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I am pleased to present you with the 2019-2020 Annual Report for the California Education Learning Lab, which is part of the Newsom Administration’s efforts to advance opportunity and equity for students in California’s public higher education systems. This report covers Learning Lab’s second year of operation, between Fall 2019 to Fall 2020. During this time, Learning Lab achieved several significant milestones: we grew our funded community by 212 percent, doubled our funding commitment to $18.5 million, and forged an important partnership with the Foundation for California Community College to further expand our reach and grow our capabilities. Geographically, our total portfolio of projects now spans Humboldt and Shasta counties to the north, San Diego County to the south, and includes both the Central Valley and Central Coast. To date, all nine undergraduate UC campuses, 19 of 23 CSU campuses, and 33 of 116 community colleges are partnering on Learning Lab funded projects. Our current portfolio of projects has the capacity to engage hundreds of faculty and have an impact on tens of thousands of students in the next three years.

While Learning Lab achieved significant milestones during this second year and successfully funded 21 new projects, 2019-2020 was a challenging year for both existing and new grantees due to COVID-19. Despite the program’s established focus on improving online and hybrid course environments, many grantees still faced significant disruptions to their workplans and new grantees had to reconsider how projects might be impacted by ongoing campus restrictions for the fall term. For all grantees, attending to the myriad challenges of COVID took up significant time, to say nothing of the toll that COVID took on personal lives. In spite of these difficulties, existing grantees rallied to keep projects largely on track, while new grantees made commitments to forge ahead, despite uncertainties about the future.

While the pandemic brought unprecedented challenges, it has also demonstrated why our efforts to improve online and hybrid learning and focus on educational equity and authentic connection are so critical. Now more than ever, we need to find ways to support and engage our students, especially our Black/African American, Latinx, Native American, first-generation students, who are, again, being disproportionately impacted by the pandemic. Our work in this regard reflects the Newsom Administration’s deep commitment to racial equity and building a strong opportunity pipeline through its Cradle-to-Career initiative.

Though the road ahead will continue to be difficult, we are proud of the work our faculty partners are engaged in to help students succeed, and we are immensely grateful for the support of the Legislature, the Newsom Administration, and the Governor’s Office of Planning and Research for the opportunity to continue this work.

Sincerely,

Lark Park
Director, California Education Learning Lab
LEARNING LAB OVERVIEW

In 2018, Assembly Bill 1809 established the California Education Learning Lab (Learning Lab) in order to improve learning outcomes and close equity gaps across California’s public higher education segments, particularly in the Science, Technology, Engineering, and Math (STEM) disciplines.

Housed in the Governor’s Office of Planning and Research (OPR), Learning Lab funds innovative, intersegmental, faculty-led projects that aim to foster student success by improving online and hybrid learning environments, and leveraging technology tools and the science of human learning. Unlike other grant programs that support the development of online courses, course improvement, or supplemental programs dedicated to closing equity gaps, Learning Lab’s unique focus is to promote a positive feedback loop between learning theory, research, and educational practice, enabled by technology-rich environments, which can then be shared and scaled for the benefit of students. Learning Lab operates on the premise that all students are capable learners with potential for success given the right conditions, supports, and motivations.

As Learning Lab enters its third year of operation, the program continues to evolve and pursue improvements to its grant offerings and expand its reach. Learning Lab is currently administered by the Foundation for California Community Colleges (Foundation) on behalf of and in partnership with OPR.

FACTS AT A GLANCE

- 2 years in operation
- 18.5 million dollars in committed funding
- 30 funded projects
- 70 funded higher education institutions
- 150+ faculty leading funded projects
- 2-3 years of funding for each project to demonstrate their impact
- 8-10 million dollars in annual funding
Our Team
Learning Lab is run by a small team of driven, adaptable, individuals that are committed to improving equity and achievement across California’s public higher education segments. Learning Lab is housed at the Foundation and operates in consultation with the Director and Chief Deputy Director of OPR, and a seven-member advisory council. Learning Lab is additionally supported by both OPR and Foundation staff.

Our Mission
Learning Lab's mission is simple: improve learning outcomes and close equity gaps to increase student success in California’s public higher education institutions.

Our approach is simple but unique: leverage faculty innovation and technology tools to achieve success at scale. We want to enable faculty to try new things using a research approach that they already know: testing hypotheses and using data to drive continuous improvements in the classroom that will benefit students—especially historically underrepresented students.

The rewards will be significant: increasing student success in California higher education will result in a new generation of graduates that are ready to tackle big problems, respond to our state’s evolving workforce needs, and, ultimately, pave the way to a stronger and more equitable California.

CORE ACTIVITIES

Awarding Grants
Learning Lab provides grant funding to California’s segments of public higher education.

Promoting Professional Development
Learning Lab helps faculty develop inclusive, asset-based teaching approaches and culturally relevant pedagogy.

Highlighting Resources
Learning Lab aims to share new insights and promote best practices.

Fostering Collaboration
Learning Lab aims to scale innovation and learning gains by creating opportunities for collaboration and supporting faculty communities.
Minding the Gaps

The Learning Lab community seeks to better understand and work toward closing several gaps in California’s system of public higher education:

Achievement gaps: “Any significant and persistent disparity in academic performance or educational attainment between different groups of students.”

Opportunity gaps: “The ways in which race, ethnicity, socioeconomic status, English proficiency, community wealth, familial situations, or other factors contribute to or perpetuate lower educational aspirations, achievement, and attainment for certain groups of students.”

Equity gaps: Racial and gender disparities in educational access and attainment for historically underrepresented and underserved student populations that are the product of persistent social and institutional barriers to educational opportunities and educational success (Lumina Foundation and USC Center for Urban Education). From the perspective of the Learning Lab, we understand equity gaps, in part, as the achievement gaps that opportunity gaps created. Our preferred term is to use equity gap, rather than achievement gap, in order to keep the focus on the multiple barriers to educational success, including institutional barriers, rather than on student performance alone.

Figure 1: "Understanding the Equity Imperative," from the Center for Urban Education, Rossier School of Education, University of Southern California

Designed by Debbie Hanson for the Center for Urban Education as part of the Racial Equity Ladders Series.

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1 The Glossary of Education Reform.
2 The Glossary of Education Reform.
Our History
Established through the Education Trailer Bill of the 2018 Budget Act, Learning Lab launched in fall of 2018. By the end of 2018-19 fiscal year, Learning Lab awarded $9 million to six Innovation and three Proof-of-Concept projects. In 2019-20, Learning Lab built upon the successes of its first year, with the following achievements:

> Awarded an additional $9.5 million to 21 project teams.

> Shared insights and best practices from Learning Lab-funded projects through a new webinar series.

> Grew the Learning Lab community by 212%, from 49 to 153 principal/co-principal investigators.

> Added important projects in biology and computer science, which had been underrepresented in the first year, and awarded five projects focused on professional development.

> Conducted seven focus groups with students across a variety of campuses to better understand the experiences of STEM undergraduates.

> Expanded our network through a strategic partnership with the Foundation for California Community Colleges.
**AWARDING GRANTS**

**Ingredients for Success**

All Learning Lab projects contain five components—outlined in Assembly Bill 1809—that uniquely reflect Learning Lab’s approach to scaling student success. To view examples of funded Learning Lab projects, please see the Appendix.

These components, when integrated into projects expressly focused on improving equity and learning outcomes, should lead to better student STEM experiences and outcomes across California’s public higher education segments.

**Consist of an intersegmental team**
The State of California invests significant resources into its public higher education institutions. Collaboration across the University of California (UC), California Community College (CCC), and California State University (CSU) segments will allow teams to draw more deeply from diverse faculty experiences and enable more widespread adoption of innovative solutions.

**Benefit lower-division instruction**
Lower-division courses are understood as courses that students ordinarily take in their first or second years which provide essential foundational knowledge for advancement in a program of study. These courses often have high enrollment and, in many STEM fields, are characterized by high withdrawal and non-passage rates. Due to the potential for largescale impact, Learning Lab incentivizes the transformation of these courses so all STEM students may end their first year feeling confident and grounded and persist as potential STEM degree candidates.

**Incorporate the science of human learning**
Learning science, or the science of human learning, is the study of how human learning takes place. This field addresses how people process, gather, and interpret information; how they develop knowledge, skills, and expertise; and the extent to which social and physical context and design environments influence learning. One of the goals of the science of learning is to create a positive feedback or continuous improvement loop between theories of learning and practice, which would result in improved student learning and advance the field of learning science.

**Incorporate aspects of adaptive learning, broadly defined**
Adaptive learning is defined in Learning Lab’s statute to mean “a technology-mediated environment in which the learner’s experience is adapted to learner behavior and responses.” Adaptive learning technologies offer opportunities to collect and analyze data on student learning, support the integration of

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3 Ibid.  
4 The Simon Learning Initiative Learning Engineering Ecosystem.
learning research and teaching practice, and encourage instructors to respond and adapt iteratively to student learning.

**Improve online and hybrid courses, broadly defined**

Prior to COVID-19, enrollment in online courses was on an upward trajectory, hybrid courses were also growing in popularity, and the focus on improving online and hybrid education was predicated on the growth of these modalities and their potential to provide flexibility for students, reduce course bottlenecks, and improve learning outcomes (specifically a feature of hybrid education). Since COVID-19, a massive shift to remote education has occurred, and the need for high quality online and hybrid instruction is greater than ever. Online and hybrid course environments have the added benefit of providing more opportunities for students to practice learning, engage differently in the classroom, and for faculty to collect and use student learning data to support student success.
2019-2020 Grant Opportunities

After extensive consultation with its advisory committee, in September 2019, Learning Lab issued three grant opportunities under the common RFP title “Using Research and Technology to Transform Undergraduate STEM Education,” to solicit innovation, professional development, and seed grant proposals from intersegmental faculty teams. In March 2020, Learning Lab issued an additional RFP titled “Enabling Institutional Change in Undergraduate STEM Education” that was oriented toward systems-level change. Each opportunity was tailored to a different faculty audience, while meeting the core requirements of the Learning Lab program outlined in Assembly Bill 1809 (Chapter 33, Statutes of 2018).

**Innovation grants** support projects that develop curricular and pedagogical innovations aimed directly at students in lower-division STEM courses as well as projects that lead to curricular and pedagogical change through the creation of innovative, large-scale faculty professional development programs.

**Professional Development grants** support the creation, refinement, or expansion of faculty professional development programs that aim to improve learning outcomes and close equity gaps in undergraduate STEM courses.

**Seed grants** support project teams that are in the early stages of project design and need additional development before proceeding to full-scale implementation. Examples of concrete deliverables from these grants include, but are not limited to, proof-of-concept testing, data collection and analysis, or development of pedagogical/curricular resources.

**Institutional Change grants** support efforts that reduce institutional barriers and/or foster institutional contexts to advance undergraduate STEM success, improve online and hybrid course environments, and close equity gaps for students.

**Table 1: Comparison of Learning Lab’s 2019-2020 Grant Opportunities**

<table>
<thead>
<tr>
<th>Grant Opportunity</th>
<th>Award Amount</th>
<th>Duration</th>
<th>Applied</th>
<th>Awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation grants</td>
<td>$1,000,000</td>
<td>3 years</td>
<td>18 projects</td>
<td>5 projects</td>
</tr>
<tr>
<td>Professional Development grants</td>
<td>$200,000</td>
<td>1-2 years</td>
<td>16 projects</td>
<td>5 projects</td>
</tr>
<tr>
<td>Seed grants</td>
<td>$100,000</td>
<td>1-2 years</td>
<td>11 projects</td>
<td>6 projects</td>
</tr>
<tr>
<td>Institutional Change grants</td>
<td>$500,000 to $650,000</td>
<td>2-3 years</td>
<td>19 projects</td>
<td>5 projects</td>
</tr>
</tbody>
</table>
Selection Process

Learning Lab’s Innovation and Professional Development grant applicants went through a two-stage selection process (concept and full proposal), while the Seed and Institutional Change grant applicants went through a single-stage process (full proposal only). In general, Learning Lab’s 2019-20 selection process consisted of three stages:

1. **External Reviews**: Learning Lab recruited external reviewers from across California as well as out-of-state higher education institutions. Two external reviewers were assigned to each proposal. In making assignments, Learning Lab staff avoided potential conflicts of interest and ensured that each proposal was assigned to at least one reviewer with expertise in a discipline relevant to the proposal. The external reviewers provided qualitative reviews along with overall impact scores in accordance with each RFP’s rubric, which contained criteria highlighted by the RFP and Learning Lab’s statute. These reviews were not used to rank proposals but rather provided a basis for the selection committee’s deliberation.

2. **Selection Committee Evaluations**: Learning Lab’s selection committee was granted access to all proposals and external reviewer comments to review individually. During the selection committee meetings, members deliberated and recommended proposals for advancement to a subsequent stage or for award (depending on the RFP) based on their consideration of the proposals in their totality, taking into account the external reviewers’ feedback. In making its recommendations, the selection committee considered the likelihood that proposed projects would be able to meet the aims of the RFP and also sought to achieve disciplinary, geographic, and institutional diversity among awarded projects, as requested by Learning Lab.

3. **OPR Director’s Approval**: In the final stage of the selection process, the selection committee’s recommendations were presented to OPR’s Director for final approval and award. During this stage, the Director reserved the right to make additional or fewer awards than recommended and alter the final funding amount for each project. After the Director approved the projects and award amounts, Learning Lab staff notified each team regarding the status of its proposal and also provided feedback from the external reviewers and/or committee members to non-awarded teams.
Distribution of Currently Awarded Projects

All projects funded in the 2019-2020 RFP cycle officially commenced on July 1, 2020, bringing the total number of actively funded Learning Lab projects up to 30. In alignment with its mission to improve undergraduate STEM education across all of California’s public higher education segments, Learning Lab strived to achieve disciplinary, geographic, and institutional diversity among awarded projects.

Disciplinary Distribution

For the first two years of operation, Learning Lab targeted funding specifically toward STEM disciplines, which the program defined as all physical and biological sciences (including earth and environmental science) as well as computer/data science and math/statistics. To date, the program is well balanced across disciplines, as the graphic below shows. Additionally, several of the currently funded projects work across multiple STEM disciplines: five teams span two STEM fields, while six project teams span three or more STEM fields, which Learning Lab labeled as interdisciplinary. (Note: projects spanning more than one discipline are counted in both fields.)

![Disciplinary Distribution of Current Learning Lab Funded Projects](image-url)
Geographic and Segmental Distribution
Seventy institutions across and beyond California are currently partnering in 30 projects funded by Learning Lab. These include all nine undergraduate UC campuses, 19 of the 23 CSU campuses, and 33 of the 116 CCC campuses. Notably, in the 2019-2020 fiscal year, statewide institutions such as the CSU Chancellor’s Office and Academic Senate for California Community Colleges are also leading or partnering in Learning Lab projects.

Learning Lab’s funded institutions span Humboldt State and Shasta College to the north, MiraCosta College and CSU San Marcos to the south, and include both the Central Valley and Central Coast; however, the greatest concentration of funded institutions are located in the Bay Area and Los Angeles regions, mirroring California’s population. For more information regarding project’s geographic and segmental distribution, see Figure 2.

Figure 2: Institutions that are currently participating in Learning Lab projects. (View a zoom-enabled version of this map).
Funding Distribution
Learning Lab’s annual budget of $10 million in 2018-19 and 2019-20 primarily funded grant awards (minus five percent in program administrative costs). Learning Lab awarded approximately $9.5 million during the 2019-2020 fiscal year across 21 projects, bringing the total amount of committed funding up to $18.5 million.

Funding by Segment
Across the segments, CSU and UC campuses received a slightly larger share of Learning Lab funding in the 2019-20 awards cycle (see Figure 3), with 37% and 33% awarded to these segments, respectively, while 28% went to CCCs. Cumulative distribution across both grant years shows CSU with 35% of all committed funds, and UCs and CCCs each with 30% of committed funds. Remaining funds went to other project partners, including other university systems and nonprofits.

Regarding the lower proportion of funding that went to community colleges in the 2019-20 grant cycle, Learning Lab believes this was the result of administrative capacity constraints that made CCCs less likely to apply as host institutions. Host institutions tend to receive a greater share of funding for costs such as convenings and distribution of faculty participant stipends. As a point of comparison, 59% of grant funding is awarded to host institutions while 41% is distributed as subawards. Currently, six projects are hosted by CCCs, 12 by CSUs and 12 by UCs. This is a significant proportional change from the first year, where three CCCs, four CSUs, and two UCs served as host institutions. As Learning Lab develops its partnership with the Foundation for California Community Colleges, greater outreach, recruitment, and capacity development of CCCs to serve as hosts will be a priority.

Figure 3: Grant Allocation by Segment

Funding By Category
Learning Lab grant funds primarily support personnel (70%) and consultant (11%) costs as shown in Figure 4. Due to COVID-19, project travel budgets were reduced significantly, only allowing for trips deemed essential to projects’ success. Two percent of grant funds are currently allocated to this category.

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5 A host institution is a college or university that serves as the grantee and fiscal intermediary for purposes of grant administration.
**Figure 4: Grant Budget Category Allocation**

Funding by Discipline
For the duration of each grant, Learning Lab investments will be used to transform a variety of STEM disciplines. Currently, 48% of the project funding is intended to support initiatives that span two or more fields. Projects focusing on multiple disciplines were awarded as part of the Innovation, Institutional Change, and Professional Development grant opportunities, whereas Seed grant funding largely supported single-discipline projects focused on computer/data science, biology, and math/statistics.

**Figure 5: Disciplinary Distribution of Awarded Grant Funds**
Highlights of Awarded Projects

As discussed above, Learning Lab created four different categories of awards in the 2019-20 grant cycle: Seed grants, Professional Development grants, Innovation grants, and Institutional Change grants. These four categories greatly increased the diversity of funded projects—from small scale start-up efforts involving just a handful of faculty participants to larger projects aimed at recruiting and training upwards of 200 faculty members, and/or impacting tens of thousands of students within the grant period.

Whether the projects were just forming (Seed grants) or sought to achieve larger institutional change, all projects were required to be intersegmental, with more than half of the 2019-20 awarded projects representing all three segments. Additionally, the average number of institutional partners in a project went from three in year one to four in year two grants, with some projects having seven to nine different partners.

Several of the 2019-20 cohort of awardees focused their attention on innovating with proven effective pedagogies, such as Reading Apprenticeship, Research Deconstruction, and Process-Oriented Guided Inquiry Learning. Innovations included introducing these methods in an online or hybrid setting, or to a new segment partner, or coupling these methods with other tools and strategies in a disciplinary framework.

The year’s cohort also included projects that aimed to scale to certain practices, such as updating cookbooks style labs with course-based undergraduate research experiences, or integrate two key areas together, such as making open educational resources available on a technology-enabled adaptive learning platform. Entirely new types of projects were also included in the 2019-20 cohort, such as a project to develop paradigm-based question generators to help students achieve mastery learning and reduce reliance on traditional high-stakes assessment.

I found it to be the best remote exam experience I’ve had this semester, in terms of reducing test-taking-related stress and anxiety as much as possible, allowing me to really focus on the material and learn it to the best of my ability.

- Student from Mastery Learning for Learner Success, Student Equity, and Institutional Resilience

Finally, several of the year’s awardees chose one particular area to experiment with change, such as: bringing active/adaptive learning to discrete mathematics; coalescing faculty around a big idea pedagogical approach on precalculus; teaching the science of human learning to increase memory and retention; and refining our understanding of online simulations as an effective pedagogical tool for understanding molecular structures.
Though the year’s funded projects were diverse in disciplinary distribution and approaches to improving learning outcomes, several common themes emerged in these proposals, including the importance of growth mindset in both students and faculty; developing student and faculty learning communities; integrating survey work; increasing student agency through different channels; and attending to student identity and belonging, especially for underrepresented students.

**Student and Faculty Experiences in the Year One Grant Cohort**

In addition to the launch of Year Two projects, 2019-2020 also marked the first full year of activity for Learning Lab’s inaugural grantees. After one year, projects were already reporting tangible impacts. Below are excerpts describing the experience of students and faculty from the first cohort of Learning Lab projects:

*From the Better Book project:*

“I found the Course Kata materials to be refreshingly modern — it completely transformed the way I teach statistics. By taking a modeling approach, I was able to foster a deep, conceptual understanding in my students, one that I always suspected was lacking teaching out of a traditional textbook. Jupyter notebooks have made integrating R into my classroom that much easier, and have served as a perfect complement to the interactive textbook. My students are leaving my class with both a practical skillset and a deeper understanding of the world around them.” — Mitchell Pumar, Professor, Math Department, Los Angeles Pierce College

*From the Developing Student Identity project:*

"I enjoyed the data task. I feel like I truly understand this concept along with my team which in turn made it a fun task to do together because I feel like we were all on the same page. I like when the team as a whole has the same understanding and can contribute equally."

- Intro Chemistry student on a digital data-task executed in Canvas and Zoom, Fall 2020.
From the Goals in CS project:

"I loved...taking control of my learning and reviewing more in class time. Every computer science class should follow this model."
- GOALS in CS student at CSU San Marcos

“This is the second time I’ve taken this course and the new OLI learning structure has really helped me learn things I never really understood the first time I took this course.”
- GOALS in CS student at MiraCosta College

From the project’s annual report:

A student commented at the end of the semester, "I decided to put more effort in my learning, my professor recognized it and was able to help build on my strengths and help improve my learning." Validating student effort and progress/process created a positive cycle for the students’ learning.
2019-2020 Advisors and Selection Committee Members

Learning Lab staff collaborate with its advisory council to determine the scope and focus of each year’s RFPs. For the 2019-2020 fiscal year, Learning Lab welcomed back six advisors from the previous year and also added one new member to the group, for a total of seven. All members were recruited to serve on the Learning Lab advisory council due to their broad STEM disciplinary expertise, expertise in the science of learning and adaptive learning technologies, STEM education improvement experience, and commitment to diversity, equity, and inclusion.

These members not only served in an advisory capacity, but also volunteered their time as selection committee members, reviewing and recommending proposals for award for the RFP titled “Using Research and Technology to Transform Undergraduate STEM Education.” For more information about Learning Lab’s 2019-2020 advisors, see their biographies below:

Carlos Gutiérrez
*Distinguished Professor of Chemistry, Emeritus, Cal State LA Founding Director, Minority Opportunities in Research Programs*

Carlos Gutiérrez is founding director of the Cal State LA Minority Opportunities in Research (MORE) Programs, an association of efforts that share the goal of preparing minority undergraduates and masters students for success in science PhD programs (over 200 have earned the PhD and 150 are in graduate programs nationwide). He has directed research training programs for 40 years, including the campus MARC and RISE programs. In 1996, Gutiérrez received the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring from former President William J. Clinton. He was named a 2005 U.S. Professor of the Year by the Carnegie Foundation for the Advancement of Teaching and Council for Advancement and Support of Education (CASE). Gutiérrez is a Fellow of the American Association for the Advancement of Science, and a Fellow of the American Chemical Society.

Kathy Kubo
*Professor of Mathematics, College of the Canyons*

Kathy Kubo is a Mathematics Instructor at College of the Canyons. She helped create the college’s redesigned statistics pathway and faculty training program. Canyons’ statistics pathway has been honored by the California Community Colleges Chancellor’s Office and the Board of Governors. In 2015, the Campaign for College Opportunity honored Kubo for her leadership in transforming remediation. She participated in a National Science Foundation grant on statistics education, worked with Stanford University’s Open Learning Initiative to revise their Concepts in Statistics courseware, and was a writing team member for the American Statistical Association’s Two-Year College Data Science Summit. She is a 2019 recipient of the American Statistical Association’s Fellowship.
Program for Two-Year College Teachers. Kubo currently works with the California Acceleration Project and coordinates the Chancellor’s Office Statistics Institute. She holds a master’s degree in mathematics from the University of California, Los Angeles.

**John Matsui**  
Assistant Dean, Biological Sciences, UC Berkeley  
Director, Biology Scholars Program, UC Berkeley

John Matsui grew up in a low-income West Berkeley household and was educated in both the California Community College and University of California systems. His personal background and life experiences drive him as Director and co-founder of the Biology Scholars Program (BSP), to make biology majors and related careers more accessible to all. Dr. Matsui’s goal is to "level the playing field" for individuals who, like himself, do not fit the historical profile of success and to help them become leaders in their future science-related careers. For more than 25 years, he has learned from over 3,500 low-income and first-to-college BSP members how our colleges and universities can better train and support undergraduate and graduate students in biology. Dr. Matsui also serves on several national advisory committees to diversify STEM including the HHMI Inclusive Excellence Commission, the NSF Leadership Council for the Biology REU Initiative, and the NIH Advisory Committee to the Director for the Diversity Program Consortium Initiative.

**Bror Saxberg**  
Vice President, Learning Science, Chan Zuckerberg Initiative (CZI)

As Vice President, Learning Science, Bror Saxberg is responsible for CZI’s thinking about how to expand and apply learning science results and good learning measurement practice at scale to real-world learning situations across the full span of learning—pre-K, K-16, and beyond. Saxberg most recently served as Chief Learning Officer at Kaplan, Inc. where he was responsible for the research and application of innovative evidence-based learning strategies, technologies, and products across Kaplan’s full range of educational services offerings. Saxberg received an Honors BA in Mathematics and a BS in Electrical Engineering from the University of Washington, an MA in mathematics from Oxford University, a PhD in electrical engineering and computer science from MIT, and an MD from Harvard Medical School.
Kimberly Tanner  
**Director, Science Education Partnership and Assessment Laboratory**  
**Professor of Biology, San Francisco State University**

Kimberly Tanner is a tenured Professor of Biology at San Francisco State University. Her laboratory–SEPAL: the Science Education Partnership and Assessment Laboratory–investigates what is challenging to learn in biology, how biologists choose to teach, and how to make equity, diversity, and inclusion central in science education efforts. As a Science Faculty with an Education Specialty (SFES), she is engaged in discipline-based education research, directs multiple K-16+ biology education reform efforts, and is deeply engaged in faculty professional development. Trained as a neurobiologist with postdoctoral studies in science education, Dr. Tanner is a proud first-generation college-going student.

Candace Thille  
**Director of Learning Science, Amazon.com, Inc.**  
**ETS Board of Trustees**

Candace Thille was the founding director of the Open Learning Initiative (OLI) at Carnegie Mellon University and at Stanford University. Her focus is in applying the results from research in the science of learning to the design and evaluation of technology mediated learning environments and in using those environments to conduct research at the intersection of human learning and machine learning. Candace has served on the board of directors of the Association of American Colleges and Universities; as a fellow of the International Society for Design and Development in Education; on the advisory council for the Association of American Universities STEM initiative; and on the advisory council for the National Science Foundation Directorate for Education and Human Resources. She also served on the working group of the President’s Council of Advisors on Science and Technology (PCAST) and on the U.S. Department of Education working groups. She holds a bachelor’s degree from UC Berkeley; a master’s from Carnegie Mellon University, and a doctorate from the University of Pennsylvania.
Carl Wieman
Professor, Stanford Graduate School of Education
Professor of Physics, Stanford
DRC Chair, Stanford School of Engineering
Founder PhET Interactive Simulations

Carl Wieman has done extensive research in both atomic physics and science education. Along with Eric Cornell and Wolfgang Ketterle he was awarded the Nobel Prize for Physics in 2001 for creating a new ultracold state of matter, the so-called Bose-Einstein condensate (BEC). He has over 100 publications on the design and comparative effectiveness of different methods of undergraduate science instruction, and on the adoption of research-based teaching methods. He established the Science Education Initiatives at the University of Colorado and the University of British Columbia which carried out unprecedented large-scale change in the teaching of undergraduate science at large research-intensive public universities. Having spent most of his career at the University of Colorado, he has been at Stanford University since 2013.
Additional Selection Committee Members, 2020

In Spring of 2020, Learning Lab recruited a three-person selection committee for its grant opportunity, “Enabling Institutional Change in Undergraduate STEM Education.” Because this RFP invited projects that would focus on larger institutional change efforts at participating campuses, Learning Lab recruited selection committee members who had experience in an institutional context effecting systems-level change, in addition to their commitment to diversity, equity, inclusion, and student success. University of California Regent Maria Anguiano, Foothill College President Thuy Nguyen, and California State University Trustee Peter Taylor served as selection committee members for this RFP.

Maria Anguiano
Regent, University of California
Senior Vice President, ASU

As a first-generation college graduate, Maria Anguiano has dedicated her career to improving access to education for all learners. Currently she serves as Arizona State University’s Senior Vice President for Strategy. She also serves on the board of the Campaign for College Opportunity, Foundry College, James Irvine Foundation, and the University of California Board of Regents.

Peter J. Taylor
Trustee, California State University
President, ECMC Foundation

Peter J. Taylor currently serves on the California State University Board of Trustees. In addition, he is the President of the ECMC Foundation, a national grantmaking organization working to inspire and facilitate improvements that affect educational outcomes, especially among underserved populations, through evidence-based innovation.

Thuy Thi Nguyen
President, Foothill College

Thuy Thi Nguyen (Thúy Thị Nguyễn) serves as the seventh President of Foothill College in Los Altos Hills, California, a position she has held since July 2016. Nguyen is the first Vietnamese American college president in the country. Prior to her arrival at Foothill, Nguyen served as interim general counsel for the California Community College’s Chancellor’s Office.
HIGHLIGHTING RESOURCES

Faculty Needs Report

The COVID-19 outbreak and subsequent transition to remote instruction posed unprecedented challenges for the students and faculty of California’s institutions of public higher education. In order to better understand faculty experiences and needs in this situation, Learning Lab put out a questionnaire in April 2020 inviting faculty to share their experiences of the transition to remote instruction and to discuss their needs and the needs of their colleagues in light of this new educational environment. In addition, Learning Lab staff spoke with senior representatives from segmental learning technology offices as well as additional faculty to understand how segments and campuses managed the transition. Through survey responses, direct interviews, and verbal feedback, more than 30 faculty and administrators informed Learning Lab’s report “Class Interrupted: Faculty Needs in the Time of COVID-19.”

Administrative and faculty responses underscored the prodigious accomplishment of California’s institutions of public higher education in transitioning to remote instruction. Responses equally, however, revealed the limitations of the transition: while campuses successfully shifted to remote instruction, faculty had little or no opportunity to redesign courses for a new instructional environment, and sometimes both students and faculty lacked equipment to make online learning successful. Looking forward, responses point to three primary areas of continuing need: student access to remote instruction; training for faculty; and technological infrastructure and resources.

The report highlighted that during the first months of remote instruction, campuses and faculty often had limited capacity to address these needs fully. Significantly, although administrators and faculty members emphasized the enormous challenges facing campuses and students, some also identified opportunities within this difficult period. In particular, opportunities identified included rethinking assessment along more equitable lines, developing new, effective instructional resources, and greater adoption of online resources on the part of faculty.
Webinar Series

Between July and August, Learning Lab staff organized a summer webinar series to share information regarding pedagogical approaches and tools that faculty could use as they shift to remote teaching. These webinars featured faculty from Learning Lab’s funded project teams. A total of 266 individuals registered for the webinars from 175 distinct institutions. Between 30-70 faculty attended each event.

How to Launch a Networked Improvement Community
- Lessons from the Better Book Project

Karen Givvin, adjunct professor of Psychology at UCLA, highlighted how the Better Book team launched a highly effective and dynamic networked improvement community around their innovative online, interactive, statistics “textbook.” One key takeaway from the webinar was to be aware of “The Settings” by paying special attention to where and when you engage with the team as well as the routines you have in place. Through workshops, sprint meetings, and a help desk, the team engaged researchers, developers, instructors, and students in the development of their project, with participation far outpacing expectations.

Deploying Learning Assistants Online
- Tips from LA Instructors

Laura Ríos and Stamatis Vokos, team members of the Mechanics of Inclusion project and professors at Cal Poly-San Luis Obispo, highlighted how to best prepare learning assistants to create a positive and rewarding experience for them and the students they work with in online/hybrid classes. During the interactive webinar, the team replicated several classroom activities. For instance, webinar attendees were able to work through a physics problem with actual student assistants. Moreover, Laura Ríos demonstrated a creative way to help the student assistants understand the theory of constructivism—i.e. the social construction of knowledge—through an exercise focused on the question: “What is a chair?” (pictured to the left).
Shazbot! - Can You Really Do Active, Adaptive, Asynchronous Learning All At Once?!

Educational leaders David Wiley of Lumen Learning and Norman Bier of Carnegie Mellon University’s Open Learning Initiative (OLI) provided tips on how to provide active, asynchronous learning opportunities using the unique capabilities of open, adaptive courseware. The webinar began by defining the different approaches to adaptivity, ranging from simple “choose your own adventure” models to the more complicated VanLehn model featuring outer and inner feedback loops. Both speakers then showed how adaptive and active learning could be put into practice using examples from the Waymaker and OLI open courseware platforms. Several Learning Lab funded projects are making use of these platforms.

Don’t be a Robot! - Lessons on How and Why to Humanize Online Teaching

Michelle Pacansky-Brock and Kim Vincent-Layton from the Humanizing Instruction project discussed what humanizing is and why it holds promise to improve the academic success of minoritized students. During the webinar they shared humanizing strategies, and discussed the work being implemented at Foothill-DeAnza Community College District, Modesto Junior College, and Humboldt State University. One key takeaway from the event was to see beyond the names on the screen. As teachers learn more about their learners, they can better support student’s cogitative understanding and address imposter syndrome, stereotype threat, and trauma that impedes learning.
FOSTERING COLLABORATION

Creating a Grantee Community

With 30 projects funded as of June 30, 2020, Learning Lab’s grant community totals roughly 153 faculty and professionals that are directly participating in projects. This represents a 212% percent increase from the prior year, and the number is expected to grow each year as each project develops and expands its reach.

Though Learning Lab was not able to convene grantees in person during 2020 as it did in 2019 due to COVID-19 restrictions, Learning Lab held a virtual community dinner in August 2020 in order to welcome new grantees and help them get acquainted with their fellow grantees. To foster greater community online, Learning Lab plans to create a Slack Channel to provide a forum for grantees to communicate more informally with one another. Learning Lab anticipates holding additional virtual community gatherings in smaller groups during the 2020-21 academic year and will consider hosting an in-person conference(s) for summer 2021.

In order to foster greater learning between project teams, beginning in January 2021, Learning Lab will invite cohort teams (Year One Innovation grantees; Year Two Seed grantees; Year Two Professional Development grantees; Year Two Innovation grantees; Year Two Institutional Change grantees) to join each project team’s bi-annual Zoom progress update.

Winter 2020-21 Conversation Series on Race and Gender Equity

Similar to the Summer Webinar Series hosted in 2020, Learning Lab will host four additional virtual meetings focused on promoting racial and gender equity in the classroom, which will intersect with its 2020-21 grant opportunity, “Learning Lab Grand Challenge: Overcoming the Calculus Barrier to STEM Success.”

Attending one of these webinars will be required for applicant teams. The series will reflect high-level discussions, such as "The Meaning of Racial Equity" (Dec. 11, 2020), as well as incorporate workshop type activities for smaller groups of faculty. The target audience for this series includes existing grantees and prospective applicants, but Learning Lab plans to invite the broader faculty community to attend high-level discussion webinars.
GATHERING INPUT

Student Survey

Educational research has identified a number of factors that contribute to low rates of retention in STEM disciplines; among them are opportunity gaps in K-12 education regarding prior preparation; sociocultural factors that make STEM departments unwelcoming to underrepresented students; and traditional STEM pedagogy that can be ineffective and uninspiring.

In order to better understand how California students experience STEM education, Learning Lab staff conducted seven focus groups between January and February 2020, consisting of STEM undergraduate students at six California institutions of public higher education – Los Medanos College, Rio Hondo College, CSU Fresno, Cal State LA, CSU San Bernardino, and UC Irvine. (Additional focus groups were planned for the spring. However, due to COVID-19, these activities were postponed.)

Several key themes emerged from the discussions and were generally consistent across campuses and segments:

> **Faculty Mindset**: Students felt that the least engaging courses were run by professors who clicked through slides and had an attitude of, “I know this material, why don’t you?” Conversely, students preferred courses where faculty were engaging, encouraging, and transmitted their passion for the subject. One participant specifically mentioned how helpful it was when faculty talked about their own pathways.

> **Active and Applied Learning**: Students broadly preferred courses where there was opportunity to engage actively with course and subject matter material, whether through group work, course projects, or hands-on/applied learning. They emphasized the importance of faculty connecting course material to career and real-world applications to shed light on its relevance.

> **Support Networks**: Some students mentioned that there were not many students who looked like them in their courses and noted that this made it harder to stay in the field. These students were generally in majors like CS, math, or physics that have lower levels of URM enrollment. Participants emphasized the importance of community and support systems (i.e., support programs, clubs, study groups) for persisting in STEM.

> **Humanizing**: Students reported that faculty, especially older faculty, often did not seem to understand “where students are coming from,” especially regarding the difficulty of balancing academic and familial responsibilities and of balancing study with work (and commuting). Participants also referred to professors who assumed an unrealistic level of prior understanding.

> **Clear Pathways**: Students also reported institutional barriers to persistence and success in STEM. Most focus groups included students who commented on the difficulties of navigating higher education as first-generation students. Many students reported dissatisfaction with academic counseling/advising, including difficulty with obtaining consistent, reliable information about degree pathways, and commented that it would be helpful to have better understanding of what they can do with their degree.
On the whole, these discussions generally align with research literature. It is important to note, however, that focus group participants were not demographically representative of California’s student population and consisted of students who persisted in STEM. Based on the information obtained from these focus groups, it may be beneficial to conduct a statewide survey of student experience in STEM that captures segmental or local differences, as well as includes non-persister perspectives. Learning Lab will continue to explore ways in which such research can add value to understanding the barriers that California students face, and how to overcome them.

**Advisor Exit Interviews**

For its second year of operation, five of seven Learning Lab advisors continued as both advisors and selection committee members from year one; one retained his role as an advisor only; and one technical advisor only from year one assumed a selection committee member role in year two. Because Learning Lab asked for one-year commitments only, with a one-year extension request, Learning Lab said farewell to its inaugural cohort of advisors but conducted exit interviews following the 2019-2020 grant cycle, to plan for program improvements in year three. Advisor feedback was wide-ranging but mostly fell into the following categories: outreach and application process, selection and awards process, existing grant community, and general programmatic development.

**Outreach and Application Process**

Advisors generally recommended increasing technical assistance to applicants. Because Learning Lab requests for proposals are unique in its emphasis on integrating research and teaching, equity and technology, advisors recommended providing more guidance to potential applicants on how to craft their proposals. Potential opportunities for technical assistance included hosting more webinars to guide institutions, providing tips on how to craft an effective proposal, including offering concrete examples from past grant applications, and pointing to specific resources that would be helpful, such as research on inclusive practices.

Advisors also recommended increasing outreach to new applicants by showcasing existing grant projects, providing examples about what current grantees are doing, and how they put their team and proposals together. Advisors also suggested partnering with specific groups such as the Central Valley Higher Education Coalition and the California Acceleration Project to grow regional and segmental participation in the Learning Lab community.

Finally, advisors recommended that for future grant opportunities, Learning Lab make clear the following, as appropriate to the RFP: grants are for institutional growth, so applicants need to demonstrate how their proposals are supported by and further the mission of the college, such as promoting racial and gender equity; the intersegmental collaborations required by the program must be robust, rather than add-ons; and applicants need to survey the larger landscape of technology and address how a project’s incorporation of technology addresses learning goals rather than assuming that use of a particular technology in and of itself results in learning gains.

**Selection and Awards Process**

Advisors recommended that if future RFPs incorporate external reviews, Learning Lab should continue to build on the pool of external reviewers, including increasing expertise in the intersection between new technology and learning, especially if more applicants incorporate new technologies in their proposals. Advisors also recommended increasing the number of calibration activities for external reviewers when used, and asking reviewers to provide direct, candid, and constructive feedback that could be directly passed on to applicants. One advisor recommended that in addition to providing direct reviewer feedback, Learning Lab also consider retaining a
dedicated professional, e.g., a postdoc, to synthesize reviewer and selection committee feedback to non-awarded applicants to help them improve their applications in the future and increase their potential to receive a grant award.

**Existing Grant Community**
Advisors saw opportunities for Learning Lab to increase collaboration among its existing grantees. Advisors recommended making community and personal relationships an explicit purpose of the Learning Lab. For future convenings, advisors recommended having an expert facilitator and possible coach for teams, or having talk stations, such as on assessment or a particular discipline.

**General Programmatic Development**
Advisors noted that there were many positive changes from year one to year two, relative to the requests for proposals issued, including improved timelines, framing, and loosening of narrative structure. Advisors were also satisfied with the rubric, and the efficiency and manner in which the selection process and selection committee meetings were conducted. In addition to the points above, advisors recommended some general ways in which Learning Lab could further fulfill its mission.

Recommendations included highlighting the intent of the program to promote social justice and equity in higher education; further emphasizing how student development is multi-dimensional and must include attention to social/emotional and identity development; encouraging innovation in professional development and faculty understanding of how to adapt materials and approaches for marginalized students; incentivizing the development of more technical infrastructure to support the integration of teaching and practice, especially in the use of data; encouraging faculty to understand more about how students learn; and creating more dialogue between equity and technology practitioners, so that faculty on the forefront of racial and gender equity and faculty on the forefront of online and hybrid education can come together on approaches to promote student success.
LOOKING AHEAD

2020-2021 Advisory Committee

In July 2020, Learning Lab welcomed a new cohort of advisors to the team. These advisors were selected for the breadth of experience in the California Community Colleges, California State University, and University of California systems, and higher education generally. Collectively, they represent deep expertise in the science of human learning, higher-education administration and institutional change, racial and gender equity, and the potential of 21st century education technology.

**Estela Bensimon**
Founding Director
Center for Urban Education

**Michael Dennin**
Vice Provost for Teaching and Learning
UC Irvine

**Candace Thille**
Director of Learning Science
Amazon.com, Inc.

**Jonathan Brack**
Director of Collaborative Impact Programs
Foundation for California Community Colleges

**James T. Minor**
Assistant Vice Chancellor & Senior Strategist
CSU Office of the Chancellor

**Sonya Christian**
President
Bakersfield College

**Wayne Skipper**
Founder and CEO
Concentric Sky

**EXPERTS IN**

- Higher Education
- Educational Equity
- Learning Science
- Technology
- STEM Education
- Institutional Change
New Partnership: Foundation for California Community Colleges

In August 2020, the Governor’s Office of Planning and Research entered into a partnership agreement with the Foundation for California Community Colleges, a 501(c)(3) nonprofit entity that serves as the official foundation supporting the California Community Colleges Board of Governors, Chancellor’s Office, and the entire California Community College system, including 116 colleges and 73 districts, and its 2.1 million students.

The three-year partnership agreement allows Learning Lab to utilize the Foundation’s infrastructure and networks to support administration of the program, expand its reach, collaborate more closely with other higher education entities, and to grow and provide enriched supports to its grantee community. The Foundation’s work championing and supporting student success (e.g., Active Learning in Undergraduate STEM Education project, Success Center, Student Centered Design Lab), and its focus on collaborative impact, advancement, and equity will be tremendous assets for Learning Lab.

2020-2021 Grant Opportunity

In November 2020, Learning Lab announced its 2020-21 grant opportunity, “Learning Lab Grand Challenge: Overcoming the Calculus Barrier to STEM Success.” Because calculus is considered to be foundational to many STEM fields, and the sequence of courses currently poses considerable barriers for prospective students, with retention gaps especially prevalent for Black/African American, Latinx, Native American, and Pacific Islander students, Learning Lab chose the introductory calculus sequence as its first Grand Challenge.

Through this Grand Challenge, Learning Lab invites faculty teams from across California’s public higher education system to reconceptualize the role of and approach to calculus in student’s first year introductory STEM experience to close equity gaps. Learning Lab seeks proposals that will directly transform the first-year calculus sequence as well as proposals that reimagine the role of calculus in STEM majors where calculus is a prerequisite. In Spring 2021, Learning Lab intends to award up to five grants between $1 million and $1.5 million to intersegmental faculty projects over three years. Full guidelines for the RFP process can be found on Learning Lab’s website.

In addition to executing on project deliverables, awardees will also be invited to join the Grand Challenge Cohort through which they will share ideas, approaches, findings, data, and outcomes over the three-year grant period, and develop model curricula, pedagogical approaches, and professional development components by the end of the grant period. A separate competitive application to be the Cohort Facilitator accompanies this Grand Challenge. As a companion piece, Learning Lab also plans to commission a brief on calculus enrollment and outcomes, and its impact on STEM persistence and completion across California’s public higher education institutions.
APPENDIX

Learning Lab Awarded Projects

From 2018 to 2020, Learning Lab collectively awarded $18.5 million to 30 project teams across five different funding opportunities. The following section provides a brief summary of each currently funded project, arranged by the following disciplines:

<table>
<thead>
<tr>
<th>Interdisciplinary</th>
<th>Biology</th>
<th>Chemistry</th>
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<tbody>
<tr>
<td>Computer/Data Science</td>
<td>Math/Statistics</td>
<td>Physics/Engineering</td>
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For more information regarding Learning Lab grants and funded projects please visit our Funded Projects webpage at https://calearninglab.org/projects/.

Interdisciplinary Projects

Building Community and Facilitating Active Learning in Online STEM Courses

This project provides opportunities for STEM faculty to increase student engagement in online introductory courses through an online synchronous faculty development program that seeks to:

- Apply the science of learning
- Facilitate active learning in online STEM courses
- Build a pedagogical support team

During the grant period, 12 faculty (six from UC Irvine and six from Santa Ana College) will participate in the program, impacting almost 1,000 students.

- Building, Facilitating, Learning
  - Award: $200,000
  - Professional Development
  - Partners: UC Irvine, Santa Ana College

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Please note: Certain projects may be listed under more than one discipline. Moreover, the interdisciplinary project category refers to projects that span three or more disciplines.
Eliminating Equity Gaps in Online STEM Gateway Courses through Humanized Instruction

Guided by the psychological theories about distance learning and social presence, the project team will implement a large-scale, collaborative online professional development program, the Humanizing Academy, to address a crucial challenge to successful learning in an online environment: greater difficulties in enabling effective human interaction. Specifically, this proposal will test whether “Humanizing” a course can help improve instructor-student and student-student interactions in online STEM courses, strengthen students’ sense of belonging and engagement, and increase learning outcomes in gateway online and hybrid STEM courses, particularly for URM students. Faculty, in partnership with instructional designers, will learn how to use free to low-cost digital tools and effectively apply them to the design and facilitation of their courses to foster instructor-student relationships.

Equity in STEM through Deeper Learning and Metacognitive Conversation

This project, led by CSU Institute for Teaching and Learning (ITL) and the California Community Colleges Success Network (3CSN), engages 200 STEM instructors over two years into a multi-faceted community of practice grounded in a powerful framework for teaching and learning, the Reading Apprenticeship framework. STEM instructors will be supported to think through and plan how to explicitly teach students how to read and problem solve in context, in their discipline. Providing time and space for redesigning lessons as well as experience using digital tools to support active learning, the learning community will accelerate the pace at which STEM faculty adopt culturally relevant and high-intensity active learning techniques in online and remote environments and will impact at least 20,000 students.
Let your path be lit

Award:
$500,000
Institutional Change Grant

Partners:
Bakersfield College
UC Merced
Merced College

Increasing Student Flow and Success Along Intersegmental STEM Program Pathways

This project aims to expand the existing Program Pathways Mapper (PPM) system in order to facilitate transfer between community colleges and UC campuses. PPM provides an interactive, pathway-based visualization of the course catalog paired with brief, easy-to-understand career data as well as videos illustrating the nature of degree programs. The Program Pathways Mapper visually clarifies student pathways through college, facilitating transfer and degree completion, particularly for students who are first-generation college students with little social capital or "college knowledge." Additionally, these clarified STEM program pathways help college and university personnel be more effective, consistent, and intentional in their support of student completion goals.

The Teaching Experiment Academy

This project will create a cohort-based faculty development program, the Teaching Experiment Academy (TEA), designed for STEM faculty teaching lower-division undergraduate courses. The TEA will facilitate a faculty learning community to revise syllabi and class activities around mastery learning and specifications grading. Estimating class size of 40-100, with 35 faculty participating, between 1,400 and 3,500 students should be directly impacted by the project. In developing and implementing the TEA, the team will investigate the following hypotheses:

- Mastery learning supported with technology and implemented with specifications grading is beneficial for student success and in alignment with growth mindset theory.
- The faculty development model is effective in helping faculty to implement a mastery learning curriculum due to a growth mindset among the faculty.
Community Sourced, Data-Driven Improvements to Open, Adaptive Courseware

This project will improve outcomes for STEM learners in targeted courses by deploying and improving open, adaptive courseware. This project builds on Open Learning Initiative (OLI) and Lumen Learning courseware that has been demonstrably effective in closing gaps and improving performance for underrepresented learners in STEM. The project has two main thrusts: effectiveness and barriers. Effectiveness research will investigate the impact of multi-sourced data driven improvement on outcomes for targeted STEM learners, and barriers research will investigate the impact of this approach on faculty attitudes and culture. Improvements will be guided by analytic tools developed for this project that provide faculty, student, and crowdsourced feedback and participation.

Biology Projects

A Hybrid Approach for Authentic Scientific Inquiry for Biology Undergraduates

This project will redesign these 15 lab courses to introduce modules featuring open-ended lab inquiries. Each of these 3-5 week long modules will guide students through the scientific process: observing systems, posing questions and hypotheses, collecting, analyzing, and graphing data, and presenting results to others. These modules – designed to strengthen quantitative skills, reflect student interests, and incorporate local context and campus resources – will develop students’ quantitative and written abilities, better preparing them for upper-division coursework and future careers. By incorporating hybrid components, this project will be able to more nimbly respond to challenges like the COVID-19 pandemic. As all of the redesigned courses are required courses in the biology programs, these changes will have a lasting impact on the curriculum at each institution.
Closing Equity Gaps in Introductory Biology through Faculty Professional Development in Active Learning Practices

Faculty Learning Optimizes Student Success (FLOSS) will develop a Community of Practice (CoP) to boost student achievement and narrow observed equity gaps via faculty professional development. The CoP will meet three goals: 1) to foster a deeper understanding of the academic and social barriers to learning in their students; 2) to provide faculty participants with critical pedagogical theory and practices to promote deeper learning and greater engagement in diverse student learners; and 3) to improve the classroom experience and increase student achievement while reducing existing equity gaps.

Introducing Research Deconstruction Pedagogy into Gateway Courses to Improve Student Engagement with STEM

This project aims to expose students to research in biology and chemistry courses by incorporating a pedagogical strategy called research deconstruction. Developed at UCLA, this approach introduces students to the process of scientific inquiry by “unpacking” a research seminar over several classes, and guiding the students through the scientific questions, fundamental concepts, experimental strategies and data presented from the research. Following a series of “deconstruction” classes, the speaker returns for a Question and Answer session, by which point the students have acquired sufficient mastery of the material to ask insightful questions about the work. Assessment from over ten years of implementation as a stand-alone course at UCLA suggests that research deconstruction is effective in increasing students’ science confidence and self-efficacy, and importantly, may also improve STEM persistence.
Building Biology Connections

Award: $100,000 Seed Grant

Partners: CSU Stanislaus UC Berkeley Los Medanos College Diablo Valley College Las Positas College

Social Online Tools to Support Collaborative and Inclusive Learning in Biology

The goal of this project is to determine how adaptive technology and other online tools can be leveraged to provide a collaborative learning experience for students in introductory biology courses. The project has three objectives: Objective 1 obtains and analyzes baseline data on online learning, reviews “best practices” in the literature, and identifies existing curriculum to modify for interventions. Objective 2 develops social, collaborative curriculum interventions to pilot test online alongside traditional classrooms. In addition, Objective 3 further develops and expands institutional partnerships and prepares to scale up the interventions.

Being brainy about STEM: Learn, belong, succeed

Award: $100,000 Seed Grant

Partners: Butte College CSU Chico UC Davis

STEM Success with Interactive Adaptable Learning Science Videos

This project addresses equity gaps in biology by developing and assessing two virtual lesson series with short, interactive and adaptable videos on the biology of learning and applying the science of learning to inform successful studying strategies. The videos will be produced in the first quarter of the project and assessed and implemented in a cycle of assessment and improvement over the following three quarters. The intersegmental team will assess the impact of the lessons on the science identity, sense of belonging and academic performance of undergraduate students taking a lower-division anatomy course at Butte College. Currently there is limited research regarding the impact of comprehending the mechanisms and biology of learning on students’ study skills, academic performance and equity gaps. The findings of this pilot project will help address this critical gap in understanding.
California Challenges in STEM Energy Education

Equity gaps in Central Valley STEM education exist despite strong demand for STEM graduates in the local economy, which is largely based upon the energy and agricultural industries. The hypothesis underlying the project is that URM students have a limited perspective of their possible contributions to improving technology due to sociocultural and curricular factors. For instance, URM students may not know a scientist or engineer from their community. Moreover, their gateway courses fail to make the connection between their studies and real-world problems explicit. This project will introduce the concepts behind practical technical problems at the intersection of energy, water, and agriculture—problems relevant to the Central Valley—into gateway STEM courses.

Developing Students’ Identity and Self-Perception as Capable STEM Thinkers and Learners

Pervasive narratives about scientific brilliance suggest that what counts is innate talent, knowing lots of information, and being quick and correct. The traditional design of STEM courses perpetuates these narrow views, which disproportionately impact students historically underrepresented in STEM. The goal of this project is to disrupt these narratives and misplaced assessments of what defines scientific brilliance. This project designs materials to help both instructors and students to see science as an expansive and inclusive set of practices. It explicitly defines scientific competence as participation in these practices.
Implementing and Testing Adaptive Learning Software for Introductory Physics, Chemistry and Engineering Classes

This project builds on a previously developed software platform to create a coherent learning delivery system that will feature, interactive content, embedded open source textbooks, problem sets with solutions, and algorithms to implement mastery-based adaptive learning. The project team will use this system to build 4 new adaptive courses (3 physics and 1 chemistry) and add adaptive functionality to an engineering dynamics course. These courses will have innovative dynamic content and automatically graded problem sets with software tags that correspond to clearly defined learning goals. Used together with well-regarded open source textbooks, the interactive content and adaptive problems will have the potential to replace expensive commercial packages that are now in common use. Through these courses, the project will impact approximately 5400 students in each project year.

Improving Learning Outcomes for All General Chemistry Students through Adaptive Hybrid Courses

The project aims to improve learning outcomes, decrease achievement gaps, and optimize the balance between the online and face-to-face components in the General Chemistry course sequence. The project plan and research strategy involve implementing Online Learning Initiative (OLI) courseware in multiple California higher education segments, collecting highly detailed usage and outcome data on out-of-class and in-class interactions, analyzing this data to determine the most effective instructional methods and balance, and providing instructors with ongoing, real-time feedback on student engagement and performance within the OLI courseware and classroom instruction to maximize effectiveness. The project includes approximately 15 faculty participants and will impact up to 10,000 students during the grant period.
Introducing Research Deconstruction Pedagogy into Gateway Courses to Improve Student Engagement with STEM

This project aims to expose students to research in biology and chemistry courses by incorporating a pedagogical strategy called research deconstruction. Developed at UCLA, this approach introduces students to the process of scientific inquiry by “unpacking” a research seminar over several classes, and guiding the students through the scientific questions, fundamental concepts, experimental strategies and data presented from the research. Following a series of “deconstruction” classes, the speaker returns for a Question and Answer session, by which point the students have acquired sufficient mastery of the material to ask insightful questions about the work. Assessment from over ten years of implementation as a stand-alone course at UCLA suggests that research deconstruction is effective in increasing students’ science confidence and self-efficacy, and importantly, may also improve STEM persistence.

Rebalancing the Equity Gap in Chemistry Education with Individualized Adaptive Learning

The project team seeks to use technology-enabled adaptive learning to improve access to quality General Chemistry education for the State’s disadvantaged and underrepresented student populations. The project will develop and widely distribute an open-education-resource (OER) adaptive learning platform that will be freely available to students without charge. The project team will further develop culturally sensitive adaptive learning homework modules for the entire General Chemistry sequence. These modules will allow for editing by instructors to meet the needs of their students and classrooms and will be developed to complement existing open-source texts within the LibreTexts platform.
Connecting the Dots of the Triangle: Bolstering Students’ Molecular Understanding

Award: $100,000 Seed Grant

Partners: UC Riverside CSU Northridge

Supporting Student Learning about Molecular Structures from Simulations

This project team will design and determine effective formative assessments and the associated feedback for online simulations presenting content about two fundamental introductory chemistry concepts: molecular structures and their properties. Two experiments, one focusing on each concept, will be conducted using student volunteers. The experiments will compare student learning gains between three distinct learning conditions: 1) simulation-based instruction using online formative assessments and online feedback; 2) simulation-based instruction using online formative assessments and in-person feedback; and 3) in-person classroom-type instruction. Findings from this project will inform the kinds of formative assessments and feedback to be used to support student learning from online chemistry simulations.

Computer & Data Science Projects

Teaching the hard stuff to all students

Award: $1,300,000 Innovation Grant

Partners: UCLA Cal State LA LA Pierce College

The Better Book Project

This project will develop, implement, and continuously improve an online interactive textbook for introductory statistics. Modern computational statistics is arguably more critical for future STEM careers than traditional mathematics courses. In addition, statistics may be the most direct pathway for students seeking to improve their mathematical preparation. This project’s innovative design involves repeatedly engaging students with the deep conceptual structure of the subject area (in this case, statistical modeling), and includes a heavy emphasis on simulation, randomization, and other tools for both doing data analysis and understanding statistical ideas. The goal is not simply students’ course completion, but the development of flexible and transferable knowledge—i.e., deep understanding—in all students.
Coding Community: Inclusive Space for Programming Tutorials and Adaptive Learning

This project aims to improve Computer Science education through the development of Coding Community—an online, inclusive, and hands-on tool for coding classes that connects a diverse population of students across different campuses. Coding Community will leverage students’ modern perspectives to communicate concepts with examples and explanations that their peers can relate to and understand. Students who come from backgrounds with less opportunity and encouragement to study Computer Science will record tutorial videos that explain coding concepts in their own words. Coding Community will further supplement the coding tutorial videos with hands-on coding exercises that will enable students to practice and develop their skills as they learn new concepts. By engaging these students in an inclusive environment where they can learn from peers they relate to, the project aims to broaden participation in Computer Science.

Creating New Pathways to Computing

The Creating New Pathways to Computing Initiative (DS-PATH) intends to create a sequence of courses in Data Science that aim to build bridges between data science and the physical sciences, social sciences, humanities, and arts, modeled on established pedagogical approaches such as Project Based Learning (PBL). Through online instruction, students will be able to select a series of laboratory problems that apply DS tools and content knowledge to a specific domain area of their choosing. The project will convene an interdisciplinary faculty team to design and to pilot-test key course components as the foundation for a subsequent full-scale project. The institutions will build a Network Improvement Community to allow institutions to test the impact of an intervention or implemented pedagogy and better design coursework.
Giving Ownership of Active Learning to Students in Computer Science

Partnering with Carnegie Mellon University (CMU) Silicon Valley, this project will take a “bottom-up” approach to re-design computer science courses with feedback and focus groups from students and faculty. Using the CMU Open Learning Initiative (OLI) platform, the project will develop a comprehensive skill map for learning objectives, create culturally responsive learning resources and activities, and build a variety of student-focused and selectable modules that are adaptive to students’ personal characteristics, background contexts, and learning experiences. In addition to online modules, the newly developed courses will include weekly face-to-face lab activities that engage students in project-based learning and help students navigate and better understand the discipline of CS, thereby empowering students at the introductory level to gain a cognitive map of the field itself.

Reorienting Formative and Summative Assessment

Mastery learning occurs when students have acquired sufficient practice, with instructor feedback and guidance, to master a skill or concept before being tested on it. This project promotes a major institutional pivot towards mastery learning by developing and deploying paradigm-based question generators (PQGs). A PQG is a piece of computer code that captures the “essence” or paradigm underlying a specific problem type and can generate randomized question instances from it. Since the PQG “knows” the correct answer to each generated problem, it can give students immediate feedback. This project will build and deploy PQGs for computer science and data science courses, evaluate their effectiveness in promoting mastery learning, and make available as Open Educational Resources all software and PQGs developed for these courses.
### Math & Statistics Projects

#### Bay Area Math Collaborative

The Bay Area Math Collaborative (BAM-C) will work together to restructure the traditional precalculus course, clustering standard concepts into a Big Ideas structure. “A Big Idea is a statement of an idea that is central to the learning of mathematics, one that links numerous mathematical understandings into a coherent whole” (Charles, 2005). This structure will add coherence and deeper meaning to the central concepts in the course. The restructuring will primarily be done in the first year by members of the BAM-C steering committee, composed of one math faculty representative from each partner institution. In the second year of the project, the steering committee will develop performance tasks to assess student learning under the new structure.

#### The Better Book Project

This project will develop, implement, and continuously improve an online interactive textbook for introductory statistics. Modern computational statistics is arguably more critical for future STEM careers than traditional mathematics courses. In addition, statistics may be the most direct pathway for students seeking to improve their mathematical preparation. This project’s innovative design involves repeatedly engaging students with the deep conceptual structure of the subject area (in this case, statistical modeling), and includes a heavy emphasis on simulation, randomization, and other tools for both doing data analysis and understanding statistical ideas. The goal is not simply students’ course completion, but the development of flexible and transferable knowledge—i.e., deep understanding—in all students.
Building College-Level Number Sense with Adaptive Technology

This project will create content that helps students develop college level number sense, concentrating on foundational and advanced aspects of measurement and units, place value, and proportional reasoning, especially approximate mental calculation. Though many math instructors presume that these thinking skills have been taught and learned in middle school, in fact they require practice at the adult level for mastery. Searches for good, conceptual curriculum at the college level in these areas turn up only traditional skills instruction. To address the need for better materials, the project team will develop video-based worked examples and virtual tutor simulations, that include culturally relevant situations and examples. Moreover, the project will include interventions to help students develop a growth mindset, improve persistence and overcome stereotype threat.

Closing Equity and Access Gaps in Discrete Mathematics

The project team aims to address equity and access gaps in discrete mathematics by centering discrete math courses on activities such as group-worthy tasks and team-based adaptive learning in order to increase student sense of belonging and increase students’ course success. For this planning project, the project team will research innovative strategies for incorporating adaptive learning technologies and active learning in discrete mathematics courses and then pilot these interventions in courses across the partner institutions. Project activities will support the development of a full scale-project with the goal to implement classroom and professional innovations that will improve discrete math instruction and student outcomes and assess the effectiveness of those innovations through rigorous research.
Deeper Math Learning through Metacognitive Conversation

This project supports 40 CSU and CCC mathematics faculty to participate in an intensive, networked, Reading Apprenticeship professional learning program focused on apprenticing students into advanced mathematics literacies. Participants will:

- design text-based lessons (text=words, problems, or graphs) where disciplinary thinking and problem solving are modeled and practiced through metacognitive conversations,
- try those lessons out with their students, and
- workshop the implementation experience with a supportive improvement community in order to revise and try again.

In so doing, participants will have the opportunity to change their practices in light of what they know about culturally responsive teaching and how people learn. Through these participants, the project will impact at least 4,000 students.

Developing Students’ Identity and Self-Perception as Capable STEM Thinkers and Learners

Pervasive narratives about scientific brilliance suggest that what counts is innate talent, knowing lots of information, and being quick and correct. The traditional design of STEM courses perpetuates these narrow views, which disproportionately impact students historically underrepresented in STEM. The goal of this project is to disrupt these narratives and misplaced assessments of what defines scientific brilliance. This project designs materials to help both instructors and students to see science as an expansive and inclusive set of practices. It explicitly defines scientific competence as participation in these practices.
The key to success in STEM is empowering all students to take ownership of their learning.

**Award:**
$1,000,000
Innovation Grant

**Partners:**
Fresno State
Fresno City College
Clovis Community College
UC Merced
University High School

### On-Ramp to STEM

The On-Ramp to STEM math team will develop and launch algebra and pre-calculus courses that form a better pathway for STEM Majors. On-Ramp to STEM, the proposed project, will develop Culturally Responsive Teaching (CRT) activities and modules for selected math courses, and then adapt, launch, test, and refine Student-Centered Adaptive Learning Environment (SCALE), an open-source adaptive learning technology to strengthen the impact of those activities. By addressing the absence of freely-available adaptive learning technology along the higher education pipeline, and by aligning that technology’s use with desired learning activities, the project will have a transformative impact on underrepresented minority and other first-generation or low-income students, many of whom come from under-resourced K-12 districts.

### Physics & Engineering Projects

#### Flipping the switch on Energy Education

**Award:**
$500,000
Proof of Concept Grant

**Partners:**
CSU Bakersfield
UC Merced
Bakersfield College

### California Challenges in STEM Energy Education

Equity gaps in Central Valley STEM education exist despite strong demand for STEM graduates in the local economy, which is largely based upon the energy and agricultural industries. The hypothesis underlying the project is that URM students have a limited perspective of their possible contributions to improving technology due to sociocultural and curricular factors. For instance, URM students may not know a scientist or engineer from their community. Moreover, their gateway courses fail to make the connection between their studies and real-world problems explicit. This project will introduce the concepts behind practical technical problems at the intersection of energy, water, and agriculture—problems relevant to the Central Valley—into gateway STEM courses.
**Active Learning in E-Games**

*Award:* $500,000  
*Proof of Concept Grant*  
*Partners:*  
- UC Davis  
- American River College  
- CSU Sacramento

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**E-Games for Active Training in Engineering Design**

This project team aims to provide scalable, meaningful exposure to engineering design to lower-division students by creating online game modules that will cover the basic steps of the engineering design process. The modules can be mix-and-matched for use in courses or offered to students for free play. The interdisciplinary project team will harness online education and gaming products that they have made for undergraduate courses in Biomedical Engineering Design and Introduction to Research and create new gaming materials. Games offer an avenue for exploration that sparks student creativity, increases engagement with the material, promotes self-confidence, and allows for “hands-on” design training at relatively low cost to students at California public institutions of higher learning. The project team will explore this adaptive learning tool and evaluate its impact on student learning and retention.

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**Enhancing Student Success via Active Adaptive Learning and Process Oriented Guided Inquiry Learning**

The goal of this project is to improve outcomes in introductory engineering courses with an emphasis on persistence and performance of a diverse group of learners. The project team aims to improve academic performance, reduce gaps and increase equitable access in engineering by redesigning a set of 6 introductory classes that together provide foundational knowledge and professional skills. The team seeks to accomplish this by addressing 1) students’ understanding of engineering concepts, 2) students’ capacity for self-regulation, and 3) students’ engineering identity. The courses will be designed using a combination of online activities, in-person active learning, and learning communities. This project will include the participation of twenty-two faculty and 2250 students will be impacted over the grant period.
Implementing and Testing Adaptive Learning Software for Introductory Physics, Chemistry and Engineering Classes

This project builds on a previously developed software platform to create a coherent learning delivery system that will feature, interactive content, embedded open source textbooks, problem sets with solutions, and algorithms to implement mastery-based adaptive learning. The project team will use this system to build 4 new adaptive courses (3 physics and 1 chemistry) and add adaptive functionality to an engineering dynamics course. These courses will have innovative dynamic content and automatically graded problem sets with software tags that correspond to clearly defined learning goals. Used together with well-regarded open source textbooks, the interactive content and adaptive problems will have the potential to replace expensive commercial packages that are now in common use. Through these courses, the project will impact approximately 5400 students in each project year.

The Mechanics of Inclusion and Inclusivity in Mechanics

This project seeks to eliminate equity and performance gaps in mechanics courses by developing a suite of adaptive web-based tools that incorporate videos that illustrate why a topic is relevant to diverse professionals in the real world and adaptive tests, while leveraging those cognitive tools and affective interventions to establish a sense of belonging, a strong STEM identity, and deep conceptual understanding. Parallel to these online efforts will be the implementation of evidence-based practices in the face-to-face classroom, such as the integration of Learning Assistants, implementation of hands-on, minds-on experiments, and development of a supportive, team-based learning environment, in which collaborative norms minimize microaggressions and toxic gendered interactions among team members.