility domestically	1
Relocating your manufacturing facility globally	0
Total respondents[108]	9

Though globalization and outsourcing have historically been viewed as threats to American manufacturing, none of the employers were considering international relocation – and domestic relocation was not much more popular. However, filling the gaps by retraining incumbent workers, or bringing labor in via subcontractors or foreign workers were strategies also considered by some.

[108] The total respondents varied by item, with earlier survey questions yielding 10 respondents and later questions yielding 9.

We asked respondents if they had automated any processes in their manufacturing facilities in the past 5 years; 6 of 9 responding reported that they had. Asked if they had any interest in increasing automation of their manufacturing processes in the next 5-10 years, 7 of 9 responding answered in the affirmative.

We presented respondents with a list of 9 factors that might be important to their decision to add automation to their factory, and asked them to select up to three factors that resonated. Increased safety, speed, and competition were the most-often cited reasons to automate. In order of importance, these included:

Table 3. Factors that are important to employers' decision to add automation to their operations

	N of respondents
Increasing safety on the shop floor	6
Increasing speed of production	6
Remaining competitive with manufacturers in the US	6
Reducing waste in production	5
Reducing physically demanding tasks for employees	5
Meeting industry demand for your company's products	4
Saving on labor costs	4
Adjusting for shortages in qualified workers	4
Remaining competitive with global manufacturers	3
Total respondents	9

Reduction in waste and physically demanding tasks for workers was also important. In a similar vein, in interviews the improved accuracy of production was also a factor, as one respondent noted: "Every time someone – every time an operator touches a part, there's a risk for failure." Workforce considerations were not at the top of the list; saving on labor costs and adjusting for shortages in qualified workers were nominated by four survey respondents each. Though safety was a top priority, efficiency (speed, competitive edge, reduced waste) loomed large, as we also found in the interview data.

EFFICIENCY AND COST CAN BE THE DETERMINING FACTORS FOR AUTOMATION

Many of the manufacturers interviewed view automation as part of a larger conversation about efficiency, which often makes or breaks the decision to add automation to the manufacturing floor. In interviews, employers discussed the challenges of automation, and efficiency concerns were the most often cited reasons why they had not automated or why their automation was not more extensive. Automation was time and resource intensive, did not make sense for all industries, and involved workforce challenges. In short, when automation will increase efficiency and capital is available, it is considered or adopted, and when there are roadblocks that would limit efficiency or the cost is prohibitive, it is not considered or adopted.

One challenge to automation is the startup phase, as discussed by interviewees. The time to get automated processes up and running smoothly can be considerable. As one manufacturer noted, "We've dabbled in it, but it's not as easy as what you want to think…. I visited a company in California that I thought was absolutely phenomenal just last week and they had one robot and it took them 12 months to get it set up to run one single part number, to do a little deburring, brush finishes on it. It took a full year. So it's not an easy thing."

This time investment makes sense for industries with large, unchanging production lines, but the payoff could seem less clear for others. For example, in industries such as short-term manufacturing, particularly in rapidly changing industries such as the medical industry, it can be inefficient to automate as the machinery needs change frequently and the capital investment does not pay off. However, in companies that manufacture a more stable list of products, where the capital exists to introduce computerization or robotics, automation can help manufacturers to be more competitive.

The capital investment is also considerable. Though the investment may pay off in the long run for manufacturers with stable needs, the upfront costs can be a deterrent. Reflecting on the sizeable investment in technology, one manufacturer noted, "The trick with a machine shop to be profitable is it has to run around the clock. Machineries – the machine we were buying, our average cost probably would be around half a million dollars per machine, the types of things we have, up to a million per machine. So we want that to run at least 20 hours a day for us to make money."

Finally, workforce factors can make or break an automated shop. Employee skills are something employers must consider as automation introduces demand for new skill sets on their manufacturing floor. When we asked survey respondents what level of training the majority of their current workforce would require to work the equipment if they were to automate, 5 respondents reported minor on-site job training, and 3 reported major on-site job training. No respondents selected minimal or no training, training off-site at a technical school or college, or that they would hire new employees rather than retrain their current workforce. These findings were mirrored in interviews, where manufacturers often discussed the symbiotic relationship that a more highly skilled workforce and automation played; automation reduces the needs for a sizeable workforce, but is only possible if a highly skilled workforce is available to run it. For those manufacturers who have been able to attract a skilled workforce, automation can greatly increase efficiency, and automation is increasing the importance of that skilled workforce. As one manufacturer who had successfully automated tasks noted, "We're driven really by cost to automate. But again, having an extremely stable and well trained workforce allows us to keep that automation running at a super high efficiency rate."

As another interview respondent noted, "That's one of the challenges, finding people. That's why the manufacturing engineers are so important."

Lingering concerns about automation

Finally, we asked respondents to consider negative factors that might be associated with automation and report how concerned they were using a four point Likert-type scale (1=not concerned at all, 2=somewhat concerned, 3=concerned, 4=very concerned). We calculated the mean score on this scale for all respondents, and present the results in order from the items that evoked the most concern to those that evoked the least. Generally speaking, employers were somewhat, but not overly, concerned about automation, with a highest mean item score of 2.86 (approaching concerned on the Likert scale), but with mean scores under 2 (somewhat concerned on the Likert scale) for 5 out of 7 items. Reflecting the interview findings above, employers were most concerned about the cost of acquiring the tools for automation, with 72% reporting they were concerned or very concerned, though they were less concerned about the cost of training incumbent workers to operate automated components, with 71% of employers reporting they were somewhat concerned and the remainder reporting they were not concerned at all. Despite the calmer attitude toward the cost of training, employers were concerned about their employees' level of training in dealing with automated parts, and that their employees would be resistant to automation or uncomfortable working with automated components.

Table 4. Employers' concerns when considering automation

	Mean score	(1) Not concerned at all	(2) Somewhat concerned	(3) Concerned	(4) Very concerned
Acquiring the tools for automation will be cost prohibitive.	2.86	14%	14%	43%	29%
Employees do not have the training necessary to deal with automated components.	2.14	14%	57%	29%	0%
Employees will be resistant to automation.	1.86	29%	57%	14%	0%
Employees will be uncomfortable working with automated components.	1.71	43%	43%	14%	0%
Training incumbent workers to operate automated components will be expensive.	1.71	29%	71%	0%	0%
The public will be resistant to automation.	1.43	57%	43%	0%	0%
Automation will make the manufacturing floor less safe for workers than before.	1.43	86%	14%	0%	0%

NEXT STEPS

The findings presented in this brief are exploratory; future research is required to make more robust statements about the state of automation in manufacturing. We are continuing to examine these trends in other manufacturing projects at the Education & Employment Research Center.

However, these findings offer a glimpse into the mindset of the American manufacturing employer. These employers perceive workforce shortages that may make them more inclined to automate processes on their manufacturing floors, if they can balance cost and efficiency, and if they can find skilled workers to work with the automated processes. For educators and advocates working with the manufacturing workforce, training toward higher level skills may be the best bet to prepare individuals to succeed in this market.

PART D: SKILL BUILDING AND CAREER PATHWAYS

CHAPTER 7: CAREER PATHWAYS

Sarah Blanchard Kyte and Heather McKay

CHAMP, PATHWAYS, AND SUPPORT FOR STUDENTS

In addition to creating and reforming programs and developing stackable credentials – short- and long- term certificates and associate degrees - CHAMP colleges were involved in supporting students' academic progress and career pathways. Activities related to such support included hiring campus navigators[1] to assist students in their educational and career trajectories; and providing students with informational resources including a web portal (Colorado Career Action Tools) that linked educational and workforce opportunities.[2] CHAMP colleges also cultivated relationships with local employers to identify internships and job openings.

CHAMP programs varied by college in terms of their programs of study, e.g., welding, engineering graphics, and in the credentials students could earn. They also varied in terms of the educational pathways students could choose, completing any number of credentials. Taken together however, the infrastructure around CHAMP – in curricula, credentials, personnel, networks, and informational resources – offered students supported educational pathways rather than structured or guided pathways. As a result, CHAMP students could choose their own path through CHAMP curricula and along the way complete any number of combinations of credentials – or none at all – en route to the labor market.

METHODOLOGY

This report uses institutional data from the Colorado Community College System (CCCS) for students who enrolled in CHAMP courses. These data were merged with postsecondary enrollment records from institutions outside the CCCS system obtained from the National Student Clearinghouse (NSC) as well as employment records from the Unemployment Insurance (UI) Wage Records Data. Details on the statistical comparisons described in the text are included in the appendix.

The reader should note that this report covers the credentials offered at each of the colleges– short and long-term certificates and associate degrees – and that not all colleges offered the same array of credentials. Further, some colleges offered only certificates for a CHAMP program of study, and not an associate degree. At the same time, some students (those at FRCC) had the option to complete an associate degree in a non-manufacturing subject area.

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[1] EERC's report on the career navigator will be available on the EERC website fall 2017

[2] See EERC brief on the website: ttps://smlr.rutgers.edu/sites/default/files/documents/CHAMP%20Website%20Brief%20FINAL%202-8-16.pdf

OVERVIEW

This report explores the pathways of the 3,070 students who enrolled in CHAMP courses between 2014 and 2017 at six CCCS community colleges.[3] The analytical decision to include all students who engaged with CHAMP coursework provides a comprehensive view of the pathways students took. It provides some insight into the role of the support structures provided under CHAMP, but can also be viewed as a look at student decisions absent formalized, guided pathways. *Pathways* can refer to a range of dimensions of students' experiences including indicators of progress, credential completion, and early career outcomes (Calcagno, Crosta, Bailey, & Jenkins, 2007; Carnevale, Jayasundera, & Hanson, 2012; Marti, 2008; Pallas, 2003). This report, however, takes an approach consistent with other examinations of community college pathways in the context of stackable credentials. It therefore operationalizes "pathways" as the various credentials completed by students following first enrollment (Giani & Fox, 2016; Karp, 2015; Shulock, Moore, & Offenstein, 2011). As such, the report follows students from their enrollment in CHAMP courses through their completion of various credentials to understand the choices made by students in CHAMP classrooms absent guided pathways.

Findings indicate that some students completed one certificate or a single associate degree but as this report will detail, many chose pathways that entailed earning multiple credentials. Moreover, this report distinguishes between two groups of students who completed multiple – or stacked – credentials. The first group includes students who completed multiple certificates while the other includes those who completed at least one associate degree *as well as* a second credential which could be either a certificate or a second associate degree, regardless of sequence. Typically, these students earned a certificate as well as their associate degree (88 percent) though a small minority earned two associate degrees (12 percent). Finally, many students taking CHAMP coursework had earned no credentials as of 2017. Therefore, the five pathways include (1) students who completed no credential, (2) students who completed a single certificate, (3) students who completed multiple certificates, (4) students who completed an associate degree, and (5) students who completed an associate degree and at least one other credential.

After exploring the distribution of CHAMP students across these five pathways, this report proceeds in three parts. First, it identifies patterns of institutional engagement and support by detailing the pathways taken by students at each community college and their patterns of engagement with CHAMP courses and navigators. Second, it examines the demographic and social characteristics of CHAMP students within each pathway to shed light on the extent to which key groups of students engaged with various types of individual or stacked credentials. The report then situates these pathways within long-term patterns of engagement with higher education to understand the extent to which participation in CHAMP represents only a portion

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[3] These include Community College of Denver (CCD), Front Range Community College (FRCC), Lamar Community College (LCC), Pueblo Community College (PCC), Pikes Peak Community College (PPCC) and Red Rocks Community College (RRCC).

of a longer educational trajectory. Finally, the report looks at the impact of various CHAMP pathways on employment and earnings within the Colorado labor market.

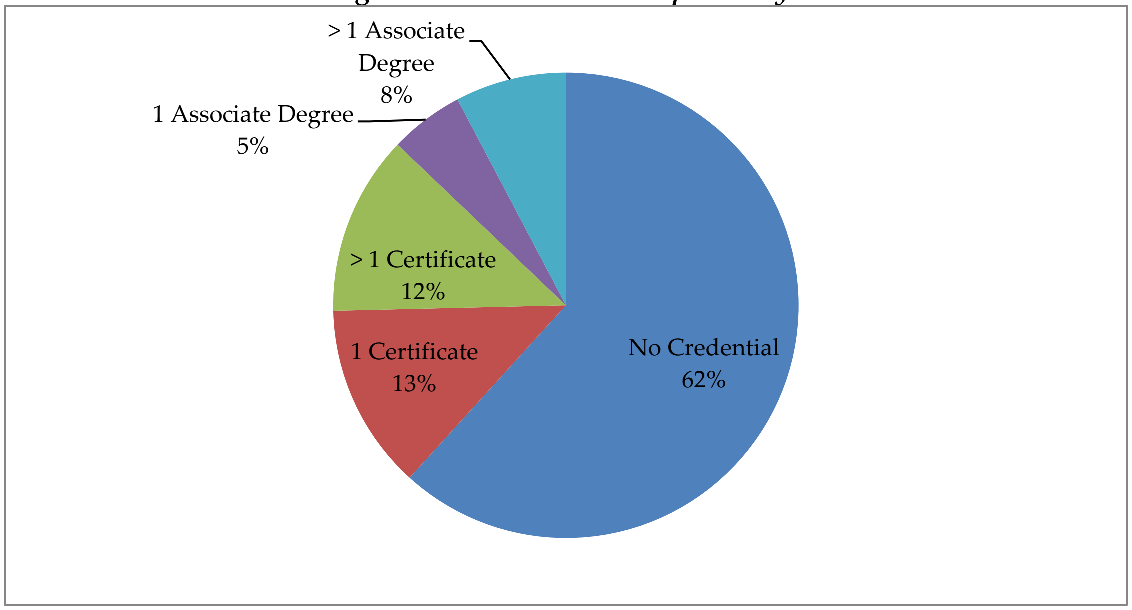
DEFINING STUDENT PATHWAYS

Figure 1 shows the proportion of CHAMP students within each pathway. Sixty-two percent of all students who enrolled in a CHAMP course had not yet completed a certificate or degree at CCCS as of summer 2017. By contrast, 13 percent of CHAMP students earned a single certificate and 12 percent earned multiple certificates. Finally, 5 percent of students completed a single associate degree and 8 percent completed more than an associate degree, meaning they earned an associates *and* at least one other credential. From a different perspective, although students' pathways often entailed only coursework and not a credential (62 percent), a similar percentage of students earned single credentials (18 percent total) as earned multiple, stacked credentials (20 percent total).

The perhaps surprisingly large percentage (62 percent) of students who had not completed a certificate or associate degree following CHAMP enrollment merits some discussion. First and foremost, in focusing on the full breadth of students who enrolled in CHAMP coursework, this analysis includes many students who took CHAMP courses only incidentally as they pursued other programs. Indeed 40 percent of CHAMP students within the "no credential" pathway were in the liberal arts or humanities programs when first enrolled; however, this was also true for 18 percent of students in the credential-bearing groups. The non-completer group also includes students who chose to pursue the skills gained through useful coursework rather than credentials (Bahr, 2014). Further, 11 percent of the students not earning credentials were enrolled in non-credit courses.

As noted above, there are some other ways to look at this group. The non-completers are disproportionately drawn from the later years of CHAMP – 48 percent enrolled in 2016 and 2017, compared to 33 percent of those in the other pathways – and so it is likely that they may not have had sufficient time to complete a credential (Bahr, 2014). Finally, some non-completers may have dropped out before completing an intended credential as evidenced by a fall to fall retention rate of 39 percent for this group, compared to 68 percent among students in other pathways.

Figure 1. CHAMP student pathways



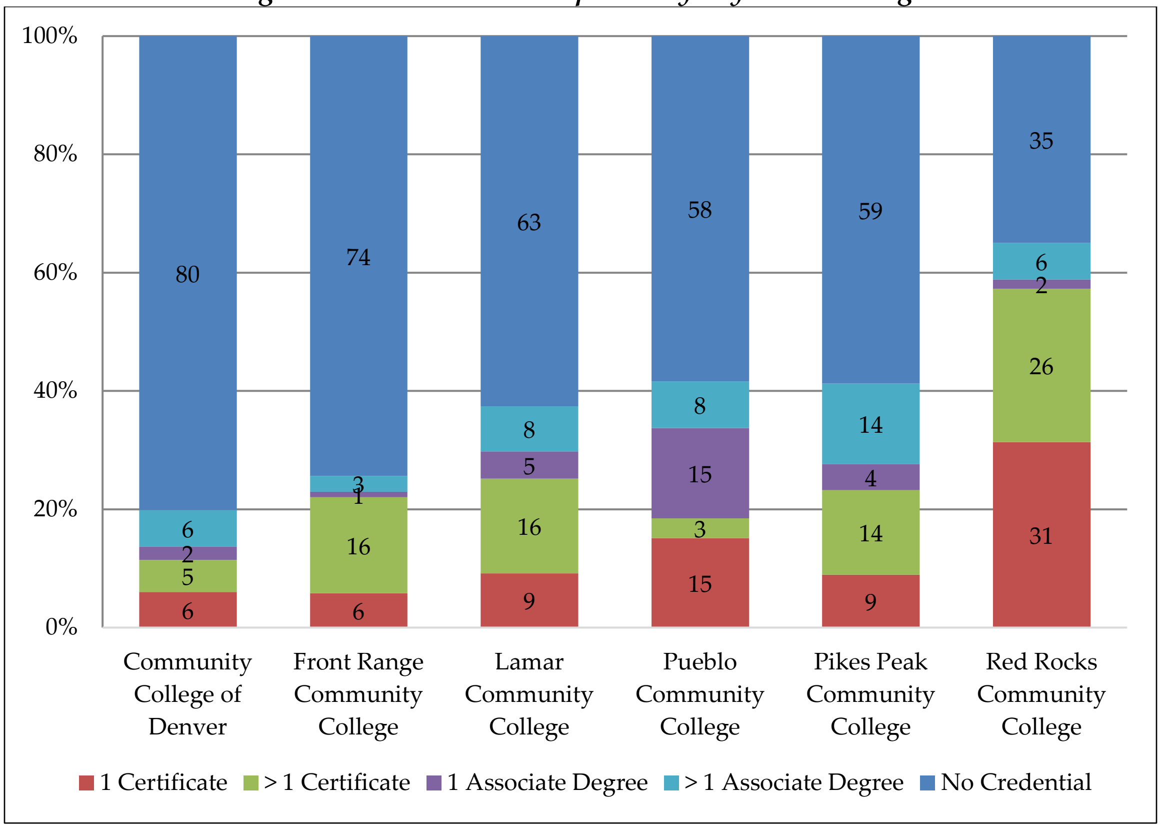
CHAMP PATHWAYS AND ENGAGEMENT ACROSS CCCS COLLEGES

Figure 2 disaggregates the data by college to depict the percentage of students within the five pathways at each of the six CCCS colleges that offered CHAMP programs. Not every college offered the same array of certificates and associate degrees, thus opportunities to stack credentials varied by institution. Student populations also varied by college – such that some had more non-traditional students or students who were incumbent workers seeking to gain skills rather than credentials.

CCD students who enrolled in CHAMP coursework were less likely to complete a credential than students at other colleges in the consortium (80 percent non-completers). Students at FRCC also had a low rate of completion (74 percent). However, among the students who did complete at FRCC, 16 percent earned multiple certificates. FRCC and CCD's low completion rates are due both to time-censorship and the inclusion of non-credit students in the data set.

LCC students and PPCC students were statistically identical to one another, with roughly 60 percent of students earning no credential. However, students who completed a credential had higher rates of stacking credentials (roughly 25 percent at each college) than earning a single credential (roughly 15 percent). PCC students were less likely to stack their credentials than students elsewhere, but PCC evidenced the largest percentage of CHAMP students earning an associate degree (15 percent). Fifteen percent of PCC students also earned a single certificate. Finally, RRCC stands out as having had the largest percentage of students completing a credential (65 percent), earning a single certificate (31 percent) and earning multiple certificates (26 percent). The completion rate of RRCC students in part reflects the active work of the navigator reviewing students' transcripts—even those who had withdrawn from the college—and helping them to apply for the credentials they had earned. In some cases, students were unaware they had even earned a credential. This finding suggests the need for more routine review of students' transcripts to identify all credentials they have earned.

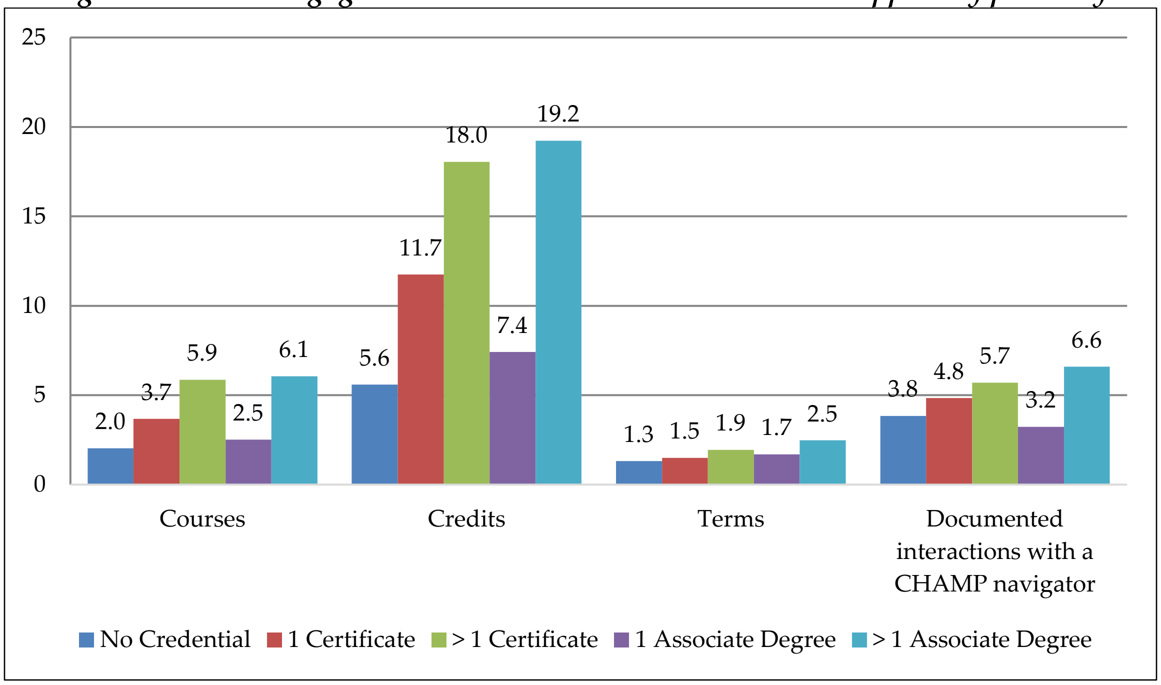
Figure 2. CHAMP student pathways by CCCS college



Taken together, despite many commonalities of CHAMP programming across the six campuses, the pathways taken by students at each college resulted in distinct profiles. We turn now to some of the patterns of student enrollment and support along these pathways. Figure 3 presents the number of CHAMP courses, credits, and terms of enrollment pursued by students as well as their interactions with CHAMP navigators. Students on the no-credential pathway or who earned only one associate degree took the smallest number of CHAMP courses (2.0 and 2.5, respectively). By contrast, students with stacked pathways who earned multiple certificates or multiple credentials including an associate degree took the most CHAMP courses (6 courses in each group). On average, CHAMP students completed 9 credits of CHAMP coursework over 1.5 semesters of enrollment; these measures follow the same general pattern across the five pathway groups.

Tracking the documented interactions between CHAMP students and navigators, EERC found an average of 4.6 interactions with a CHAMP navigator; however, the number of interactions ranged from 3.2 among those earning a single associate degree to 6.6 among those who earned more than one associate degree. Thus, students who had some interaction with a navigator earned more credentials – either certificates or associate degrees. This suggests the effect of navigator support and advisement on credential completion. This is likely a result of navigators' discussions with students about the availability of additional educational options as well as linking academic and career pathways.

Figure 3. Student engagement with CHAMP coursework and support by pathway



DEMOGRAPHIC AND SOCIAL PROFILE OF CHAMP STUDENT PATHWAYS

Table 1 considers the demographic and social characteristics of students across the various pathways. We begin with gender; one in ten CHAMP students was female. EERC found no statistically significant difference in what pathway they pursued.

Ethnic differences in participation across CHAMP pathways do appear and are shown in Table 1. Specifically, white students (64 percent of all CHAMP students) were more likely to pursue a pathway where they received multiple credentials than to be in a pathway with no credential. By contrast, Hispanic students (16 percent of all CHAMP students) were more likely to follow conventional pathways resulting in a single credential – either a certificate or an associate degree – rather than to stack their credentials. Part of this finding may be accounted for by the concentration of Hispanic students at Pueblo Community College where these single-credential pathways were more typical (James & Edwards, 2016).

In terms of students' ages, non-credential earners and those who earned more than a single associate degree tended to be slightly older on average (28-29 years old) than CHAMP students pursuing other pathways (25-27 years old).

The second half of Table 1 shows social background characteristics - Pell grant eligibility and veteran status of CHAMP students by pathway. The 38 percent of CHAMP students who were

Pell grant eligible, were concentrated within the group of students who had earned one or more associate degrees. This suggests that access to financial aid may facilitate students' academic progress and attainment of credentials, i.e., they may have to work less or not at all while they are studying. To clarify if this is the case, a deeper analysis that includes part time/full time student status and concurrent employment would be needed.

Finally, while 12 percent of all students were veterans, these students were more likely to have earned multiple credentials including an associate degree (20 percent) than to have earned no credentials (11 percent). These students also did well in terms of completion. This finding requires future investigation. Does this mirror the experience of the general CCCS veteran student population or is it reflective of the supports these students may have received under the CHAMP grant? Alternatively, did CHAMP present a particularly strong pathway for students to leverage their prior military training and development?

Table 1. Demographic and social characteristics of CHAMP students by pathway

	No credential		**1 Certificate**		**> 1 Certificate**		**1 Associate degree**		**> 1 Associate degree**	
	Mean	(StD)	Mean	(StD)	Mean	(StD)	Mean	(StD)	Mean	(StD)
Gender (%)										
Male	89.9		87.4		93.0		91.8		92.8	
Female	10.1		12.6		7.0		8.2		7.2	
Race/Ethnicity (%)										
White	60.6		65.4		75.5		64.6		74.7	
Hispanic	16.5		19.4		10.9		24.1		11.8	
Other	23.0		15.2		13.5		11.4		13.5	
Age*	29.1	(12.4)	27.0	(11.5)	25.3	(10.6)	26.1	(10.5)	27.6	(9.6)
Pell grant eligible (%)	33.8		39.4		34.9		61.4		58.2	
Veteran (%)	10.7		11.6		14.6		13.9		20.3	
N	1895		396		384		158		237	

SITUATING CHAMP PATHWAYS WITHIN EDUCATIONAL AND EMPLOYMENT TRAJECTORIES

This section examines students' pathways within the context of their postsecondary educational experiences. It then looks at students' pathways in terms of the students' pre- and post-CHAMP employment history.

First, Figure 4 examines the extent to which CHAMP students on various pathways earned certificates or associate degrees at CCCS prior to their enrollment in CHAMP. It also uses National Student Clearinghouse (NSC) records to shows if, post-CHAMP, students went on to enroll in a different postsecondary college or university.[4]

Overall, only 6 percent of CHAMP students across all groups had previously earned a certificate at a CCCS college. However, of note, 17.3 percent of students who had earned a certificate prior to enrollment in CHAMP went on to earn multiple degrees including an associate degree. And 10.1 percent went on to earn a single associate degree. Thus, of the students who had prior certificates, 27.4 percent went on to earn one or more associate degrees. Further research is necessary to assess the clustering of credentials across subject areas.

Far fewer students overall earned an associate degree prior to their enrollment in CHAMP courses (3 percent). However, of interest, 5.1 percent of those who did have a prior associate degree went on to earn a second associate degree and 3.1 percent went on to earn multiple associate degrees.

Finally, CHAMP students who earned either a single CHAMP certificate or multiple CHAMP-related credentials, including an associate degree, were more likely to have earned a previous certificate. And students without a prior credential were less likely to have earned a single certificate or completed their CHAMP program of study.

Fifteen percent of all CHAMP students enrolled at another postsecondary institution post-CHAMP. Students who had earned one or more associate degrees (38.1 percent) went onto for further post-secondary education. However, almost a third of students who had earned one or more certificates also went on for further post-secondary studies (31.3 percent). Overall, forty two students, 1.5% of all CHAMP participants in this analysis, went on to enroll at Metropolitan State University (MSU), the four-year university which offered an articulated pathway for students from CHAMP's community colleges.

Figure 4 shows that students who earned a single associate degree were more likely to transition to postsecondary enrollment elsewhere (23 percent) than students on other pathways. Thus, CHAMP students built on prior certificates to earn associate degrees, and also used CHAMP as an avenue towards further education. In many cases, it may be best to look at the stacking of credentials within CHAMP as part of a larger sequence of stacking credentials preceding and following from CHAMP.

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[4] This analysis relies on available National Student Clearing House (NSCH) data.

Figure 4. Pre- and post-CHAMP participation in higher education by pathway

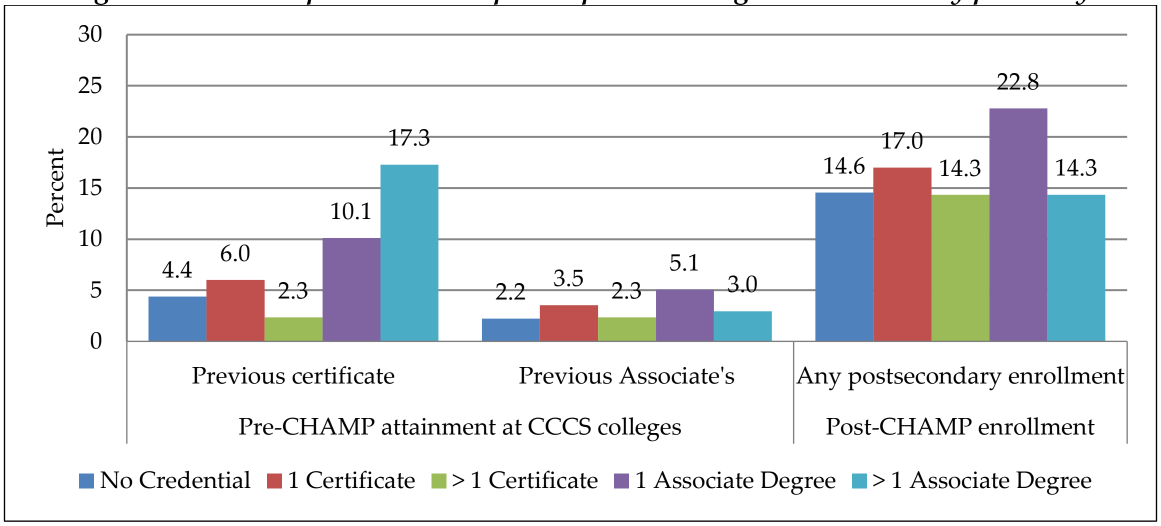
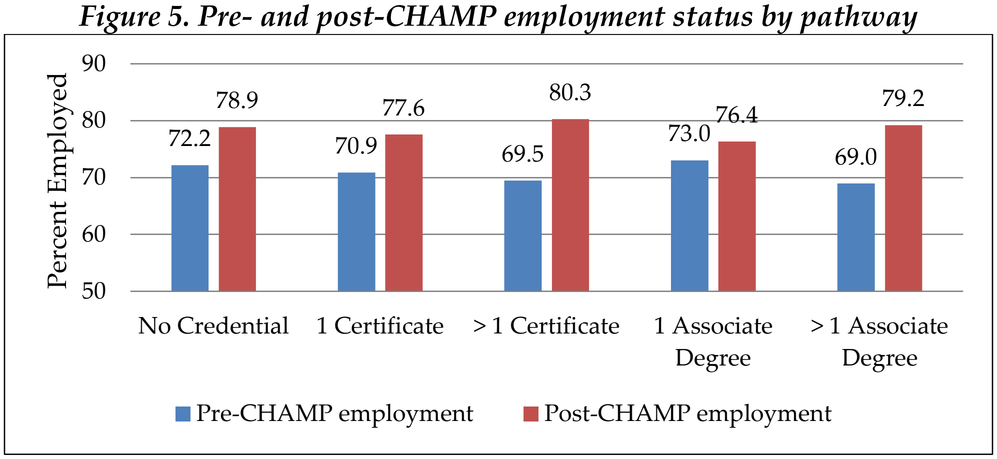


Figure 5 shows the employment rate of CHAMP students within each of the five pathways before and after participation in CHAMP. Students are included in this table if they had quarterly earnings reported in the unemployment insurance (UI) database during the timeframe of this report.[5] Overall, 71 percent of students were employed in the year prior to enrolling in CHAMP, and 79 percent were employed in the year following; an 8 percentage-point increase. However, given the small sample sizes within some pathways, only the increase in employment among those who did not earn a credential (72 percent employed before CHAMP and 79 percent employed after) and those who earned multiple certificates (70 percent employed before CHAMP and 80 percent employed after) reached statistical significance. Nevertheless, these findings suggest that in addition to earning credentials, CHAMP coursework resulted in higher rates of employment in the Colorado labor market.

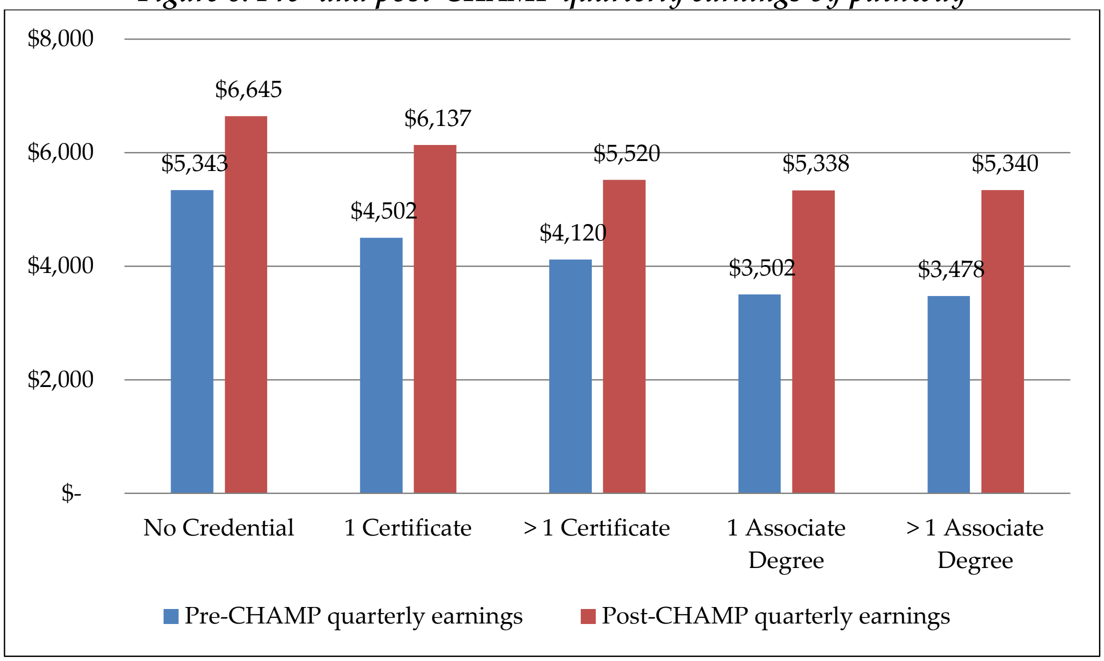
Figure 5. Pre- and post-CHAMP employment status by pathway



[5] UI data exclude those employed out of state, in the military or federal civilian workforce, and self-employed workers. Consistent with other CHAMP reporting, employment rates are calculated as the percentage of incumbents earning a minimum of $1,000 quarterly.

Finally, Figure 6 details the average quarterly earnings before and after enrollment in CHAMP coursework for students with available UI data. Across each group, students' earnings increased significantly following participation in CHAMP. For example, students who earned a single certificate had average quarterly earnings of $4,500 prior to CHAMP enrollment and $6,100 on average following CHAMP. Surprisingly, students who took CHAMP coursework but did not earn a credential had higher incomes before CHAMP participation ($5,343 quarterly) than those who earned one ($3,502) or more than one ($3,478) associate degree. This finding may reflect incumbent workers in manufacturing who were re-skilling rather than individuals coming into manufacturing from other fields where the wages are lower. Nevertheless, following CHAMP, statistical differences in earnings were no longer present, and the gaps in students' quarterly earnings across pathways closed following CHAMP participation.

Figure 6. Pre- and post-CHAMP quarterly earnings by pathway



KEY FINDINGS

- One in five CHAMP students earned multiple credentials.
- CHAMP students were almost as likely to stack credentials (20 percent) as they were to earn a single credential (18 percent); still, many had completed no credentials as of 2017.
- Institutional factors played an important role in the choices students made about their pathways:
    - Colleges varied in the number and nature of available certificates and CHAMP-related associate degrees.
    - The types of pathways students took varied across colleges.

    - Students who took more CHAMP coursework and interacted with the navigators were more likely to stack credentials.
- Older students, Pell grant eligible students, and veterans were more likely to stack associate degrees with additional credentials suggesting that this is an important pathway for the postsecondary success of these groups.
- The completion of credentials in CHAMP often built on previously earned certificates; and in many cases led to further engagement with higher education.
- Students often are not aware that they have earned a credential – thus colleges have to be more active in identification of credential completion and helping students apply for them.
- CHAMP students were more likely to be employed a year after CHAMP participation than they were the year prior to participating.
- Regardless of pathway, students from all groups had significantly higher earnings after CHAMP participation, closing prior gaps in earnings across pathways.

DISCUSSION AND IMPLICATIONS

The above findings suggest some programmatic interventions that Colorado colleges should consider in respect to student pathways. Given some variations by race/ethnicity, age, Pell eligibility and veteran status – colleges might consider new strategies to further assist those students who are historically less successful in completing credentials, if not stacking credentials. Further, the impact of the navigator on the completion and stacking of credentials suggest that the navigator role can make a critical difference for students' academic as well as employment trajectories.

This report is limited by the number of students who have moved on from coursework to credentials and/or employment. More time is needed to study the whole cohort of CHAMP enrollees, especially those who entered a program towards the end of the grant when support for pathways was arguably the strongest. As such, this report is suggestive of possible patterns – more definitive pathway patterns and the factors that influence them require further study.

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APPENDIX

	All CHAMP Students		No Credential		1 Certificate		>1 Certificate		1 Associate degree		>1 Associate degree	
	Mean	*(Std)*	Mean	(Std)	Mean	(Std)	Mean	(Std)	Mean	(Std)	Mean	(Std)
CHAMP Pathways (Figure 1)												
Percentage of all CHAMP students (%)	*100.0*		61.7		12.9		12.5		5.2		7.7	
Campus (%)* (Figure 2)												
Community College of Denver	*21.6*		80.1		6.0		5.4		2.3		6.2	
Front Range Community College	*14.6*		74.4		5.8		16.3		0.9		2.7	
Lamar Community College	*4.3*		62.6		9.2		16.0		4.6		7.6	
Pueblo Community College	*20.3*		58.4		15.1		3.4		15.3		7.9	
Pikes Peak Community College	*22.3*		58.8		8.9		14.3		4.4		13.6	
Red Rocks Community College	*17.0*		35.0		31.4		26.0		1.5		6.2	
CHAMP Participation (Figure 3)												
Courses [a, b, d, e, f, g, h, j]	*3.1*	*(3.1)*	2.0	(1.8)	3.7	(2.6)	5.9	(4.4)	2.5	(2.0)	6.1	(4.7)
Credits [a, b, d, e, f, g, h, j]	*9.1*	*(10.3)*	5.6	(6.6)	11.7	(8.6)	18.0	(13.5)	7.4	(6.6)	19.2	(15.4)
Terms [a, b, c, d, e, g, h, i, j]	*1.5*	*(1.0)*	1.3	(0.7)	1.5	(1.0)	1.9	(1.1)	1.7	(1.0)	2.5	(1.5)
Documented interactions with a CHAMP navigator [c, d, g, j]	*4.6*	*(4.6)*	3.8	(3.6)	4.8	(4.7)	5.7	(5.7)	3.2	(3.1)	6.6	(6.1)
Demographics (%) (Table 1)												
Gender												
Male	*90.3*		89.9		87.4		93.0		91.8		92.8	

Female	*9.7*		10.1		12.6		7.0		8.2		7.2	
Ethnicity												
White [b, d, e]	*64.4*		60.6		65.4		75.5		64.6		74.7	
Hispanic [e, h, j]	*16.2*		16.5		19.4		10.9		24.1		11.8	
Other [a, b, c, d]	*19.4*		23.0		15.2		13.5		11.4		13.5	
Age [a, b, c]	*28.1*	*(11.8)*	29.1	(12.4)	27.0	(11.5)	25.3	(10.6)	26.1	(10.5)	27.6	(9.6)
Pell-grant eligible [c, d, f, g, h, i]	*37.9*		33.8		39.4		34.9		61.4		58.2	
Veteran [d, g]	*12.2*		10.7		11.6		14.6		13.9		20.3	
Pre-and Post-CHAMP Educational Characteristics (%) (Figure 4)												
Pre-CHAMP postsecondary attainment at CCCS colleges												
Previous certificate [d, g, i]	*2.6*		4.4		6.0		2.3		10.1		17.3	
Previous associate degree	*5.6*		2.2		3.5		2.3		5.1		3.0	
Any postsecondary enrollment [d]	*15.3*		14.6		17.0		14.3		22.8		14.3	
Postsecondary enrollment at MSU after CHAMP	*1.5*		1.5		2.0		0.5		2.5		1.7	

Pre- and Post-CHAMP Employment Status (%) (Figure 5)												
Pre-CHAMP employment	*71.4*		72.2		70.9		69.5		73.0		69.0	
Post-CHAMP employment	*78.8*		78.9 §		77.6		80.3 §		76.4		79.2	
Pre- and Post-CHAMP Average Quarterly Earnings ($) (Figure 6)												
Pre-CHAMP quarterly earnings [b, c, d]	*4809*	*(5952)*	5343	(6461)	4502	(4953)	4120	(6049)	3502	(3826)	3478	(4007)

Post-CHAMP quarterly earnings	*6198 §*	*(6543)*	6645 §	(6992)	6137 §	(5860)	5520 §	(6899)	5338 §	(5206)	5339 §	(4637)
N	*3070*		1895		396		384		158		384	
*Note that percentages sum to 100 across the pathways columns for each college.												
Superscript letters denote significant differences between group means via Tukey's range test (p < 0.05) as follows: no credential compared to [a] 1 certificate, [b] >1 certificate, [c] 1 associate degree, [d] >1 associate degree; 1 certificate compared to [e] >1 certificate, [f] 1 associate degree, [g] >1 associate degree; >1 certificate compared to [h] 1 associate degree, [i] >1 associate degree; [j] 1 associate degree compared to >1 associate degree.												
§ Denotes statistically significant gain in pre-post comparison of employment or earnings via paired t-test (p < 0.05).												

CHAPTER 8: LABOR MARKET EXPECTATIONS AND CAREER PATHWAYS: A SURVEY OF CHAMP COLLEGE STUDENTS

Alexander Ruder and Heather McKay

INTRODUCTION

In this report, we examine to what extent career pathways information influences community college students' beliefs about labor market outcomes in their chosen field. Career Pathways were promoted by the USDOL as an important strategy for community colleges under the TAACCCT grant program. Beyond TAACCCT, policymakers are increasingly focused on career pathways, and there is a need to understand how students actually use the information presented to them about pathways. However, little is actually known about whether and how career pathways information influences the educational and career decisions students make.

Career pathways were an important part of the CHAMP grant work and emerged in a variety of ways. Colleges developed programs with stackable credentials where students could have multiple points for entry and exit. Each school hired a special advisor, a navigator, to help students navigate educational and career pathways. Additionally, a website was developed to provide information on career pathways to prospective and current students. This website, Colorado Career Action Tools, was developed to help students and educators better understand "the wide variety of occupations across the many segments of the advanced manufacturing spectrum, the many opportunities they represent, and the various education and training pathways to them."[114] Understanding how students use the information gathered on the website was important to the leadership of the CHAMP grant.

CONTEXT

Unlike simple college scorecards that provide wage and graduation information, a typical career pathway guide contains a variety of information about different careers over different time spans. With such extensive information contained in a career pathways guide, community colleges risk providing students with an "information dump" that overwhelms the student and ultimately has little effect on the students' decision-making (Grubb 2006; Karp, O'Gara, and Hughes 2008; Deil-Amen and Rosenbaum 2003). Research offers a variety of explanations why complex information hinders decision-making. For example, when presented with too much information individuals tend to avoid expending the effort necessary to process it. Instead, they

[114] CHAMP grant statement of work.

take the path of least resistance, often defaulting to the status-quo options (Agnew and Szykman 2005).

SURVEY STRUCTURE

EERC's survey examines two dimensions of labor market expectations: student beliefs about the typical graduates' labor market outcomes and student expectations for their own labor market outcomes. First, to assess whether or not students have accurate beliefs about the labor market outcomes of average graduates from their field of study, we ask respondents to estimate labor market outcomes for the average graduate from their program. Students base their own expectations, in part, on their estimates of how well past graduates have done in the labor market (Wiswall and Zafar 2015). If students believe past graduates earn more than they actually do, then they may themselves have unrealistic expectations about their earnings after graduation.

Second, we ask students about their own individual labor market expectations once they earn their degree. Community college students base their academic and career choices, in part, on their expectations of labor market outcomes (Baker et al. 2017). Thus, knowing how career pathways information provision affects student labor market expectations can help career counselors more effectively use limited time and resources to guide students into manufacturing programs that lead to in-demand careers vital to the economic growth of the state.

The survey uses a before/after repeated measure design to assess whether or not the career pathways information influences students' beliefs and expectations about labor market outcomes. After we ask students about both past graduates' and their own expected labor market outcomes, we show all students a career pathway information guide for their chosen academic field. We then ask students again about both past graduates' and their own expected labor market outcomes.

CAREER PATHWAYS IN MANUFACTURING

Research Questions

Our research questions focus on three issues raised by career pathways counseling tools. First, career pathways ask students to consider the long-term career outcomes associated with a specific pathway. However, to what extent do community college students weigh long-term outcomes when choosing a career pathway?

Research question 1: Do students prioritize short-term or long-term economic outcomes when choosing an academic program?

To use labor market information when making an academic choice, students need to have reasonably accurate estimates of the labor market outcomes of graduates in their fields. We investigate to what extent do community college and university students' estimates of past graduates' labor market outcomes correspond to the actual labor market outcomes of past graduates:

Research question 2: Do students have accurate beliefs about the labor market outcomes of graduates from their chosen academic program?

Third, we assess to what extent the disclosure of career pathway information changes students' beliefs about labor market outcomes. Information provision is a central component of counseling at the community college level (Grubb 2006; Karp, O'Gara, and Hughes 2008). As stated previously, the assumption is that students are able to interpret and use the information when making their choices:

Research Question 3: Does the provision of career pathways information change students' expectations about labor market outcomes?

SURVEY

In the spring of 2017, we recruited approximately 245 Colorado college students to take a survey that asks about their beliefs and expectations of labor market outcomes in their chosen career pathway.[115] Surveys were fielded in person at eight of the nine CHAMP schools – Aims, CCD, FRCC, LCC, PPCC, PCC, RRCC, and MSU.[116] All CHAMP and CHAMP related courses being offered on the day that the research team visited the college were surveyed. Our final sample includes 78 students from MSU and 167 from Aims community college and the CCCS colleges.

Three researchers visited the classrooms at the start of class time. Students were informed about their rights as research subjects and provided with a consent form. A brief introduction about the purpose of the survey was also provided. Students were asked to select the career that most fit their interests out of four choices: Engineering, Production and Assembly, Machining or Welding. These fields of interest were selected from the information provided on the CHAMP created website – Colorado Career Action Tools. This website is also where all of the above cited career pathways information provided in the survey (see below) was gathered. Students were also asked not to skip ahead, due to the structure of the survey. Students were expected to take about 15-20 minutes to complete the survey, but they were allowed to spend more or less time as needed. Some students completed the survey in 5 minutes, others took 30 minutes to complete.

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[115] We remove several observations due to either significant data entry errors by student (e.g., entering dollar amounts in fields for percentages) or clear evidence the student did not take the survey seriously (using the same numerical response value for all answers).

[116] In the main analysis, we exclude MSU, as outcomes across community colleges and four-year universities are incomparable in many ways. We analyze MSU student responses in a supplementary section.

DESCRIPTIVE STATISTICS: COMMUNITY COLLEGES

Descriptive statistics for the community college sample are presented in Table 1. A majority of survey respondents are White Non-Hispanic (71.2 percent) and male (90 percent). Respondents are distributed fairly evenly across the different academic programs of Machining, Production and Assembly, and Welding. Only 16.9 percent of respondents are in interested in the Engineering program.

Table 1: Descriptive statistics of CCCS sample.

Race/Ethnicity	American Indian/Alaskan Native	3.8
	Asian or Pacific Islander	3.1
	Black Non-Hispanic	2.5
	Hispanic	14.4
	Unknown	3.1
	White Non-Hispanic	71.2
	Hispanic	1.9
Gender	Female	9.4
	Male	90.0
Pathway	Engineering	16.9
	Machining	36.9
	Production and Assembly	21.2
	Welding	25.0

RESULTS

Research Question 1

Do students prioritize short-term or long-term economic outcomes when choosing an academic program? We ask students about three different aspects of careers related to short- and long-term labor market outcomes. *Table 2* shows the students' average ratings, on a 0-100 scale, of the importance of each factor in their careers. The factor with the highest average rating is getting a job immediately after graduation. Students on average place less importance on getting a job that allows quick advancement, and getting a job that allows late advancement. The estimated differences between these factors are statistically significant.

Table 2: Factors of employment that are important to students

Question	Average Importance
1) Get job immediately after graduate	83
2) Get job that allows quick advancement	78^{*}
3) Get job that allows late advancement	68^{***}

*We conducted two separate T-tests: one test comparing quantities in row 1 to row 2, and one test comparing row 1 to row 3. Statistical significance indicated by stars (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.01$).*

Research Question 2

Do students have accurate beliefs about the labor market earnings of graduates from their chosen academic program?

Table ***3*** shows students' estimates of the earnings for the population of college graduates (population) and of their own expected earnings (self). We ask this question for both immediate earnings after graduation, and the long-term outcome of earnings ten years after graduation. We compare students' expected annual earnings to the annual earnings implied by the hourly wage given in the career pathways information.

The first two rows of

Table ***3*** show the median estimates for how much students' believe the typical graduate of the program earns. The last two rows of

Table ***3*** show students' own expectations for future earnings. Generally, students expect to earn equal to or above the typical graduate in the population. The only exception is the long-term outcome for Production and Assembly, where students expect to earn slightly less than their estimate of the typical graduate in the population.

Generally, median earnings estimates are close to the labor market data listed on the career pathways information. *Table 4* shows the average percentage error, or how far off, students' estimates are from the labor market information. There is no consistent pattern across majors; however, absolute short-term errors for Engineering and Machining are larger than those for Production and Assembly and Welding; long-term errors for Production and Assembly and Welding are positive and larger than those for Engineering and Machining.

Table 3: Median estimated earnings of the average program graduate (population) and expected earnings for survey respondent (self), for job obtained right after graduation (immediate) and job held ten years from graduation (ten).

	Engineering	Machining	Production and Assembly	Welding

Population earnings (immediate)	37500.0	35000.0	39760.0	40000.0
Population earnings (ten)	69000.0	55000.0	67000.0	70000.0
Self-earnings (immediate)	40000.0	38000.0	39760.0	40000.0
Self-earnings (ten)	75000.0	60000.0	65000.0	70000.0

Table 4: Percent error of student estimate of population earnings and actual population earnings as identified by labor market data. Positive percent error indicates student overestimated population earnings.

	Engineering	**Machining**	**Production and Assembly**	**Welding**
Population error (immediate)	− 9.9	12.2	6.2	−3.8
Population error (ten)	− 5.2	3.4	26.9	34.6

Employment probability asked for job obtained right after graduation (immediate) and job one year from graduation (one).

Table 5 and Table 6 explore student expectations about the probability of finding a job, advancing in their career over time, and having job security in their chosen career. Students have generally high estimates of the employment probability, advancement opportunity, and job security of past graduates in all fields.[117] Table 6 shows students' own expectations, which are equal to or greater than their estimates of past graduates' outcomes. Students are very confident that they will find a job within one year of graduation, they will advance to better jobs within the career pathway, and they will have job security.

Table 5: Estimated employment probability, career advancement probability, and job security probability, for the average program graduate (population).

	Engineering	**Machining**	**Production and Assembly**	**Welding**
Population employment (immediate)	0.70	0.75	0.70	0.70
Population employment (one year)	0.88	0.90	0.90	0.90
Population advancement	0.70	0.80	0.75	0.80
Population security	0.81	0.80	0.80	0.80

Employment probability asked for job obtained right after graduation (immediate) and job one year from graduation (one).

Table 6: Estimated employment probability, career advancement probability, and job security probability, for the survey respondent (self).

[117] We do not compare this to population data, as we lack precise data on employment, advancement, and job security.

	Engineering	Machining	Production and Assembly	Welding
Self-employment (immediate)	0.82	0.85	0.80	0.82
Self-employment (one year)	1.00	1.00	1.00	1.00
Self-advancement	0.90	0.90	0.85	0.88
Self-security	0.85	0.82	0.80	0.80

Employment probability asked for job obtained right after graduation (immediate) and job one year from graduation (one).

Research Question 3

Does the provision of career pathways information change students' expectations about labor market outcomes? Our final research question asks to what extent do student responses change after we provide them with career pathways information. We focus on earnings and employment probability, which are the two classes of labor market information directly presented in the career pathways information tool. *Table 7* shows the average percent change in student earnings expectation and population earnings estimates. Average changes range from over 7% to under -8%. In Machining, all the differences are negative and statistically significant, suggesting students in the Machining field expect to earn less after seeing the career pathways information.

Table 7: Post- minus pre-intervention changes in student earnings estimates.

	Engineering	Machining	Production and Assembly	Welding
Population (immediate) revision	7.53	-4.62^{**}	4.44	4.72^{*}
Population (ten) revision	3.18	-3.09^{**}	7.24^{*}	6.54
Self (immediate) revision	-0.44	-5.41^{**}	4.44	6.08
Self (ten) revision	-0.48	-8.05^{**}	1.55	1.32

*Positive change indicates students revised earnings expectations upwards. Statistical significance indicated by stars (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.01$).*

Table 8 shows percent changes in employment estimates. Percent changes in Engineering are negative and particularly large, ranging from -22% to -11.8%. Three of the estimates are statistically significant. Similarly, we find negative and statistically significant changes for students in Machining. As with Engineering students, Machining students revise downward the expected probability of getting a job themselves and their estimates for the population of past graduates.

Table 8: Post- minus pre-intervention changes in student employment probability estimates.

	Engineering	Machining	Production and Assembly	Welding
Population employment change (immediate)	-22.0^{*}	-8.0^{**}	-10.9	3.7
Population employment change (one year)	-19.8^{***}	-5.5^{**}	-3.9	-1.1
Self-employment change (immediate)	-12.6	-5.0^{*}	5.5	-5.2

Self-employment change (one year)	-11.8^{**}	-5.2^{**}	-2.2	-3.9

*Positive change indicates students revised earnings expectations upwards. Statistical significance indicated by stars (*** p < 0.01, ** p < 0.05, * p < 0.01).*

DISCUSSION

Career pathways focus on long-term advancement opportunities for students. It is important to know to what degree students value long-term outcomes when making a career choice. We find some evidence that students value long-term outcomes, though they place more weight on short-term outcomes. Regarding factors important to their career choice, student's rate getting a job after graduation as more important than either getting a job that allows quick advancement or a job that allows late advancement.

The accuracy of students' estimates of the earnings of program graduates varies depending on the field of study and the time period under consideration. In addition, students mostly expect their own earnings to exceed their estimates of the average past graduates' earnings.

We find limited evidence to suggest that students revise their labor market expectations after seeing the career pathways labor market information. There were some exceptions to this. Students significantly revise downward their earnings expectations in Machining after seeing the career pathways information. The career pathways information had a more consistent negative effect on employment expectations. After seeing the labor market information, students significantly reduce their employment expectations in Engineering and Machining. They also reduce employment expectations in all but two estimates in Production and Assembly and Welding, though the changes are not statistically significant.

FUTURE WORK

This project provides evidence that career pathways information has a small impact on student employment expectations. A limitation of this project is that our analysis focuses on expectations and not actual program choice. The next steps of this project must examine how the labor market information provided in the career pathways information affects students' actual preferences over academic programs in college.

MSU SUBSAMPLE

We now provide descriptive results for the MSU subsample of students. On average, university students are likely to have different labor market expectations and career preferences than community college students. If university students are more informed about labor market outcomes, they may also react differently to the survey information we provide. For these reasons, we separate the university students from community colleges students. The main focus of this analysis is on students in the Engineering and Production and Assembly programs, since only 7 students combined took the survey in Machining or Welding.

Table 9: Descriptive statistics for MSU sample. Ethnicity variable missing in too many observations to include.

		Percent
Gender	Female	10
	Male	90
Program	Electrical Engineering	73
	Machining	4
	Production and Assembly	21
	Welding	3

Comparing the MSU results to the Aims/CCCS results, we find several notable differences. First, compared to Aims/CCCS students, MSU students are slightly less likely to value the importance of getting a job that allows quick advancement and getting a job that allows late advancement.

Table 10: Factors of employment that are important to students.

Question	Average Importance
1) Get job immediately after graduate	83
2) Get job that allows quick advancement	73*
3) Get job that allows late advancement	64***

We conduct two separate T-tests: one test comparing quantities in row 1 to row 2, and one test comparing row 1 to row 3. Statistical significance indicated by stars. MSU sample only

Second, compared to Aims/CCCS students, MSU students generally estimate higher values for the annual earnings of program graduates and higher expectations for their own earnings post-graduation. The exception is Welding, but the small sample size precludes us from making any firm conclusions from these numbers.

Table 11: Estimated earnings of the average program graduate (population) and expected earnings for survey respondent (student), for job obtained right after graduation (immediate) and job held ten years from graduation (ten). MSU sample only.

	Electrical Engineering	Machining	Production and Assembly	Welding
Population earnings (immediate)	54500	60000	60000	33500
Population earnings (ten)	80000	90000	85000	45000
Self earnings (immediate)	60000	60000	60000	32500
Self earnings (ten)	90000	100000	85000	57500

Third, compared to Aims/CCCS students, we find that MSU students have slightly lower estimates of employment probability in all rows except the Population Advancement. Employment and advancement estimates in Production and Assembly are similar to Aims/CCCS students.

Table 12: Estimated employment probability, career advancement probability, and job security probability, for the population.

	Engineering	Production and Assembly
Population employment (immediate)	0.60	0.72
Population employment (one year)	0.80	0.88
Population advancement	0.80	0.72
Population security	0.80	0.80

Employment probability asked for job obtained right after graduation (immediate) and job one year from graduation (one). MSU sample only.

Similar to Aims/CCCS students, MSU students themselves place a high probability of finding employment after graduation, advancing in their careers, and having job security. We do find some small differences between the responses for students in the two school groups, but no pattern is apparent.

Table 13: Estimated employment probability, career advancement probability, and job security probability, for the student (self).

	Electrical Engineering	**Production and Assembly**
Self- employment (immediate)	0.80	0.90
Self-employment (one year)	0.95	0.90
Self-advancement	0.90	0.85
Self-security	0.85	0.88

Employment probability asked for job obtained right after graduation (immediate) and job one year from graduation (one). MSU sample only.

Finally, we present the MSU student revisions in labor market expectations. Overall, the patterns are similar to the Aims/CCCS sample. All but one of the estimated changes in earnings estimates is substantively small. In addition, all but two estimated changes in employment probability are negative. Compared to the Aims/CCCS students, fewer of the employment probability estimates are statistically significant, but, as discussed above, the small sample size warrants caution when interpreting these statistical tests.

Table 144: Post- minus pre-intervention changes in student earnings estimates. Positive change indicates students revised earnings expectations upwards. MSU sample only.

	Engineering	Production and Assembly
Population (immediate) revision	-3.87	-12.82^{*}
Population (ten) revision	3.36	-3.52
Self (immediate) revision	-2.14^{*}	2.70
Self (ten) revision	-3.28^{*}	0.82

*Positive change indicates students revised employment expectations upwards. MSU sample only. Statistical significance indicated by stars (*** p < 0.01, ** p < 0.05, * p < 0.01).*

Table 15: Post- minus pre-intervention changes in student employment probability estimates.

	Engineering	Production and Assembly
Population employment change (immediate)	-4.30	-11.97^{**}
Population employment change (one year)	-1.97	-9.42^{**}
Self-employment change (immediate)	-5.10	2.33
Self-employment change (one year)	-3.46^{**}	0.39

*Positive change indicates students revised employment expectations upwards. MSU sample only.Statistical significance indicated by stars (*** p < 0.01, ** p < 0.05, * p < 0.01).*

KEY FINDINGS

We briefly summarize the key findings from the study:

1. Compared to the midpoint or minimum of the salary range given in career pathways information, current students have reasonable estimates of the earnings of former students immediately after graduation (Tables 3 and 4).

2. Compared to the midpoint or minimum of the salary of the salary range given in the last job title in the career pathway, current students believe ex-graduates earn significantly more money than the data suggest in the fields of Production/Assembly and Welding (Tables 3 and 4).

3. Students themselves expect to earn significantly more than their estimates of the average, or typical, graduate of their program (Table 3).

4. A significant majority of students expect to find a job immediately after graduation (Table 6). Nearly all students expect to have a job in their field within one year after graduation.

5. More students consider finding a job immediately after graduation to be more important that finding a job that offers long-term advancement (Table 2).

6. The career pathways information has little effect on students' earnings expectations (Table 7), except in Machining, where we find statistically significant differences reductions in earnings expectations.

7. The career pathways information has a mostly negative effect on students' employment expectations, particularly in Engineering and Machining (Table 8).

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PART E: EMPLOYERS AND EMPLOYMENT OUTCOMES

CHAPTER 9: THE EMPLOYER – COLLEGE RELATIONSHIPS

Heather McKay, Rachel Hare Bork and Suzanne Michael

INTRODUCTION

Research suggests that strong relationships between community colleges and local business partners are key to building robust workforce development programs for students (Mann, 2017; Jenkins & Spence, 2006).

> *Slow economic recovery, rapid transformations in technology, higher-skill and credential requirements for good-paying jobs, and emerging mismatches between employer needs and worker skills make business and educational partnerships critical*. (Wilson, 2015, p. 2)

Close collaboration between industry and higher education, however, is not new. The literature is filled with research extoling the importance of having employers and educators work together to train future generations of Americans (Spaulding & Martin-Caughey, 2015). Increased employer engagement - to ensure that students are graduating with skills that meet employer demands - has also been a key element of all rounds of TAACCCT grants (Mikelson, Eyster, Durham & Cohen, 2017).

Employer's involvement with postsecondary education can be thought of as:

> *A continuum of involvement that ranges from serving on advisory boards for technical degree programs to actively participating in the development of curriculum and training* (U.S. Department of Education, 2012, p. 3).

At the lower level of the continuum, employers join college advisory boards to review curriculum and offer general advice on workforce issues and labor market needs. Further along the continuum, employers and educators form partnerships to design training for immediate workforce needs and/or contribute to industry-led efforts to prepare students for jobs. They may also donate equipment, provide internships, and serve as adjunct faculty to teach a specific subject area. At the higher end of the continuum, employers and colleges work closely together to analyze workforce needs and develop curriculum and training that will meet those needs (U.S. Department of Education, 2012, p.4). Employer involvement in CHAMP represents the low and middle parts of the continuum, but for some of the CHAMP colleges, the grant allowed them to begin to move towards that higher level of the continuum as will be discussed below.

Over the course of the CHAMP grant (2013-2017), local employers were critical partners and these partnerships were central to the grant's successes. The collaborations included: establishing advisory boards to review curriculum; integrating industry standards and knowledge into course curriculum; fostering the development of internship opportunities; posting information about current and anticipated job openings; and helping colleges identify state-of-the-art equipment and software to purchase for programs.

While college-industry partnerships are not a new phenomenon, how these groups work together is not always straight-forward. This brief provides perspective from both local employers and community college staff about the implementation of the CHAMP grant, the relationship between the partners, and the legacy that was created. The brief was prepared by Rutgers University's Education and Employment Research Center (EERC), the third-party evaluator for the CHAMP project.

Part I describes methodology and data sources. Part II focuses on ways in which employers interacted with the colleges and ways in which they influenced CHAMP. Finally, Part III discusses best practices to continue college/employer relationships as the CHAMP grant concludes.

PART I: METHODOLOGY

EERC used qualitative methods to explore the ways in which employers interacted with the colleges. EERC team members engaged in phone and in-person interviews with 19 employers[118] as well as with faculty and staff at consortium colleges, and senior staff at the Colorado Community College System (CCCS) office.

Most interviews were taped and transcribed; non-taped interviews involved extensive note taking. These transcriptions and notes were coded using NVivo qualitative data management software and analyzed by EERC team members.

PART II: HOW EMPLOYERS WORKED WITH THE COLLEGES

For over a decade, Colorado has been involved with sector partnerships that foster industry-driven alignment across economic development, workforce development and education. Targeting key industries, Colorado's Workforce Investment Board (CWIB) and Colorado's Workforce Development Council (WDC) have invested in a number of initiatives that involved regional, public-private partnerships to support the expansion of a region's economic vitality – including the development of programs to train and retrain individuals to meet changing industry needs.[119] As such, the eight regional manufacturing sector partnerships which predated CHAMP, not only laid the "foundation for industry engagement for the CHAMP proposal" (CCCS, 2011, p6), but also provided critical insights to the CHAMP program.

Under CHAMP, CCCS required each of the colleges interested in joining the consortium to demonstrate that they had well–established relationships with industry partners. For many, these relationships grew out of the federal mandate for industry to be involved in the

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[118] While ERCC reached out to employers across the consortium, most of the interviewees had worked with Front Range Community College (FRCC) and Pueblo Community College (PCC). Those that agreed to participate in the research also tended to have more positive views of the program. EERC thus recognizes selection bias.
[119] See https://www.colorado.gov/pacific/cwdc/sector-partnerships

development and revision of Career and Technical Education programs.[120] In some cases, curriculum committees had been formed, and other times more formalized business or industry advisory boards had been established to build community colleges' technical capacities. These advisory boards often reviewed new programs as part of the college's accreditation requirements (Spaulding & Martin-Caughey, 2015, Rose & Stiefer 2013).

In addition, prior to CHAMP, all of Colorado's community colleges participated in one or more federal grant programs including the first and second rounds of TAACCCT grants – Colorado Online Energy Training Consortium (COETC) and the **Consortium for Healthcare Education Online** (CHEO). Under these programs, the colleges had established or expanded their engagement with industry using their industry advisory boards. It was through these advisory boards that most employer-college partnerships occurred.

Advisory Boards

Some key ways community colleges have traditionally targeted employer input are with curriculum committees or advisory boards that approve new programs as part of accreditation requirements (Spaulding & Martin-Caughey, 2015, Rose and Stiefer 2013). Business advisory boards have also been a tactic to engage employers in federal grant programs aimed at building the capacity of community colleges (Spaulding & Martin-Caughey, 2015, Eyster et al. 2010). The CHAMP proposal indicated that each college either recommit to an existing industry advisory board, or establish a new one to focus specifically on the needs of advanced manufacturing. Through the advisory boards, colleges were to "solicit ongoing feedback about how well its courses met industry needs" and to use industry input to modify courses and/or create new ones so that CHAMP-related courses included "the content necessary for students to gain stackable, industry-recognized credentials" (CCCS, 2011, p20). Advisory boards were to provide on-going review of curriculum and credentials that were needed in the field. In addition, college staff members were to use the expertise of advisory board members to make decisions on equipment purchases and software updates for CHAMP programs.

While the CHAMP proposal stipulated that college advisory boards had to meet at least once a year, colleges were given the latitude by CCCS to choose the size of their board, the range of board functions, and the frequency of meetings. They were also able to choose whether they wanted to have a single advisory board or multiple boards each focused on a different manufacturing program at their respective college, e.g., welding, machining, engineering graphics.

During EERC's interviews, employers generally described a positive advisory board experience. An employer working with the Industrial Advisory Board (IAB) at MSU Denver – a committee comprised of local industry leaders who extended their considerable professional experience

[120] Pursuant to federal Perkins' regulations all CTE programs are required to hold regularly scheduled advisory board/committee meetings. Colorado Community College System (2008). A guide to the operation of career and technical education advisory committees. Denver, Colorado: Author. p ii

towards helping with decisions about new curriculum development and equipment purchase choices –spoke highly of the experience:

> *Metro State is very good at working with industry. So, they were good listeners…This is all through the advisory board.*

Some colleges had multiple boards. Aims, for instance, had the challenge of maintaining its four different advisory boards each focused on a separate program area – engineering technology, manufacturing (industrial) technology, building/construction site management, and oil and gas technologies. Not all of these boards are CHAMP related, but they are all run by faculty and staff involved in the CHAMP programs.

> *We have four advisory committees, which is unwieldy to say the least. I get the need we've got four programs so it follows we should have four committees…Because for me as department chair the most difficult area I have to deal with are the committees. It's lining up the committee members. It's running the meetings. It doesn't sound like a whole lot, but oh my gosh, it is such a chore. And then maintaining them. And that's where I've really done a poor job. I'll be the first to say that I don't have the resources and the time on my own to be able to maintain all four committees in between meetings. And to me that's the key that we're missing.*

While it was at the college's discretion whether to combine or keep boards separate, it is clear managing multiple groups of employers can be burdensome.

FRCC faced the additional challenge of creating a brand new employer board, because the program was newly created under CHAMP. [121] To facilitate the process of forming the advisory board, FRCC hired an employer outreach coordinator in addition to the grant required navigator position. The person in this new position focused on building and managing relationships with local industry leaders; gathering feedback from employers for the program; recruiting incumbent workers to training; and securing internships, apprenticeships, and employment opportunities for FRCC's machining students. One employer working with FRCC recalled how the early advisory board meetings helped employers gain confidence in the college:

> *The Dean of the school, and then the President would show up [at advisory board meetings] every once in a while, and the Head of Curriculum would show up and just they were very committed and bright people. I was actually kind of amazed. I guess I previously had an image of community college of kind of being a little bit of like the second team. But these guys were – they were all first teamers. I was very impressed.*

Employers, however, were not without their critiques of the advisory boards. The time commitment was a frequent concern discussed in interviews. One employer explained, "Personally, the challenges for me was to find the time to attend the meetings." Like some employers, project staff also expressed concerns about advisory board attendance – as well as engaging employers between the bi-annual meetings. The challenge was described by Aims'

[121] At the start of CHAMP, FRCC reinstated their machining program in response to the industry demands.

CHAMP navigator, “from February until October is a very long time.” Similarly, an administer from Aims commented,

> *They [employers] forget about us a little. And I get that, but in order to get those partnerships really strong, we need to stay at the front of their mind.*

At the start of the CHAMP project, some college faculty who worked with their respective advisory board were hesitant about placing too much emphasis on the input provided by the advisory board. For example, an instructor at FRCC recalled,

> *It was certainly really challenging in the beginning. But, once I understood that this is really our requirement in order for us to have this great facility I was able to change my thinking 180 degrees.*

While faculty often did not have a formal role on advisory boards, many looked to them to guide curriculum development – wanting to ensure that new curriculum was responsive to industry needs.

> *We don’t make a change without consulting them [the advisory board] because we want their buy-in. They’re the ones hiring our students.*

High CHAMP project staff turnover (e.g., PPCC and CCD) was also an issue for employers. Employers partnering with these colleges complained about such disruptions. For example,

> *One of the challenges is they – the person that was in charge of the CHAMP grant - changed three times. So that was a challenge. So, there wasn’t as much continuity as there could have been just because each time a person changed, they had to come up to speed. And that’s not that the individual left or was fired. They were repositioned to do something else within the college. So that was a little frustrating. That was probably the biggest challenge, I would think.*

Overall, however, employers perceived the advisory boards positively. For many new to working with higher education institutions, the meetings helped them to understand the scope of the CHAMP initiative and the capacities of the colleges.

Curriculum Development

One of the major objectives of the CHAMP project was to enhance the alignment of program curriculum with industry needs. This alignment included updating course materials to include new industry processes and technologies, and modules that addressed use of new state of the art equipment. There was also attention to aligning course assessments with industry standards, e.g., NIMS certification. In addition, some colleges transformed some curriculum into online and hybrid modules. Lastly, there was attention to the establishment of new short and long-term certificates that could be stacked, and/or creating new career pathways, addressing both industry needs as well as those of new and incumbent workers.

Members of industry advisory boards worked with college faculty as co-designers—collaborating on new curricula and pathways (Wilson, 2015). In the process, employers new to curriculum development observed the challenges of their work. As one employer observed,

> *It is sometimes difficult to know what the best thing to do is with curriculum. It's a lot like a puzzle. You got X number of credits – 43 credits, for instance. We got to fill 43 credits, and what do you want to do? Well, you want them to know this. We want them to know this, this, this and this. And then, they start doing the math and we're up to 90 credits, and well, we got to trim something, so what do we cut out? So, it's a little difficult to help with that. I know it's not on my shoulders completely, but I still feel responsibility for that and try to do the best we can, but it's not that easy.*

The remainder of this section describes how employers successfully worked with the colleges to emphasize soft skills in the curriculum and help with equipment purchases.

Soft Skills

Employers across the country have increasingly indicated the need for individuals to enter the workforce with better *soft skills* - work-related skills that facilitate communication, problem solving, flexibility, responsibility, leadership, and teamwork. In fact, some employers have stated that soft skills are at times more important than hard skills (Davidson, 2016) in securing employment, keeping a job and getting promoted (Robles, 2012). The development of soft skills has therefore become a focus of CTE programs as well as of post-employment trainings (Mitchell, Skinner, & White, 2010; Bronson, 2007; Houghton & Proscio, 2001).

During CHAMP, most employers sitting on advisory boards felt that it was important to include soft skills in CHAMP curriculum. A small minority, however, felt that,

> *…. if they don't know that by now, you can't teach it. We don't want you spending your time teaching that…*

The majority prevailed, even if there were some differences as to what aspects of soft skills should be taught, and when and how they should be integrated into the curriculum. Employers working with FRCC's CHAMP program were leaders in pushing for the establishment of a *professionalism curriculum.*"[122] These employers believed such a curriculum could boost motivation, and enhance, if not instill, in students a work ethic, and the discipline needed to be successful in their chosen careers. Initially, however, some FRCC faculty were not on board, concerned that such content would take time away from other course material. One employer on FRCC's advisory committee captures the process or evolution of soft skills in the CHAMP curriculum:

[122] Courses that are affected by the professionalism curriculum award 24 percent of the final grade on the basis of student "professionalism," with points awarded for punctuality, teamwork, communication, wearing uniforms, and so forth.

…Actually, the first time I brought it (soft skills) up I was pretty well shot down. And then, within a year, it seemed like everybody was on board. And then, it became 100 percent, do it. And actually, Front Range weren't (sic) overly enamored by the idea themselves when the manufacturers came in. But, they did it and came back later with the instructors and said, 'we didn't want to do it. We didn't want to give up machine time, but it was a good choice and we're seeing improvements with students coming to class on time.' They like the professional environment of everyone wearing the outfits, the shirts, the Front Range shirt. So, I think it's a good example of that where we ended up working and collaborating together.

Other FRCC advisory members confirmed the above change in perceptions, as did interviewed faculty, one of whom recalled how an advisory board member pitched the idea to staff:

[He said], 'You guys can teach them technical content, but we need them to have those soft skills. Show up on time, if you can't be at work on time, call in. Come to work dressed appropriately, those kinds of things.'

These comments indicate how critical employers were to changing the curriculum to include soft skills at FRCC. One staff member described how faculty recognized the impact of their advisory board's recommendations, and how it was paying off with their students: "It puts them into a community. It builds a culture that they're going to take with them on to the job."

An advisory board member at PPCC observed,

Well, one of the biggest recommendations, again, was that soft skill recommendation that – which they took to heart and have done a lot with. So that's really good to see.

A department chair at PPCC echoed the importance of the soft skills curriculum:

We're finding that a lot of our industry partners are looking for somebody that's just not one, you know, does one thing – that can think on their feet, have those critical thinking skills, have great employability skills, such as, you know, time management and presents themselves well.

Finding the right mode of delivery, however, was not always easy. At PPCC the college initially contracted with Goodwill Enterprises, interweaving Goodwill's soft skills modules into CHAMP courses. But students gave feedback that many of the modules were too simplistic, and did not stimulate interaction. As a result, PPCC's navigator began to go into classrooms and cover the soft skills curriculum face-to-face with the students.

The integration of soft skills and program curriculum is a rich example of the mutual benefits of partnering with the very businesses that will hire students. It also shows the value employers can introduce to help colleges move beyond more traditional curriculum.

Equipment[123]

In employer/college partnerships, it is common for colleges to engage employers to "*advise on, loan, or even donate technology to support hands-on learning*" (Wilson, 2015, p. 8). During CHAMP, this area of partnership was no exception. In general, employers provided guidance through the college's advisory boards – but a number of colleges worked more closely with local employers who advised the college over time. Such was the case at both PPCC and FRCC.

At PPCC the advice was targeted to the specific needs of the region's businesses – recognizing the capacities of these companies, and the capacity of the college. A staff member described how one employer helped CHAMP staff choose equipment to purchase:

> *…He was wise enough to recognize that we needed to train a core or critical mass for all of Colorado Springs so buy generic equipment, buy generic CNC equipment, and buy things that are readily used by all companies.*

One of FRCC's employer partners echoed the pragmatics of both affordability and training.

> *We told them what we were using in our shops, what the industry's using for machines that [are] affordable. We [want students to] come out of the program with some experience on machines that folks are going to have in their business[es].*

PPCC also reached out to specific employers asking for their direct input. In a number of cases faculty and staff toured company shops to "look at their shops, see what kind of equipment they're on [employees are using] and see what kind of tools they're using, that kind of stuff." Faculty reported to EERC that these tours were very helpful providing "…good insight as to what kind of equipment we should buy."

Interviewed employers also spoke about their role in helping the colleges to identify specific vendors facilitating purchases. An employer working with PPCC commented,

> *I worked closely with them on that [selecting equipment], as well, and* made *several recommendations and gave them different contacts for vendors that we use for equipment and things like that.*

Some companies also donated both equipment and materials to college shops. An employer working with FRCC recalled,

> *We'd use our contacts in the industry to help them get machinery and we donated machinery – our own machinery to get the thing going – multiple machines.*

Employers also helped faculty create the conceptual and hands-on content that was needed to train students in the use and maintenance of the new equipment.

[123] See also EERC's brief on Addressing Industry Needs in the CTE Classroom

In their interviews with EERC, faculty and administrators spoke of the critical importance of their work with employers – significant partners in building the CHAMP curriculum and programs. A CAD instructor at PPCC commented,

> *I attend all of the advisory committee meetings…and they do help out. For instance, 'Do I need to teach this?' and they say 'No, you don't' or 'Yes.'. So they are helpful. They have driven a lot of the purchasing too. 'Do we need to have this?', 'Yes, you have to have this.'*

A machining instructor at RRCC shared similar experiences, and how the partnership between employers and the college benefited both:

> *Industry actually picked the equipment we were choosing. We pitched ideas of what we thought would be interesting to teach at advisory meetings and then as we went through it, industry actually selected all of our equipment. We went through and said, 'What do you want to see here?' And then when we got bids in and everything else, we said, 'This is how everything played out. What do you want? What do you think is the most valuable for us to teach?' And so there's machines that maybe I thought would be more interesting that ultimately don't have as much as a representation in the market. It was important to me to make sure that they [industry] had the buy-in and that we were picking equipment that was for them because ultimately, this is to support them.*

Equipment purchases were another way industry helped the colleges revise their curriculum. Across faculty and administrator interviews it was clear that they valued this insight and the two groups of stakeholders could work cooperatively around equipment decisions.

Internships and Apprenticeships

Workplace hands-on learning experiences - internships and apprenticeships – are another way in which students and employers can mutually benefit:

> *…Apprenticeships offer a turnkey solution to common hiring conundrums, such as how to attract and retain qualified workers who understand an employer's way of doing business; how to identify the technical and foundational skills necessary in a specific line of work; and how to streamline training to use time, money and other resources efficiently.* (National Network of Business and Industry Associations, 2014).

For students, hands-on experience provides opportunities to get practical on-the-job training, while still in school. In some instances, students may also earn money while obtaining work experience.

The intention under CHAMP was to offer students a range of workplace opportunities that would enrich their learning and better prepare them for employment. Opportunities in which students move between school and a jobsite internship were also seen as a means to enhance communication between the shop floor and the classroom – furthering partnerships between industry and colleges.

Many employers with whom EERC spoke, however, identified the logistical challenges of internship programs which prevented them from hosting internships, even when they otherwise wanted to do so. Liability and insurance (for persons and equipment) were the most widely cited reasons for not hosting an intern. An employer working with FRCC explained,

> *They've [FRCC] asked us to try to bring in some students and give them some time on the job here while they're in school and going through the education. Currently, we still can't do that because of insurances and things like that. That stuff still needs to be worked out.*

Another challenge faced by employers, especially smaller shops, was the time needed to supervise or mentor students. At the same time, one employer working with CCD reflected,

> *I think it's a time issue. In my experience, it comes down to making a commitment of time and staffing, and people that are out there doing jobs.*

An employer working with Pueblo further explained:

> *We were trying to figure out how us smaller manufacturers could get an apprenticeship program up and running, so they [the PCC Innovation Center] actually hosted a meeting to give us information on that kind of stuff.*

Nevertheless, even with barriers, some CHAMP employer partners hosted interns – and spoke about the benefits:

> *This is our second semester of sponsoring a week-long internship (an exposure) to manufacturing. The candidates can't do a whole lot because they aren't certified but they can shadow and do some fun tasks and get a feel for the manufacturing environment.*

And another employer reflected, "Without a doubt, the interns. I can name them by name… those people have been my success stories."

For students, internships provided an opportunity to obtain practical on-the-job training, while still in school. In a few cases, apprenticeship programs provided both job experience and money. It allowed students to showcase their skills. Subsequently a few were hired directly from their apprenticeship or internship.

However, the employment of student interns created a new challenge: attrition from programs prior to completion. Colleges expressed anxiety about employers hiring good interns regardless of their successful credential completion. In some cases, students would drop out of their program to work full-time. This affected enrollment and the rate of completion of credentials – certificate and degrees – always a significant concern for colleges.

One PPCC department chair described the conundrum colleges faced with interns getting jobs prior to credential completion:

> *If we can't let them complete, then our programs would never stay in business - I mean, we would be shut down because we wouldn't have completers. And it took a little while to get them [employers] – their minds adjusted to that. "Well, we're hiring your students." Well, yes, but they're not finishing their education.*

A CCD department chair echoed this issue,

> *One of the problems with being able to finish students on the associate degree is that unless they had that as their focus when they came, as soon as they get some skills, somebody hires them and then they're gone.*

The paradox of training for employment and losing students to employment was captured in the following comment by a CCD faculty member:

> *The best way for us to get those numbers up [create more internships] would be to get more of a commitment from them (employers) to actually bring folks into their operation, spend time with them. The challenge that we have is once they get them into their machine shop, for example, there is a good chance that they will be hired, and that's a challenge, students don't complete that credential. But this shouldn't keep us from doing internships, because that's good, it's a win-win for both the student and the machine shop. But it does not help our numbers much, and it doesn't help overall CHAMP numbers.*

In sum, across the board, employers and colleges agreed on the importance of workplace training, and recognized this an area for further growth. However, colleges wanted employers' assistance in promoting the value of completing certificates and degrees.

Hiring Program Graduates

In addition to providing workplace internships, employers working with CHAMP colleges act as a source of job information about industry trends as well as anticipated job openings within their own companies. When colleges worked closely with employers, students often got up-to-date, local job information, which enabled the colleges to better help students find jobs after graduation. Community college faculty and staff recognized this - having graduates get good jobs was the ultimate goal. As a CHAMP staff member stated,

> *Students, that are, you know, they complete the program, they're going out and getting decent jobs. And that's, for me, that's what it's all about.*

The more intimate knowledge employers had about CHAMP curriculum and skill assessment the greater the chance a program's reputation will be part of the equation of recruitment and hiring. For example, one southeast Colorado employer EERC interviewed stated, when he/she is looking to fill an open position, "The first thing that I do is reach out to LCC, about the CHAMP grant." Another employer described the appeal of hiring new workers from the CHAMP colleges – as he/she has found CHAMP graduates are a better fit with changing manufacturing needs:

> *Manufacturing is a constant learning environment. The materials are changing, the equipment's changing, the software is changing. All these things are changing all the time. You really need somebody that has a learning orientation and likes the challenges of new things. Somebody that is showing some proficiency in school and a desire to continue there has a lot of appeal to us.*

A college administrator further reflected on the value of college-employer relationships and how they affect student employment.

> *The employer outreach coordinator has been huge…you create those relationships. You get the feedback that, you know, we're hitting the target or we're missing the target. We need to add these skillsets or these competencies. You have the relationship. You can say, hey, you know what, I need an internship for, you know, Suzie. You know, do you have anything? And if you've got that relationship already, they're more apt to say, yeah, I can bring someone – because they know, they've worked with you. They've seen your grads. They're like, oh, these are, you know, good quality employees coming in, and give someone a great opportunity. That's something that I would like to see continue.*

Receiving industry input through advisory boards also helped the colleges better prepare their students for the job search process. A LCC Dean explained,

> *Something we recently started which I think is really cool in conjunction with the advisory board meeting is that there are mock interviews for senior, last-semester students. Last time, the mock interviews actually turned out to be real interviews, and that was when a couple of the students were offered jobs. I think the advisory board is providing a direct connection to industry for our students, which is nice.*

Ultimately, employers found that engaging with CHAMP enabled them to secure a better educated workforce. One employer said,

> *It is so hard to get people. The thing that constrains our growth the most is the availability of people. This is very much a self-interest being involved with them [the community college].*

An employer working with PCC echoed this sentiment,

> *We were needing employees. And there wasn't (sic) enough kids there with a two-year degree. And so, they started sending us kids on the CHAMP program.*

Even though college faculty are feeling positive about their students getting jobs after completing their programs, employers are still complaining that there are not enough people in the market. An employer connected with LCC said,

> *I think that they know what's required of our job and we keep hiring and using their interns in their machining program. … but right now we want two more and they can't find them for me.*

The navigator working with Aims College bluntly said, "The challenge that I have here is we don't have enough students to fill the jobs that the companies would like filled."

PART III: BEST PRACTICES

Under CHAMP, employers and community college staff have demonstrated that working together results in mutual benefits and improve students' educational experience. Through college-industry partnerships, curricular changes were made to improve the knowledge, skills and readiness of students to enter the workforce. Students are also receiving more hands-on experience in advanced manufacturing while they are working towards their credential—a direct result of a strong industry role in the partnership. Stepping back from the experience of CHAMP, a number of lessons were learned and best practices identified. For colleges and employers hoping to form such strong partnerships in their own industry and geographic region, the CHAMP experience suggests the following:

- **Engage employers early and often.** Beginning with the advisory boards, the CHAMP colleges were able to use employer input to design and maintain their programs.
- **Do not assume that employers will have a monolithic voice.** Although the employers engaged in CHAMP were all part of the advanced manufacturing sector, they did not always agree. Incorporating soft skills into the curriculum is a prime example of disagreement amongst stakeholders. Colleges facilitating advisory boards should be prepared to help groups of employers' work through their different perspectives about the best strategies to achieve common goals.
- **Employers and colleges may have different definitions of success.** Industry and college staff have different opinions about when it is appropriate to hire students. Employers are engaging with colleges to find better trained future employees. When interns and apprentices come to their companies, they are eager to hire them sometimes at the detriment of students completing their certificate or degree. Colleges are accountable for having students complete their programs and are assessed based on those numbers. Colleges and employers, therefore, need to be up front with each other about their ultimate goals and to be understanding of each other's needs.
- **Industry and colleges have different cultures and often work on different time tables**. Industry tends to move quickly and academic institutions tend to work more slowly. These differences need to be explicitly discussed so that a realistic timetable can be created. This can demonstrate the commitment of all stakeholders to achieve their common goal.

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CHAPTER 10: ADVANCED MANUFACTURING EDUCATION IN THE CONTEXT OF LOCAL LABOR MARKETS: UNDERSTANDING REGIONAL DYNAMICS OF WORKFORCE DEVELOPMENT IN COLORADO

Sarah Blanchard Kyte and Heather McKay

INTRODUCTION

Historically, manufacturing has been critically important to the United States' economy providing many high wage jobs, supporting innovation, and helping to reduce the US trade deficit. (BLS, 2016) In 2015, manufacturing employed 12 million people,(BLS, 2016) and in 2016 it contributed 18.5 percent to the gross domestic product (GDP). (Bureau of Labor 1910, 2015) Like many industries, manufacturing is a sector that has experienced a great deal of change due to new technologies, automation, and changes in production processes. Additionally, manufacturing is also a graying field –where many workers are on the verge of retirement. (Manufacturing Institute, n.d.)

In this context, employers are experiencing multiple challenges to recruit and hire workers who have the requisite skills and knowledge. The current "skills gap" includes the absence of workers with: a) relevant knowledge and skill sets for advanced manufacturing including STEM skills (science, technology, engineering and math); b) relevant educational credentials; and/or c) "employability skills such as leadership, effective verbal/written communication, professionalism, project management, dependability, initiative, teamwork, and problem solving skills."(CCCS 2011) In fact, in recent national surveys of manufacturers by the Manufacturing Institute and Deloitte, 82% of manufacturers reported moderate-to-serious gaps in the availability of skilled manufacturing candidates. (Deloitte 2011a) This included the employers identifying deficient skills in the following areas: technology computer skills (70 percent); problem solving skills (69 percent); basic technical training (67 percent); and math skills (60 percent). (Deloitte 2015)

Fifty-six percent of surveyed employers anticipated the shortage to grow worse in the next three to five years. (Deloitte 2011a) In part, this is a result of the younger generation's negative image of manufacturing (Deloitte 2017), (Deloitte 2011b)– often thinking of the old dark factory floor assembly lines. But is also the result of a decline in technical education programs in many public high schools, (Deloitte 2015) and the active marketing of baccalaureate and higher level degree education in contrast to technical training at the pre-baccalaureate levels.

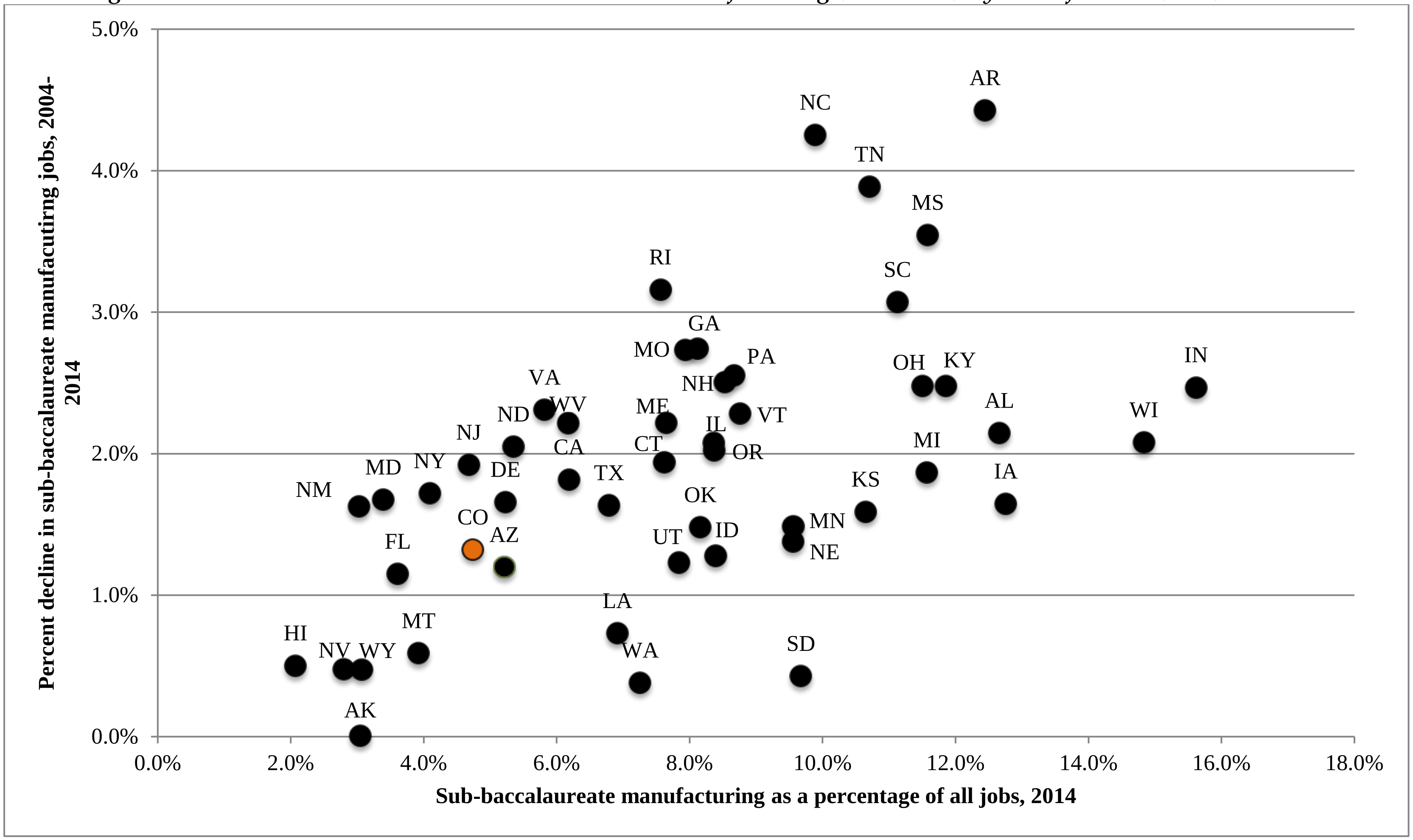
Colorado provides a microcosm of what is happening in manufacturing on a national scale. Between 2006 and 2011, Colorado's manufacturing production increased by 29%, which is higher than the U.S. average of 11%.

Like national trends, however, Colorado's manufacturing sector has experienced a skills gap. The state needs a manufacturing workforce trained in sophisticated new manufacturing methods including automation and high-technology equipment. In response, a statewide sectors project, funded by the state's Department of Labor and Employment, was initiated in 2008 to bring manufacturers, the academy (community and four year colleges) and workforce centers together to examine needs and to collaborate on solutions to better prepare workers to meet changing industry needs. The continuation of these efforts was seen in the National Governors Association Policy Academy on advanced manufacturing in 2013. (NGA 2013)[124]

This report examines the impact of CHAMP on Colorado Community College students at CCCS schools and Aims community college and employment-related outcomes for those students in the context of local labor markets related to advanced manufacturing. After identifying each regional Workforce Development Board (WDB) or Investment Board (WIB) and the CHAMP community college set within it, it will analyze local patterns of sub-baccalaureate participation in manufacturing, construction, and technology as well as the premium on post-secondary training in these fields. Finally, it takes a close look at patterns of the enrollment, completion, and employment outcomes of CHAMP students in the context of these local trends.

[124] NGA. (2013). Retrieved from http://www.nga.org/files/live/sites/NGA/files/pdf/2013/ 1301NGASSSReport.pdf.

Figure 1. State-Level Declines in Sub-Baccalaureate Manufacturing (2004-2014) by Size of Sector (2014)



Source: Quarterly Workforce Indicators (2004-2014).

DATA AND METHODOLOGY

The analysis and findings in this report focus the geographic areas that are included in Colorado's county and regional Workforce Development Boards (WDB) and Colorado's Workforce Investment Board (WIB). (CDLE 2013)[125] Each WIB and WDB identified in Table 1 below is home to one participating CHAMP community college campus. In considering each WIB/WDB and its associated CHAMP community college program, analyses follow the same three-phase methodology for each pairing.

Table 1. Workforce Investment Boards and CHAMP Community Colleges

Workforce Investment Board (WIB) and Workforce Development Boards (WDB)	Participating Community College
Boulder County WDB	Front Range Community College
Denver WDB	Community College of Denver
Pikes Peak WFD (El Paso and Teller counties)	Pikes Peak Community College
Tri-County WDB (Clear Creek, Gilpin and Jefferson counties)	Red Rocks Community College
Pueblo County WIB	Pueblo Community College
Southeastern WIB (Baca, Crowley, Huerfano, Kiowa, Las Animas, Otero and Prowers counties	Lamar Community College
Weld County WDB	Aims Community College

Phase One: Local Labor Markets for Advanced Manufacturing. The first part of the analysis uses public-use Quarterly Workforce Indicators from the Longitudinal Employer-Household Dynamics (LEHD) linked employer-employee microdata and the U.S. Census Bureau to characterize local labor market dynamics within the area served by each Colorado Workforce Investment Board (WIB)/Colorado Workforce Development Board (WDB). These data are first used to detail the percentage of incumbent workers who had less than a bachelor's degree and were working in advanced manufacturing sometime in the last 12 years inclusive of the decade preceding CHAMP through the third year of the CHAMP grant, fall 2016. EERC's analysis of this percentage will be in Figure a's throughout this report. Quarterly Workforce Indicators (QWI) data used in this study rely on 2-digit North American Industry Classification System (NAICS) codes, three of which are related to advanced manufacturing: manufacturing, construction, and technology.[126] QWI data are used here to examine the premium to sub-

[125] In Colorado there are 9 workforce regions and 10 sub-regions in which WIBs and WDBs are located to engage in "strategic planning to meet the employment and training needs of local businesses and industries." CDLE (2013) Orientation Guide for Colorado Local Workforce Investment Boards. Colorado Workforce Development Council, p.10.

[126] Manufacturing (31-33) includes workers employed in the manufacture of everything from consumer goods to aerospace products. Examples of sectors within construction (23) include building construction, civil engineering construction, and specialty trades. Finally, professional, scientific, and technical services (54), referred to here as

baccalaureate postsecondary training in each of the three CHAMP-related NAICS sectors over the same period (Figure b's throughout). EERC uses "premium" to refer to the percentage difference, or advantage, in the quarterly earnings of employees who took college coursework or completed a certificate or an associate degree, but lack a bachelor's degree, and those employees with a high school education or less in each of the specific NAICS coded areas.

Phase Two: CHAMP Participation and Completion in Context. In the second phase of EERC's analysis, CHAMP course enrollment and degree or certificate completion data are used to identify trends in participation over the three completed calendar years of CHAMP, 2014-2016 (Figure c's throughout). This calendar-year approach allows for the most direct comparison to employment and wage data, using calendar-year quarters, rather than academic semesters. Students are counted as participants in each year and at each college where they were enrolled in a CHAMP course. In addition, Figure c's include the number of students who completed a degree or certificate.

Phase Three: Returns to CHAMP Participation in Employment Outcomes. Colorado unemployment insurance (UI) data for CHAMP participants were obtained from the U.S. Department of Labor to shed light on students' labor market participation before and after participating in CHAMP (2013-2016 calendar years). These data allow for measuring both students' employment and their average quarterly earnings in the calendar year before and after enrollment in CHAMP courses (Figures d and e, respectively). Because UI data are only available from 2013 through 2016, some students' data were truncated (i.e. left or right censored). As a result, these students' pre- and/or post-CHAMP information have been omitted from the analysis. To illustrate, if a student enrolled only in 2014, then his/her pre-CHAMP employment and earnings information would be derived from 2013, the year prior to enrollment; by contrast, his/her post-CHAMP information would be drawn from 2015. By contrast, students enrolled in 2016 would have no post-CHAMP employment or earnings information available because the 2017 data is not yet available. Further, it is important to note that because UI data exclude individuals in the military, the self-employed, and those employed out of state, findings in phase three include only civilians working for pay in Colorado. Finally, when reporting average quarterly earnings of CHAMP students in the year before and the year following enrollment (Figure e's), students' earnings are contrasted against the average quarterly earnings of manufacturing workers with different levels of education (high school only, some college, a bachelor's degree) using QWI data from this same period.[127]

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technology, is a particularly heterogeneous group and includes architectural, engineering, and related services and specialized design – fields related to the computer-aided design curriculum at several campuses.

[127] Consistent with other CHAMP reporting, earnings are restricted to include only incumbents earning a minimum of $1,000 quarterly, see latest summary report.

RESULTS

Boulder WDB and Front Range Community College

The Workforce Development Board serving Boulder County, within the larger Central Colorado Planning Region, benefits from a diverse and technology-driven economy. Among the local industries, professional, scientific, technical services, and manufacturing[128] are anticipated to experience the highest rates of growth prior to 2020. Consistent with expected growth, the primary goal of Front Range Community College's (FRCC) CHAMP program was to reintroduce and redesign their machining program. Major strengths of FRCC's CHAMP program were the close ties between CHAMP staff and local employers, which facilitated industry involvement in the design/redesign of curriculum to meet their changing needs. One result of this is that machining students have received job offers from local manufacturers while still in the program. Given this experience, students felt that they were "all but guaranteed" good jobs at the conclusion of the program.[129]

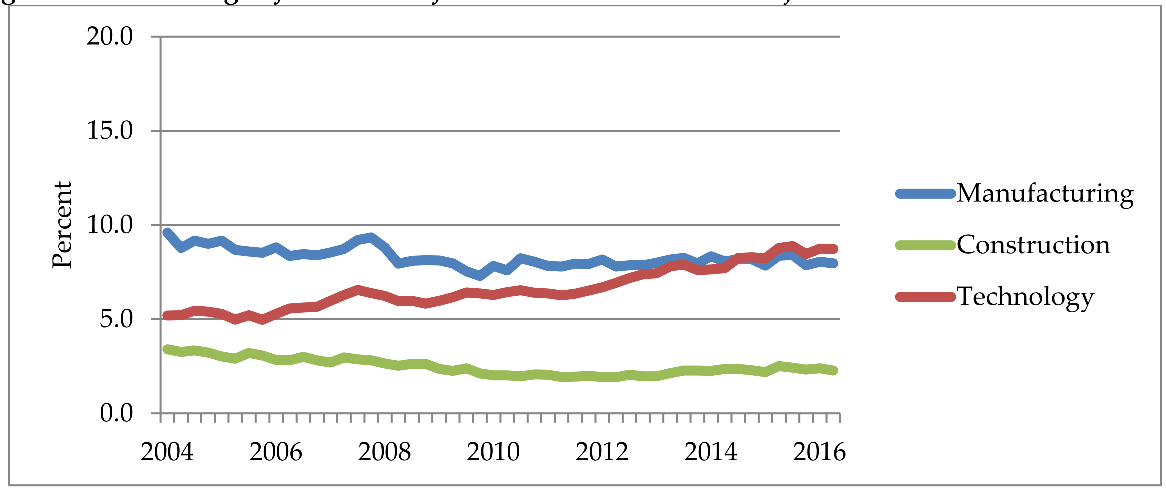
Over the past decade, the local Boulder labor market has been evolving, particularly for workers with less than a bachelor's degree. Figure 2a shows the percentage of the local workforce with less than a bachelor's degree employed in CHAMP-related fields from 2004 through fall 2016, the most recent data available. In 2004, roughly 10 percent of the local labor market was comprised of sub-baccalaureate workers in manufacturing (blue line). By the onset of the Great Recession in 2008, the group had shrunk slightly to about 8 percent, and then held steady through 2016. Over the same twelve-year period, construction jobs (green line) in the Boulder area declined, from 3 percent to 2 percent.[130] On the other hand, sub-baccalaureate jobs in professional, scientific, and technical services (red line) have increased, growing from 5 in 2004 to nearly 9 percent of the workforce in 2016. Thus, although CHAMP-related fields may offer a fast-track toward good jobs within the local economy, local opportunities for sub-baccalaureate workers are increasingly shifting towards scientific and technical areas and away from manufacturing or construction.

[128] https://www.colorado.gov/pacific/sites/default/files/2016_Boulder_County_ Local_Plan.pdf

[129] See EERC's Front Range Community College CHAMP Case Study" at http://smlr.rutgers.edu/sites/smlr.rutgers.edu/files/ images/Research documents/frcc_case_study_final_2016.pdf

[130] This may be a result of Boulder's restrictive policies on growth.

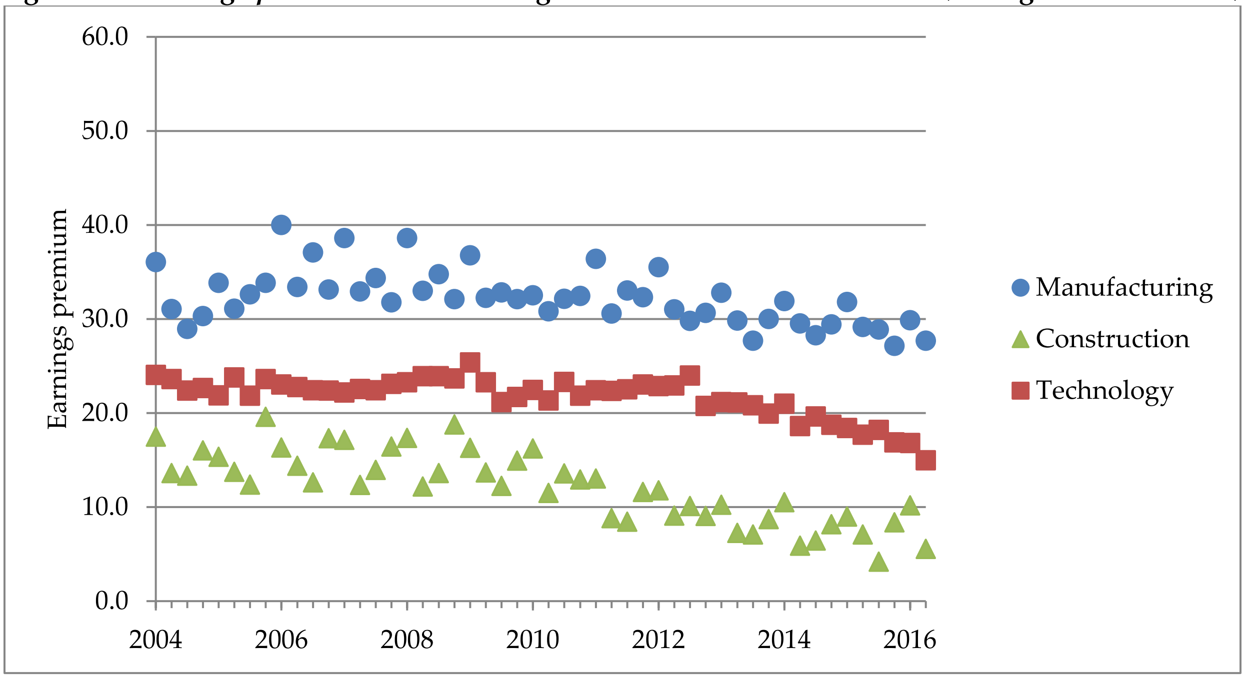
Figure 2a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



When evaluating the benefit of pursuing additional education, workers' choices are likely motivated by the premium that additional training will bring them in the workforce. Figure 2b shows the percentage increase from 2004 to 2016 in earnings associated with some postsecondary education including college coursework, a certificate or an associate degree (compared to a high school education or less) for workers in manufacturing, technology, and construction.

Historically and in general, workers in manufacturing with some postsecondary training have enjoyed the largest premium for their advanced training compared to construction and technology, although since the recession some of these benefits have declined. Nevertheless, the most recent data show that workers in manufacturing with some postsecondary education earn nearly 30 percent more than peers in the same sector with a high school degree or less. By comparison, the premiums for workers in technology and construction were only 15 percent and 6 percent, respectively. Therefore, when considering advanced training in the Boulder area, workers stand to gain the most – on average – from training in manufacturing compared to other CHAMP-related fields.

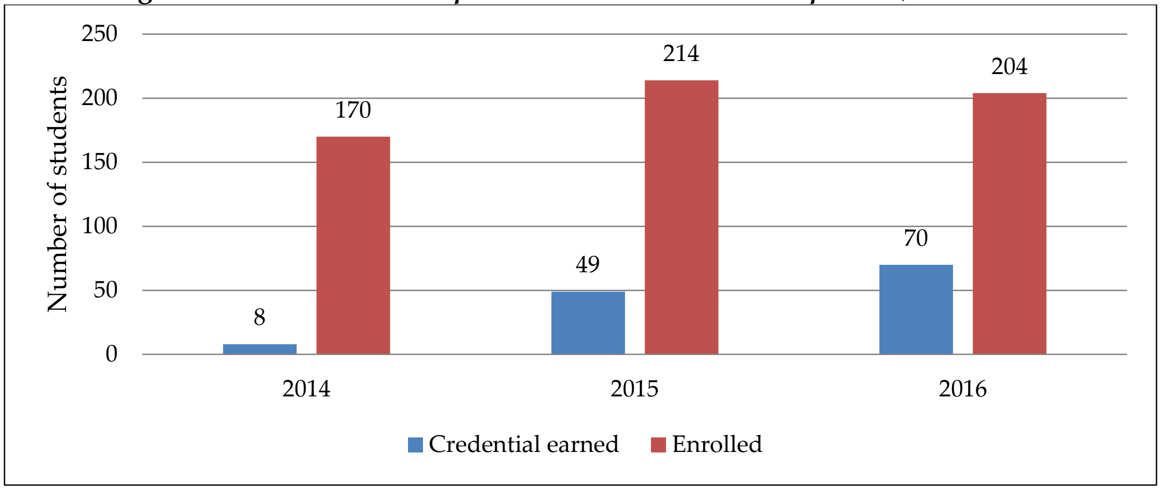
Figure 2b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



Within this context, increasing opportunities for sub-baccalaureate workers within technology, and steady but sizable returns to postsecondary training, CHAMP at FRCC is well positioned to meet not only the needs of individuals seeking access to good local jobs but also the demands of employers.

Figure 2c presents participation in CHAMP over three calendar years, 2014-2016, in terms of enrollments in CHAMP courses and the completion of CHAMP related credentials (degrees and certificates). By both measures, participation in FRCC's CHAMP program has grown substantially since 2014. A total of 170 students participated in CHAMP during the 2014 calendar year, growing to 214 students in 2015, and then dropping slightly to 204 students in 2016. On the other hand, an increasing numbers of students earned credentials each year, from only 8 during the first year of CHAMP, to 49 in 2015, and 70 in 2016. Despite the slight dip in enrollment between 2015 and 2016, the growing number of FRCC students enrolling in CHAMP courses or completing CHAMP related credentials was helping individuals to position themselves to enter a stable (or growing) and profitable areas in the local labor market for the sub-baccalaureate workforce.

Figure 2c. CHAMP Participation and Credential Completion, 2014-2016



As the final piece of this analysis, Figures 2d and 2e consider how FRCC's CHAMP students have fared in the labor market. Figure 2d contrasts the rate at which CHAMP students were employed the year prior to their enrollment against their employment rate the year following, regardless of whether they completed a degree or certificate. Fifty-eight percent of students were employed prior to CHAMP compared to 64 percent who were employed after enrollment. Across the WIBs/WDBs considered in this report, FRCC had the highest employment rate among participants before becoming CHAMP students, and also had the highest post-CHAMP employment rate.

Figure 2e details the average quarterly earnings of FRCC's CHAMP students before and after participation against the average earnings of workers in the Boulder WDB working in manufacturing who had completed high school, some college, or a bachelor's degree. This comparison shows that FRCC students earned on average roughly $9,100 each quarter the year before enrolling in CHAMP and $10,900 each quarter the year following CHAMP regardless of their highest academic level. These earnings are considerably higher than the average quarterly earnings of workers with bachelor's degrees in manufacturing in the Boulder area ($8,855). Taken together, FRCC students were among the most strongly positioned in terms of both their employment and earnings before CHAMP, and they benefitted in both of these areas following their participation.

Figure 2d. Employment rate of CHAMP students pre- and post-participation

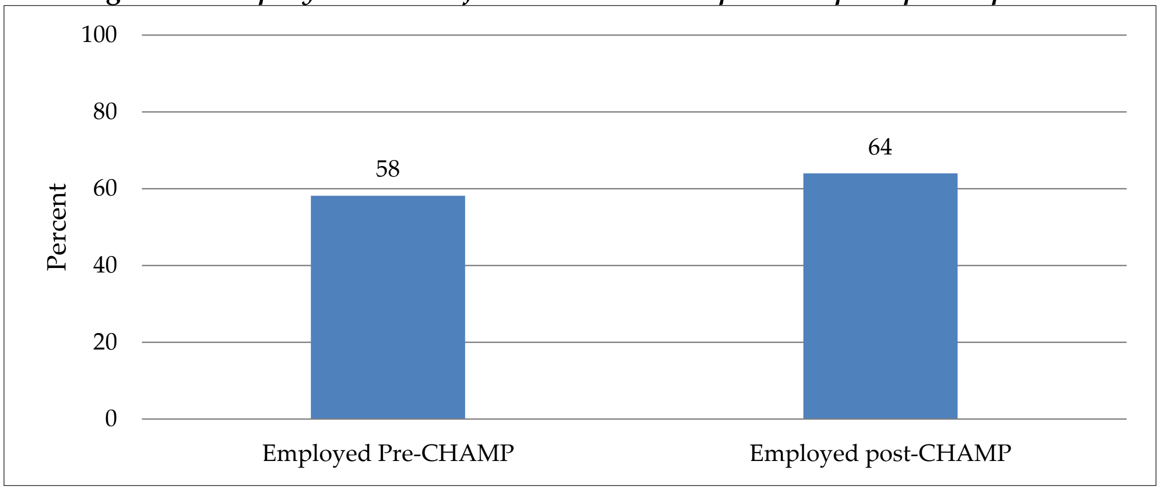
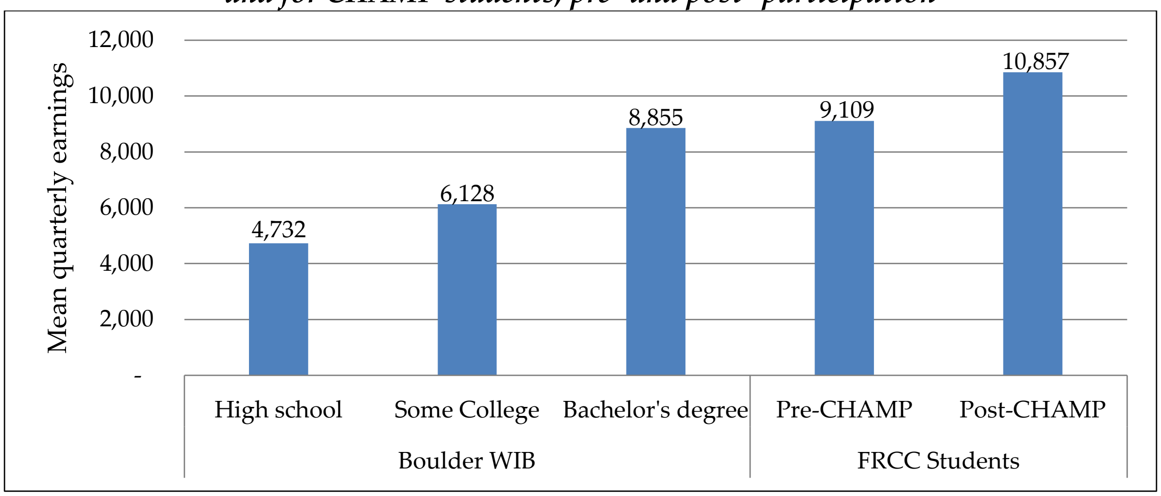


Figure 2e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Denver WDB and Community College of Denver

The goal of the Denver Workforce Development Board is empowering job seekers and enabling local businesses to foster economic growth for its diverse range of industries and talent.[131] The Denver WDB particularly focuses on manufacturing, technology, healthcare, and finance as key economic sectors.[132] Within this context, the Community College of Denver (CCD) developed a range of CHAMP programs including fabrication welding; machine technologies; and engineering graphics and mechanical design. In addition, CCD heavily invested in a new, state-

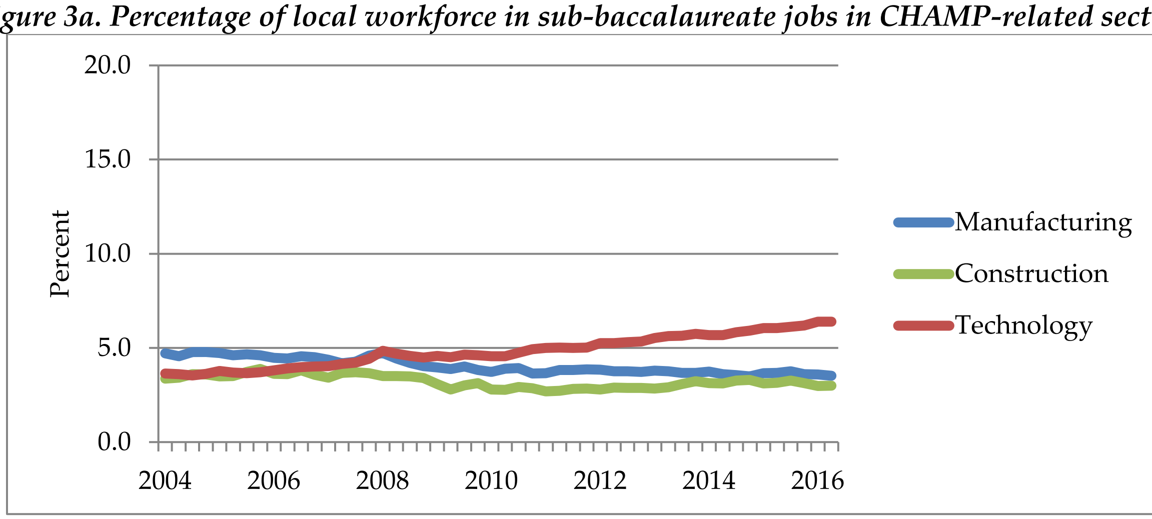
[131]See https://www.denvergov.org/content/dam/denvergov/Portals/690/WorkforceDevBoard/Denver_WDB_StrategicActionPlan_2016-2020.pdf

[132] See EERC's "See EERC's Community College of Denver CHAMP Case Study" at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

of-the-art Advanced Manufacturing Center (AMC) to house these programs. CHAMP programming at CCD, however, faced major delays in the launch of their new manufacturing building the AMC, and experienced limited engagement from local employers. The college also noted that local employers were hiring their students before they completed. This meant that participants did not complete credentials and may have undermined their training.

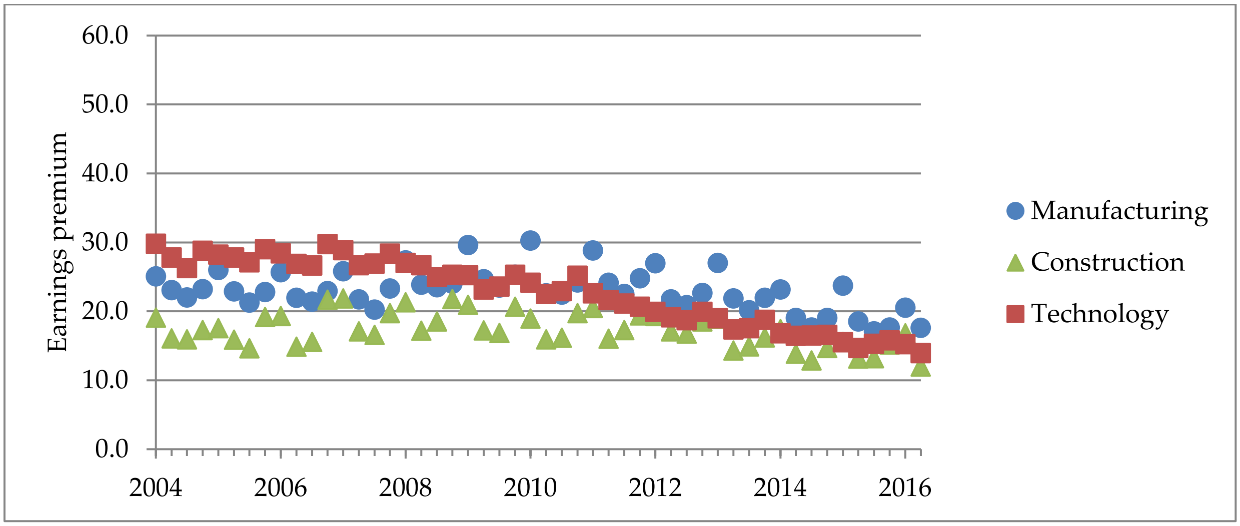
To situate these dynamics within context, Figure 3a shows the percentage of those working in CHAMP related sectors in the Denver WDB labor market from 2004 to 2016 who had less than a bachelor's degree. Compared with Boulder, these CHAMP-related sectors comprise a smaller portion of Denver's local economy; yet, some similar trends emerge in terms of declines in manufacturing and increases in technology. To illustrate, while the share of the local workforce in manufacturing (blue line) declined slightly from 5 percent in 2004 to just under 4 percent in 2016, the percentage of workers without college degrees in technology and related fields (red line) increased from 4 percent to 6 percent over this same period. Finally, despite population growth in the Denver area which suggests the need for new construction, during the study period 2004 to 2016, only about 3 percent of Denver's sub- workforce with less than a bachelor's degree worked in construction (green line). Taken together, local opportunities for sub-baccalaureate workers in the Denver area seem to be moving slowly away from manufacturing and towards jobs related to technology.

Figure 3a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



As before, Figure 3b considers trends over time in the earnings premium for workers within the local labor market with some college experience compared to those with a high school education or less. Figure 3b shows that the quarterly earnings of workers with some college experience compared to those with less education has declined across sectors. And, since the onset of the recession, jobs in manufacturing have evidenced a higher premium compared to jobs in construction and technology. For example, the "some college" premium for jobs in technology shows a steady decline from 30 percent to 15 percent during the study period. Earnings premiums for those in manufacturing were more variable, but showed an overall decline. Still, by the beginning of 2016 the quarterly premium for having taken postsecondary coursework or completing an associate degree was approximately 20 percent greater than those with a high school degree or less.

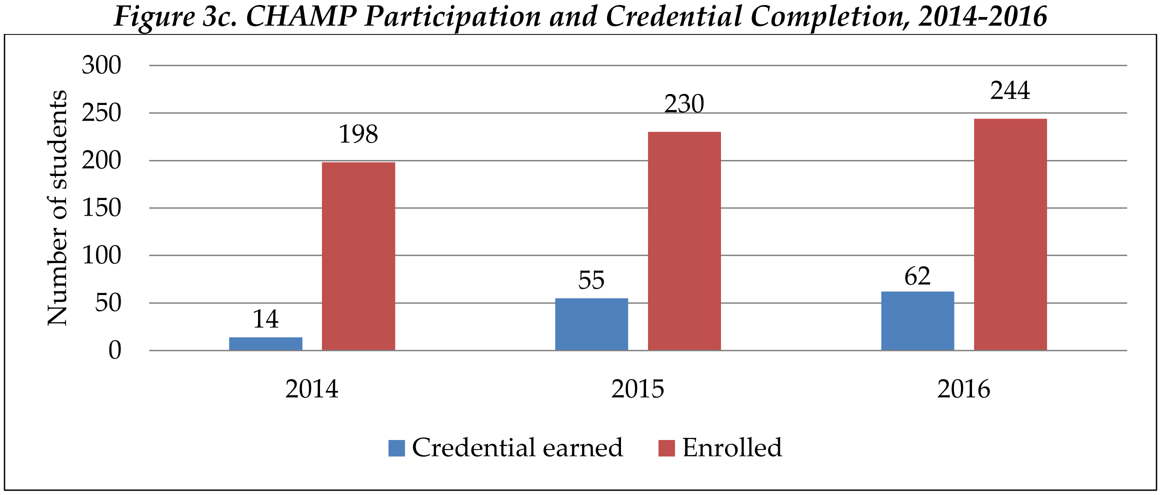
Figure 3b. Earnings premium: "Some college" in CHAMP-related sectors (vs. high school or less)



CCD's CHAMP program, with its emphasis on advanced manufacturing technologies, offered students access to these growing opportunities in technology for sub-baccalaureate workers as well as the steady premium to postsecondary training in manufacturing.

Figure 3c details rates of participation in CHAMP at CCD in terms of course enrollment and credential completion between 2014 and 2016. By both measures, CHAMP's reach expanded at CCD each year. In particular, the number of students completing degrees or certificates increased from 14 in 2014 to 62 in 2016. At the same time, while 198 students enrolled in 2014, this number grew to 244 students by 2016. We thus see an alignment between trends within the Denver's local labor market and patterns of student engagement with the CCD's program.

Figure 3c. CHAMP Participation and Credential Completion, 2014-2016



Finally, Figures 3d and 3e present the employment-related outcomes for CCD's CHAMP students reflecting the extent to which those participating in the program were able to leverage their training into jobs and higher wages. Looking first to Figure 3d, employment increased from 38 percent before participating in CHAMP to 46 percent a year after exiting, an 8 percentage point difference.

In Figure 3e the quarterly earnings of CCD students are compared pre- and post- CHAMP enrollment. As before, the figure benchmarks these changes against the earnings of local workers in manufacturing who had completed high school, some college, or a bachelor's degree. In each quarter pre-CHAMP earnings of CCD students averaged $4,386, considerably higher than local manufacturing incumbents with only a high school education ($3,762) but similar to those with some college ($4,495). A year after leaving CHAMP, CCD students were earning an average of roughly $5,000 each quarter, or an income that falls roughly between Denver area incumbents with some college ($4,495) and those with a college degree ($6,156).

Looking at Figures 3d and 3e together, the data suggests that not only are CCD students more likely to be employed following participation in CHAMP, but that their earnings receive a boost which lands them somewhere between the wages for those with an associate and a bachelor's degree within the local labor market.

Figure 3d. Employment rate of CHAMP students, pre- and post-participation

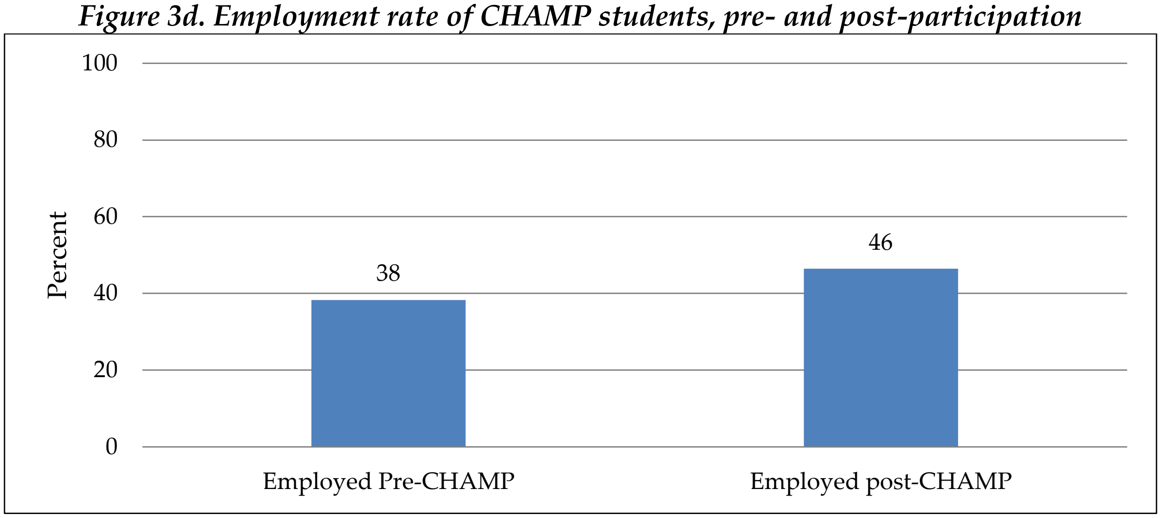
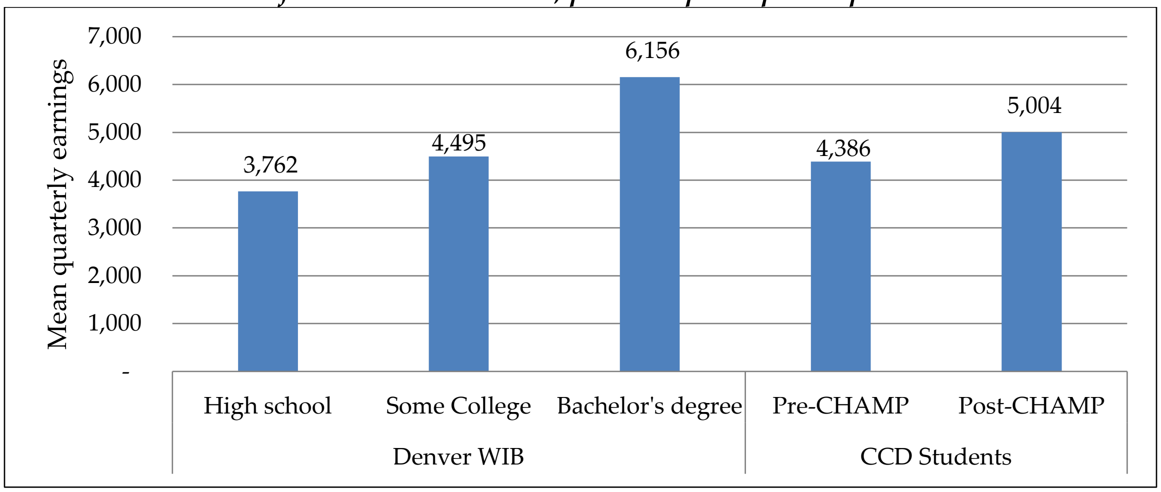


Figure 3e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Pikes Peak WBD and Pikes Peak Community College

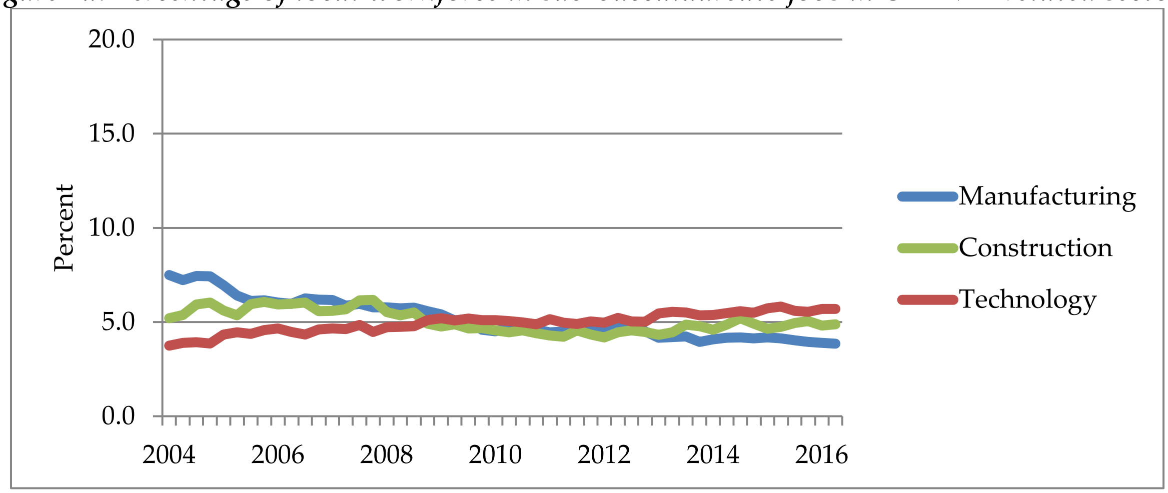
South of Denver, in the region covered by the Pikes Peak WDB, El Paso and Teller counties include Colorado Springs and the surrounding rural areas. This is the location of Pikes Peak Community College (PPCC) as well as an army base and several air force bases. The military are a significant presence in this area playing a major role in the community's culture, and economy. Yet, in a recent study of the region's workforce, representatives of local industries including manufacturing, construction, aerospace and defense, healthcare and finance reported an acute shortage of middle-skill jobs – those requiring more than a high school education but less than a bachelor's degree.[133] Consistent with this need, the collaboration between the El Paso/Teller counties WIB and PPCC was notably strong. For example, PPCC administrators and faculty regularly attended monthly meetings of the Pikes Peak Manufacturing Partnership (PPMP) and PPMP advisors weighed in on the development of the manufacturing program.[134] The synergy between PPCC and the El Paso/Teller WIB resulted in CHAMP funded programming around machining technology, computer-aided design, and electronics technology. The focus of the curriculum design was on developing specific job skills, industry qualifications, and short-term certificates rather than multi-year programs.

Figure 4a presents the region's labor market trends for workers with less than a bachelor's degree. It shows that between 2004 and 2016, the percentage of the sub-baccalaureate workforce holding jobs in manufacturing (blue line) was roughly halved, falling from 7.5 percent in 2004 to 3.9 percent in the beginning of 2016. By contrast, the share of sub-baccalaureate workers in technology (red line) increased from 3.8 percent to 5.7 percent over the same period. Finally, although construction (green line) has fluctuated a bit over time, it has remained steady at about

[133] See EERC's "Skills Building" at https://www.ppwfc.org/pageFiles/pgDir6167/files/Skills/Employers_Skills_ Report_2018.pdf
[134] See EERC's "Pikes Peak Community College CHAMP Case Study" at https://smlr.rutgers.edu/content/ education-employment-research-center-eerc

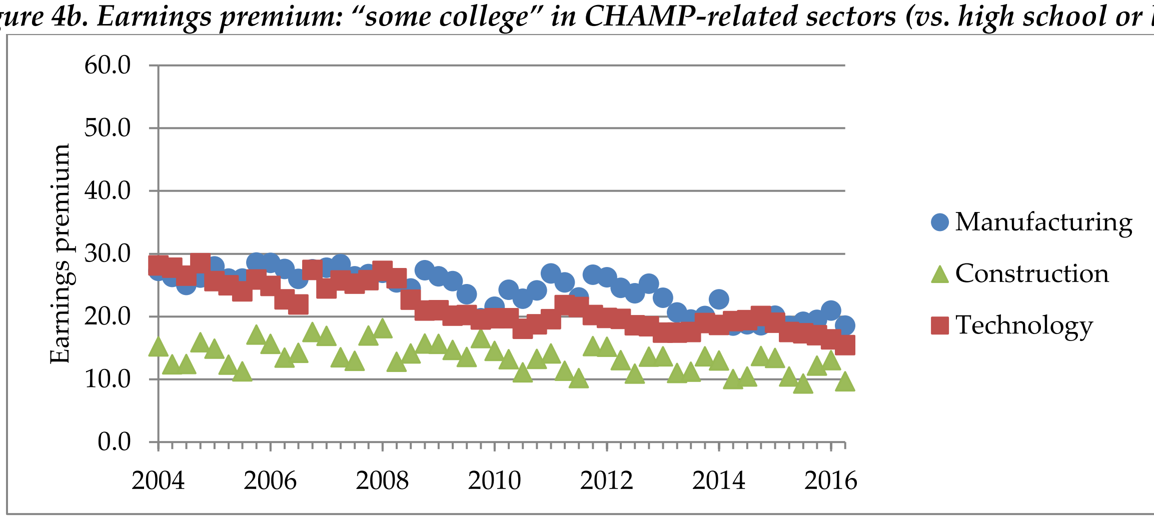
5 percent. The focus of PPCC's CHAMP program on more technologically-driven aspects of manufacturing therefore appears to be well suited to a local labor market shifting away from manufacturing and towards scientific and technical areas for workers with less than a bachelor's degree.

Figure 4a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



In the region, the wage premium of some college education –either postsecondary coursework, a certificate or an associate degree – has also been evolving. Figure 4b, shows for each quarter of 2004 that workers with some college training in the El Paso/Teller area typically earned about 30 percent more than their peers with less education. This premium, however, declined to about 20 percent by 2016. Jobs in manufacturing (blue dots) and technology (red squares) track similarly in respect to the premium of postsecondary experience. But manufacturing jobs had a 5 percent higher return. And, as has been shown elsewhere, construction related jobs typically carried the smallest premium for postsecondary education – somewhere between 10 and 20 percent.

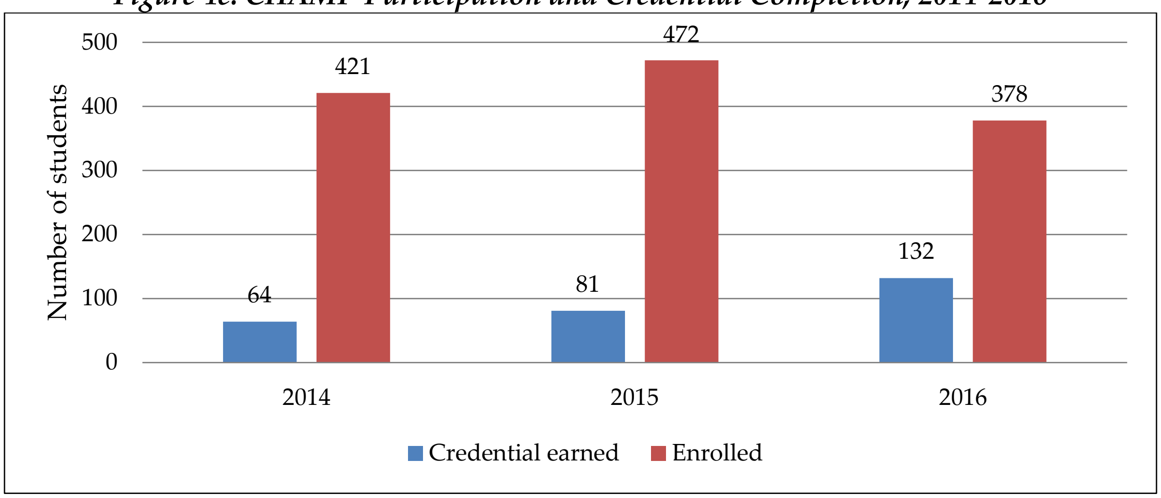
Figure 4b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



Reflecting on the above cited trends in the local labor market – a transition from manufacturing to tech jobs concurrent to a declining, but still substantial postsecondary training premiums, PPCC's CHAMP created program seem well positioned. They offer a pathway via training to good jobs in the local economy.

Figure 4c details the number of students who completed degrees or certificates or simply enrolled in CHAMP coursework at PPCC. In the first year of the CHAMP grant, a total of 421 students took CHAMP coursework and 64 students completed CHAMP related degrees or certifications. Though degrees and certificates earned by PPCC students rose steadily each year of the grant reaching 132 in 2016, CHAMP course enrollment peaked in 2015 with 472 students and then declined in 2016 to 387 students. Of interest, across the CHAMP consortium of colleges, PPCC had the highest enrollment, while awarding comparatively fewer degrees and certificates. This skill building without concurrent credentialing is consistent with PPCC's collaborating industry partners' emphasis on skill training then employment, rather than earning longer term credentials.

Figure 4c. CHAMP Participation and Credential Completion, 2014-2016



Finally, as before, Figures 4d and 4e examine the payoff to students in terms of increases in employment and earnings following participation in PPCC's CHAMP programs. Figure 4d presents the employment rate of students at PPCC before and after enrolling in CHAMP coursework. In the year prior to enrolling in CHAMP courses, 45 percent of students were employed. By contrast, 55 percent were employed one year after leaving PPCC, a 10 percentage point increase. Figure 4e contrasts the quarterly earnings of PPCC CHAMP students before and after participating against the average quarterly wages of workers with various levels of education in the local labor market. Prior to enrolling in CHAMP courses, the average PPCC student was earning $4,865 quarterly at his or her job, slightly more than the average incumbent in manufacturing with some college or an associate degree. A year following enrollment in one or more CHAMP courses, students were earning on average $6,599 each quarter, about $150 less than manufacturing workers with college degrees. In sum, PPCC's CHAMP students were able to leverage their educational experience into greater rates of employment and furthermore, had earnings higher than those earned by sub-baccalaureate workers in manufacturing jobs.

Figure 4d. Employment rate of CHAMP students, pre- and post-participation

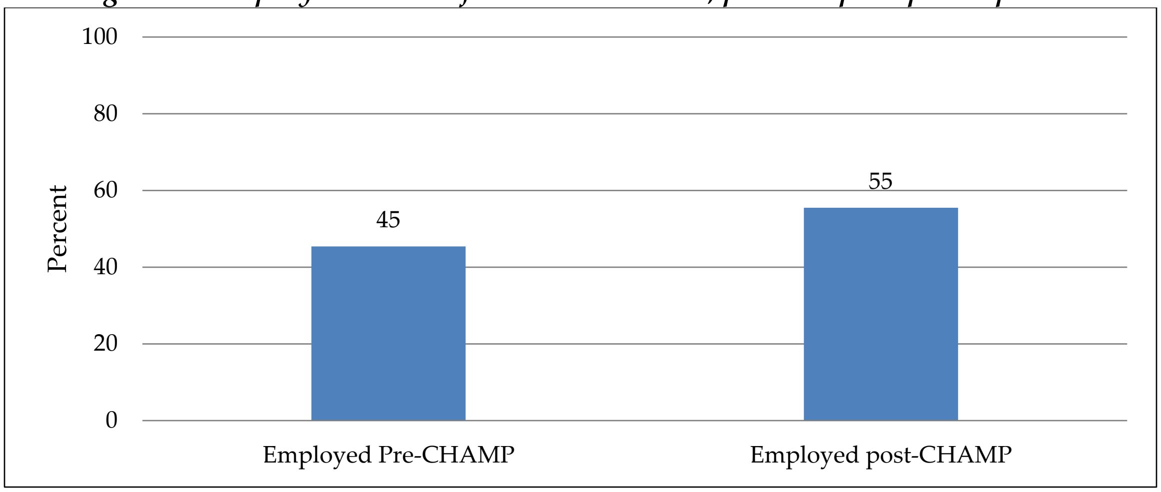
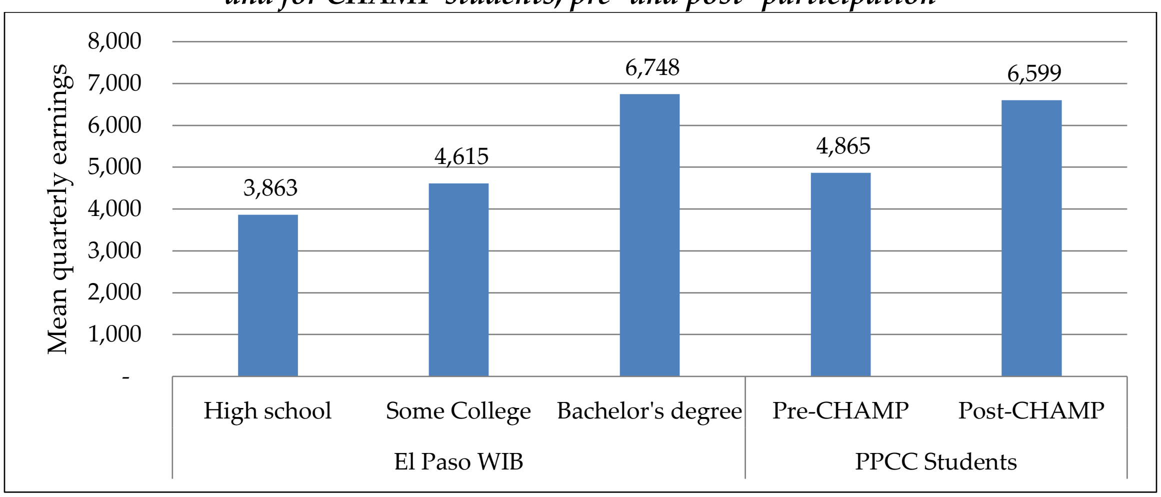


Figure 4e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



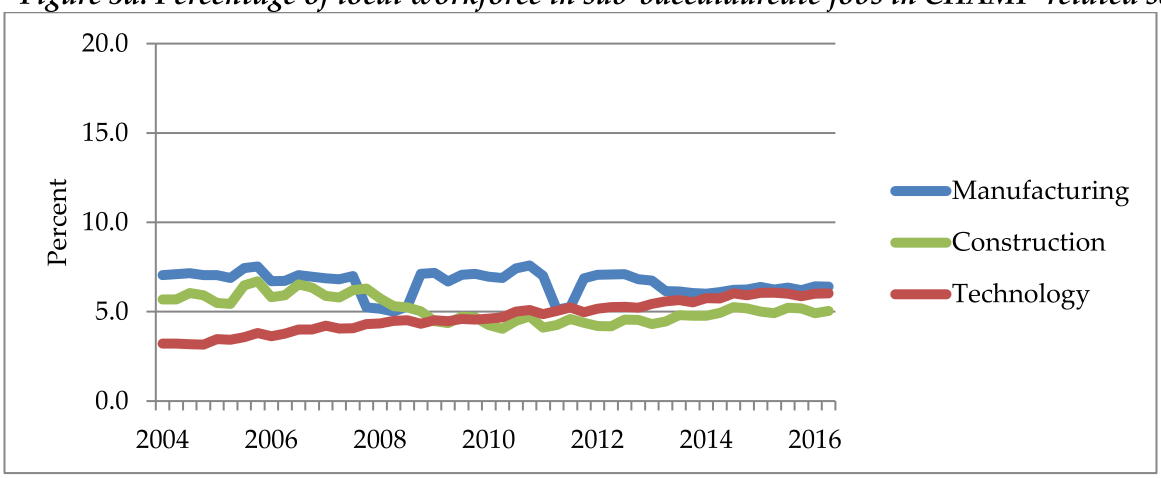
Tri-County WDB and Red Rocks Community College

Workers in Jefferson, Clear Creek, and Gilpin counties, just east of Denver, benefit from a range of in-demand local industries. The Tri-County Workforce Development Board which serves the area, had previously identified three high demand industry sectors – healthcare, IT, and advanced manufacturing. In response to increasing demand for skilled tradespeople the WDB recently added construction. Prominent employers within advanced manufacturing include the aerospace leader Lockheed Martin, which employs engineers as well as machinists and skilled production workers. (Ibid)

Red Rocks Community College (RRCC), located in Lakewood, has historically benefitted from strong relationships with local industries. As part of CHAMP, local employers played an active role in the development of curriculum for RRCC's precision machining and engineering graphics technology programs.[135]

Figure 5a presents the percentage of the sub-baccalaureate workforce in the Tri-County area involved in a CHAMP-related sector between 2004 and 2016. In contrast to the steady decline seen elsewhere, the percentage of sub-baccalaureate manufacturing workers in the Tri-County area was only slightly lower in 2016 compared to 2004; 7 percent and 6.5 percent respectively. Of note, the local manufacturing labor market suffered two rapid shocks: in 2008 and 2012. During the study period, the percentage of construction workers with less than a college degree (green line) typically hovered around 5 percent, Figure 5b. At the same time, and as seen elsewhere, over the past 12 years, the percentage of sub-baccalaureate workforce in technology-related jobs (red line) nearly doubled, from 3.2 percent to 6 percent. In summary, within the Tri-County sub-baccalaureate labor market, the manufacturing sector has shown variability but has been steadier in recent years. This is concurrent to a growth in opportunities in technology, which are now at similar levels to manufacturing.

Figure 5a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



During the study period, across these three workforce sectors, the premium to pursuing college coursework or obtaining an associate degree has increased. Figure 5b compares earnings premium of those workers with some college education but without a bachelor's degree, with workers with a high school degree or less. Of note is the divergence in premium patterns between 2004 across the three industry sectors. In 2004, construction (green triangle) had a 20 percent advantage for workers with some college, compared to technology (red square) with a 22 percent advantage, and manufacturing (blue circle) with a 26 percent advantage. By 2016,the pattern had shifted with the premium for workers with some post-secondary experience

[135] See EERC's "Red Rocks Community College CHAMP Case Study" at http://smlr.rutgers.edu/sites/smlr.rutgers.edu/files/images/Research_Documents/frcc_case_study_final_2016.pdf

manufacturing to be about 22 percent compared to technology at 16 percent, and construction dropping to 11 percent. Thus, within the three CHAMP-related sectors, workers with less than a bachelor's degree who completed some college coursework or an associates' degree, can expect the highest return on their training in advanced manufacturing, and the lowest return in construction, with technology-related fields in the middle.

Figure 5b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)

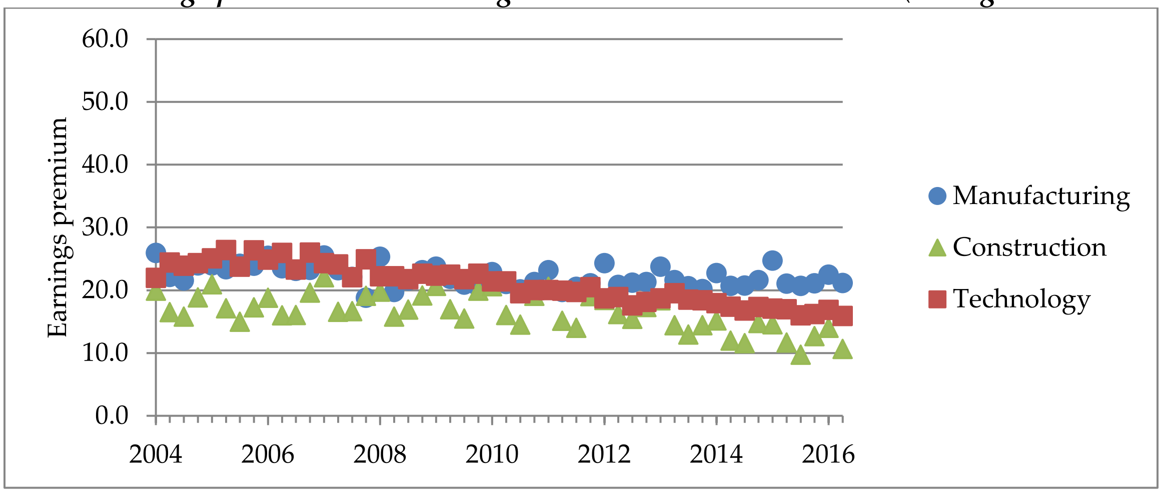
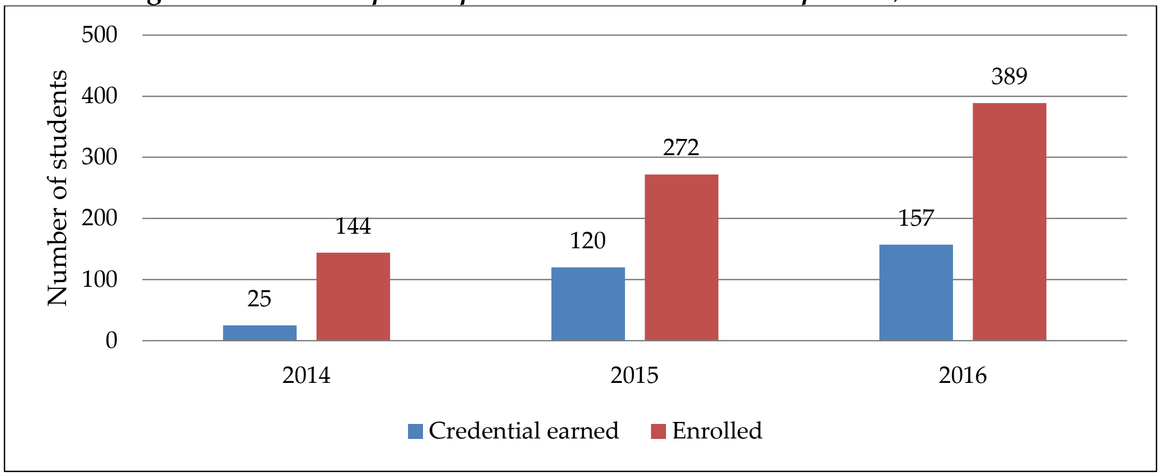


Figure 5c shows the rates of participation – enrollment and credential completion - in RRCC's CHAMP programs during the 2014, 2015, and 2016 calendar years. Enrollment in RRCC CHAMP programs increased each year: 144 in 2014 to 272 in 2015 and a greater increase in 2016 to a total of 389; the most of any CHAMP college that year. Twenty-five students completed degrees or certificates in 2014, 120 did so in 2015, and by 2016, 157 had completed a CHAMP related credential. Thus despite perceptions that local employers were unsure of how to interpret CHAMP certificates, each grant year RRCC 's CHAMP program gained momentum in terms of enrollment and credential completion.

Figure 5c. CHAMP participation and credential completion, 2014-2016



Finally, Figures 5d and 5e illustrate how RRCC students were doing in the labor market before and after their CHAMP coursework. In Figure 5d, the employment rate of RRCC CHAMP students the year prior to their enrollment is contrasted with their employment rate the year after their participation. Forty-one percent of students were employed before they began CHAMP, 62 percent were employed the year following – a 21 percentage point increase.

Figure 5e examines how CHAMP students' average quarterly earnings before and after participation compare to the average of Tri-County manufacturing workers with various levels of education. Prior to enrolling in CHAMP coursework, students earned an average of $5,115 each quarter, slightly below the average earnings of high school educated workers in manufacturing. However, after enrolling in CHAMP, these students typically earned $7,001 – quarterly earnings akin to the $7,146 earned by local workers in manufacturing who had taken college-level courses or completed an associate degree. Thus, CHAMP appears to have boosted earnings from below those of high school students to roughly on par with peers with some college experience.

Figure 5d. Employment rate of CHAMP students pre- and post-participation

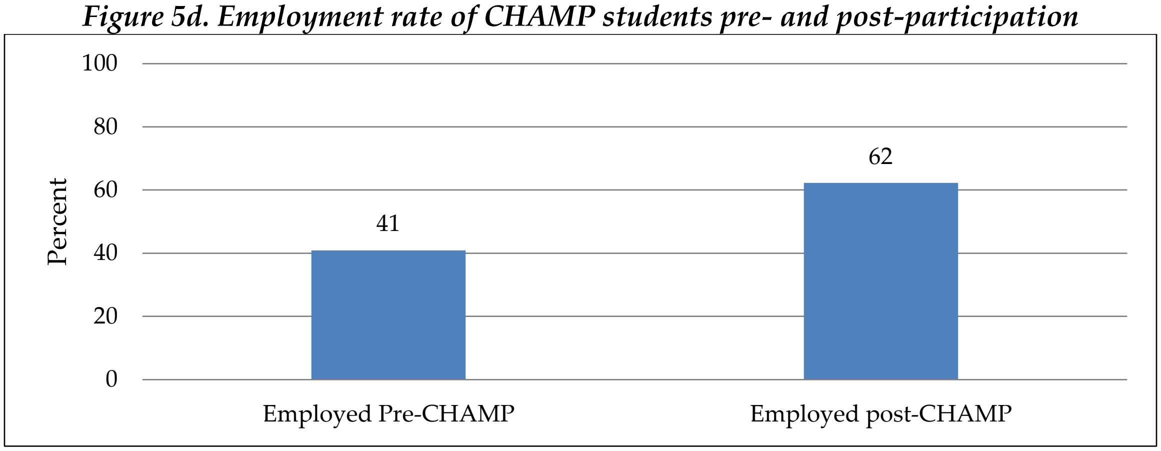
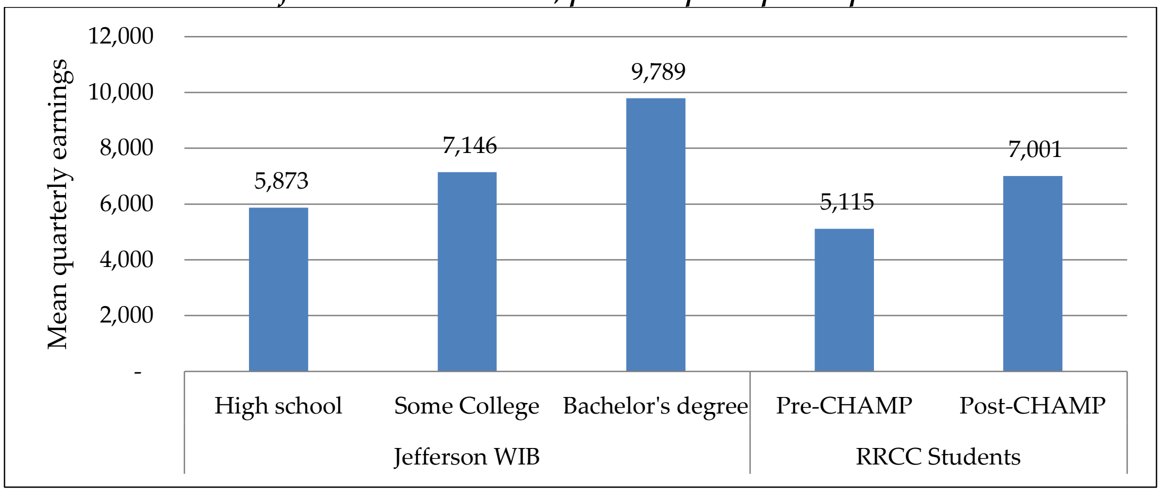


Figure 5e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Pueblo WIB and Pueblo Community College

Located in southern central Colorado, Pueblo's history as a transportation and manufacturing hub features prominently in its identity. To meet current and emerging needs in Pueblo, CHAMP programming at Pueblo Community College (PCC) sought to efficiently train students for jobs in welding, electro-mechanical technology, and machining.[136] In addition, PCC students could train for local jobs in wind energy or lucrative oil and gas jobs across the state, e.g., jobs in the Denver and Greeley areas. Adding to the success of CHAMP at PCC were the close relationships between CHAMP personnel and the local workforce center. This relationship facilitated communication with local industry representatives as well as PCC students' employment with local employers.

In the context of Pueblo's history as a manufacturing center, Figure 6a looks at trends in the local labor market for CHAMP-related sectors over the past twelve years. In general, all three sectors – manufacturing, construction, and technology - have not experienced more than a 5 percent change, but the direction of this change has been different for each sector. Manufacturing (blue line) has been the most stable sector employing about 8 percent of sub-baccalaureate workers in the Pueblo area. As such, the Pueblo region is just behind Boulder and Weld counties which have the largest share of manufacturing jobs of all WIBS/WDBs served by CHAMP. Construction (green line) has dipped slightly in the rate of sub-baccalaureate worker employment, from 6.5 percent to 5.5 percent during the study period. The technology sector (red line) has nearly doubled its rate of employment of sub-Baccalaureate employees, going from 1.5 percent in 2004 to nearly 3 percent in 2016. Overall, for sub-Baccalaureate employees,

[136]See EERC's Pueblo Community College CHAMP Case Study" and EERC's Colorado Sector Strategy Evaluation Case Studies, both at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

Pueblo offers a steady labor market for sub-baccalaureate jobs in manufacturing and construction, concurrent to increasing opportunities within technology.

Figure 6a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors

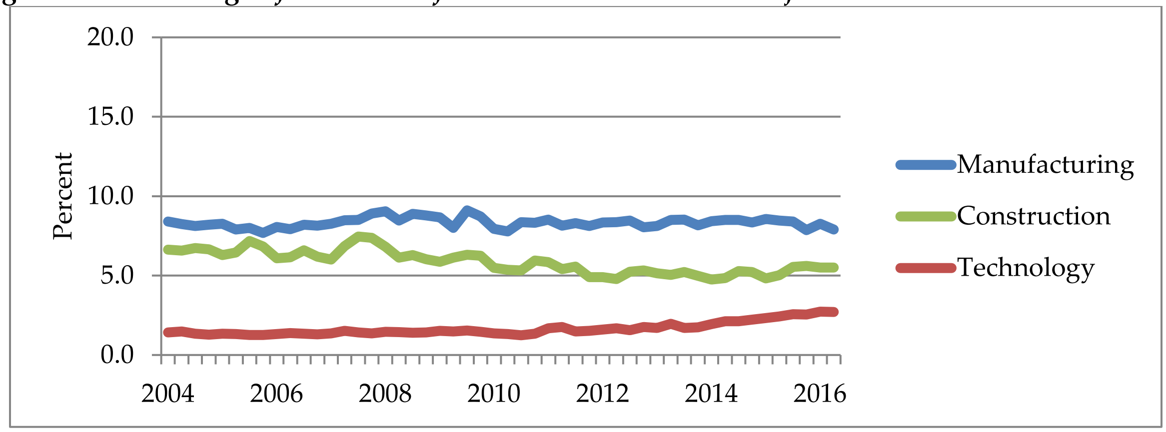
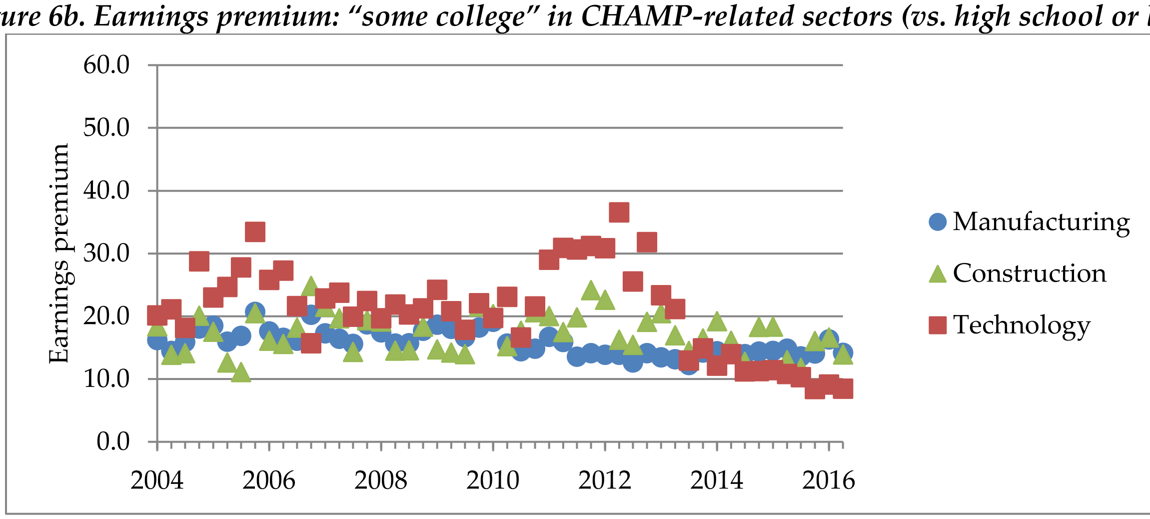


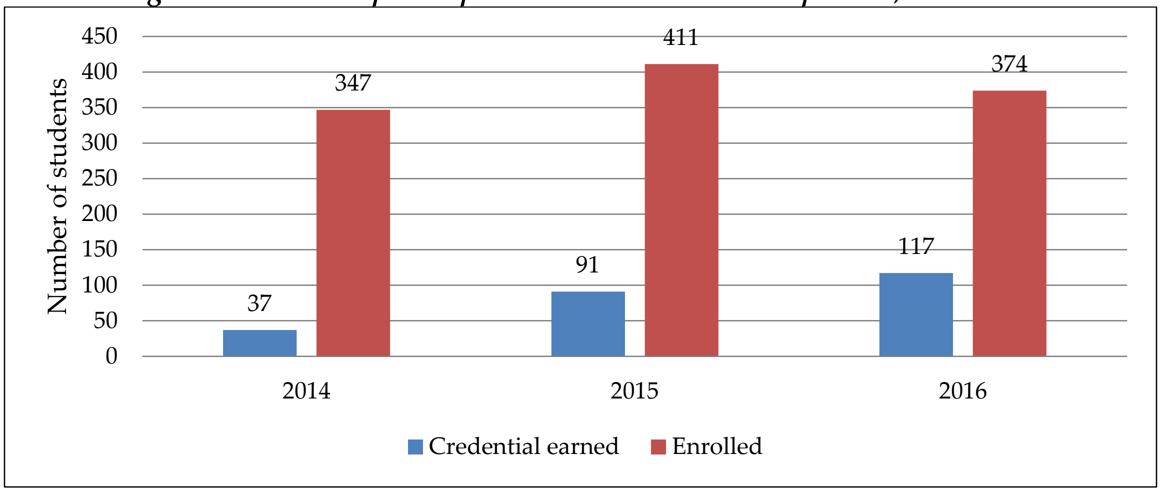
Figure 6b charts the earnings premium enjoyed by workers in the Pueblo area who have completed "some college" – either college coursework, a certificate or an associate degree – over those with a high school education or less. Manufacturing jobs (blue circle) have offered workers with some college experience a steady, although declining, premium over the last several years, dropping from almost 19 percent in 2009 to about 14 percent in the most recent data. By contrast, quarterly earnings in construction (green triangle) and technology (red square) have been more volatile, characterized by sudden increases that generally taper downward over time. To illustrate, the earnings premium in manufacturing hovered around 20 percent from 2008 to 2010, spiked to 37 percent in early 2012, and has declined recently to about 8 percent. Jobs in construction have followed a similar pattern, but to a less dramatic extent. Thus, though premiums in manufacturing have been slowly declining, other CHAMP-related sectors in the Pueblo area have experienced both spikes and declines.

Figure 6b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



PCC's CHAMP programs appear to offer the college training needed for an entry level job in the region's fairly stable manufacturing sector and its growing technology sector. Figure 6c shows the rates of enrollment and certificate/degree attainment for those participating in PCC's CHAMP programs. In 2014 enrollment in CHAMP courses was 247, rising to 411 in 2015 and then falling in 2016 to 347. At the same time, an increasing number of degrees and certificates were awarded: 37 awarded in 2014, 91 in 2015, and 117 in 2016. Despite its enrollment, PCC had relatively fewer completers than other campuses in the CHAMP consortium.

Figure 6c. CHAMP participation and credential completion, 2014-2016



Finally, Figures 6d and 6e shed light on the impact of CHAMP on participants in the Colorado labor market. First, Figure 6d indicates the extent to which students taking CHAMP courses at PCC were employed the year prior to their participation in CHAMP compared to a year afterward. It shows that while 36 percent of PCC's CHAMP students were employed before starting a CHAMP program, a year after their enrollment ended, 54 percent were working in Colorado.

Figure 6e shows the average quarterly earnings of these students the year before and after CHAMP participation as compared to manufacturing workers in the Pueblo Workforce Investment Board area with different levels of education. Prior to enrolling in CHAMP, PCC students were earning an average of $3,292 – well below the average quarterly earnings of manufacturing workers with a high school degree, $4,435. By contrast, a year after their participation in CHAMP, students were earning an average of $5,079 each quarter, roughly the equivalent of local manufacturing workers with some postsecondary experience or an associate degree. This suggests that by leveraging their CHAMP training, PCC students were able to substantially boost their rates of employment and their earnings.

Figure 6d. Employment rate of CHAMP students pre- and post-participation

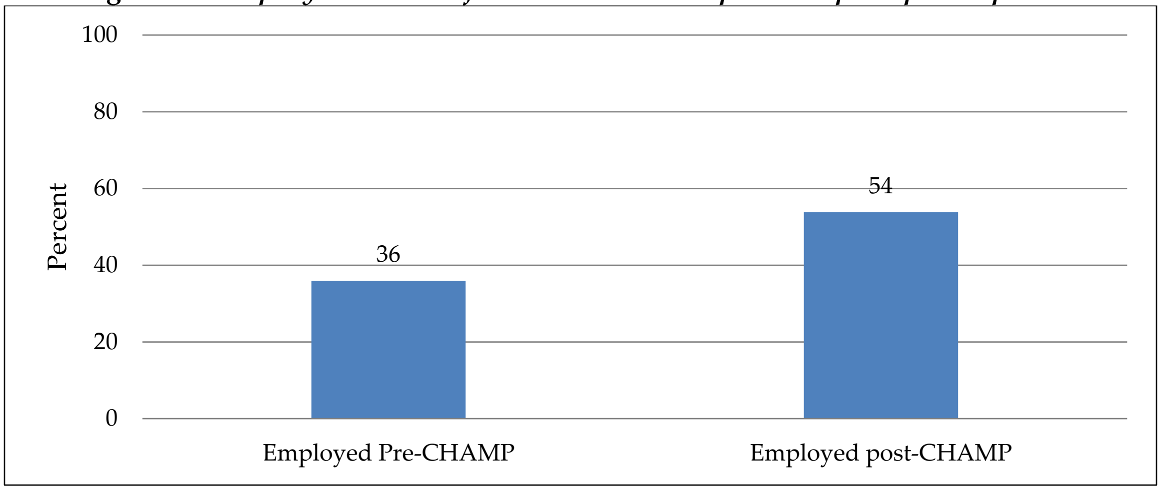
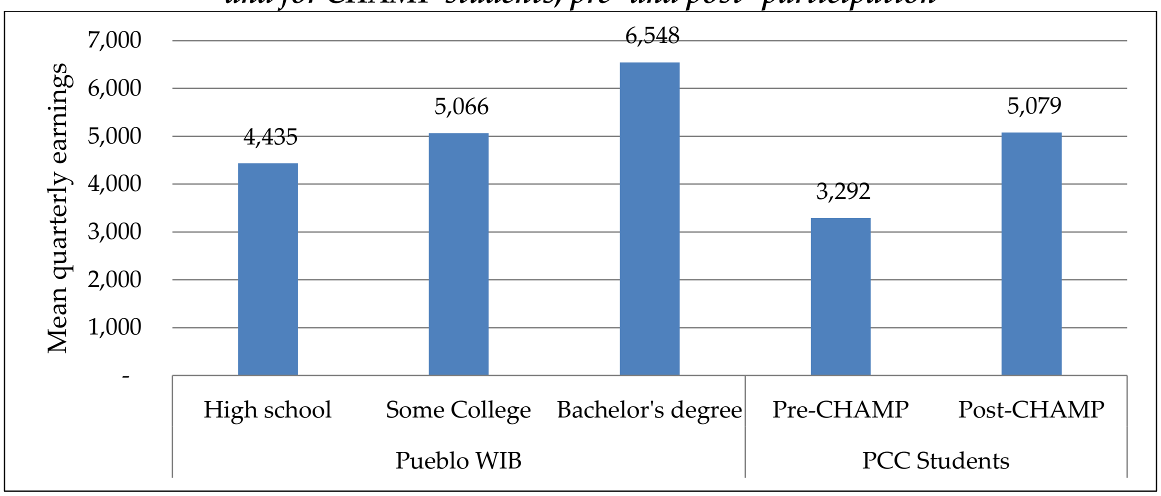


Figure 6e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Southeastern WIB and Lamar Community College

The Southeastern Workforce Investment Board covers an expansive area of rural Southeastern Colorado, including Crowley, Kiowa, Otero, Prowers, Huerfano, Baca, and Las Animas counties. Strategically, the regional workforce center seeks to expand regional opportunities in agriculture, advanced manufacturing, healthcare, as well as in wind energy by fostering partnerships with educational institutions and business.[137] In this context, Lamar Community College's (LCC) CHAMP-supported welding program[138] seems positioned to train workers for

[137] Sector strategies paper, plus https://www.colorado.gov/pacific/sites/default/files/SE Regional Highlight 092414_0.pdf

[138] See EERC's "Lamar Community College CHAMP Case Study" at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

an expanding advanced manufacturing sector. However, despite the college's and the Southeastern WIB commitment to advanced manufacturing, the region's manufacturing sector is far more limited than in other areas in the state. Thus, while CHAMP instructors and staff tried to place welding students with local employers, they encouraged students to consider relocation to other parts of the Colorado or even to other states where job opportunities in welding were more robust.

Figure 7a presents the share of all jobs within the local labor market held by sub-baccalaureate workers in CHAMP-related industries in the decade preceding CHAMP. Although manufacturing jobs (blue line) with 8 percent of these workers had the largest share of sub-baccalaureate workers this share fell to roughly 5 percent in 2006, and remained a smaller but stable share through 2016. By contrast, despite some fluctuations, construction (green line) only occasionally surpassed the 5 percent mark. During the study period, technology (red line) had less than 2 percent of jobs, the fewest sub-baccalaureate workers. This limited technology market for workers without bachelor degrees mirrors that seen in other regions in Colorado, e.g., Denver, Tri-County, Pueblo, Pikes Peak.

Figure 7a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors

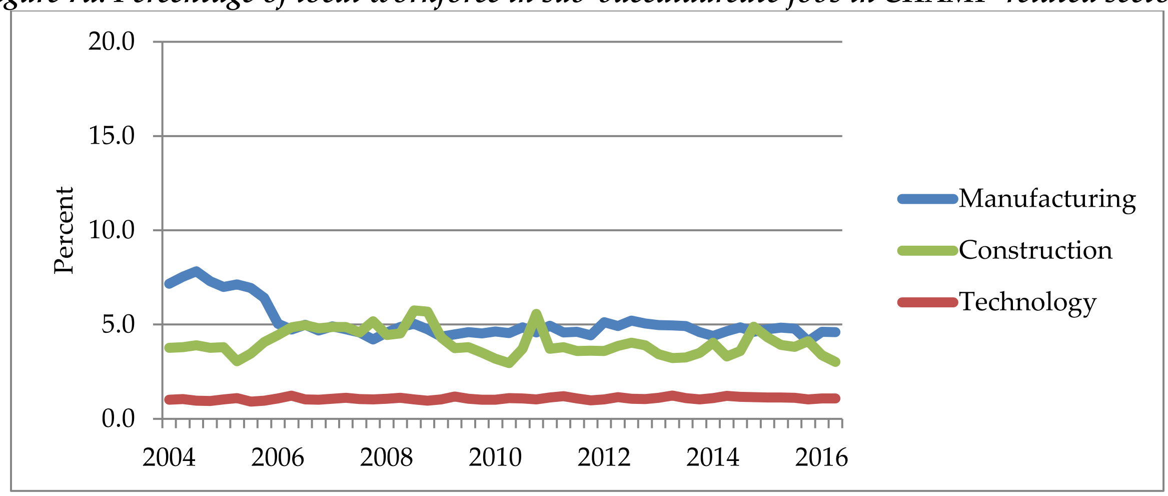


Figure 7b reports the average quarterly earnings of workers in the Colorado's Southeastern region with some college training compared to those without postsecondary experience. The scatter graph showcases a good deal of volatility in premiums across the three sectors, possibly because of the region's relatively small labor market. In the early 2000's, technology experienced some higher returns for post-secondary experience, but its volatility then parallels manufacturing until about 2006 when a steady decline occurs in technology, while the premium for manufacturing workers with post-secondary education, increases. After 2014 when LCC launched its CHAMP programs, premiums for workers in manufacturing (blue circles) with some college training rose to about 20 percent while those for tech workers (red triangles) and those in construction (green triangles) experienced declines both sectors hovering between 0 and 10 percent. Locally, when students consider their options for postsecondary training, manufacturing clearly emerges as the most attractive financial option among the three sectors.

Figure 7b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)

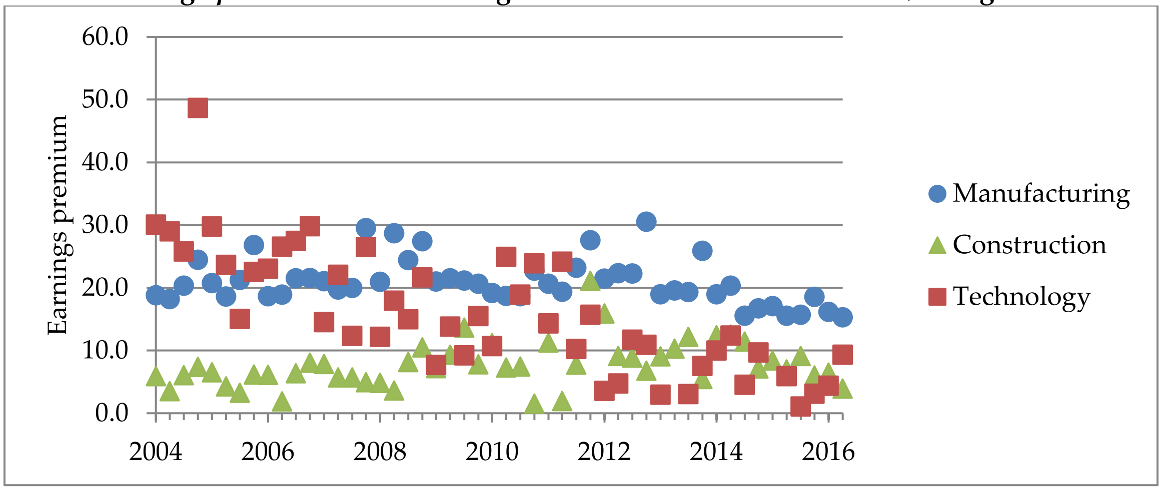
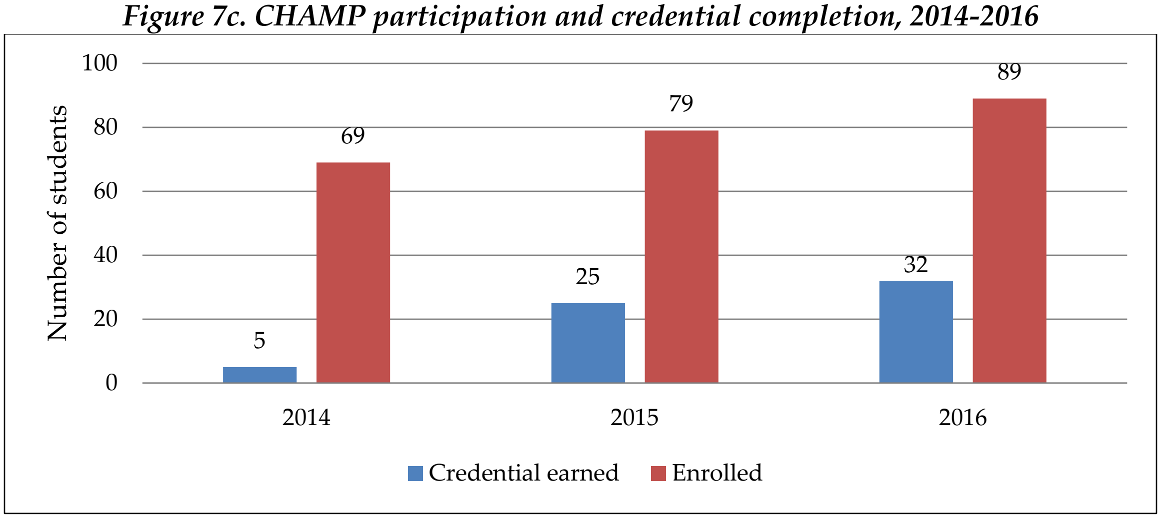


Figure 7c presents rates of participation in LCC's CHAMP program by calendar year. Each year of CHAMP, the college saw increasing enrollments and increasing numbers of certificates and degrees earned by students. Specifically, in 2014 69 students enrolled in CHAMP courses, this number grew to 89 by 2016, with a college waiting list for new enrollees. Similarly, over this same period the number of degrees or certificates awarded increased from 5 to 32. Therefore, it appears despite the local economic landscape, LCC's CHAMP grew each year of the grant.

Figure 7c. CHAMP participation and credential completion, 2014-2016



Unfortunately, LLC had a relatively small cohort of CHAMP students; and more significantly, very few could be linked to UI database earnings (less than 100). This paucity of data precluded EERC's analysis of LCC's CHAMP students' employment and quarterly wage premiums. The most likely explanation for the absence of good data for this cohort is that CHAMP students moved out for state for job opportunities, and Colorado UI data does not include out of state employment outcomes.

Weld WIB and Aims Community College

Weld County's Workforce Investment Board, north of Denver, covers one of the largest and most diverse counties in Colorado in terms of its population and range of industries. Local workforce strategies emphasize manufacturing, a well-established and growing sector, as well as both fossil and renewable energy. (Ibid) To meet labor market demand, Aims Community College developed its CHAMP programs in manufacturing and industrial technology, engineering technology, and building and construction site management.[139] Despite the number and diversity of local industries and the variety of CHAMP programs being offered, Weld county employers were generally less engaged than those in other communities served by colleges in the CHAMP consortium. Nevertheless, networking and interchanges between local industry, CHAMP instructors, and the Weld workforce center benefitted Aims' CHAMP programs.

To shed light on the scale of CHAMP-related fields in the local labor market, Figure 8a presents trends in the percentage of Weld's sub-baccalaureate workforce employed in the CHAMP-related NAICS sectors including manufacturing, construction, and technology. Historically, Weld has had the largest share of its workforce with less than a bachelor's degree employed in both manufacturing and construction. Further, although the percentage of sub-baccalaureate workers employed in each sector was essentially the same in 2004 as in 2016, both sectors experienced volatility in the interim period. For example, 13 percent of sub-baccalaureate workers were employed in manufacturing (blue line) in 2004 and in 2016. However, the sector experienced a brief dip during the Great Recession circa 2008, and then peaked at 14 percent in 2009, followed by a steady decline until 2014 to close to 11 percent. Since 2014 there has been a steady return to 13 percent share in 2016. The construction sector (green line) began with an 8 percent share in 2004, then experienced a downturn at the onset of the Great Recession (about 2008) that continued to 2012, at which time there was a strong recovery in 2014 followed by another downturn. Finally, over the study period, Weld County has had a consistently poor market (less than 2 percent) for jobs in technology (red line) for those without at least some college experience. This contrasts with some other areas in which workers without college education have a higher rate of technology jobs, especially in Tri-County, but also in Denver, Boulder and Pikes Peak areas. In sum, manufacturing remains the largest CHAMP-related sector for sub-Baccalaureate workers in Weld's local labor market, with a considerable number of these workers employed in construction as well.

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[139] See EERC's "Aims Community College CHAMP Case Study" at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

Figure 8a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors

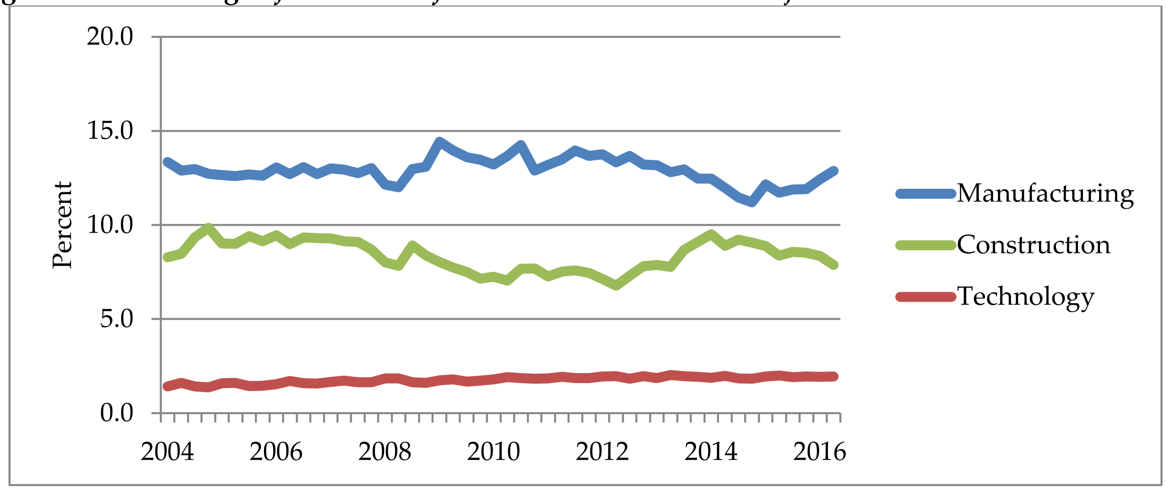
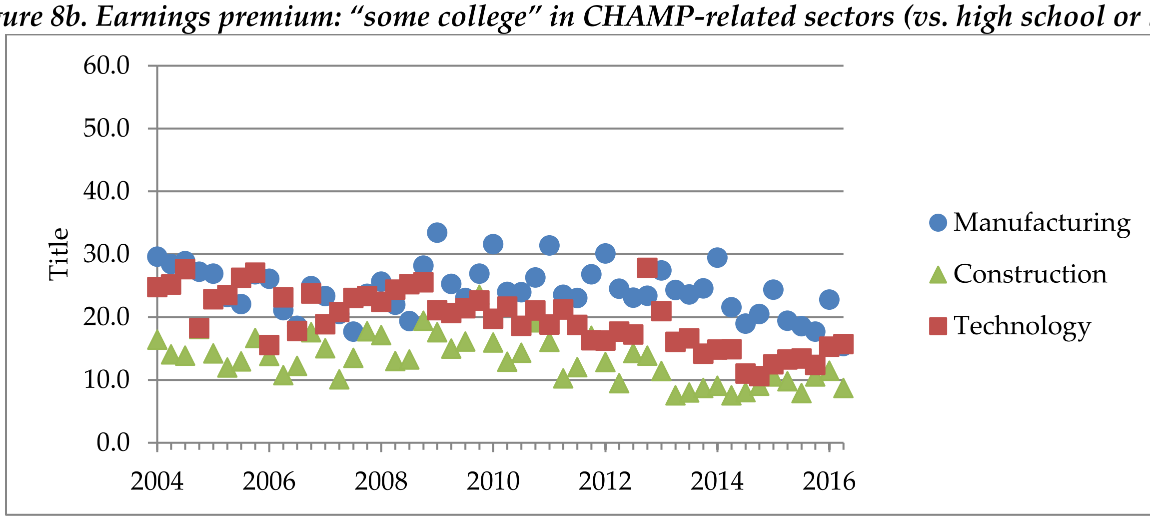


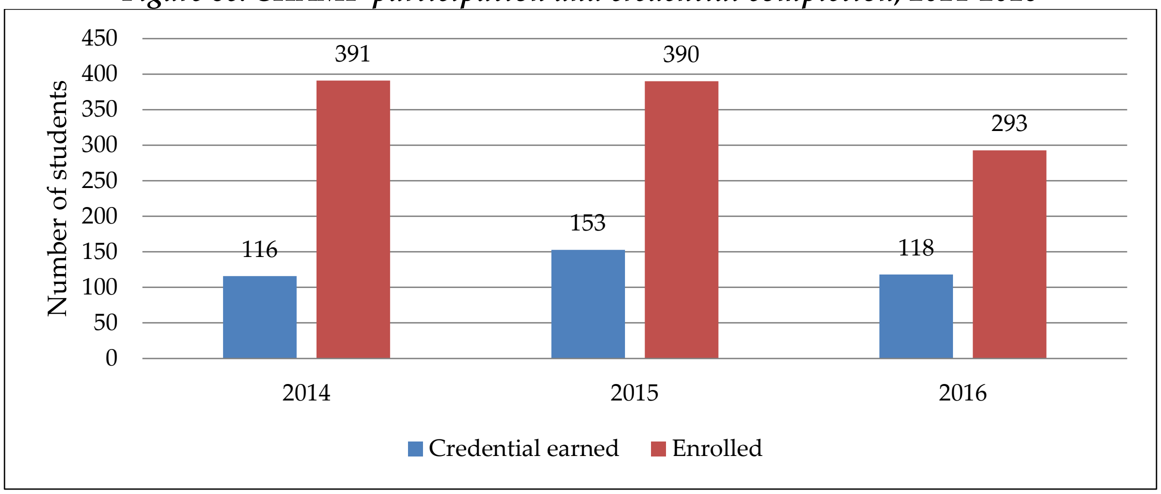
Figure 8b looks at the premium of post-secondary training in Weld during the 12 year study period, by contrasting the earnings for employees who have taken college coursework or completed a certificate or an associates' degree (but less than a bachelor's degree) and those employees with a high school education or less. Although earnings premiums vary in Weld year to year and quarter to quarter, workers in manufacturing (in blue) have typically earned higher premiums over those in technology (red) and those in construction (green). For example, in the first quarter of 2016, manufacturing workers with some college training were typically earning 23 percent higher wages than peers with only a high school education. The premium earnings in construction for workers with some postsecondary training was much lower at 15 percent. Still lower were the premiums for workers in technology, about 9 percent. Finally, it is worth noting that in Weld County, as seen in other WIB/WDB areas, premiums for workers with some college saw a decline between 2004 and 2016.

Figure 8b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



In this context—growing opportunities in manufacturing and higher premiums for postsecondary training—Figure 8c details enrollment and the number of student who earned credentials at Aims. Across the CHAMP consortium Aims had one of the highest rates of enrollment and degree and certificate completion. In both 2014 and 2015, approximately 390 students enrolled in Aims' CHAMP courses. However, enrollment dipped in 2016 to 293 students. In terms of earning a certificate or an associate degree, Aims CHAMP students earned 116 in 2014, and 153 in 2015. By 2016, however, this number fell to 118. Thus, although Aims' enrollment reached a large number of students, and granted many degrees and certificates, participation rates declined in the final grant year.

Figure 8c. CHAMP participation and credential completion, 2014-2016



Figures 8d and 8e present pre- and post-employment and average quarterly wage outcomes for Aims CHAMP students. Figure 8d shows that one year prior to enrolling in Aims' CHAMP courses, 53 percent of students were working for pay. By contrast, 64 percent of Aims students were working for pay a year after their CHAMP participation. Thus, participation in CHAMP at Aims was associated with an 11 percentage point increase in employment.

Figure 8e contrasts the pre- and post-CHAMP average earnings of Aims students against the average quarterly earnings of manufacturing workers with different levels of education in the Weld WDB area. It shows that before enrolling in CHAMP courses, Aims' students earned an average of $4,823 each quarter, several hundred dollars more than the average for manufacturing workers in Weld county with some college training ($4,549). However, following their CHAMP experience, Aims' students earned an average of $6,199 quarterly. This was nearly $600 above what bachelor's degree recipients working in manufacturing earned ($5,579). Taken together, Aims' students enjoyed increased employment as well as gains in their earnings subsequent to enrollment in Aims' CHAMP programs.

Figure 8d. Employment rate of CHAMP students pre- and post-participation

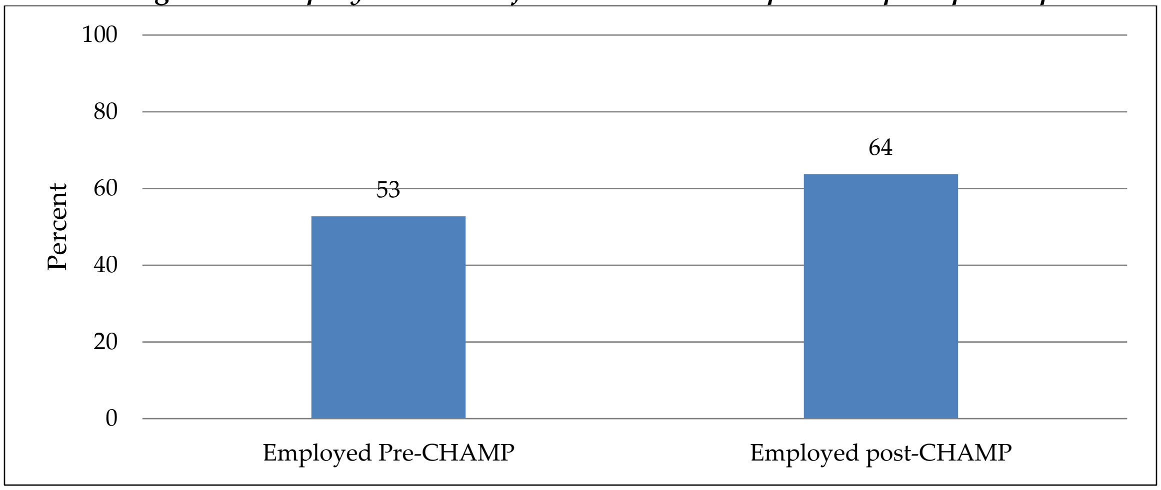
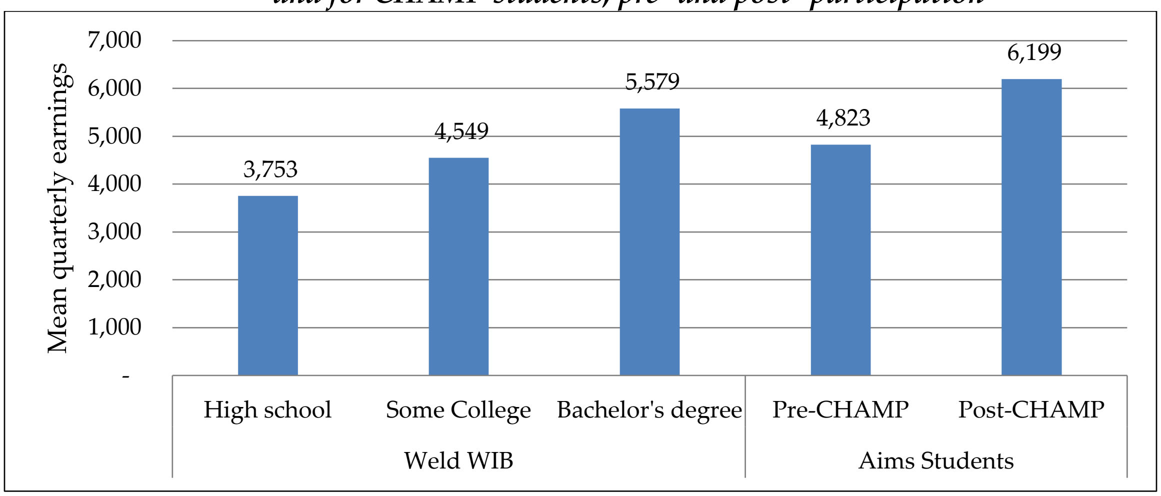


Figure 8e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



THEMES

In this section, we identify several of the themes that emerge from the above data analysis.

- Across the state of Colorado, local labor markets are shifting away from jobs in manufacturing and construction, and toward jobs in technology. Weld county is a notable exception to this pattern – its manufacturing evidencing a larger share of the labor market and even showing a slight increase in jobs over the past two years
- In local labor markets across Colorado, jobs in manufacturing typically offer the greatest returns to sub-baccalaureate postsecondary training – such as that offered through CHAMP programs. However, this premium is now declining.

- During the grant period 2014-2016, students who enrolled in CHAMP courses and/or received a CHAMP-related certificate or associate degree, gained a competitive edge in their local labor markets:
    - They were more likely to be employed a year after their CHAMP enrollment than they were the year previously, AND
    - CHAMP training typically and substantially boosted students' quarterly earnings.
    - In some cases, post-CHAMP earnings for those with some coursework, or a certificate and/or associate degree were on par with peers in the manufacturing local labor market with bachelor's degrees, e.g., Aims and PPCC or higher, e.g., FRCC.
- Over time, all colleges in the CHAMP consortium except for Aims, experienced increasing enrollments in their CHAMP program courses.
- Of the 7 CHAMP colleges studied for this report, three colleges experienced increasing numbers of students who earned credentials/certificates and four colleges experienced decreasing numbers. Among the reasons that may have contributed to declines in students earning credentials is time censoring – students enrolled later in the grant period have yet to complete a credential; staffing changes as the grant sunset so that career navigators[140] were not available to support and advise students in their respective CHAMP programs; and employers hiring students prior to the completion of their credential.

Taken together, the above findings underscore how each WDB/WIB area presents a unique local labor market for advanced manufacturing. The findings also suggest that overall, CHAMP students were able to leverage the training they received at their respective CHAMP community college to find employment in their fields and earn higher wages than they previously earned, as well as wages higher than those typically earned by sub-Baccalaureate workers.

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[140] See EERC's brief on the Navigators at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

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PART F: THE STUDENT EXPERIENCE

CHAPTER 11: STUDENT VOICES

Suzanne Michael and Heather McKay

INTRODUCTION

Students were the heartbeat of CHAMP. CHAMP existed to facilitate student recruitment and enrollment, their development of new knowledge and skills, their earning new credentials, and ultimately, their employment in advanced manufacturing.

How did students learn about CHAMP programs? What were their academic and employment goals when they enrolled? What were their experiences as they pursued their CHAMP credentials? What were the challenges and what were their successes? This brief prepared by CHAMP's third party evaluator, Rutgers Education and Employment Research Center (EERC), is based on individual and group interviews with 46 CHAMP students. As such, it only represents these specific students' experiences. Nonetheless, EERC believes that it provides a window into the experiences of students served by CHAMP over the past four years.

Part I provides a profile of the students; how they learned about their respective CHAMP program; their academic and employment goals. Part II explores students' experiences with Prior Learning Assessments (PLA); new online and hybrid learning formats, and soft skills curriculum; internships/apprenticeships; as well as their interactions with their college's CHAMP navigator. Part III focuses on CHAMP as a program – the challenges students said they faced, and the things they liked about their respective programs. The report concludes with some of the promising practices identified by the students, and general observations. For information on who was served in the grant and their outcomes please see Chapter 1: Student Profiles, and Academic and Employment Outcomes.

METHODOLOGY

EERC asked project leads and instructors to invite students to meet with one or more members of the EERC team during an EERC site visit. Student volunteers were scheduled for an individual or focus group session. The meetings with students lasted between 15 minutes and an hour. All were taped with the permission of the participating students. These tapes were then transcribed and analyzed to surface themes and patterns.

The invitation to students did not specify credential or program area – and thus was somewhat random in its reach. Students self-selected for the EERC interviews for any number of reasons – including schedules. The reader thus should not interpret the contents of this report as signifying more global experiences in CHAMP.

Further, to provide anonymity, this brief does not identify individual students by college or program. Instead, references are made as appropriate to the students' field of study and/or credential.

PART ONE

Profile of Students Interviewed

A total of 46 CHAMP students were interviewed in the final year of the grant. These interviews are the focus of this report. The students were enrolled at Aims, CCD, FRCC, PCC, PPCC, MSU and RRCC. In addition, EERC has included in this report interview information from three LCC students collected in a year three site visit.[141] The EERC students interviewed were both traditional and non-traditional[142] in age; and overwhelmingly male. Only 5 of the 49 interviewed students were female students. This mirrors the relatively small number of women students in CHAMP over the life of the grant.[143]

One student started his CHAMP program without a GED; a few were recent high school graduates; others had graduated high school years earlier. A number of the students already had associate degrees, bachelor degrees and/or masters in a field related to technology or design. Several students had been in the military. Most of the students had been employed including holding jobs in such fields as oil and gas industry, retail sales, interior design, and solar energy (sales and installation). A few owned their own businesses, e.g. construction. Others were currently working as a bookkeeper, at a go-cart track, at Vestas, and selling tires. A handful were already working in some type of machining shop. Some students were holding down several jobs as they pursued their CHAMP credential. A few students were working in their college's advanced manufacturing shop as either work study students or hourly student workers.

As a group, the students interviewed by EERC reflected the full range of possible CHAMP credentials – certificates, associate degrees and bachelors' degrees. A number of students had already earned one or more credentials under the CHAMP grant, and were continuing to stack certificates and associate degrees. Several students shared their plans to continue on with their studies and to earn a bachelor's degree, or even masters. Some spoke about wanting to acquire skills for jobs they were already in or to pursue entrepreneurial activities.

The fields of study for the interviewed students included oil & gas, CAD, computer graphics, machining, welding and mechanical engineering. Oil and gas was not a CHAMP focused program, but some of the classes used CHAMP purchased equipment in them.

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[141] During EERC's final year site visit to LCC, the team's schedule conflicted with class schedules so no students were interviewed.

[142] Students 25 years and older.

[143] Male 85.4% vs. 14.6% female students – See demographics section in the Final CHAMP Report

Learning About CHAMP Opportunities

As discussed in other EERC reports, colleges in the CHAMP consortium utilized multiple strategies to recruit students for their respective programs including flyers and open houses. However, when EERC asked how the students had learned about the CHAMP program in which they enrolled – they most frequently stated that they found out about their programs through an online search by industry, credential or college's program offerings. A number had learned about a field of study or a specific program of study from a family member or friend. Several students learned about an advanced manufacturing program through their employer.

One student shared that he learned about CHAMP when a local college's CHAMP faculty member visited his job site to learn more about what goes on the shop floor. A few students told the ERRC team that they had already been enrolled at the college, when they heard about CHAMP. In most cases this was through a faculty member teaching an advanced manufacturing course, or another CHAMP related course. One student had been referred to the CHAMP navigator by an admissions officer with whom he explored various program options prior to enrolling in CHAMP. Another student learned about the program on a campus tour that included the college's newly renovated lab. One student noted that he saw a flyer about the CHAMP program, and another found about CHAMP through a newspaper article. And one student heard about CHAMP by serendipity.

> *I heard about the field when I was visiting this drag racing motor engine guy I know. He knew about Warren Tech and the machining program here.*[144]

Academic goals

In their interviews some students expressed crystal clear clarity about their academic and career goals, while others were still considering options as they pursued additional set of skills. A number of students said that as they were exposed to new possibilities, their goals had changed over time – either in terms of credential or field of study. For example, one student working on an associate's degree in CAD stated,

> *I initially started out studying engineering. While studying engineering, I fell in love with the software called Solidworks and decided I wanted to pursue that as closely as I could as a career choice… You can produce detailed drawings with it and hand them off to a machinist or a welder and they can use your drawings to create and assemble those parts.*

Another student stated,

> *Originally, I came here thinking that maybe I wanted to do C&C machining and then once I took one of the software classes I realized that I liked the design work much better and so I've transitioned into that.*

[144] Warren Tech is associated with Red Rocks Community College

And a third student spoke of a progression of credentials as new fields and opportunities were introduced to him.

> *Yeah. I started in welding, technology degree. I finished that up in 2013 and decided to keep going to school because I like learning a lot and I just ended up getting introduced to the CAD and machining department through – my academic advisor and she just pretty much told me that I could keep going for my education and ended up doing my CAD associates in mechanical and my machining emphasis in advanced manufacturing as well. So I should be graduating with three associate degrees.*

A few students were exploring what career path they would follow subsequent to being laid off from their jobs.

> *I was in oil – am in oil and gas. I was laid off for eight months, and it was looking pretty grim. So I decided to take this (mechanical engineering). And the Workforce Center gave me a grant to take it. So hopefully with my oil and gas experience, I can transition into, not architecture, but more structural, and use …*

A number of students were very specific in their interests and/or needs. One student spoke of needing a training in Revit (software program), his employer paying for his certificate.

> *I was working in engineering …. I'm the designer, so I draw in – I've been drawing in CAD and then giving it them. And then they convert it all. So they're thinking they can save a step if I would draw it in Revit.*

A student who had joined the military before graduating high school stated he had enrolled in the associate's degree program in mechanical engineering because he could concurrently earn a GED. He then planned to "transfer when I get my associate's or just before" so he could go on to earn a bachelor's degree.

Employment goals

The interviewed CHAMP students had a diverse range of employment goals. We start with the more general goals. These included a student who shared that he just wanted to job that would allow him to retire by the time he was 35; and a single dad who wanted to job that would pay between $20 and $30 to allow him to raise his son and get him to retirement. One welding student, a veteran, shared that since his family immigrated, "… here a long time ago, every one of my family has served in the military and has also been blacksmiths, he wanted to continue in the family tradition.

A few of the CAD and engineering students wanted to pursue drafting and design especially doing structural design including bridges. The student who had a degree in architecture wanted to continue her career designing interior spaces. A student who had been employed in the oil and gas field wanted to return to that field and do gas exploration. Additive manufacturing and doing composites were other job foci. A few students talked about jobs in aerospace working for NASA or for Elon Musk's SpaceX observing that" both have said that by 2030 they will be men in missions to Mars." Ball and Lockheed Martin were identified as two companies where students wanted to work.

One welding student observed "They're gonna need welders everywhere." And in fact, a number of welding students shared interest in using their skills in rather adventurous, if not dangerous jobs – underwater welding and working in the Seattle fishing industry.

> *The fish folk stuff do – they've gotta – they're hiring the welders like crazy. You can look online right now, dude. They'll start you off with bonuses, like up to $10,000 and all kinds –*

Others spoke about using their skills to find opportunities beyond their rural communities.

> *I'm considering working on the oil pipelines in North Dakota or Alaska*

Regardless of their employment goals – the students expressed their eagerness to use the skills they were learning, as well as their excitement about finding well-paying jobs after earning their respective credentials.

PART TWO

Prior Learning Assessment (PLA)

As part of the CHAMP grant, CCCS revised some PLA policies and procedures, followed by the colleges restructuring their campus' PLA procedures and staffing. While still early in the colleges' re-configuring of PLA, EERC asked the interviewed students if they had heard about PLA; and if any had applied for PLA credits. The majority of students were not familiar with PLA, including those coming from the military. Among the students who knew about PLA, most stated that their skills did not transfer into credits. As one student shared,

> *I looked into it too but none of mine correlated either, which is weird because I was in the Army for welder/machinist so none of those carried over.*

This was somewhat surprising given the system of PLA crediting skills developed within the military. It is unclear what this student had done to pursue PLA credits and at what point. Was this a timing issue in respect to the revamping of PLA on his campus or some miscommunication in the process, or some other issue?

Of note, several students did report success with PLA and were very pleased with the credits they accrued through PLA. As one student observed,

> *Yeah. So it saved me a year of school, 17 credits!*

Learning/Format

EERC asked students to talk about their experiences with online/hybrid courses, lectures as well as hands-on labs and workshops.

Online/Hybrid courses

Few interviewed students spoke about online or hybrid courses. One student noted that when he took EGT 103 and 104 (applied dimensioning and tolerancing) it was not yet online, but he believed it was now a hybrid courses. Of those who had taken an online or hybrid course, their experiences were basically positive. They liked the flexibility of asynchronous coursework, and the fact they could work at home. They found the website "pretty easy to navigate through;" and appreciated that instructors were available via email to answer questions.

Hands-on

Across the colleges and programs of study, students spoke positively about opportunities for hands-on learning. Many students were drawn into a CHAMP field because they liked working with their hands. For them, going to class working with their hands was very fulfilling.

One student observed:

> *They're two different things. I mean, learning in class is looking at pictures, reading things. When you're out there in the shop, you're actually touching them, feeling them, seeing how they move and things like that. …. I prefer being on the shop because when I'm working I'm not gonna be in a classroom learning or writing, things like that. I'm gonna be moving machines, working on them. So I like the actual hand-on aspect of it more.*

Another student stated:

> *I know –initially I was very kinesthetic. I learn by doing and I learn working through*

A number of students recognized the need for a mix of lecture and lab, first learning concepts and then applying them, but still for these students, the emphasis was on the doing. That was truly where their learning took place.

> *…I wouldn't have been able to understand what we're supposed to be learning in the class if I didn't already apply it on what I'm working with.*

One student quite eloquently used the metaphor of learning a language.

> *… I still get the most quality learning by doing. Kinda like language. You can learn it all you want, but unless you practice and speak it you'll just – you'll lose it.*

Another student captured the enthusiasm for "doing" …

> *it's just so satisfying watching this lifeless piece of metal become your own creation, something with youth.... kinda goofed on it, didn't get too good of a grade. But at least I learned something.*

And yet another, focused on the marketability of their new skills and knowledge

> *I like working with my hands. This is a skill that is dying in our country. It's an industry people need in this country. You can get fantastic jobs.*

Acceleration

A number of the CHAMP programs are considered Fast Track. Fast Track programs condensed curriculum so that in one or two semester, students could earn a certificate in their field of study. EERC asked students how they found these time-limited programs.

In general, like Goldilocks and the three bears, most students found the pace fit their needs, "Just right. Any slower and I would be bored. Faster and I would miss things." One student reflected that he was surprised how much he had to learn, and was learning within a week. He felt such a pace was helpful in preparing him and his fellow students for the real world – where customers have different needs, and one needs to move quickly from one task to another.

> *I'm surprised how much we could learn within a whole week of just getting there, doing what we needed to do. And then the next week, we're on another weld, a different weld to do, something else. It's a lot a learning like in a week, but it helps a lot because I know some jobs, they'll put you on one spot and they'll be like, all right, you need to do this. And then after a while, they have another customer come in, and they'll just tell you, you need to quit that and do this one too. So I know what they're doing is fast, but in the field, that's how it is. Within an hour*

Soft Skills

Early in the establishment of the US Department of Labor's TAACCT grants, industry partners across the nation indicated a need for better prepared workers, not only in terms of job skills but also in terms of "soft skills." Soft skills include time and attendance, team work, problem solving, leadership, and the ability to work well with supervisors, co-workers and customers. With each tier of TAACT grants, industry looked to their college partners to include more "soft skills" training in the curriculum. Under each TAACCT grant, Colorado Online Energy Training Consortium (COETC), Consortium for Healthcare Education Online (CHEO), and now CHAMP, consortium colleges have made a concerted effort to integrate soft skills into course curriculum and/or to create parallel opportunities for students to develop them. In addition to employment-based soft skills, many colleges have addressed job search skills, e.g., resume preparation, interviewing skills.

Overall the students with whom EERC spoke were positive about CHAMP's attention to soft skills. As one student commented, "helped me get into that groove of working with other people." Another student spoke of the focus on professionalism.

> *I think it's a fantastic addition to the program because you could just go to the program. You could be a total jerk. You could dress up in ripped or inappropriate clothing every day, and they won't care a bit because it's not in the grade. Well, they might care if it's bad enough, but the fact that there's a professionalism grade, it really gives it that workplace atmosphere, where you gotta come in. You gotta leave your bad thoughts at the door. You have to go in, gotta where this fancy program shirt. I think it's a very good addition.*

Yet another student referred to the issue of respect – including towards the machines on which they were working.

> *Being respectful and respecting the machines, taking things in the right process. It's easy to get too excited and move too fast. … I think it's really good that we're – we're around dangerous machines. We're gonna be in a loud kinda crazy industry. It's really good to try to hammer it into our heads that there's a certain attitude and a certain way of carrying yourself through this to keep a job.*

Students also referred to building team skills; and being helped to prepare resumes and develop interview skills - "how to do a handshake, proper handshake, and you can tell by body language what that person's trying to convey."

At the same time, a number of students felt that the modules took precious time away from other class work; or that the format used was not helpful, e.g., PPCC initial use of online Goodwill modules. Students who compared online versus face-to face soft skill training formats all stated that the face to face format was much better.

In discussing soft skill training, a number of students stated that their colleges were not being mindful of the past experiences of the students - some who had been in the military and/or had years of work experience. A few of these students felt it was helpful to "… to brush up" on their skills. However, most of these students were critical of the soft skills modules stating that they were too elementary, and therefore basically a waste of their time. In this regard, one student referred to the module on time management, and how he and his fellow students were already balancing multiple demands as they attended college.

> *I felt like for most students, as far as time management, they already are good at time management. A lot of us work. A lot of us go to school full-time and work full-time. So a lot of us have kids and stuff like that. So we're already – our time management skills are already up to par. So I felt like there could've been other options for us that would've been more relevant for me.*

Internships/Apprenticeships

Internships are a means for students to try out and further develop their skills, as well as to explore different types of job sites. Internship programs also help colleges build and solidify relationships with industry partners. They act as a form of advertising for the college's advanced manufacturing programs, and provide ready access to information on job openings.

Only a small number of the interviewed CHAMP students had participated in an apprenticeship or internship. This reflects the pattern identified across all CHAMP students. Multiple factors affect the availability of internships: the number and size of employers in the college's service area, e.g., fewer companies in rural areas; small shops that do not have the staff capacity to host interns; the level of skill employers need; and concerns about liability. There is also a use factor, that is, the time students have available to participate in an internship.

Nevertheless, the three students who had participated in an internship spoke positively about their experiences. All students had earned academic credits, and one had also been paid for a "co-op internship" with Lockheed Radio Frequency.

One student shared that he now works part time at his former internship. Another student, who had interned at Ball Aerospace, told the EERC team,

> *They said if I came back after my associate's degree they would pay for my bachelor's degree. So yeah, probably. My employer there said I could start working now if wanted to, and he joked around about me dropping out to work now, but he said no, no, just kidding, finish your associates. Then come back!!*

Work with Navigator

EERC asked students about their contact with the campus' CHAMP navigator. While most knew about the navigator, only a handful of those we interviewed had actually met with him or her. This may have been a result of the timing of these interviews in the final year of the grant. Some of the navigators had already left their positions and moved onto other things. For those students who met with a navigator, the focus for most had been academic planning – identifying courses and/or getting help with stacking certificates. A few students had found the navigator helpful with developing their resumes." I think I wouldn't have the resume I have now if it wasn't for her. I know that." A number of students planned to meet with the navigator as they neared the end of their program and began their job search.

> *Because all my jobs in the last 15 years have come from word-of-mouth, because once you're in the industry you know everybody. Literally within days after her helping me redo my resume, I got another job, and the lady expressed that it was one of the cleanest resumes she's had in a long time.*

PART THREE

In this last section, we examine the challenges students spoke about, as well as what they found positive about their CHAMP experiences. We end with a number of activities students identified as especially beneficial, and some general observations. As noted above, it is important that the reader keeps in mind that the students' comments in this report only reflect their individual experience and/or the program in which they are enrolled. In addition, the students' perspectives were no doubt shaped by their age, prior military and work experience as well as the field and credential on which they were working.

Challenges

Several themes emerged in students' discussion about the challenges they had experienced in their respective CHAMP programs. Some of the challenges were personal and unique to the individual. Others were specific to a campus or program of study, e.g., schedule of classes; pace and amount of work to learn; preference for hands-on versus lecture format; and the availability and condition of equipment.

As noted above, a number of students were working full or part time as they pursued their CHAMP credential. For these students, balancing work and studies was a significant challenge. For example, at PCC, the Fast Track program met at different times of day during the course of the week. This made it difficult for employed students to establish a regular work schedule.

Students also identified the pace of some of the programs, and the amount of content covered as challenges.

> *It's so hard to get it all in. I think it's too fast for some stuff. You have to be really dedicated. But, the teacher is really good,*

One student observed that coming into the program with some basic skills had made a real difference in his ability to learn course content. He felt without his foundational level skills, he would not have been successful in his program. This student also echoed comments made by several other students, more hands-on opportunities were needed.

Another student felt challenged by course structure in which multiple software programs were being coveted concurrently or sequentially.

> *I like learning the programs. But I wanted to just learn SolidWorks, and instead I'm learning several programs at once. Which could be good, I guess, because I'll know more than one, but it's also confusing too. I have to learn all the different commands and they're all different and we switch back and forth between the programs. I forget what is what. You learn one software for 5 weeks and then you learn another software for 5 weeks and then you learn Revit, another software, and…it's a lot.*

One student observed that the math course that was required in the first term of his program felt disconnected from the remainder of the program – "I think they're a little out of touch." However, it was not clear if this student referred to a remedial math course or a course that had been developed for his specific program.

Several students spoke about the lack of enough work stations – equipment for students to use. A few students complained about broken equipment that was not repaired on a timely basis.[145]

Students whose CHAMP classes were on a satellite campus, e.g., CCD, felt isolated, missing out on student service resources and campus events. Although this does not directly relate to CHAMP program development, it is important concern to consider moving forward. Student social integration has been found to impact rates of student retention and completion (Varney, 2007; Heisserer & Parette (2002).

> *We don't get as much attention as the main campus does. The main campus always has something going on. We're kind of excluded out of it. That's one thing I wish could happen. There are things that happen on the main campus that we don't really hear about. That's one thing I*

[145] See EERC's Equipment Report which explores equipment repair and the difference in follow for CHAMP purchased equipment and equipment purchased under another college line item: https://smlr.rutgers.edu/content/publications-0

wish we could change. We could be more involved with the main campus. We kind of find out things are happening after they already happened and it's too late for us.

Finally, and of note, one student suggested that the lack of available or required internships affected the extent of student skill and knowledge acquisition.

Maybe it's (internship) more of a requirement, because that hands-on actually, in that environment, that's where you're actually going to see and know, oh, this is how I apply what I've learned. And, okay, yes, I can see myself here doing this, or – but yeah. In a classroom you get as much as you can, but it's not the same.

Positive Experiences

Overwhelmingly, the CHAMP students with whom EERC spoke were positive, if not enthusiastic, about their respective CHAMP programs.[146] They praised the quality of the faculty, the state of the art curriculum, and their access to equipment. They also spoke of the flexibility of, and pacing of their respective programs, and CHAMP's training focus on hands-on learning. Finally, they spoke of the sense of program support and community with other students.

Faculty, Curriculum and Equipment

The teachers are great. They're both passionate about transferring that knowledge to those who want it.

Across the colleges, students found faculty approachable and helpful – willing to answer students' questions. And students liked that fact that their instructors were teaching them not only the "doing," but also "the science behind it."

… great to really understand kind of what's involved in the science of making parts and that kind of a thing, which I never would've gotten in any other kind of a program I don't think. I mean they're great at answering questions that come up. Well, why do you do it this way and why do you do a spot drilling operation before you do regular drilling and they'll talk about the shape of the tools and what's actually happening and that sort of a thing. …. I think they really have done a nice job of balancing – starting out each way because it just kinda reinforces it at the next level and you have a good feel for what the level you're at is trying to do.

Another student noted the progression of skill building who said, "the projects successively bring up skills and techniques, each one builds on the one before and brings up skills that former didn't.

Other students remarked on the pragmatics – the fact that the courses were designed to replicate real world situations and were not abstractions.

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[146] It is not clear to what extent this reflects overall CHAMP student experience – or the self-selected group of students who volunteered to speak with EERC volunteered because of their positive experiences and investment in CHAMP programs.

We actually get pragmatic application of the technologies. So having the facilities and the equipment on campus, and integrated into the program, really it gives you, honestly, fun experiences

My favorite part is knowing that we're actually gonna be given a blueprint of something that would be actually useful in real life. And to me that's just a bulking hammer head. But you've gotta know how to make tools. And so we're actually gonna be given a blueprint for a real tool as a project and we're gonna get to make that. So that's what I'm most excited about.

The inclusion of industry standards in the curriculum[147] was cited by one student as an important addition to his education, and an asset when he began to look for work.

During the first year you learn a lot of manual stuff on the machines, and you learn the knowledge—the background knowledge. Your second year you learn the industry standard—and it's more complicated. Most shops have people who can only do one or the other but not both. The have maybe one or two people who will know both. I will know both manual and CNC, so that will help for employment.

The diversity and the currency of the equipment available[148] in program shops were also identified by students as important to their learning and preparation for industry jobs

"I attended school way back in the '80s here and I took some CIS programming and at the time, the school was teaching old technology and I felt like you never wanna go to school to learn something that's not relevant and so I feel like right now this program is cutting edge and is gonna be on the cusp of what is going to be with advanced manufacturing."

"So you know how to operate different types of machines, and most employers want this."

At PCC students spoke about assembling a large piece of machining equipment that had been purchased through CHAMP. This exercise gave them an opportunity not only learn to use the equipment, but to understand how it worked from the inside out, "this whole idea of really being part of the development of equipment, not just using equipment or main*taining it, was kind of exciting."* The success of this exercise resulted the assembly and dis-assembly process becoming part of the machining course curriculum.

A student at PPCC shared that he had an immediate opportunity to utilize what he was learning, and to contribute to his own program, learning more in the process.

"I've actually built some parts for the school using some of the equipment that we got from the CHAMP grant that would normally – that would cost the school to buy a kit it was between $1,500.00 and $2,000.00 and it costs like $60.00 for me to design it and make it and prototype it and then find one that actually works."

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[147] Some of the machining students actually took the exam for NIMS certification as part of their program of study. As a result, they graduated with an academic credential – certificate or degree – as well as a recognized industry certification.

[148] Much of this new equipment was purchased through the CHAMP grant. See ERRC's forthcoming brief on CHAMP equipment.

A number of students observed that their faculty seemed to focus less on grades and more on making sure that students understood what they were doing, and why. This allowed students to make their own discoveries.

> *"The instructor allows you to make mistakes. And then he will ask you 'what did you do wrong?'*

> *"I like learning by doing also, and the program lets you tackle projects and figure them out on your own."*

Another student commented, (they) "really trying to make us machinists, rather than curriculum, grade this, grade that, do this."

Students also appreciated faculty's flexibility, their recognition that many students were balancing school with work and family demands. As long as students got their work done – they were open to flexible about time and attendance.

> *"But they're just – they're really understandable. I'm pretty sure that everybody is working at least some part-time job, or have a 40-hour job, and here in class for 20 hours a week. So sometimes you come in late, or you have to leave early, or – and they're just – they're really understanding. They're not just, you have to be here at this time and this time. As long as you're getting your work done, as long as you're working on it outside of class, they really work with you. And that's something that's been very, very fundamentally good for me."*

Note, while this schedule elasticity may have worked well for some students – it did contrast with the soft skill training CHAMP students were also receiving – and possibly counter-acted the development of professionalism – with unknown long term consequences.

Community and Support

A sense of community and mutual support was a theme that emerged EERC's interviews with CHAMP students. Something very positive was happening in the classrooms and shops.

> *"Just the atmosphere. It's very relaxed. It's very knowledgeable. Everybody is so knowledgeable and friendly and all they wanna do is help you and help them."*

> *"Pretty much everyone in the class is really cool. Everyone's just here to kinda learn."*

Several students described the "value-added" of students' sharing a sense of commitment and motivation.

> *I really feel like the motivated students take the time to involve themselves in other areas, besides just putting their head down and knocking out the curriculum, and really – they try and seek out other opportunities networking, as well as this program that really helps give you that competitive edge in a very competitive market*

Mutual learning and collaboration, as well as inspiration were also described by the students.

> *"I think that's my favorite thing in the department is just being able to see what other people are doing because it inspires me and it gives me an opportunity of going hey, well, what if you try it*

like this? And then they can go no or yes or whatever they do but it's still – I still have that opportunity. You know what I mean? Which is – anyone has that opportunity. Will could come to me and be like hey, man, you should do it like that or like – culture of the program…"

"Students help out students all the time. You see student who have already done it helping out students that just came in. Little things that make it better decision wise or heat wise. Everybody gets along, everybody helps each other out. If you have a question you can go to a student and they'll help you out. ….. I like the help and support student and instructors have. That's one thing you can't find in other places."

Promising Practices

A number of activities were identified by the CHAMP students that seemed especially important to them, enriching their experiences and/or prospects for the future.

Use of Portfolio

A number of RRCC students talked to the EERC team about the portfolios they were developing as part of their employment seeking activities. As one noted,

I think it's good to show what you've done. You feel committed – if it is a resume and it's – I don't know. The – it seems more – a picture's worth a thousand words kinda thing. You show them a couple quick shots of I worked in this, I worked in that.

As they were finishing up their course work these students were gathering together photos or actual samples of their work, e.g., "floor plans and electrical plans and framing plans and stuff like that;" with which they could showcase their work. The nature of the portfolio varied – physical objects or photos on a laptop. At the same time, students seemed mindful that they had to be selective and not include too many examples of their work.

… has three or four different projects I've worked on. And I've been told don't bring more than that, because you either have it or you don't. And if they see what they want, they don't wanna see 18 different things.

It is not clear from the interview data to what extent faculty or the navigators were involved in helping students develop their respective portfolios – and what discussions surrounded them, e.g. mutual critiques and refinements. However, the development of portfolios seems to be important activity to prepare students for employment searches, and colleges should consider how they can integrate portfolios into their respective advanced manufacturing programs.

Manufacturing Meet and Greet

Over the last two years, PPCC has established an annual "meet and greet" that brings together regional manufacturers, students and faculty. The fall event brought close to a 100 people to PPCC.

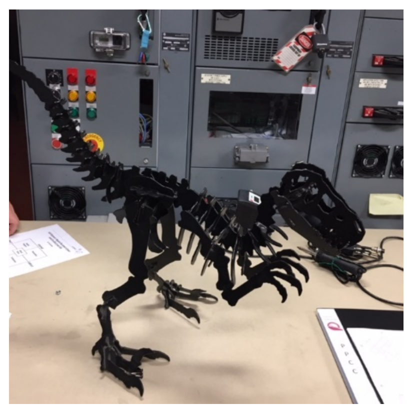
PPCC faculty asked students to develop an elevator speech "a personal sales pitch is what I call it. That impression that you can make in 30" which students could use as they mingled with employers. The mixer also gave students a chance to learn more about the focus and operations of regional companies.

> *I asked every company I spoke to there. Some of them don't do any of their own CAD work so there were a couple machine shops there that don't have any CAD work. But I asked them. I was like what is it that you look for when you have drawings come in because they receive drawings from other companies and I said what do you – so even though those companies weren't necessarily catered to me when I was there, I was still able to ask the relevant questions*

Company representatives also had the chance to meet students and get to know them outside of a formal job interview. Students spoke about the mutual benefits of such interactions and networking.

> *…just being able to go in and see these manufacturers and the people that run it and having them know your face and recognize hey, I've seen you two or three times. And I know I've seen you two or three times. That alone is – when you're in that interview for that first time, they go I've seen you like four times so.*

At the fall 2016, several PPCC students displayed their work including a whimsical dinosaur. EERC overhead a number of student-employer conversations in which students described how they created these objects using CNC technology and 3D printers.



Photos by Suzanne Michael

Work with Industry Associations and Advisory Boards (MSU)

Students spoke enthusiastically about the experiences they had attending industry advisory boards and/or meetings of professional industry organizations, e.g., Colorado Advanced Manufacturing Alliance (CAMA). In some cases, students presented their work. As one student observed, this was an opportunity for the students to show off the capacity of their college (MSU), the quality of students, and their products.

Participation in meetings with industry representatives also provided opportunities for students to hear industry's needs and training concerns. In the process, they also learned how much some industries valued job applicants coming with industry recognized certificates such as NIMS certification. Networking with potential employers also occurred at these meetings.

> *…. a good networking tool to talk to the industry people, and actually really cemented my relationship with …Lockheed liaison to MSU. So that was huge for me in that respect.*

Industry sponsored or affiliated student competitions were also an important experience for students. These events enabled students to showcase their work, meet students from across the nation, and gain peer and industry recognition. For example, three students from PPCC competed in Skills USA competitions[149] – and won a number of awards in the technical drafting and robotics competitions. A few students also participated in the American Society of Mechanical Engineers' (ASME) human-powered vehicle competition.

GENERAL OBSERVATION

For some students, CHAMP programs provided an opportunity to enter a new field, for others it expanded their skill sets and knowledge. The comment from the student below captures this secondary group, and the dramatic impact of CHAMP on his view about the field of welding.

> *I came into this program thinking, shit, I've been welding for seven years, man. I've been holding down the same job for 15 hours a day, sometimes four or five days out of the week, man. I got this licked. I never even knew there was more than one process of welding, man. Yeah, reality's gonna knock you right in the face.*

We close this report with the observation of one student who spoke to the multiplier effect of CHAMP. He identifies the training of students, and giving students a competitive edge for finding employment; as well as how CHAMP expanded the training capacity of his college. But he goes on to identify an unanticipated benefit of the program – the provision of equipment to inmates at a regional correctional facility so they could learn new skills. This, figurative and literal downstream consequence of CHAMP also needs to be recognized.

> *The CHAMP grant also has given me access to so many different pieces of equipment that normally I wouldn't have. If the program didn't have the CHAMP grant, I don't think we would have the group that we do right now. And it gives me an opportunity to become competitive in the workforce. It also gives the school an opportunity to be competitive in their goals for reaching students and stuff like that to offer that education. Yeah. So three new mils, five lathes, a new mini-mil. It was pretty cool to watch that all come in, get swapped out. And those actually went down to, what, the prison down there? No, they donated them to the prison out here so the inmates can learn machining*

[149] See http://www.skillsusa.org

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PART G: THE FUTURE

CHAPTER 12: SUSTAINABILITY

Suzanne Michael, Heather McKay and Renee Edwards

INTRODUCTION

In the final year of the CHAMP grant, the focus at most schools shifted from implementation to sustainability in respect to four inter-related areas: program and curriculum design/redesign; staff roles; the maintenance and upkeep of equipment purchased during the grant period; and on-going partnerships with industry. In the following pages, we highlight some of the colleges' decisions and plans in respect to these key areas. Most colleges' sustainability actions fell within the following four categories: suspension, modification, continuation, and continuation with expansion.

Sustainability of CHAMP Programs

Across the consortium in interviews with ERRC, college staff stated that they planned to continue most certificate and degree programs developed or redesigned under CHAMP. A number of colleges, however, indicated program changes. For example, during the grant, PCC launched a fast-track program in welding and one in machining. Feedback from fast-track welding students and faculty has been very positive. Nevertheless, an in-depth examination of the program's continuation is now planned by the Dean's office. Issues of concern include the higher cost of consumables for fast-track students versus traditional welding program students; limited classroom space; and the potential saturation of entry-level welders in the region.

In contrast to welding, students and faculty involved in PCC's 16-week machining program reported that it was - "too much too fast." In response, machining faculty developed a 20-week program. But this program also turned out to have too much content to be covered in too short a period of time. As of EERC' fall 2016 visit, PCC was considering a longer introductory-level machining certificate to replace the fast track program.

In addition to program development, a focus of CHAMP was the transformation of courses into hybrid—a combination of online and hands-on learning--formats. Some hybrid courses were found to be successful by the colleges, e.g., LCC. But over time, other colleges were less enthusiastic about the online portions of courses. PCC's faculty reported that its hybrid CHAMP courses were not working well for either students or for faculty. In place of these courses, PCC's faculty created "web enhanced" teaching - a combination of traditional classroom lectures linked to online videos and teaching tools students could access on their own time. These courses were reported to be far more successful.

At FRCC, one of the primary accomplishments of the final grant year was the college's alignment of machining courses with the National Institute for Metalworking Skills (NIMs) certifications. This has created a great opportunity for hands-on-learning in the program as well as the opportunity for students to earn industry recognized certifications. NIMS certification benefit both entry-level and incumbent workers. In addition to NIMS certification, FRCC is exploring other strategies to expand its offerings in advanced manufacturing.

Some CHAMP colleges are currently considering the development of non-credit and competency-based course options in addition to credit-based courses, e.g., Aims and LCC. These new options are hoped to address changing industry needs as well as to provide opportunities for incumbent workers to enhance current skills and/or retool.

At LCC much of the focus of the final grant year has been on its extremely successful welding program – a series of stacked certificates progressing into an associate degree program. The reputation of LCC's welding program has grown over the course of CHAMP. As a result, classes have been over-enrolled, and there is a waiting list. LCC is exploring strategies to sustain and expand the program without sacrificing quality. Plans include employing additional instructors and building a larger facility to house welding and other CTE programs. In addition, LCC is exploring the development of some non-credit certificates to better align with the training needs of local and regional industries. Further, the college is considering launching "turn-key" training opportunities wherein employers send an employee to be trained at LCC, and then returns to the company to train his/her colleagues.

Sustainability of Staffing

Sustaining staff is generally more challenging than sustaining programming. Across the CHAMP continuum colleges report that many grant-funded positions such as lab techs, shop techs, navigators and even some instructor positions will not be maintained. In some cases, functions have been or will be absorbed by other staff. However, given the already stretched faculty and staff at most colleges, there is real concern that it will be difficult to maintain some critical functions that have been shown to make a difference. These areas include 1) the navigator position and 2) employer/industry relations. Sustainability of the navigator is discussed here;[150] staffing in respect to industry relations is discussed below.[151,]

LCC is the only college that has decided to retain the navigator position--building her into the school's budget, and expanding her role to Career and Technical Education (CTE) students. At FRCC, the grant-funded Employer Outreach position has been combined in part with the navigator position in a new Advanced Manufacturing Program Coordinator (AMPC) position. However, while the AMPC will continue to advise FRCC's non-credit manufacturing students, credit students will be served by the college's general advising staff.

Over the course of the grant, EERC found navigator-served students had higher rates of retention and stacked more certificates than those who were not served by a navigator. Both these outcomes affect program enrollments. As such, for some colleges the absence of a navigator may impact the size of some their programs as well as their long-term sustainability.

Sustainability of Equipment[152,153]

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[150] See Chapter 2 on the Navigator

[151] See Chapter 9 on Employer-College Relationships

[152] See Chapter 9 on Employer-College Relations

[153] See Chapter 5 on Addressing Industry Needs in the CTE Classroom

One of the major challenges facing the consortium schools is the ongoing maintenance of the equipment purchased under CHAMP. Most equipment requires regular upkeep and maintenance. This can be costly, as can equipment-related supplies. During CHAMP, schools used grant funds to cover these costs. In the final grant year some colleges developed solid plans to pay for on-going maintenance and supplies. For example, FRCC now has college-supported vendor contracts to maintain its equipment. However, as of spring, 2017, most colleges were still exploring how to fund their maintenance costs.

Colleges report that lab fees are not sufficient to cover the supplies and maintenance. Some plan to use departmental funds, e.g., RRCC. Colleges have also begun to seek external resources. Both FRCC and RRCC are working with their industry partners to provide some funds and/or in-kind donations. Other colleges plan to apply for county, state and/or federal funds, e.g., Perkins grants—to maintain their equipment.

Colleges also plan to utilize faculty, many who work in the field, to perform maintenance tasks on equipment. As a staff member from FRRC observed,

> *one of the benefits to creating a manufacturer technician kind of program is that we can 'grow our own' to take care of the things that we implement, so take care of the machines, be able to diagnose issues and things like that as they come in.*

Given changes in technology, the currency of equipment is also an issue of sustainability. To keep abreast of changes in the industry, colleges need to purchase new kinds of equipment, often high-dollar equipment. Post-CHAMP colleges are concerned if they will find the funds to make these purchases. As noted by one staff member, equipment—with proper maintenance—will "last 20 years" but staying current with industry technology means adding equipment in the future.

Another challenge closely associated with equipment was space allocation. At least two of the consortium schools, PPCC and FRCC, were discussing space expansion as part of their sustainability planning. At PPCC, limited lab and classroom space was causing classes to be capped below demand, affecting recruitment and enrollment. At FRCC students and equipment were fast outgrowing the school's shop facilities. To remedy the situation, FRCC staff hopes that the CHAMP programs will become part of the college's proposed "Center for Integrated Manufacturing" to be housed in a newly built center or a suitable space in the community.

Sustainability of Industry Partnerships

Over the course of CHAMP, colleges have increasingly recognized the importance of building and actively sustaining partnerships with regional businesses. Colleges found that 1) maintaining an engaged advisory board and 2) being involved in sector partnerships and regional manufacturing groups were critical to their ability to refine and build their CHAMP programs. These partnerships have also served the college as a "pipeline" for students. And for industry, a "pipeline" for employees. Most colleges report that the strong industry relationships that have developed will continue post-CHAMP. Nevertheless, across the continuum there is real concern about losing dedicated staff to sustain advisory boards and engage in employer outreach.

CLOSING OBSERVATIONS

For the colleges in the consortium, CHAMP provided a major stimulus plus the resources to innovate, enhance and solidify their advanced manufacturing programs. The funding enabled them to do more employer outreach and to establish new or strengthen old relationships with industry partners. Many new certificate opportunities have been developed, and program curriculum has been enriched and redesigned to better serve industry needs. These achievements were made possible through active employer input as well as faculty release time, the availability of instructional designers, and new equipment--all paid out of grant funds.

Over the past four years, the colleges in the CHAMP consortium have created different programs to meet different regional needs, institutional cultures and resources. As the colleges move beyond CHAMP, many programs will continue, but changes will also be made. These changes will come from technological and industry shifts, but also because of reduced funding. The colleges' approaches to sustainability will continue be different. But in the end, it is clear across the consortium, that, CHAMP, as one project lead said, "has been a game changer for our programs and the college." And this legacy – and the stimulus it provided, will continue to be carried on after CHAMP sunsets, September 30, 2017.