

Creating a Network of Community Colleges with Makerspaces: California's CCC Maker Model

Carol Pepper-Kittredge¹ M.H.R.O.D., B.S., Paul A. DeVoe, M.A., B.S., A.A.²

¹Carol Pepper-Kittredge, Director, Center for Applied Competitive Technologies, Sierra College;
e-mail: cpepper-kittredge@sierracollge.edu

²Paul A. DeVoe, Co-Founder, BusinessComposer, LLC; e-mail: paul@devoel.com

INTRODUCTION

California's 2.1 million full and part-time community college students comprise the largest system of higher education in the United States. Sixty-seven percent of community college students are people of diverse ethnic backgrounds and roughly 53 percent are female [1]. As part of the "Doing What MATTERS for Jobs and the Economy" initiative and the Strong Workforce Taskforce recommendations to prepare students for high-value jobs in regions throughout the state, the California Community College Chancellor's Office (CCCCO) is investing \$17,000,000 to grow a statewide network of community college-based STEM/STEAM-focused makerspaces over the next three years. This paper introduces the new CCCCCO initiative named *CCC Maker* as an open-source model that will be used in community colleges throughout California. Community colleges are uniquely positioned to deliver makerspace benefits to its students, instructors, the regional business community, and government entities.

BACKGROUND

The California Community Colleges is the largest provider of workforce training in the state and nation, offering postsecondary technical education in 175 fields, and educating more than 100,000 individuals each year in industry-specific workforce skills. However, California's education pipeline is not keeping pace with the higher levels of skills and education required by employers. By 2025, 30 percent of all job openings in California – or a total of 1.9 million jobs – will require some form of postsecondary education short of a four-year degree [2].

In response, the California Community College Chancellor's Office (CCCCO) has developed multiple organizational structures and strategies to address these workforce needs. The Doing What MATTERS for Jobs and the Economy (DWM) framework, managed by the Workforce and Economic Development Division, is designed to supply in-demand skills for employers, create relevant career pathways and stackable credentials, promote student success, and get Californians into open jobs.

The CCC Maker initiative is an emerging action strategy under the DWM and Strong Workforce Taskforce system. It is the first statewide community college system effort in the United States that will intentionally 1) grow a statewide network of STEM/STEAM focused makerspaces linked to

California Community Colleges to develop a workforce for the innovation economy, 2) develop a California Community College makerspace 'Community of Practice' to serve as a state and national model, 3) align 21st century skills with STEM/STEAM research and practice, 4) support work-based opportunities for California Community College students, and 5) disseminate information and resources to ecosystem partners and key stakeholders.

The initiative is built upon research and findings from a California Council on Science and Technology white paper, "Promoting Engagement of the California Community Colleges with the Maker Space Movement" [3]. The paper asserts that:

- "Making" offers complementary learning environments to the traditional classroom and helps participants develop skills that differ from those in traditional student projects and learn-by-doing classes" and
- Makerspaces should be part of a community college's instructional strategy to: 1) help students master 21st century and soft skill sets, 2) engage with business, industry and other ecosystem partners, and 3) establish their role as a key stakeholder in strengthening regional workforce development.

Concurrent with the publication of the white paper, the CCCCCO released a Request for Proposals in April 2016, seeking qualified community college applicants to serve as fiscal agent and technical assistance provider [4]. Sierra Joint Community College District was selected and awarded in July 2016 by the Board of Governors. The CCC Maker grant is operational from July 2016 to May 2019.

THE MODEL: CREATING STANDARDS AND REWARDING CUSTOMIZATION

Fifteen California Community Colleges currently have operational makerspaces, and another 17 have committed to starting up a makerspace. These current and future spaces are and will be customized to the education and economic ecosystem in which they operate, but operate using existing and prototyped operational structures such as Fab Labs, Hackerspaces, Co-Working Spaces, and Makerspace models to deliver services to students. This is challenging to build from a statewide perspective – encouraging customization and experimentation, but holding colleges accountable for outcomes built around common metrics.

CCC MAKER DESIGN

The organizational structure [Fig. 1] is designed to accelerate the integration of makerspaces into California Community College educational strategies and operations. At the leadership level, an advisory committee is the voice and the inspiration for the CCC Maker initiative. Committee members bring in their unique perspectives to discuss progress, recommend strategies, aid in the tactics of building the ecosystem, and provide a voice to educate and influence. Dale Dougherty, CEO of Maker Media and the founder of Make Magazine and the Maker Faire, is chair of the advisory. As the leader of a California-grown phenomenon that has spread globally, Mr. Dougherty has a keen interest in engaging community college students and faculty in new ways of learning that will “lead to a truly innovative economy and society” [5]. Other advisory members include representatives of business, education, foundations, and government.

The Project Manager coordinates administrative operations and resources available to colleges including ecosystem mapping through the National Association for Community College Entrepreneurship (NACCE); Making Across the Curriculum faculty workshops by Zack Dowell at Folsom Lake College; 21st Century Skills workshops by the New World of Work; How to Start Up and Improve Your Makerspace workshops by Maker Education Initiative; Infusing Social Entrepreneurship into the Community College Experience workshops by Kiva, and more.

A Technical Assistance Provider (TAP) administers and manages a mini-grant application and selection process, facilitates the delivery of training and other resources to colleges, builds a makerspace communication network; and serves as a facilitator for building business/industry partnerships and student work-based experiences.

WHAT LESSONS HAVE WE LEARNED?

1. There are plenty of best practice examples in the higher education-makerspace world that can be deployed in this initiative. Many of the core CCC Maker components don't need to be recreated; they just need to be found.
2. Communication is the most important feature to successfully deploy this huge undertaking. There are many different stakeholders that need to be in the loop of communication. We are communicating on multiple fronts: face-to-face meetings, social media, an accessible website, on-site training and small conference gatherings. We intend to closely monitor what works and what doesn't work for communication channels, our success depends on it. We are deliberately seeking to create a sharing culture that uses the benefits inured from collective learning.
3. An engaged advisory committee with a wide range of perspectives is invaluable. Our first advisory meeting uncovered interesting and useful insights that came from this diversity.

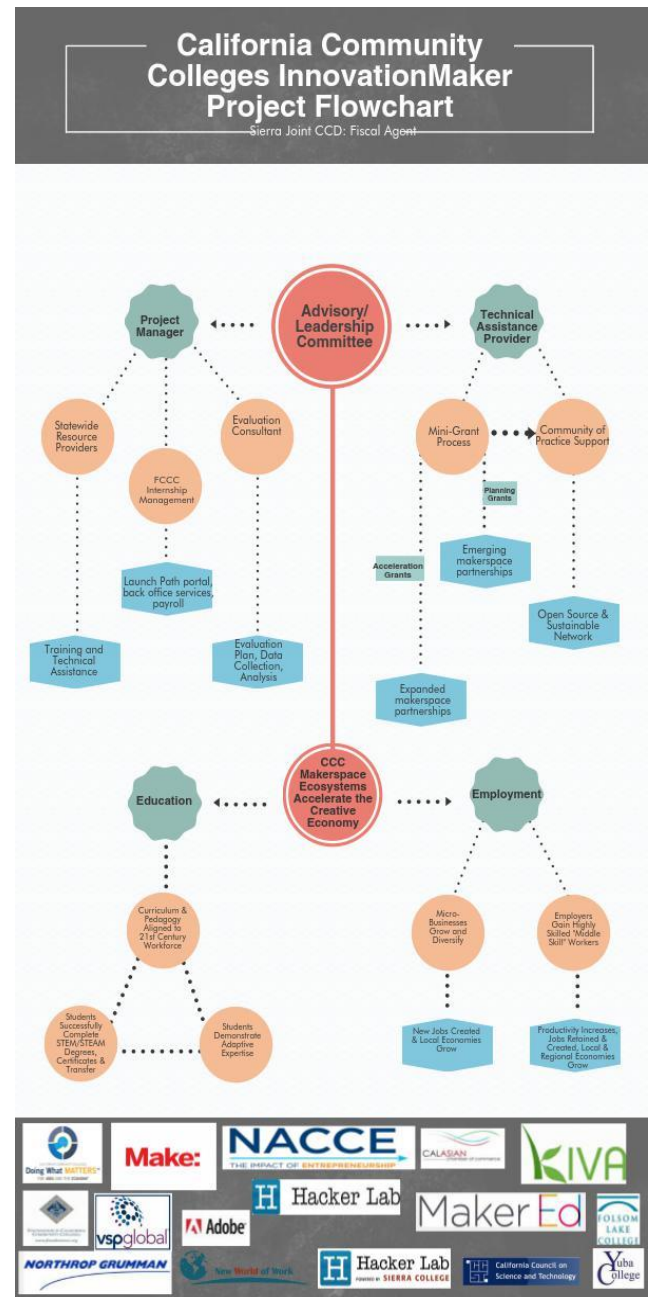


Fig.1: Structure and Projected Outcomes of CCC Maker

4. There is support for community college-based makerspaces in the business community. There are a number of clear benefits for local business involvement in the education process as well as moving part of the educational experience into the local business environment. We feel we are being encouraged to tailor each site to the needs of the local community (industry or agriculture for example), which adds value to the local business economy.

EXAMPLES OF CHALLENGES WE ARE FACING

1. Some community colleges have a broad and deep understanding of makerspace and education integration; others have no experience at all. Our initiative needs to be able to accommodate this spectrum of starting points.
2. What are the CCC Maker core features that should be found in all sites and what are the features that can be unique to the individual setting? We feel that finding this balance can only be “learned by doing” as the mini-grant sites begin in 2017.
3. Un-written rules of wide and willing collaboration, unsuccessful outcome discussions, sharing resources, and trying new ideas at the edges of traditional learning models are important and challenging cultural features we seek. We intend to deliberately create and model a positive common culture.
4. Communication structures (website, Facebook, Twitter) need to empower colleges as they experiment and iterate. Similar to using You Tube to learn how to do or fix something, the CCC Maker community needs to build a peer network for makerspace support and learning.
5. What are the most effective metrics to describe our progress? Do we use a combination of retrospective measures? For example, should we use utilization data (number of sites), student participation, degrees and certificates completed, or derive the number of jobs that have been created?

CONTEMPLATING THE INTENDED OUTCOMES

Imagine the implications of a successful CCC Maker initiative. What does success look like? What are the stories that will be told?

Integration of the maker movement and an entrepreneurial mindset will deeply affect how education is delivered, and how students are prepared for future careers. [Table 1].

These possible future outcomes can be divided into five distinct categories that include student success, educator leadership in pedagogic platforms, the value of community college-local community linkages, repeatable models of CCC Maker sites guided by the CCCCO, and successful inclusion of non-traditional student populations into this education system.

A. STUDENT SUCCESS IS THE DRIVING FORCE BEHIND THE CCC MAKER MOVEMENT. COMMUNITY COLLEGES REFINE THEIR EDUCATIONAL PORTFOLIO WITH ADAPTABLE LEARNING PLATFORMS THAT CHANGE AS THE DEFINITION OF STUDENT SUCCESS CHANGES.

1. Students create customized curriculum tracks based on their personal interests. They combine traditional academic courses with exploration and skill building from the makerspace labs. New combinations of curriculum tracks are common; electronics could go with art, app design might be combined with accounting, social programs could go with math. All combinations are possible.

2. There is a measurable increase in STEM/STEAM careers because of the interesting, interactive, and relevant content taught at the community college.
3. 21st Century workforce skills are an integral part of the curriculum.
4. Students are recruited into careers because of their participation in the CCC Maker programs. Some go on to become entrepreneurs. Others are employed in technical careers based on their makerspace-led training. A portion of the students are artistically inspired by their instructors, their peers, and their access to art-making equipment found in the makerspaces.
5. Student support services including counseling, career planning, and personal growth, shows measureable results in path-finding, self-confidence, and social skills

Table 1: Projected Outcomes of CCC Maker

California Community College Makerspace Ecosystems Accelerate the Creative Economy	
Education	Employment
Curriculum and Pedagogy Aligned to 21 st Century Workforce	Micro-businesses Grow and Diversify Employers Gain Highly Skilled Middle Skill Workers
Students Successfully Complete STEM/STEAM Degrees and Certificates, and/or Transfer to University Students Demonstrate Adaptive Expertise	New Jobs Created and Local Economies Grow Productivity Increases, Jobs Retained and Created, Local and Regional Economies Grow

B. EDUCATORS ARE LEADING THE CCC MAKER PROGRAM AND CURRICULUM DESIGN.

6. Student success is due in large part to the competencies, academic support, and educational experiences that faculty have designed.
7. Educators have incorporated self-paced instruction, peer learning, digital programs, and makerspace lab team learning into a cogent model that is effective and inspiring [6][7]. Students have been challenged to learn new skills in teamwork, accountability, and empathy for the world around them.
8. The makerspace environment is a component of faculty professional development and currency. It includes curriculum design support, community business interaction, and continued learning encouragement. Program design and outcomes are evaluated for effectiveness.

C. THE COMMUNITY COLLEGE ENHANCES ITS ROLE IN THE COMMUNITY AS PARTNERSHIPS WITH BUSINESSES AND OTHER COMMUNITY ORGANIZATIONS LEAD TO STRONG INTERDEPENDENT RELATIONSHIPS.

9. Businesses take on new community college roles as mentors, coaches, and curriculum contributors.
 10. Community colleges adapt instruction to the needs of the region and employers that drive the local economy.
 11. Community partnerships give students the opportunity to see inside the world of commerce. Student and instructor internships add value to the student, instructor, and business.
- D. THE CALIFORNIA COMMUNITY COLLEGE CHANCELLOR'S OFFICE BUILDS A GROWING NETWORK OF CCC MAKER SITES THAT INCORPORATE PROGRAMMATIC STANDARDS AND SYSTEMATIZED METRICS.
12. The CCC Maker program evolves as campus experiences help refine and shape the successful initiative. The initiative is always evolving.
 13. Programmatic standards and metrics are used to show the effectiveness of each key program area.
 14. A key contributor to the success is the overarching communication network that ties students, instructors, and campuses together with meaningful interaction.
 15. Key findings and insights are shared at the state, national, and international levels creating a super-network sharing infrastructure.
- E. THE CCC MAKER INITIATIVE IS A CIVIC MODEL OF SUCCESS BECAUSE OF ITS POSITION AS A THOUGHT-LEADER AND DEMONSTRATED COMMITMENT TO INCLUSION OF NON-TRADITIONAL POPULATIONS OF STUDENTS, INSTRUCTORS, AND SUPPORT STAFF [8].
16. Non-traditional students are valued and encouraged to participate in community college makerspaces at all levels. Deliberate efforts to engage non-traditional students and instructors create makerspaces that are reflective of campus and community diversity.
 17. College makerspaces become an effective platform for reforming social-economic problems through dialog and demonstrated outcomes.

CONCLUSION

This paper is an overview of the California Community College Chancellor's Office CCC Maker statewide initiative, designed to grow a network of STEM/STEAM focused makerspaces on a significant scale. Through the Doing What MATTERS framework and the recommendations of the Strong Workforce Taskforce, the CCC Maker initiative is a three-year strategy with a goal to create relevant career pathways and stackable credentials, promote student success, and get Californians into open jobs.

A nationally recognized leadership/advisory group guides the project and provides a voice to educate and influence. A Project Manager oversees administrative operations and guides training opportunities and resources. A Technical Assistance Provider is developing a mini-grant award process to community colleges and will facilitate training and re-

sources to grantees to support the planning and implementation of makerspaces and affiliated ecosystem partnerships, and build a community of practice that is open to all. Anticipated outcomes include adaptable learning platforms that support student success; new delivery models designed and delivered by faculty; strong partnerships with business and industry that support student transitions to employment; metrics and evaluative models that communicate the value of makerspaces integrated into the educational environment; and the democratization of 'Making' and STEM/STEAM career paths and occupations by engaging special populations reflective of community college demographics: women, racial and ethnic minorities, veterans, students with disabilities, economically disadvantaged, and English-language learners.

REFERENCES

- [1] California Community College Chancellors Office, Key Facts, cccco.edu
- [2] California Community College Chancellors Office, "Board of Governors: Task Force on Workforce, Job Creation, and a Strong Economy Report and Recommendations." November 2015. 54pp.
- [3] California Council on Science and Technology, "Promoting Engagement of the California Community Colleges with the Maker Space Movement." April 2016. 56pp.
- [4] California Community College Chancellors Office, InnovationMaker3 Request for proposals, cccco.edu
- [5] D. Dougherty, "The Maker Movement," Innovations / volume 7, number 3, 2012, 4pp.
- [6] Michael Prince, Department of Chemical Engineering, Bucknell University, "Does Active Learning Work? A Review of the Research", July 2004. 10pp.
- [7] Karl A. Smith, Purdue University & University of Minnesota, "Preparing Students for an Interdependent World: Role of Cooperation and Social Interdependence Theory", 2011. 12pp.
- [8] Beth Godfry, Georgia Institute of Technology, "Making Gender: Technologists and Crafters in Online Makerspaces", May 2015. 122pp.