



***Advancing and Evaluating the CREO Program in Southern Arizona  
Research and Development Concept Paper***

March 6, 2018

**INTRODUCTION**

The US Department of Education reports “few American students pursue expertise in STEM fields—and we have an inadequate pipeline of teachers skilled in those subjects”.<sup>1</sup> Research consistently underscores (1) the need to recruit and prepare our youth for careers in fast-growing STEM-related industries and (2) the declining numbers of students, especially under-represented youth such as Hispanic students, moving through high school with sufficient math proficiency to be prepared for STEM careers. The CREO project was designed to address this national need through an innovative curriculum that, based on preliminary research, develops students’ interest in STEM related careers, prepares youth for those careers, and supports their planning for post-secondary educational programs. The purpose of this concept paper is to introduce the need for and aims of the CREO program and to propose a next phase of development and rigorous evaluation.

**PROBLEM**

In *STEM Occupations: Past, Present, And Future*, the US Bureau of Labor Statistics (BLS) reported “there were nearly 8.6 million STEM jobs and employment in STEM occupations grew by 10.5 percent between May 2009 and May 2015 as compared with 5.2 percent net growth in non-STEM occupations.” BLS projected mathematical science occupations will grow 28.2% between 2014 and 2024, compared to average projected growth for all occupations of 6.5%.<sup>2</sup>

Similarly, the National Research Council concluded “successful citizenship in the twenty-first century will increasingly require a foundation of interest, facility and comfort with STEM ideas, practices and fields”.<sup>3</sup> Moreover, workers currently employed in STEM jobs tend to be older and will soon exit the workforce, creating openings for a potentially more diverse labor force.<sup>4</sup> Unfortunately, STEM degree attainment and placement rates for underrepresented groups are alarmingly low. To wit, 25% of US K-12 students are Hispanic;<sup>5</sup> but only 10% of college and university degrees awarded

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<sup>1</sup> *Science, Technology, Engineering and Math: Education for Global Leadership*, Washington, D.C.: U.S. Department of Education, March 2015 Retrieved from <https://www.ed.gov/Stem>

<sup>2</sup> Fayer, S., Lacey, A., Watson A. (2017). *STEM Occupations: Past, Present, And Future*. Washington, DC: US Bureau of Labor Statistics. Retrieved from <https://www.bls.gov/spotlight/2017/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future/pdf/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future.pdf>

<sup>3</sup> National Research Council (NRC). (2011). *Successful STEM education: A workshop summary*. A. Beatty, Rapporteur. Committee on Highly Successful Schools or Programs for K–12 STEM Education, Board on Science Education and Board on Testing and Assessment. Division of Behavioral and Social Sciences and Education. Washington, DC: National Academies Press.

<sup>4</sup> Buckley, P., & Bachman, D. (2017) *Meet the US workforce of the future: Older, more diverse, and more educated*. Deloitte Review, issue 21

<sup>5</sup> Kena, G., Aud, S., Johnson, F., Wang, X., Zhang, J., & Rathburn, A. (2014). *The condition of education: 2014*. Washington, D.C.: U.S. Department of Education, National Center for Educational Statistics.

in a STEM field are granted to Hispanics, and Hispanics make up only 2% of the US STEM workforce.<sup>6</sup>

This national challenge also provides opportunity. A diverse STEM workforce is key to fostering a strong and inclusive economy; however, robust economies depend on the development and implementation of evidence-based educational programs that serve students in need.

### **SANTA CRUZ COUNTY CREO PROGRAM**

The STEM preparation gap is particularly stark in Santa Cruz County, which is located in southern Arizona on the Mexican border. Here, 94% of the K-12 students are Hispanic and less than 29% passed the statewide summative high school math assessments in 2017. Historically, less than 10% of Santa Cruz County's Hispanic students who enter a post-secondary bachelor's program will complete their program of study, and very few of these students will earn STEM-related postsecondary credentials and land a job in a STEM-related field. To address this need, Santa Cruz County established the CREO (*I Believe*) program at Rio Rico High School. Its goal is to improve students' preparation for STEM careers. CREO focuses on four essentials: developing STEM identity, academic and technical success, building persistence and resilience skills, and college and career planning.

CREO's core math curriculum, MetroMatematicas, was developed in Mexico to prepare talented youth for postsecondary education and careers in that country's STEM industries. With funding from the US Department of Labor (DoL) Youth Career Connect program (YCC), MetroMatematicas was brought to the US, translated, and aligned to Arizona Academic Standards by the Santa Cruz County Superintendent's Office. A comprehensive curriculum guide and associated calendar were developed to help teachers reorganize their classrooms into STEM workplace environments and teach math using tools used by STEM professionals. Math classrooms were transformed into labs to provide students with applied learning experiences and prepare them for STEM professions. Based on constructivist learning theory, MetroMatematicas students follow a scientific inquiry-based approach to learn trigonometry, plane, solid, and analytical geometry, and probability and statistics.

In addition to the MetroMatematicas curriculum, CREO incorporates Six Sigma principles. First instituted in the manufacturing industry as a set of techniques and tools for process improvement, Six Sigma is now used throughout STEM-related industries. CREO has established a high school curriculum that allows students to apply Six Sigma principles to both their academic and personal lives. CREO students earn their Six Sigma White Belt and a Yellow Belt certificate. Those who wish to learn more Six Sigma principles may earn their Yellow Belt.

Through its applied project-based learning curriculum, which requires students work in teams while developing their math knowledge and skills, CREO helps students build technology skills, scientific instrumentation, reasoning, communication, and interpersonal skills (leadership, cooperation, motivation) as they master the fundamental concepts of Six Sigma.

Although career-themed and/or project-based STEM curricula are in place in high schools across the country, to our knowledge, CREO's approach is unique. It blends constructivist pedagogy, mathematics through visualization, project-based learning, and Six Sigma certification at the high school level to support the academic learning and soft-skill development essential for postsecondary and career success. In this regard, CREO and its curriculum target college readiness as defined by

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<sup>6</sup> New Scientist. (2016). *Hispanic Disparity and STEM*. Retrieved from <https://jobs.newscientist.com/article/hispanic-disparity-and-stem/>

Conley (2017), encompassing a broad set of academic content knowledge, habits of mind, and postsecondary transition skills.<sup>7</sup>

### **PRELIMINARY FINDINGS**

CREO and specifically MetroMatematicas have been the focus of two studies. The first, conducted in Mexico by an independent evaluation team found significantly higher measures of commitment, interest, and satisfaction for MetroMatematicas students relative to comparison-group peers.<sup>8</sup> The second study was conducted in Arizona. Following a one-year beta test period that involved afterschool, summer school, and weekend classes, CREO was piloted at Rio Rico High school in 2016-17 as an elective class involving 60 students who, in accordance with YCC requirements, were randomly assigned to CREO by DoL's research partner, Mathematica Policy Research. Freshmen students studied trigonometry and plane and solid geometry. Year-one results provide small-scale evidence of positive impact on student achievement. An independent evaluation of the treatment students by SWECA Inc. found that 50% of the treatment group (CREO participants) demonstrated proficiency on the statewide summative test compared to a significantly smaller percentage (19%) of the control group ( $p < 0.001$ ). Across Arizona, 39% of students demonstrated proficiency on the same statewide standardized assessment.

### **REQUEST**

Preliminary evidence suggests CREO helps address sizeable STEM preparation gaps for minority students. School districts in Arizona, Texas, and California have expressed interest in broader adoption, but funding is required to support that expansion. Importantly, the expansion should be designed and carried out to both study the impact on a larger student population and refine the program as lessons are learned. This will require a rigorous implementation and outcomes evaluation to further build understanding about what works to support STEM career readiness for underrepresented minority students.

Accordingly, CREO is seeking funding to further refine its curriculum and research of its effectiveness for a broader group of students. We seek funding to expand the program to 40 classrooms (20 treatment and 20 comparison) in the southwest and rigorously evaluate its impact on student outcomes. Without funding, CREO will remain a program located in a small rural county on the Arizona-Mexico border. Santa Cruz County students may continue to benefit, but STEM degree attainment and placement rates for underrepresented groups will remain distressingly low if programs like CREO are not developed, evaluated, and scaled up.

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<sup>7</sup> Conley, D T. (2017). The new complexity of readiness for college and careers. In K. McClarty, K. Mattern, & M. Gaertner (Eds.), *Preparing students for college and careers: Theory, measurement, and educational practice* (pp. 11–22). New York, NY: Routledge.

<sup>8</sup> González-Montesinos, M. (2013). *Technical Report on the Observational Monitoring for the Implementation of the Teaching Prototype MetroMatematicas*. Retrieved from <https://www.santacruzcountyaz.gov/DocumentCenter/Home/View/6682>