Colorado Helps Advanced Manufacturing Program

Final Report Executive Summary

Heather McKay
Renée Edwards
Suzanne Michael

Released January 2018

RUTGERS

Education and Employment
Research Center

Colorado Helps Advanced Manufacturing Program
Final Report Executive Summary

Heather McKay
Renée Edwards
Suzanne Michael

Education and Employment Research Center
School of Management and Labor Relations
Rutgers, the State University of New Jersey
Janice H. Levin Building
94 Rockafeller Road
Piscataway, NJ 08854

January 2018

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 evaluation on programs and policies at the intersection of education and employment. Our work strives to improve policy and practice so that institutions may provide educational programs and pathways that ensure individuals obtain the education needed for success in the workplace, and employers have a skilled workforce to meet their human resource needs. For more information on our mission and current research, visit smlr.rutgers.edu/eerc.

Table of Contents

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, e.g., the use of online and hybrid courses	Increase access to courses for rural and non-traditional students es; 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, user-friendly tool to explore and plan their future advanced manufacturing career; e.g., Colorado career Action Website	Facilitating student participation in career pathways in advanced manufacturing
Develop material to expand the available online database of open education resources and encourage the use of OER resources	; Expand access to educational 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 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

---

[1] EGTC was not included in the analysis

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 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 EERC 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

- o Student-focused navigators sharing promising practices and challenges with other student-focused navigators
- o Employer-focused navigators sharing promising practices and challenges with other employer-focused navigators
- o Project leads sharing promising practices and challenges with other project leads
- o Faculty sharing challenge tests for prior learning assessment

- **External collaboration included**:
  - o Faculty and employers working together to develop new/redesigned curriculum and to choose equipment for purchasing
  - o Faculty and employers working together to integrate soft skills into the classroom
  - o Employers visiting classrooms to discuss job expectations and career paths with students
  - o Navigators working with staff from the regional workforce center, interacting with employers, and interacting with members of the CHAMP advisory boards and industry representatives
  - o Navigators working with employers to understand expectations for potential new hires
  - o 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
  - o 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.

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 prior 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
- 403 (9 percent of all CHAMP students) earned an associate degree as their highest credential
- 56 (1 percent of all CHAMP students) earned a long-term certificate as their highest credential
- 831 (19 percent of all CHAMP students) earned a short-term certificate as their highest credential
- 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,[2] 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).

---

[2] Note, no summer sessions are included here.

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)[3]
    - Incumbent workers without military background had higher wage increases than their counterparts without military experiences (68 percent vs. 59 percent).

---

[3] PELL grant eligibility as collected by the colleges, was used as the surrogate for financial aid.

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[4] 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
- 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

---

[4] EGTC was not included in the analysis

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

REFERENCES

Ausbum, L. (2004, January). Course design elements most valued by adult learners in blended online education environments: An American perspective. *Educational Media International 41*(4), 327–37.

Benson, A. D., Johnson, S. D., Taylor, G. D., Treat, T., Shinkareva, O. N., & Duncan, J. (2004). *Distance learning in postsecondary career and technical education: A comparison of achievement in online vs. on-campus CTE courses.* St. Paul, MN: National Research Center for Career and Technical Education. Retrieved from http://www.nrccte.org/sites/default/files /publication-files/distlrng5_benson.pdf.

Bettinger, E. & Baker, R. (2011, March). The effects of student coaching in college: An evaluation of a randomized experiment in student mentoring (Working Paper No. 16881). *Educational Evaluation and Policy Analysis, 36*(1), 3–19. Retrieved from the National Bureau of Economic Research website: http://www.nber.org/papers/w16881.

Graham, C. R., & Dziuban, C. D. (2008). Core research and issues related to blended learning environments. In J.M. Spector, M.D. Merrill, J.J.G. Van Merrienboer, & M.P. Driscoll Eds., *Handbook of research on educational communications and technology* (3rd ed.). Mahwah, NJ: Lawrence Earlbaum Associates. Retrieved from http://cdl.ucf.edu/research/rite /publications/.

Jona, K., Roque, R., Skolnik, J., Uttal, D. & Rapp, D. (2011). Are remote labs worth the cost? Insights from a study of student perceptions of remote labs. *International Journal of Online Engineering, 7*(2). doi:10.3991/ijoe.v7i2.1394.

Kennepohl D., & Shaw L. (2010). *Accessible elements: Teaching science online and at a distance.* Canada: Athabasca University Press. Retrieved from http://www.aupress.ca/books /120162/ebook/99Z_Kennepohl_Shaw_2010-Accessible_Elements.pdf.

Means, B., Toyama, Y., Murphy, R., Bakia, M., and Jones, K. (2009) *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. Washington, D.C.: U.S. Department of Education, Office of Planning, Evaluation, and Policy Development, Center for Technology in Learning. Retrieved from http://files.eric.ed.gov/fulltext/ED505824.pdf