EXHIBIT A

STATE OF CALIFORNIA
OFFICE OF PLANNING AND RESEARCH
GRANT AGREEMENT

BSO-02 (Rev 8/18)

GRANT AGREEMENT NUMBER
OPR18117

1. This Agreement is entered into between the State Agency and the Grantee named below:

STATE AGENCY'S NAME
Office of Planning and Research

GRANTEE'S NAME
Rancho Santiago Community College District

2. The term of this Agreement is: June 30, 2019 through June 30, 2022

3. The maximum amount of this Agreement is: **$1,300,000**
One million, three hundred thousand dollars and no cents

4. The parties agree to comply with the terms and conditions of the following exhibits which are by this reference made a part of the Agreement.

Exhibit A – Scope of Work	10 Page(s)
Exhibit A1 – Schedule of Milestones and Deliverables	2 Page(s)
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Exhibit C* – General Terms and Conditions	GTC 04/2017
Exhibit D – Special Terms and Conditions (Attached hereto as part of this agreement)	1 Page(s)
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Items shown with an Asterisk (*), are hereby incorporated by reference and made part of this agreement as if attached hereto. These documents can be viewed at https://www.dgs.ca.gov/OLS/Resources/Page-Content/Office-of-Legal-Services-Resources-List-Folder/Standard-Contract-Language

IN WITNESS WHEREOF, this Agreement has been executed by the parties hereto.

GRANTEE
(if other than an individual, state whether a corporation, partnership, etc.)
Rancho Santiago Community College District

BY *(Authorized Signature)* ✍
DATE SIGNED *(Do not type)* 6/21/19

PRINTED NAME AND TITLE OF PERSON SIGNING
Dr. Raul Rodriguez, Chancellor

ADDRESS
2323 North Broadway, Santa Ana, CA 92706

STATE OF CALIFORNIA

AGENCY NAME
Office of Planning and Research

BY *(Authorized Signature)* ✍
DATE SIGNED *(Do not type)* 6-24-2019

PRINTED NAME AND TITLE OF PERSON SIGNING
Scott Morgan, Deputy Director of Administration

ADDRESS
1400 Tenth Street, Sacramento, CA 95814

Exempt From DGS | OLS
per: SCM vol. 1, 4.06

PI Name: Professor Crystal Jenkins

Project Title: Community Sourced, Data-Driven Improvements to Open, Adaptive Courseware

Exhibit A – Scope of Work

Describe the goals and specific objectives of the proposed project and summarize the expected outcomes. If applicable, describe the overall strategy, methodology, and analyses to be used. Include how the data will be collected, analyzed, and interpreted as well as any resource sharing plans as appropriate. Discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the goals and objectives.

I. Overview

In 2018, Assembly Bill 1809 established the California Education Learning Lab ("Learning Lab"). Housed at the Governor's Office of Planning and Research, the Learning Lab has an annual budget of $10 million to fund intersegmental faculty teams in order to increase learning outcomes and close equity and achievement gaps across California's public higher education segments.

In 2019, Learning Lab grant opportunities focus on curricular and pedagogical innovations that combine educational technologies with the science of learning to reduce equity and achievement gaps in online and hybrid STEM "gateway" courses across California's public higher education segments.

Learning Lab's grant awards are intended to support faculty in discovering, designing and implementing learning environments and pedagogical approaches that work best for today's students and support faculty in their teaching mission. Learning Lab is part of California's vision to grow and sustain a highly educated workforce that can meet the challenges of our changing world, whether it is combating the effects of climate change, feeding the world sustainably, ensuring a healthy population or lifting communities out of poverty. Learning Lab's goal is to promote collaboration among and leverage the assets within all our institutions of public higher education in California.

II. Problem Statement

Open, adaptive courseware, such as the Open Learning Initiative (OLI) and Lumen Learning courseware, have proven effective in closing gaps for underrepresented STEM learners in part by combining multiple proven approaches (such as course redesign, active learning, frequent practice, targeted hints and feedback in the problem-solving context, careful attention to measurable, student-centered learning objectives, and close alignment between practice and assessment) into their platforms. These learning analytic systems can provide learners with better guidance, faculty members with better insights into student needs and misconceptions, and instructional designers with a view of course deficiencies that can be addressed during iterative course improvement cycles. Broader deployment and effective implementation of these adaptive courseware solutions will address some challenges for STEM learners and should improve student success—in particular, retention and completion.

While these centrally maintained learning environments have been successful, they represent, by definition, a generalized solution that is not always easy to adapt to specific local contexts or needs. Though the materials are designed and improved by teams of experts, even a large and diverse team cannot effectively

represent all perspectives, and often those missing perspectives are ones that would be most useful in identifying and addressing challenges facing specific learner populations. The challenges of a limited authoring team can be especially apparent during data-driven, iterative improvement, when addressing identified course deficiencies can require new insights and creativity. As one OLI author noted, "The data is showing me that there's a problem here, but I'm not sure how to address it…I've already used my best stuff [in the course]."

STEM learners benefit when course materials are adapted to local contexts and needs, but too often such local adaptations lack a strong evidence base and are driven purely by faculty intuition. Moreover, extensive evidence has demonstrated the importance of recognizing and connecting to the novice perspective, particularly for early STEM learners (Kelley & Knowles, 2016). But by definition, experts are removed from this novice perspective; this "expert blind spot" has proven to be a major impediment in developing learning activities that that can engage with learners' perspectives and that identify and address learner misconceptions [Koedinger et al., 2001].

III. Goals and Objectives

This project aims to improve outcomes for STEM learners in targeted courses (College Mathematics, Concepts of Statistics, Statistical Reasoning, Introduction to Computer Science, Chemistry I/II, Biology, and Engineering Statics) by deploying and improving open, adaptive courseware. This project will attempt to address these challenges by providing faculty at Santa Ana College, CSU-Fullerton, and other college partners engaged through the Lumen, OLI, and Carnegie Mellon University networks, with the opportunity to customize courseware for the needs of their learners, but to do so in a way that is informed by data via actionable course improvement analytics. In this way, the project team will see a broader population of educators contribute to building more effective learning solutions. This approach takes advantage of open licensing, which provides faculty with the ability to adapt and change course materials, while the data collection provided by the adaptive platforms provides a window into learners' performance that is absent in static OER.

The project team will also involve learners in the iterative improvement process in a way that will directly connect their perspectives and prior experience with the improvements that are needed in learning activities. This approach will insure the inclusion of diverse and underrepresented perspectives in the courseware.

The project team will test the hypothesis that improvement of outcomes for underrepresented STEM learners can be accomplished via two interconnected sets of activities. First, data-driven course improvements, solicited from a broader community but interpreted and contextualized for local needs, can improve outcomes for targeted STEM learners. Contextualization in this case accommodates broader student concerns (i.e. what are concerns and points of resonance for regional STEM learners in my class?), as well as specific concerns for vulnerable STEM learners. The model will iteratively improve course materials in ways that will address challenges presented by prior knowledge, local context, and expert blind spot, making the learning environment more effective for targeted learners over time. Second, the project team's work will reshape the role of students in the learning and resource development process, transforming them from consumers of learning assets to active participants and co-creators in the development process.

In addition to developing a process to improve open, adaptive courseware, and implementing this process in various courses, this project seeks to investigate multiple questions: How can the data generated from learner interactions be most effectively used to improve learning activities and larger learning/skills/knowledge models in adaptive, open courseware? How can researchers better access the broadest set of students and educators for more diverse talent and insights in identifying and correcting

course issues for diverse learners? Does a crowdsourced approach, informed by data, provide insight into the types of challenges showing up in this data and the types of innovations and approaches most likely to address them for vulnerable and struggling learners? And how does this approach to course improvement affect understanding of the barriers or facilitators to the development, adoption, and sustained use of technology-enhanced, open learning resources?

At its core, this project is motivated by Herbert Simon's challenge to his colleagues: "Improvement in post-secondary education will require converting teaching from a solo sport to a community based research activity." This vision is at the heart of the learning engineering approach, and offers a future vision of higher education that combines learning research with instructional practice, forming a virtuous cycle that will simultaneously improve learning outcomes while advancing larger understanding of how humans learn.

IV. Expected Milestones and Deliverables

The project will produce:

- Open, adaptive STEM courseware in College Mathematics, Concepts of Statistics, Statistical Reasoning, Introduction to Computer Science, Chemistry I/II, Biology, and Engineering Statics that have been improved using data to target underrepresented learners.
- Open tools to support the iterative, data-driven improvement of open courseware, via contributions from students, instructors, and broader crowdsourced mechanisms.
- A clearer understanding of the ways that these data-driven improvement approaches can support or hinder learning, particularly for vulnerable learners.
- Insights into the barriers and facilitators for sustained adoption and effective use of these technology-enhanced learning (TEL) innovations

The project has four main thrusts: **Use** of OLI and Lumen courseware; **Improvement of** courseware; **Tools** for community-sourced, data-driven improvement; **Research**, with sub-thrusts focusing on effectiveness and barriers.

Year 1:

Use track: Co-PIs Jenkins and Robson will use the initial summer period to familiarize themselves with Chemistry and Statics courseware and incorporate it into instructional practice in their institutions, using the materials with students during the Fall. During this initial six months, they will also engage in outreach and recruiting to develop a 20-person faculty cohort from their local institutions and from across the OLI/Lumen California network. Winter workshops led by the Co-PI team will support this initial use and evaluate cohort; members of the cohort will select courseware for use during the Spring.

Improvement track: PI team will leverage faculty-facing tools to customize and improve their courseware, based on their own Fall experiences and on the tools' improvement analytics.

Tools track: The development and research team will consult with Co-PIs to design and test a suite of tools to support faculty in customization and data-driven improvement of their courseware; a first generation of these tools will be released for use during Winter, allowing the PI team to begin improvement of their own courses and to include these tools in their initial workshop.

Research track: Effectiveness research will focus on data collection efforts during Y1, with initial course use providing baseline data that will serve as a comparison condition after modified courseware has been

used by students. Co-PIs Pardos and Moore will finalize analytic approaches for identifying improvement opportunities and evaluating effectiveness of changes in improving outcomes for targeted learners in consultation with PI team and advisers. Herckis will finalize barriers research plan and IRB protocols, and the barriers research team will begin data collection.

Year 2:

Use track: The PI team will continue to use customized/improved courseware and will expand the faculty user community, recruiting two new faculty members to begin work improving courseware (use and improvement) and two additional 10-person use and evaluate cohorts; workshops in the Summer and Winter will support faculty in selecting courseware to be used in the Fall and Spring. These cohorts will expand courseware use, with the new cohorts joining the project and selecting at least two new courses for inclusion in the research (likely College Math, Statistics, Concepts of Statistics—based on Statway™—Computer Science, Biology, or similar, which will be drawn from the existing OLI/Lumen STEM catalog).

Improvement track: Use and improvement faculty will continue to use evolving interfaces to make changes focused on improving outcomes for targeted learners. The 2nd half of Y2 will see deployment of student and crowdsourced improvement tools.

Tools track: Y2 will fine-tune faculty improvement tools, providing support for more actionable, human centered views into improvement data for both learning models and activities. These tools will be expanded to provide student- and crowdsourced-focused interfaces. The initial focus will be on learner-facing tools, building activities that embed into the courseware and engage students to improve materials and evaluate the results of other learner-created improvements. These interfaces will then be used to support crowdsourced improvements (via Amazon Mechanical Turk).

Research track: Effectiveness research will begin data analysis from initial improvement efforts, validating and improving initial approaches and providing direct guidance to tool development team. Work will expand to provide preliminary analysis for impact on students who participate in improvement efforts. Barriers research will see continuation of data collection and translation of initial analyses into recommendations for iterative improvement of implementation strategies. Postdoc will work with Herckis to finalize research protocols during the first half of the year and will begin data collection in the winter of Y2. By the end of Y2, the barriers research team will finalize protocols for administering across multiple institutions.

Year 3:

Use track: Co-PIs will lead continued use and recruiting efforts across four courses, scaling up use and evaluate efforts to involve up to 40 faculty, with appropriate onboarding workshops in Summer and Winter. Four additional faculty will be recruited to formally join the use and improve cohort.

Improvement track: Continued use of improvement activities across Y3, with scaled efforts in learner-driven improvement and sustained efforts in crowdsourced improvements during the first half of Y3.

Tools track: Y3 will emphasize a final fine-tuning of student-facing and crowdsourced tools and development of workflow components in LearnSphere to enact effectiveness analysis (ensuring replicability and reuse). Final code review and licensing, with source made openly available via the Simon

GitHub repository.

Research track: Effectiveness research will continue data analysis of impact of instructor, student, and crowdsourced improvements, using learning curve and causal inference analysis. During the 2nd half of Y3, the team will begin final reporting, with focus on comparing courseware-focused (learning models, alignment) and course-focused (grades, DFW, persistence) outcomes. Barriers research will complete phase one data analyses and extend research efforts to faculty, staff, and administrators across institutions (beyond project participants).

Learning Lab Deliverables

In addition to the milestones and deliverables described above, the project team will provide progress reports and updates to the Learning Lab on a quarterly basis.

- For each year of the project, the project team will provide the Learning Lab with a written mid-year progress report and an annual summary report.
- In the quarters where the project team does not provide the Learning Lab with a written report, the team will engage in a Zoom meeting with the Learning Lab to provide a progress update.

At the end of the grant period, the project team will provide a written, final report summarizing the project's outcomes and what was learned through implementation of the project.

In addition, the project team will provide to the Learning Lab by **September 1, 2019** (or another mutually agreed upon date) a 3-minute TED-style video describing the project for posting on the Learning Lab webpage. This video, which must be ADA compliant, will discuss the project, its approach and goals and should offer an accessible introduction to the project.

V. Strategy/Methodology

The project team's work builds on a foundation of meaningful student engagement that has been embedded in the OLI and Lumen platforms and that is an explicit part of the courseware's design. The learning environments are built upon student-centered, measurable learning objectives, prioritize connections with students' prior knowledge, and explicitly build a big picture of the course's knowledge structure, supporting learners in connecting their immediate learning with the larger domain being studied. The courses also support a range of activities and resources that explicitly target learners' metacognitive skill development and practice; students are taught a larger metacognitive cycle that encourages self-evaluation, assessment, and planning, and then connects this cycle to the learning activities throughout the course. This approach supports learners to take responsibility for their own learning. Past research efforts in OLI have led to the development of a range of activities that target development and boosting of learner identity and growth mindset, in ways that have proven successful in supporting underrepresented STEM learners; these activities will be incorporated into the larger learning environments as appropriate and will be included as part of the suite of improvement options that can be applied via the project team's improvement analytics.

The project team's work will reshape the role of students in the learning and resource development process, transforming them from consumers of learning assets to active participants and co-creators in the development process, which will have a positive learning impact for participants. This work will more concretely tie their current experiences to their prior knowledge and will provide the benefit of learning-by-teaching (Fiorella & Mayer, 2013). The very act of asking students to weigh in on the development of TEL tools is an empowering acknowledgement that the student experience might be improved. This participation

in the development and improvement of STEM learning resources can contribute to students' sense of belonging and the development of a STEM identity, and also normalizes questioning, identifying challenges and considering different approaches to problems that can be encountered in learning. This approach also directly tackles the well-known challenges of expert blind spot and implicit bias, privileging the novice point of view and eliciting input from all students.

The project team will utilize initial course runs and existing data from previous courses to develop a baseline for the research. By using this data to track learning and closely examine interactions with the courses, a suite of tools will be developed that represent a major innovation, supporting suggestions/creation of improvements informed by data and utilizing three levels of "humans-in-the-loop": 1) instructors: 2) students: and 3) crowd workers. The tools will make it easy for human input to the machine learning methods to identify and act on opportunities for improvement:

1. For example, in a situation where the data shows low or no learning, but the final course exams suggest learning has occurred, the instructor will be able to flag problems that may appear more difficult due to additional skills required to solve the problem. Additionally, the tools will show areas where there is a lack of data and allow instructors to quickly add new activities, questions, and feedback where appropriate.
2. For students, the project team will create activities that will allow the students to learn while improving the system. These interfaces will present students with options suggesting new questions or feedback. Other interfaces will specifically query students to explain issues in the learned cognitive models, such as asking "why is this problem harder?" Previous research on self explanation has shown this is a valuable exercise for increased student learning, and the team believes it will also help in continuous improvement of the courses. As more data is collected from instructors, students, and crowd workers, interfaces will allow students to comment on and evaluate other students' suggestions.
3. Finally, the team plans to utilize crowdsourced workers (via mturk or other platforms) to also help explain learned cognitive models in a similar interface that it provides to students. The team expects that this will be helpful in some domains, although crowdsourced insight might diminish as team members expand to more concise areas of some courses.

The team will evaluate three levels of the impact of improvements: 1) internal to the course: 2) external to the course: and 3) comparison of specific populations. Within the course, the team will look at student performance on assignments, quizzes, and exams and see if there are gains over time as course improvements are initiated as well as the impact of the course improvement activities as part of student learning. Since project courses will allow tracking of individual skills at a fine level of granularity, the project team can also see learning through the use of learning curves provided by project tools. The project team will also track student engagement through interaction data collected. External to the course, the team will look at grades and grade trajectories as students work through project courses. Special attention will be placed on whether overall student withdraws or failing scores are reduced throughout the study. For all evaluations, the team will run analysis across the total population as well as the targeted populations in order to see impact at all levels.

The project will rely on e**ffectiveness** research, which will investigate the impact of multi-sourced data driven improvement on outcomes for targeted STEM learners, and **barriers** research, which 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. This approach ensures that student voices will play a central role in identifying areas of difficulty, evaluating materials and improvements, and recognizing student experience. **Barriers** research expands upon

established protocols from Carnegie Mellon University, including embedding a cultural anthropologist who will use a mixed-methods approach to better understand barriers and facilitators for effective adoption of TEL innovations. (Anthropological approaches are particularly attuned to structural barriers which may not be evident to individual actors within a system.) Barriers research will help to better understand and adapt to the interplay between data-driven course improvements, institutional culture, and the improvement of outcomes for targeted STEM learners. Ongoing insights from this research will be incorporated back into the tool development, recruiting, and implementation efforts of this grant, which will have a direct impact. But over the life of the grant, this research will expand and strengthen the research base around effective strategies for STEM learners and how to best encourage the adoption of these strategies.

Incentivizing adoption and adaption

Experience across the open community has shown that too much of the work of adopting, adapting, and improving OER depends upon unaccounted-for time from faculty, which increases workloads while dampening enthusiasm for the effort. The project acknowledges the real labor involved in the proposed effort, both initially and in an ongoing way. Lead faculty will be paid release time to use and evaluate the OER baseline and improved materials, as well as for their work with the Instructional Designer and OER Librarian on an exemplary model course for departmental adoption. Adopting faculty will be paid stipends for their curricular work on course review, development of supplemental materials, and continued advisement and feedback. Too often, ongoing support for OER's updating and continuous improvement is not accounted for after the conclusion of grants; OLI and Lumen's business models explicitly account for this need for ongoing support and provide a number of mechanisms for ensuring ongoing funding.

Beyond direct funding incentives, the project team's model for data-driven course improvement provides implicit encouragement for faculty to authentically engage in this work; the improvement analytic tools that the team develops will allow faculty to directly see the impact of the changes and customizations that they make to the courseware, tightening the cause-and-effect loop of their improvement work with the impact that it has on student success. These courses will continue to be maintained and improved beyond the grant period; the current sustainability model uses support fees from either individual learners or from institutions to ensure continued delivery and ongoing improvements.

VI. Data Collection/Analysis/Interpretation

The project team's measurements for success include specific metrics from within the adaptive courseware: improved learner performance and engagement on within-course learning activities, specifically focusing on formative and summative assessment; improved learning curves and similar metrics for evaluating the learning model comprised by the courseware; improved patterns of use by learners, demonstrating metacognitive skill development and mindset growth; and improvement in faculty use and engagement with adaptive instructional tools, particularly OLI's Learning Dashboard and Lumen's messaging tools. The project team will measure the impact of these learning outcomes within and across the initial 30 months of the grant period.

The project team will also consider success in the context of metrics outside the courseware: improvements in retention and success rates, reductions in DFW rates, and particular improvements for traditionally underrepresented STEM learners (using gender, underrepresented minority status, and Pell-eligibility as characteristics useful across institutions for identifying vulnerable learners). The team will also measure elements relating to the impact on courseware development and use: metrics for understanding cost vs. improvement for the different approaches, and greater diversity in the creation and inclusion of learning

activities (from faculty and students). Student engagement with learning science research will also be measured; the team will track participation in student-focused webinars about how learners' data is being used in learning science, and in students' follow-on participation in secondary data analysis.

Both OLI and Lumen platforms exhaustively capture learner-interaction data and related semantic context. While many learning platforms capture full clickstream data ("The user selected point X, Y on the screen"), such clickstream data is rarely useful without additional context ("The student was attempting to distinguish between anabolic and catabolic reactions during a self-assessment opportunity and demonstrated this misconception..."). Learner interaction data from the OLI and Lumen platforms is tied to learning objectives, skills, and larger pedagogical context. In addition to the benefits for learners and classroom educators, these data also offer benefits in the aggregate, providing insights on course performance that can support faculty in empirically improving the design of a course over time. This capability supports one major focus of the project: new approaches to data driven, iterative improvement. The project will build new, open tools and analytics for course improvement; these tools will use the learning interaction data and semantic context captured by the platform to identify areas of potential course deficiency and provide students and instructors with opportunities to make or suggest improvements. These tools will also support broader crowdsourced improvements to learning models, particularly for understanding areas of difficulty or confusion.

All data will be uploaded to the CMU Simon Initiative's DataShop tool for warehousing, sharing, and analysis, specifically using DataShop's analytic methods (such as Learning Factors analysis) and visualizations (such as Learning Curves) to drive courseware improvement and to evaluate the impact of changes in the courses. Deidentified datasets will be available for secondary analysis, as permitted by IRB protocols, supporting broader research in the learning sciences; as the world's largest repository of learner interaction datasets, DataShop supports an exceptional community of learning and data science researchers, and this community will leverage these datasets to develop new analytic methods for and insights into human learning.

Finally, the barriers research will measure the relationship between these approaches and the adoption, sustained use, and faculty behaviors via observation, semi-structured interviews, and faculty surveys, in comparison to existing datasets from research at CMU.

VII. Resource Sharing

With the involvement of OLI and Lumen Learning, the project's work is inherently scalable and replicable from the start of the project. These projects have already seen active use of their courseware in over 80 California postsecondary institutions over the past five years across all segments; in the same time period, these projects have seen over 800,000 enrollments from students in academic contexts and millions of enrollments from independent learners. They are recognized leaders in the Open Education community and all courseware involved in this project exists and will be expanded as OER.

OLI and Lumen Learning offer open, adaptive courseware as a hosted service that provides support and analytics for faculty and students. The courseware is built upon OER: freely and openly licensed learning materials that include expository text, images, movies, interactive learning activities, learning objectives and assessment items. These materials are licensed using Creative Commons licenses; new materials created under this award will also be licensed using an appropriate Creative Commons license. This project will use and create OER that any institution, faculty or student may reuse, revise, remix and redistribute.

OLI and Lumen provide additional support around this OER: hosting the open courseware on software platforms that offer additional capabilities; providing human support that contributes to faculty and learner success; and ensuring the ongoing, iterative improvement of the OER. This additional support has been

designed to specifically leverage the power of OER for increased learning success; elements include learning analytics that leverage cognitive modeling and descriptive statistics to provide faculty and students with actionable learning estimates; automated and supported messaging capabilities that deliver targeted student engagement; and iterative improvement approaches that leverage data while addressing longstanding challenges in ensuring that OER are effectively updated over time. From servers to software updates to learning professionals to faculty content time, this support has real costs. OLI and Lumen's student support fee has been structured to provide sustained use of OER within the context of these wraparound tools and supports. The support fee is normally $25 per student, though it is normally paid by institutions so that there is not a price paid by the individual learner.

The project is targeting 1000 enrollments each for the OLI and Lumen courses (though if the team's efforts are successful, the project may exceed this goal); as part of the partnership with OLI and Lumen, the project team has budgeted $25,000 to offset the support fees that would otherwise be paid by the learner or the institution. All course content delivered and/or developed under this award will be made available under open license as OER; any new software that is developed under this award will be made available under an open source software license. At the completion of the grant, participants (and any other CA institutions) may choose to leverage these open licenses to host and support the courseware within their own technical and human infrastructure. They may also choose to continue to use OLI/Lumen's hosting and support services, at a per-student or negotiated institutional rate. This model will continue to support fresh development and improvements, which will be broadly available as OER.

The project also learns from and builds upon the success and experience of Santa Ana College in supporting broad and robust adoption of OER materials with strong faculty buy-in. The college's Academic Senate and the college district's Board of Trustees have formalized their support for OER as a strategy that lowers costs for students and increases access to quality instruction. This experience will form the foundation for the project's dissemination model, which will emphasize ease of faculty review and adoption, and ensure compensation for participating faculty. Santa Ana has been particularly successful in leveraging a "Model Course" approach to disseminating OER materials. The lead OER faculty builds the model course in Canvas with an Instructional Designer, using a structured student-friendly organization and weekly modules. The modules contain the OER material for the week (reading, videos, slides), assessments, supplemental materials for a deeper dive, and discussion or group work assignments. The model course has proven to be an effective way for faculty colleagues to easily review materials, course layout, and sample syllabi in a familiar location. The approach builds upon support from OER Librarians and Instructional Designers, who insert information about the course design, OER materials used, and rationale behind the material selection and organization, much like a publisher preface for instructors. After review, the course can be copied into the interested faculty's course shell for the upcoming semester. This method for OER review has proven to be an effective way to onboard faculty colleagues and support OER adoption.

VIII. Problems/Alternative Strategies

Success in the barriers research requires some level of institutional buy-in and access in order to engage with faculty through a mixed methods approach; without this buy-in, access to faculty and faculty survey participation can be restricted. The involvement of the lead institutions should help to ameliorate this issue, and the breadth of the OLI, Lumen and Chemistry networks should make alternate sources for engagement, as needed.

Over the life of the project, the team anticipates serving a minimum of 2,000 learners, across a variety of

STEM domains. Initial effort will focus on the lead institutions (SAC and CSU Fullerton), and a focused set of STEM courses (Statistics, Chemistry I, Chemistry II, Engineering Statics). As the project progresses, the team will expand faculty participation and make available other STEM courses on the OLI/Lumen platforms (College Mathematics, Introduction to Computer Science, Biology, Concepts of Statistics); the project budgets funding for 70 faculty participants. While preliminary efforts will focus on expanded use at the lead institutions, the team will also work to involve educators and students at other California institutions via existing partnerships in the OLI and Lumen networks. The team members also have strong interest in participation from Mark Blaser (Shasta College) and the chemistry network he assembled for a separate CA Learning Labs submission (American River, Fresno City, Merced, Mt. San Antonio, CSU East Bay, CSU San Jose Sate, Cal Poly); while their proposal was not funded, they have indicated their interest in engaging with the project using/improving Chemistry I and Chemistry II. With the involvement of these three networks, the project team plans to engage multiple institutions and faculty across a range of STEM courses beyond the initial lead institutions/courses. But specific involvement will depend upon needs and recruiting efforts; as such, initial course and learner targets are estimates and will be adjusted as the broader community engagement efforts mature:

	SAC	CSU-Fullerton	Lumen Network	OLI Network	Shasta Network	Estimated Course Sections	Estimated Student Enrollments
College Mathematics			X			5	125
Concepts of Statistics			X	X		6	150
Statistical Reasoning	X	X	X	X		24	600
Introduction to Computer Science	X			X		10	250
Chemistry I/II	X		X	X	X	20	500
Biology			X	X	X	5	125
Engineering Statics		X		X	X	10	250

IX. Benchmarks for Success

The primary benchmarks to assess the project's success are the following:

1) Meet annual targets for course offerings, faculty participation and student enrollment.
2) Faculty, student and crowdsource workers' response rates meet targets and they provide quality feedback that is useful to identify and enact improvements.
3) The Research Team completes the initial effectiveness research and barriers research studies, and findings are used to improve the courseware and faculty engagement and support.
4) The courses demonstrate promising impact on improving student achievement in STEM courses, especially among underrepresented students.
5) The open STEM courseware model designed for local modifications that incorporate student feedback is validated by research and available for adoption/adaptation.
6) A suite of improved and expanded OER is validated by research, and available for faculty to adopt/adapt.
7) Report out barriers and facilitators to using and creating TEL and/or OER resources, with actionable strategies for future practitioners and policy makers.
8) New learning activities supporting student input as a means of creating and improving OER.

Exhibit A1 – Milestones and Deliverables

SCHEDULE OF MILESTONES AND DELIVERABLES

List all items, including items that will be delivered to the State under the proposed Scope of Work. Include all reports, including draft reports for State review, and any other Deliverables, if requested by the State and agreed to by the Parties.

Unless otherwise directed by the State, the Principal Investigator shall submit all Deliverables to the Program Officer (Tristan Stein) at learninglab@opr.ca.gov.

Milestone or Deliverable	Description	Qtr/Year Fiscal Year	Due Date
Deliverable	ADA compliant TedTalk style video of projectto be posted on Learning Lab's Web site on project page.	Q1:2019/20	09/01/2019
Deliverable	YEAR 1 QUARTERLY REPORT - ZOOM	Q1:2019/20	10/31/2019
Milestone	Faculty engagement targets met	Q2:2019/20	11/30/19
Deliverable	YEAR 1 SEMI-ANNUAL REPORT - WRITTEN	Q2:2019/20	01/31/2020
Milestone	Students enrollment targets met	Q3:2019/20	02/28/2020
Deliverable	YEAR 1 QUARTERLY REPORT - ZOOM	Q3:2019/20	04/30/2020
Deliverable	Faculty-facing tools to customize and improve their courseware	Q4:2019/20	6/30/2020
Milestone	Baselines derived from initial cohorts	Q4:2019/20	6/30/2020
Deliverable	YEAR 1 ANNUAL REPORT - WRITTEN	Q4:2019/20	07/31/2020
Milestone	Completion of first series of evaluations to make data-informed improvements to the courses	Q1:2020/21	8/31/2020
Deliverable	YEAR 2 QUARTERLY REPORT - ZOOM	Q1:2020/21	10/31/2020
Milestone	Data analytics to make targeted improvements to courses and user interfaces	Q2:2020/21	12/15/2020
Deliverable	YEAR 2 SEMI-ANNUAL REPORT - WRITTEN	Q2:2020/21	01/31/2021
Deliverable	YEAR 2 QUARTERLY REPORT - ZOOM	Q3:2020/21	04/30/2021
Milestone	Initial results and review of effectiveness research and barriers research	Q4:2020/21	6/30/2021
Deliverable	Learner-facing tools that engage students to improve materials and evaluate results	Q4:2020/21	6/30/2021
Deliverable	Crowdsourced-faced interfaces	Q4:2020/21	6/30/2021
	YEAR 2 ANNUAL REPORT - WRITTEN	Q4:2020/21	07/31/2021
Milestone	Meet faculty participation and student enrollment expansion targets	Q1:2021/22	09/31/2021
Deliverable	YEAR 3 QUARTERLY REPORT - ZOOM	Q1:2021/22	10/31/2021
Milestone	Conduct 3-tier evaluation series, and meet response targets	Q2:2021/22	12/31/2021
Deliverable	YEAR 3 SEMI-ANNUAL REPORT - WRITTEN	Q2:2021/22	01/31/2022
Deliverable	YEAR 3 QUARTERLY REPORT - ZOOM	Q3:2021/22	04/30/2022
Deliverable	YEAR 3 ANNUAL REPORT - WRITTEN*	Q4:2021/22	06/30/2022

Deliverable	Open tools to support the iterative, data-driven improvement of open courseware, via contributions from students, instructors, and broader crowdsourced mechanisms.	Q4:2021/22	06/30/2022
Deliverable	Open, adaptive STEM courseware that has been improved using data to target underrepresented learners.	Q4:2021/22	06/30/2022
Deliverable	Completion of effectiveness research and barriers research studies*: • Provide a clearer understanding f the ways that data-driven improvement approaches can support or hinder learning, particularly for vulnerable learners. • Provide insights into the barriers and facilitators for sustained adoption and effective use of TEL innovations. • Contribute to research base on effective strategies for STEM learners. • Provide new analytic methods, and insights into human learning.	Q4:2021/22	07/30/2022
Deliverable	YEAR 3 FINAL WRITTEN EVALUATION*	Q4:2021/22	06/30/2022
Deliverable	YEAR 3 FINAL DEBRIEF – ZOOM	Q4:2021/22	06/30/2022
	* A 3-month no cost extension may be granted to finish evaluation activities.		

EXHIBIT A

Exhibit A2 – Authorized Representatives

AUTHORIZED REPRESENTATIVES AND NOTICES

The following individuals are the authorized representatives for the State and the Grantee under this Agreement. Any official Notices issued under the terms of this Agreement shall be addressed to the Authorized Official identified below, unless otherwise identified in the Agreement.

State Agency Contacts	Grantee Contacts
Agency Name: Office of Planning and Research	Grantee Name: Santa Ana College
Contract Project Manager (Technical)	***Principal Investigator***
Name: Tristan Stein Research Analyst and Program Officer Address: California Education Learning Lab 1400 Tenth Street Sacramento, CA 95814 Telephone: 916-327-8085 Fax: n/a Email: Tristan.Stein@opr.ca.gov	Name: Professor Crystal Jenkins Address: Chemistry Department Russell Hall, R-324 Santa Ana, CA 92706 Telephone: 714-564-6635 Fax: <Fax#, if available> Email: Jenkins_Crystal@sac.edu
Authorized Official (contract officer)	***Authorized Official***
Name: Scott Morgan Deputy Director Address: Office of Planning and Research 1400 Tenth Street Sacramento, CA 95814 Telephone: 916-322-2318 Fax: n/a Email: Scott.Morgan@opr.ca.gov	Name: <Name> <Title> Address: <Department> <Address> <City,State,Zip> Telephone: <Telephone#> Fax: <Fax#, if available> Email: <EmailAddress>
Send notices to (if different):	***Send notices to (if different):***
Name: Lark Park Director Address: California Education Learning Lab 1400 Tenth Street Sacramento, CA 95814 Telephone: 916-324-9750 Email: Lark.Park@opr.ca.gov	Name: <Name> <Title> Address: <Department> <Address> <City,State,Zip> Telephone: <Telephone#> Email: <EmailAddress>
Administrative Contact	***Administrative Contact***
Name: Beth Hotchkiss Program Analyst Address: California Education Learning Lab 1400 Tenth Street Sacramento, CA 95814 Telephone: 916-323-2629 Fax: n/a Email: Beth.Hotchkiss@opr.ca.gov	Name: <Name> <Title> Address: <Department> <Address> <City,State,Zip> Telephone: <Telephone#> Fax: <Fax#, if available> Email: <EmailAddress>

EXHIBIT A

Financial Contact/Accounting	***Authorized Financial Contact/Invoicing***
Name: Office of Planning and Research	Name: Sarah Santoyo Assistant Vice Chancellor, Educational Services
Address: Accounts Payable 1400 Tenth Street Sacramento, CA 95814	Address: Rancho Santiago Community College District 2323 North Broadway, #201 Santa Ana, CA 92706
Telephone: 916.323.9158	Telephone: 714-480-7466
Fax: 916.558.3187	Fax: <Fax#, if available>
Email: accountspayable@opr.ca.gov	Email: Santoyo_Sarah@rsccd.edu

Exhibit B – Budget Table*

Budget for Project Period: June 30, 2019 – June 30, 2022 ☒ **Awardee** ☐ **Subawardee**

Name of Institution: Santa Ana College

COMPOSITE BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD
06/30/2019 to 06/30/2022

From: / To: / BUDGET CATEGORY	6/30/2019 6/30/2020 Year 1	6/30/2020 6/30/2021 Year 2	6/30/2021 6/30/2022 Year 3	TOTAL
PERSONNEL: *Salary and fringe benefits.*	$77,000	$90,000	$108,000	$275,000
TRAVEL	$2,000	$2,000	$1,000	$5,000
MATERIALS & SUPPLIES	$442	$0	$0	$422
EQUIPMENT	$0	$0	$0	$0
CONSULTANT	$0	$0	$0	$0
SUBRECIPIENT	$225,963	$213,753	$222,628	$662,344
OTHER DIRECT COSTS (ODC)				
ODC #1 Cultural Anthropologist	$80,000	$80,000	$80,000	$240,000
ODC #2 Amazon Web Services	$2,500	$8,750	$8,750	$20,000
ODC #3 Lumen/OLI	$10,000	$15,000	$25,000	$50,000
TOTAL DIRECT COSTS	**$397,885**	**$409,503**	**$445,378**	**$1,252,766**
Indirect (F&A) Costs** ***Rate ≤ 8%***	*$13.754*	*$15.660*	*$17.820*	*$47.234*
TOTAL COSTS PER YEAR	**$411,639**	**$425,163**	**$463,198**	
TOTAL COSTS FOR PROPOSED PROJECT PERIOD* **				**$1,300,000**

* Each subawardee/subrecipient must fill out its own budget table above and justification form (see next page).

** Each sub-recipient applied the 8% indirect costs to their own costs. Santa Ana College applied the 8% indirect rate on all its direct costs, excluding the allocations to the sub-recipients

*** Total Costs for Proposed Project (indirect plus direct costs) cannot exceed the maximum award amount for your project over the 3 years.

Additional Notes: 1) Funds Reversion Dates: Unless otherwise specified, fund reversion dates are three years from fiscal year end of year funded. 2) Project Period Budget Flexibility: Prior approval will be required for budget changes between approved budget categories above the negotiated thresholds in Exhibit D.

Exhibit B1 - Budget Justification

1. **Personnel.**

Personnel Name	*Role on Project*	*Percent Effort*	*Year 1 Salary*	*Year 1 Benefits*	*Year 2 Salary*	*Year 2 Benefits*	*Year 3 Salary*	*Year 3 Benefits*	*Total*
Crystal Jenkins	Co-PI	15%	$27,336	$6,664	$27,336	$6,664	$27,336	$6,664	$102,000
Faculty TBD	Use and Improve	Stipends	$0	$0	$6,432	$1,568	$12,864	$3,136	$24,000
Faculty TBD	Use and Evaluate	Stipends	$4,020	$980	$8,040	$1,960	$16,080	$3,920	$35,000
Cherylee Kushida	Coordination & Admin	10%	$14,472	$3,528	$14,472	$3,528	$14,472	$3,528	$54,000
TBH	Instructional Technologist	Hourly	$18,425	$1,575	$18,425	$1,575	$18,425	$1,575	$60,000

FRINGE BENEFITS:
FY 2019 composite benefit rate for faculty is 24.38%, and for classified is 34.183%. Hourly rate is 8.55%.

2. **Travel.**
Years 1 and 2: $470 for travel to team meetings (flight $330 Orange County to San Francisco, per diem $80, taxi to and from airport to meeting site $60) x 2 (Co-PI and Project Coordinator) = $940. $1,060 available for faculty to attend OER conferences (registration, travel, per diem, hotel, if applicable).

Year 3: $1,000 for mileage and/or travel (flight, lodging, per diem) for dissemination. Because the dissemination events are not pre-determined the funds are sufficient to cover one inter-state dissemination opportunity (flight, hotel, per diem), or multiple in-state dissemination opportunities (e.g., mileage or flight, hotel (if needed), and per diem).

3. **Materials and Supplies.** $422 for basic meeting materials to convene faculty groups and orient them to participation in the project: binders, dividers inserts, folders, USBs, toner, copier paper, basic hospitality items (water, coffee, small food items).

4. **Equipment.** N/A.

5. **Consultant Costs.** N/A

6. **Subawardee/Subrecipient (Consortium) Costs.**
   - CSU – Fullerton $297,693
   - UC Berkeley $53,460
   - Carnegie Mellon University $311,191

7. **Other Direct Costs.**
   - Cultural Anthropologist (to be hired by one of the college partners): $240,000 ($80,000 annually Years 1-3)
   - Amazon Web Services: $20,000 ($2,500 Year 1, and $8,750 Years 2-3)
   - Lumen Learning/OLI: $50,000 ($10,000 Year 1, $15,000 Year 2, and $25,000 Year 3)

EXHIBIT A

Exhibit B – Budget Table*

Budget for Project Period: June 30, 2019 – June 30, 2022 ☐ **Awardee** ☒ **Subawardee**

Name of Institution: California State University, Fullerton

COMPOSITE BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD
06/30/2019 to 06/30/2022

From: / To: / BUDGET CATEGORY	6/30/2019 6/30/2020 Year 1	6/30/2020 6/30/2021 Year 2	6/30/2021 6/30/2022 Year 3	TOTAL
PERSONNEL: *Salary and fringe benefits.*	$71,301	$78,156	$86,685	$236,142
TRAVEL	$0	$0	$0	$0
MATERIALS & SUPPLIES	$0	$0	$0	$0
EQUIPMENT	$0	$0	$0	$0
CONSULTANT	$5,000	$10,000	$20,000	$35,000
SUBRECIPIENT	$0	$0	$0	$0
OTHER DIRECT COSTS (ODC)				
ODC #1 Hosting workshops	$1,500	$1,500	$1,500	$4,500
ODC #2 Amazon Web Services	$0	$0	$0	$0
ODC #3 Lumen/OLI	$0	$0	$0	$0
TOTAL DIRECT COSTS	**$77,801**	**$89,656**	**$108,185**	**$275,642**
Indirect (F&A) Costs** ***Rate ≤ 8%***	*$6,224*	*$7,172*	*$8,655*	*$22,051*
TOTAL COSTS PER YEAR	**$84,025**	**$96,828**	**$116,840**	
TOTAL COSTS FOR PROPOSED PROJECT PERIOD* **				**$297,693**

* Each subawardee/subrecipient must fill out its own budget table above and justification form (see next page).

** Each sub-recipient applied the 8% indirect costs to their own costs. Santa Ana College applied the 8% indirect rate on all its direct costs, excluding the allocations to the sub-recipients

*** Total Costs for Proposed Project (indirect plus direct costs) cannot exceed the maximum award amount for your project over the 3 years.

Additional Notes: 1) Funds Reversion Dates: Unless otherwise specified, fund reversion dates are three years from fiscal year end of year funded. 2) Project Period Budget Flexibility: Prior approval will be required for budget changes between approved budget categories above the negotiated thresholds in Exhibit D.

Exhibit B1 - Budget Justification

1. **Personnel.**

Personnel Name	*Role on Project*	*Percent Effort*	*Year 1 Salary*	*Year 1 Benefits*	*Year 2 Salary*	*Year 2 Benefits*	*Year 3 Salary*	*Year 3 Benefits*	*Total*
Nina Robson	Co-PI / Instructional Designer/ Administrative -PM Support	Year 1-3 25% Academic Year Year 1-3: 100% Summer	$51,862	$19,439	$50,451	$19,697	$51,964	$20,287	$213,700
TBD	Use and Improve Faculty	Year 2: 8% Academic Year Year 3: 7% Academic Year each for 2 faculty	$0	$0	$7,214	$794	$13,004	$1,430	$22,442

An annual salary base increment of 3.0% has been estimated every July 1 for faculty. If funded, costs applied will be based on the actual/current academic year salaries.

FRINGE BENEFITS:
Fringe benefits are calculated based on current estimated average rates.
Faculty and State employees: Release/reassigned time: 63.966%.
Non-academic effort or overload (additional compensation): 11.00%.

2. **Travel.** N/A.

3. **Materials and Supplies.** N/A.

4. **Equipment.** N/A.

5. **Consultant Costs.** Funds are being requested for 35 faculty members from Southern California institutions to receive $1,000 per person to support their use/evaluation of the adaptive courseware. The number of members per year will be 5 in Year 1, 10 in Year 2, and 20 in Year 3.

6. **Subawardee/Subrecipient (Consortium) Costs.** N/A.

7. **Other Direct Costs.** Workshops – Hosted at CSUF: Funds are requested in the amount of $1,500 per year during the project period to host a workshop once per year for new participants, which includes rental of rooms and supplies to host the event.

EXHIBIT A

Exhibit B – Budget Table*

Budget for Project Period: June 30, 2019 – June 30, 2022 ☐ **Awardee** ☒ **Subawardee**

Name of Institution: University of California, Berkeley

COMPOSITE BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD
06/30/2019 to 06/30/2022

From: / To: / BUDGET CATEGORY	6/30/2019 6/30/2020 Year 1	6/30/2020 6/30/2021 Year 2	6/30/2021 6/30/2022 Year 3	TOTAL
PERSONNEL: *Salary and fringe benefits.*	$16,000	$16,000	$16,000	$48,000
TRAVEL	$500	$500	$500	$500
MATERIALS & SUPPLIES	$0	$0	$0	$0
EQUIPMENT	$0	$0	$0	$0
CONSULTANT	$0	$0	$0	$0
SUBRECIPIENT	$0	$0	$0	$0
OTHER DIRECT COSTS (ODC)				
ODC #1 Cultural Anthropologist	$0	$0	$0	$0
ODC #2 Amazon Web Services	$0	$0	$0	$0
ODC #3 Lumen/OLI	$0	$0	$0	$0
TOTAL DIRECT COSTS	**$16,500**	**$16,500**	**$16,500**	**$49,500**
Indirect (F&A) Costs** ***Rate ≤ 8%***	*$1,320*	*$1,320*	*$1,320*	*$3,960*
TOTAL COSTS PER YEAR	**$17,820**	**$17,820**	**$17,820**	
TOTAL COSTS FOR PROPOSED PROJECT PERIOD* **				**$53,460**

* Each subawardee/subrecipient must fill out its own budget table above and justification form (see next page).

** Each sub-recipient applied the 8% indirect costs to their own costs. Santa Ana College applied the 8% indirect rate on all its direct costs, excluding the allocations to the sub-recipients

*** Total Costs for Proposed Project (indirect plus direct costs) cannot exceed the maximum award amount for your project over the 3 years.

Additional Notes: 1) Funds Reversion Dates: Unless otherwise specified, fund reversion dates are three years from fiscal year end of year funded. 2) Project Period Budget Flexibility: Prior approval will be required for budget changes between approved budget categories above the negotiated thresholds in Exhibit D.

Exhibit B1 - Budget Justification

1. **Personnel.**

Personnel Name	*Role on Project*	*Percent Effort*	*Year 1 Salary*	*Year 1 Benefits*	*Year 2 Salary*	*Year 2 Benefits*	*Year 3 Salary*	*Year 3 Benefits*	*Total*
Zach Pardos	Co-PI / Development of Course Improvement analytics and evaluation efforts	Year 1-3 Summer	$11,594	$4,406	$11,594	$4,406	$11,594	$4,406	$48,000

FRINGE BENEFITS:
FY 2019 composite benefit rate for Academic staff is 38%.

2. **Travel.** $500 for mileage and possible lodging to participate in project team meanings and in dissemination activities, each year.

3. **Materials and Supplies.** N/A.

4. **Equipment.** N/A.

5. **Consultant Costs.** N/A

6. **Subawardee/Subrecipient (Consortium) Costs.** N/A.

7. **Other Direct Costs.** N/A

Exhibit B – Budget Table*

Budget for Project Period: June 30, 2019 – June 30, 2022 ☐ **Awardee** ☒ **Subawardee**

Name of Institution: Carnegie Mellon University

COMPOSITE BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD 06/30/2019 to 06/30/2022				
From: 6/30/2019 To: 6/30/2020 **BUDGET CATEGORY**	6/30/2019 6/30/2020 **Year 1**	6/30/2020 6/30/2021 **Year 2**	6/30/2021 6/30/2022 **Year 3**	**TOTAL**
PERSONNEL: *Salary and fringe benefits.*	$112,924	$89,764	$80,452	$283,140
TRAVEL	$2,000	$2,000	$1,000	$5,000
MATERIALS & SUPPLIES	$0	$0	$0	$0
EQUIPMENT	$0	$0	$0	$0
CONSULTANT	$0	$0	$0	$0
SUBRECIPIENT	$0	$0	$0	$0
OTHER DIRECT COSTS (ODC)				
ODC #1	$0	$0	$0	$0
ODC #2	$0	$0	$0	$0
ODC #3	$0	$0	$0	$0
TOTAL DIRECT COSTS	**$114,924**	**$91,764**	**$81,452**	**$288,140**
Indirect (F&A) Costs ***Rate ≤ 8%***	*$9,194*	*$7,341*	*$6,516*	*$23,051*
TOTAL COSTS PER YEAR	**$124,118**	**$99,105**	**$87,968**	
TOTAL COSTS FOR PROPOSED PROJECT PERIOD* **				**$311,191**

* Each subawardee/subrecipient must fill out its own budget table above and justification form (see next page).

** Each sub-recipient applied the 8% indirect costs to their own costs. Santa Ana College applied the 8% indirect rate on all its direct costs, excluding the allocations to the sub-recipients

*** Total Costs for Proposed Project (indirect plus direct costs) cannot exceed the maximum award amount for your project over the 3 years.

Additional Notes: 1) Funds Reversion Dates: Unless otherwise specified, fund reversion dates are three years from fiscal year end of year funded. 2) Project Period Budget Flexibility: Prior approval will be required for budget changes between approved budget categories above the negotiated thresholds in Exhibit D.

Exhibit B1 - Budget Justification

1. **Personnel.**

Personnel Name	*Role on Project*	*Percent Effort*	*Year 1 Salary*	*Year 1 Benefits*	*Year 2 Salary*	*Year 2 Benefits*	*Year 3 Salary*	*Year 3 Benefits*	*Total*
Lauren Herckis	Co-PI	16% Academic Year	$12,400	$3,335	$12,400	$3,335	$12,400	$3,335	$47,204
TBH	Programmer	50% Yr1 25% Yrs 2-3	$36,500	$9,819	$18,250	$4,909	$18,250	$4,909	$92,637
Kim Larson	Learning Engineer	20% Yrs 1-2	$7,338	$1,974	$7,338	$1,974	$0	$0	$18,624
TBH	Research Assistant	Hourly	$9,529	$2,220	$9,529	$2,220	$9,529	$2,220	$35,250
Steven Moore	Ph.D. Student	Hourly	$24,176	$5,633	$24,176	$5,633	$24,176	$5,633	$89,425

FRINGE BENEFITS:
FY 2019 composite benefit rate for full-time is 26.9%, and for part-time as 23.3%.

2. **Travel.**
Years 1 and 2: CO-PI and other project staff person to attend team planning meetings (roundtrip flight to San Francisco $600, hotel $120, $80 per diem x 2 days, $120 for incidentals (taxi to and from airport, hotel and meeting site) = $1,000 x 2 people.

Year 3: $1,000 travel related to dissemination efforts (roundtrip flight to California $600, hotel $120, per diem $80 x 2 days, plus incidentals taxi to and from airport and venue $120).

3. **Materials and Supplies.** N/A.

4. **Equipment.** N/A.

5. **Consultant Costs.** N/A

6. **Subawardee/Subrecipient (Consortium) Costs.** N/A.

7. **Other Direct Costs.** N/A

Exhibit C – General Terms and Conditions

https://www.dgs.ca.gov/OLS/Resources/Page-Content/Office-of-Legal-Services-Resources-List-Folder/Standard-Contract-Language

Exhibit D – Special Terms and Conditions (Attached hereto as part of this agreement)

1) **Electronic and Timely Submission of Invoices.**

Invoices shall be submitted electronically by email to accountspayable@opr.ca.gov.

Invoices shall be submitted in arrears not more frequently than monthly and not less frequently than quarterly.

Invoices shall use the template provided by Learning Lab.

Invoices must include the following certification for State certification to the State Controller's Office, in compliance with SAM8422.1:

> This bill has been checked against our records and found to be the original one presented for payment and has not been paid. We have recorded this payment so as to prevent a later duplicate payment. Signed: Authorized Accounting Officer/Financial Contact

2) **Final Invoice**.

The Grantee shall submit the final invoice to the State, no later than thirty (30) calendar days after the agreement completion date.

3) **Budget Flexibility**.

Budget revisions between identified budget categories in cost reimbursement agreements that are within the total Agreement amount, comply with the Prior Approval Requirements, above and do not change the Scope of Work or substitute Key Personnel, as defined in this Agreement, are allowed as described below:

1) Up to 10% of each annual budget category amount or $10,000, whichever is less, is allowed with approval of the State's Contract Project Manager,

4) **Open Educational Resources Definition.**

Pursuant to Government Code Section 65059.2(f), courses and course series, and technology and technology platforms developed or redesigned with Learning Lab funds shall be available as open education resources. As used in this agreement, "open educational resources" are any educational resources released under one of the Creative Commons licenses (or its equivalent). Under the terms of this agreement, grantees agree to release all resources developed with Learning Lab grant funds under one of the Creative Commons licenses other than CC-BY. "Open educational resources" include, but are not limited to, full courses, course materials, modules, textbooks, faculty-created content, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge.

5) **Use of Templates**.

Grantee agrees to use templates to be developed by the Learning Lab in consultation with the grantee for invoicing and submission of written reports.

Exhibit E – Additional Provisions

Fiorella, L. & Mayer, R. E. (2013). The relative benefits of learning by teaching and teaching expectancy. *Contemporary Educational Psychology*, 38 (4), 281-288.

Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education*, 3 (11), 2-11.

Koedinger, K. R., Corbett, A. C., and Perfetti, C. (2010). The Knowledge-Learning Instruction (KLI) framework: Toward bringing the science-practice chasm to enhance robust student learning. CMU-HII Tech Rep. No. 10-102. http://reports-archive.adm.cs.cmu.edu/hcii.html

EXHIBIT A

Exhibit F – Key Personnel

List Key Personnel as defined in the Agreement starting with the PI, by last name, first name followed by Co-PIs. Then list all other Key Personnel in alphabetical order by last name. For each individual listed include his/her name, institutional affiliation, and role on the proposed project. Use additional consecutively numbered pages as necessary.

Last Name, First Name	Institutional Affiliation	Role on Project	Email address
Co-PI(s):			
Jenkins, Crystal	*Santa Ana College*	*Co-Principal Investigator*	Jenkins_Crystal@sac.edu
Robson, Nina	*CSU Fullerton*	*Co-Principal Investigator*	nrobson@fullerton.edu
Pardos, Zachary	*UC Berkeley*	*Co-Principal Investigator*	pardos@berkeley.edu
Herckis, Lauren	*Carnegie Mellon University*	*Co-Principal Investigator*	lrhercki@andrew.cmu.edu
Other Key Personnel (if applicable):			
Larson, Kim	*Open Learning Initiative*	*Learning Engineer*	kllarson@cmu.edu
Moore, Steven	*Carnegie Mellon University*	*PhD Student*	stevenmo@andrew.cmu.edu
Kushida, Cherylee	*Santa Ana College*	*Project Management*	Kushida_Cherylee@sac.edu
Wiley, David	*Lumen Learning*	*Advisor*	david@lumenlearning.com
Bier, Norman	*Open Learning Initiative*	*Advisor*	nbier@cmu.edu
Stamper, John	*Carnegie Mellon University*	*Advisor*	jstamper@cs.cmu.edu
Thanos, Kim	*Lumen Learning*	*Advisor*	kim@lumenlearning.com
Siegel, Darren	*Simon Initiative*	*Advisor*	darrensiegel@cmu.edu
TBD	*Santa Ana College*	*Use and Improve Personnel*	
TBD	*CSU Fullerton*	*Use and Improve Personnel*	
TBD	*Santa Ana College*	*Instructional Technologist*	
TBD	*Santa Ana College*	*Use and Evaluate Personnel*	
TBD	*CSUF, UCB, or CMU*	*Cultural Anthropologist Post-Doc*	

Resume/Biosketch for the PI and other Key Personnel attached ……19 Pages

Crystal Jenkins
Chemistry Department
Santa Ana College
1530 W. 17th Street, Santa Ana, CA 97206
Jenkins_Crystal@sac.edu, (714) 564-6635

Professional Preparation

Institution	*Location*	*Major / Dept.*	*Degree & Year*
University of CA, San Diego	San Diego, CA	Biomedical Engineering	B.S. 1987
University of CA, San Diego	San Diego, CA	Biomedical Engineering	M.S. 1989
CA State University, Long Beach	Long Beach, CA	Chemistry (Organic)	M.S. 2011

Professional Experience

2010 – 2014 Chair, Chemistry Department, Santa Ana College, Santa Ana, CA
2004 – Present Professor, Chemistry Department, Santa Ana College, Santa Ana, CA
1990 – 1999 Research Chemist/Formulator, Allergan, Irvine, CA

Synergistic Activities

Courses Taught:

Introductory Chemistry, General Chemistry, Organic Chemistry, Chemistry for Educators

Classroom Pedagogy

1. POGIL – Process-Oriented Guided Inquiry Learning
2. PLTL – Peer-Led Team Learning
3. SI – Supplemental Learning
4. Reading Apprenticeship
5. Online Discussion Boards

Technology

1. OER – Open Education Resources
2. Camtasia – online lecture content for hybrid courses
3. Posting material online, use of discussion boards, electronic communication, surveys
4. Skype for online office hours (video and chat)
5. Wiley PLUS – online homework, quizzes, etc.
6. Drop Box for cloud storage of course material

Professional Affiliations

American Chemical Society, Two-Year College Chemistry Consortium, Faculty Association of California Community Colleges, Faculty Association of RSCCD

Community Service

Girl's Inc. Summer STEM Week, Chemistry Olympiad for high school students, National Chemistry Week to introduce local children to chemistry

EXHIBIT A

Nina P. Robson, Ph.D
Associate Professor, Mechanical Engineering
California State University, Fullerton
email: nrobson@fullerton.edu

Professional Preparation

Technical University of Sofia, Electronics and Automation Engineering, M.S., 1988 – 1994
Technical University of Sofia, Robot and Flexible Manufacturing Systems, M.S., 1995 – 1996
University of California, Davis, Mechanical and Aeronautical Engineering, M.S., 1998 – 2001
University of California, Irvine, Mechanical and Aerospace Engineering, Ph.D., 2003 – 2008

Appointments

06/18-pres Associate Professor, College of Engineering and Computer Science, Mechanical Engineering Department, California State University, Fullerton.

06/18-pres Associate Researcher, Mechanical and Aerospace Engineering Department, University of California, Irvine.

08/12-06/18 Assistant Professor, College of Engineering and Computer Science, Mechanical Engineering Department, California State University, Fullerton.

11/11-06/18 Assistant Researcher, Mechanical and Aerospace Engineering Department, University of California, Irvine.

09/11-08/14 Adjunct Assistant Professor, Engineering Technology and Industrial Distribution Department, Manufacturing and Mechanical Engineering Technology, Texas A&M University.

08/09-08/11 Assistant Professor, Engineering Technology and Industrial Distribution Department, Manufacturing and Mechanical Engineering Technology, Texas A&M University.

11/08-08/09 Postdoctoral Research Scientist, Biomechatronics, Mechanical and Aerospace Engineering Department, , University of California, Irvine.

09/96-09/98 Project Engineer, Bulgarian Academy of Sciences, Sofia, Central Laboratory of Mechatronics.

02/98-06/98 Visiting Researcher, Department of Automation and Systems Technology, Helsinki University of Technology, Espoo, Finland.

Products

(i) Five Products Most Closely Related to the Proposed Project

[1] Robson, N., Gautreau, C., Rasche, M.E. (2019) Learning through Discovery: Empowering Lower Division Undergraduates to Engage in Cross-Disciplinary Research. Proceedings of the 124th American Society for Engineering Education (ASEE) Annual Conference and Exposition, June 15 - 19, 2019, Tampa, FL.

[2] C. Limsakoune, N. Robson, M. Mashni, D. Estelle, J. Cuevas, O. Rosales, M. Salgado, K. Yin, Edwards Lifesciences: Automated Sewing Machine, 2018, U.S. Provisional Application, docket #9365US01, serial # 62161711.

[3] Robson, N., Rasche, M.E., Ahir, V.R., Mocanu, I. (2017) Incorporating Bio-Related integrated research in undergraduate Kinematics of Mechanisms course. Proceedings of the 124th American Society for Engineering Education (ASEE) Annual Conference and Exposition, June 25 - 28, 2017, Columbus, Ohio, Paper ID #17754.

[4] J. Buchanan, J. Ramos, N. Robson, 2015, " The Perception-Action Dynamics of Action Competency are Altered by Both Physical and Observational Training", *Experimental Brain Research,* 233(4), pp. 1289-1305, DOI:10.1007/s00221-015-4207-y.

[5] J.J. Buchanan, N. Robson, J. Ramos, 2013, "Development of the Link between Perception and Action is Supported by Both Observational Learning and Physical Practice Training Protocols*", Journal of Sport and Exercise Psychology,* supplement vol. 35: S23.

(ii) Five Other Significant Products

[1] Suzette Herrera, Allison Serrano, Daniel Arroyo, Axel Alvarez-Loya, Nina Robson, Madeline Rasche, 2019, "Towards Designing DNA Nano-structures for Chemotherapeutic Drug Delivery", *Dimensions* (in press).

[2] Guan Rong Tan, N. Robson, Gim Song Soh, 2017, "Motion Generation of Passive Slider Multiloop Wearable Hand Devices", *Journal of Mechanisms and Robotics,* vol. 9, 041011-1.

[3] S. Muthukumaraswamy, A. Banrjee, A. McCulloch, J. Buchanan, N. Robson, 2017, "An AR System for Monitoring Arm Movements for Stroke Patients", *Proc. of Industrial and Systems Engineering Conference.*

[4] Nina Robson, Gim Song Soh, 2016, "Geometric Design of Eight-Bar Wearable Devices based on Limb Physiological Contact Task", *Mechanism and Machine Theory*, pp. 358-367.

[5] E. Simo-Serra, A. Perez, H. S. Moon, N. Robson, Kinematic Synthesis of Multi-fingered Robotic Hands for Finite and Infinitesimal Tasks, In: *Latest Advances in Robot Kinematics*, ed. J. Lenarcic and M.Husty, pp. 173-181, ISBN 978-94-4619-0, Springer 2013.

Synergistic Activities

2018	Organizing committee, competitions co-chair, IEEE International Conference on Robotics and Automation ICRA 2018 annual conference, Australia.
2016 - 2018	Symposium organizer, *Medical and Rehabilitation Robotics (MR-6)* in 2019 and 2018; *Novel Mechanisms, Robots and Applications (MR-8)* in 2017; *Software and Education in Mechanisms and Robots (MR-11)* in 2016, American Society of Mechanical Engineers ASME/IDETC annual conferences.
2014	Elected general member, ASME Mechanism and Robotics committee (term ending in 2018).
2014-pres	Editorial advisory board member, American Journal of Engineering Education.
2013, 2018	Panelist, National Science Foundation.

ZACHARY A. PARDOS

Graduate School of Education & School of Information (50/50)
University of California, Berkeley
2121 Berkeley Way, Suite 4232, Berkeley, CA, 94720-1670
+1 (321) 219-9224 - pardos@berkeley.edu – zachpardos.com

Professional Preparation

Institution	*Location*	*Major / Dept.*	*Degree & Year*
Worcester Polytechnic Institute	Worcester, MA	Computer Science	B.S. 2006
Worcester Polytechnic Institute	Worcester, MA	Computer Science	M.S. 2009
Worcester Polytechnic Institute	Worcester, MA	Computer Science	Ph.D. 2012
Massachusetts Institute of Technology	Cambridge, MA	RLE & CSAIL	Postdoctorate 2012-2013

Appointments

2013-Present Assistant Professor, Graduate School of Education and School of Information (50/50), University of California, Berkeley

Products

Five Products Most Closely Related to the Proposed Project:

Pardos, Z.A., Horodyskyj, L. (2019) Analysis of Student Behaviour in Habitable Worlds Using Continuous Representation Visualization. *Journal of Learning Analytics*, 6(1), 1-15.

Jiang, W., Pardos, Z.A., Wei, Q. (2019) Goal-based Course Recommendation. In C. Brooks, R. Ferguson & U. Hoppe (Eds.) *Proceedings of the 9th International Conference on Learning Analytics and Knowledge* (LAK 2019). ACM. Tempe, Arizona. Pages 36-45.

Pardos, Z.A., Fan, Z., Jiang, W. (2019) Connectionist Recommendation in the Wild: On the utility and scrutability of neural networks for personalized course guidance. User Modeling and User-Adapted Interaction. https://doi.org/10.1007/s11257-019-09218-7

Le, C.V., Pardos, Z.A., Meyer, S.D., Thorp, R. (2018) Communication at Scale in a MOOC Using Predictive Engagement Analytics. In M. Mavrikis, K. Porayska-Pomsta & R. Luckin (Eds.) *Proceedings of the 19th International Conference on Artificial Intelligence in Education* (AIED). London, UK. Pages 239-252.

Luo, Y., Pardos, Z. A. (2018) Diagnosing University Student Subject Proficiency and Predicting Degree Completion in Vector Space. In E. Eaton & M. Wollowski (Eds.) *Proceedings of the Eighth AAAI Symposium on Educational Advances in Artificial Intelligence* (EAAI). New Orleans, LA. AAAI Press. Pages 7920-7927.

Five Other Significant Products:

Pardos, Z. A., Farrar, S., Kolb, J., Peh, G.X., Lee, J.H. (2018) Distributed Representation of Misconceptions. In J. Kay & R. Luckin (Eds.) *Proceedings of the 13th International Conference of the Learning Sciences* (ICLS). London, UK. Pages 1791-1798.

Pardos, Z. A., Tang, S., Davis, D., Le. C.V. (2017) Enabling Real-Time Adaptivity in MOOCs with a Personalized Next-Step Recommendation Framework. In C. Thille & J. Reich (Eds.) *Proceedings of the 4th Conference on Learning @ Scale* (L@S). ACM. Pages 23-32.

Pardos, Z. A. (2017) Big Data in Education and the Models that Love Them. *Current Opinion in Behavioral Sciences*. Vol 18, 107-113.

Pardos, Z. A., Whyte, A., & Kao, K. (2016) moocRP: Enabling Open Learning Analytics with an Open Source Platform for Data Distribution, Analysis, and Visualization. *Technology, Knowledge and Learning*, Vol 21(1), 75-98.

Pardos, Z. A., Baker, R. S., San Pedro, M. O., Gowda, S. M., & Gowda, S. M. (2014). Affective States and State Tests: Investigating How Affect and Engagement during the School Year Predict End-of-Year Learning Outcomes. *Journal of Learning Analytics*, 1(1), 107-128.

Synergistic Activities

2016-2019, Lead investigator of the UC Berkeley campus course curriculum recommendation tool, AskOski (https://askoski.berkeley.edu)

2015-2019, Course creator and instructor of "Machine Learning in Education" (EDU/INFO C260F), and "Data Mining and Analytics" (INFO154/254)

2018-2019, Senate member of UC Berkeley Data Science Minor Committee

2016, Panelist, National Academy of Education: Big Data and Privacy Workshop Panel on Learner Process Data, Washington, D.C.

2014, Panelist, White House Office of Science and Technology Policy: Big Data and Privacy Workshop, Berkeley, CA

Lauren Herckis, Ph.D.
Simon Initiative Research Faculty
Dietrich College of Humanities & Social Sciences
Human-Computer Interaction Institute, School of Computer Science
Carnegie Mellon University
lrhercki@andrew.cmu.edu

(a) Professional Preparation
A list of the individual's undergraduate and graduate education and postdoctoral training as indicated below:

University of Michigan	Ann Arbor, MI	Anthropology	B.A. 1999
University of Pittsburgh	Pittsburgh, PA	Anthropology	Ph.D. 2015
Carnegie Mellon University	Pittsburgh, PA	Humanities & Social Sciences	Postdoc 2015-2017

(b) Appointments

2017-Present Simon Initiative Research Faculty, Dietrich College of Humanities & Social Sciences and Human-Computer Interaction Institute, School of Computer Science, Carnegie Mellon University, Pittsburgh, PA.

2015-2017 Senior Research Associate, Anthropology, Simon Initiative, Carnegie Mellon University, Pittsburgh, PA

2013-2015 Coordinator of Teaching Assistant Services, University Center for Teaching and Learning, University of Pittsburgh, Pittsburgh, PA.

2011-2013 Research Health Science Specialist, Center for Health Equity Research and Promotion, VA Healthcare Research, Department of Veterans Affairs, Pittsburgh, PA.

1999-2002 Data Archive Specialist, Institute for Social Research, University of Michigan, Ann Arbor, MI.

(c) Products
Products most closely related to the proposed project

Passing the Baton: Digital Literacy and Sustained Implementation of Adaptive Learning Technologies by Lauren Herckis. *Current Issues in Emerging eLearning: Special Issue on Leveraging Adaptive Courseware* 5(1). 2018.

Implementation Science for Software Engineering: Bridging the Gap between Research and Practice (Keynote) by Lauren Herckis. In *Proceedings of the 2018 33rd ACM/IEEE International Conference on Automated Software Engineering* (ASE '18), September 3–7, 2018, Montpellier, France. ACM, New York, NY, USA. https://doi.org/10.1145/3238147.3264581

Understanding and Overcoming Institutional Roadblocks to the Adoption and Use of Technology-Enhanced Learning Resources in Higher Education by Lauren Herckis and Joel Smith. Report submitted to the Carnegie Corporation of New York. April, 2018.

Implementing Evidence-Based Instructional Practices by Lauren Herckis. In Shaping the future of learning: Book of Abstracts, ICWE GmbH: Berlin, Germany. 2017. ISBN 978-3-941055-47-6

Other significant products

Cultivating Practice by Lauren Herckis. *Practicing Anthropology* 40(1). 2018.

Paces of Change by Lauren Herckis. In Shaping the future of learning: Book of Abstracts, ICWE GmbH: Berlin, Germany. 2017. ISBN 978-3-941055-47-6

(d) Synergistic Activities

Principal Investigator for research projects including, "Knowing What We Know: The Relationship Between Self-Assessment, Self-Efficacy, and Instructional Practice", a grant funded by the Professional and Organizational Development in Higher Education Network, 2016-2018; and "Deploying Educational Technology with Fidelity: Capitalizing on Research from Biomedicine" Co-Investigator: Bruce McLaren, Carnegie Mellon University. Funded by Simon ProSEED

Co- Investigator for research projects including "Understanding and Overcoming Institutional Roadblocks to the Adoption and Use of Technology-Enhanced Learning Resources in Higher Education", a grant funded by the Carnegie Corporation of New York, 2015-2017 PI: Richard Scheines Co-Is Lauren Herckis, Norman Bier, and Joel Smith.; and "Bridging Opportunity Gaps in Urban School Contexts: Techniques and Tools for Personalized Learning Through AI and Culturally Responsive Mentoring" PI: Ken Koedinger Co-Is: Lauren Herckis, Elon Dancy, Lee Branstetter. Funded by the Chan Zuckerberg Initiative

Research Specialist and Methodologist. With expertise and experience in quantitative, qualitative, and mixed-methods research design and execution, I have provided guidance, support, and research designs or mixed-methods design components in public, private, and non-profit contexts. I have participated in more than 70 research projects across a wide variety of disciplinary domains.

Simon Initiative Research Anthropologist, Carnegie Mellon University, Pittsburgh, PA. Contribution of anthropological methods and theory to Simon Initiative research endeavors. The Simon Initiative harnesses a cross-disciplinary learning engineering ecosystem that has developed over several decades at Carnegie Mellon. The initiative's goal is to measurably improve student learning outcomes.

EXHIBIT A

Kimberly L. Larson

A. Professional Preparation

California College of Arts	Photography	B.F.A	1995
Carnegie Mellon University	Education Technology	M.S.	2019*

*December 2019

B. Academic and Professional Appointments

2017 – Present: Learning Engineer, Simon Initiative, Carnegie Mellon University.
2014 – 2017: Developer/Project Manager, Open, Open Learning Initiative, Stanford University.
2011 – 2014: Developer/Project Manager, Open Learning Initiative, Carnegie Mellon
2008 – 2010: Product Development Online, Interaction Associates
2003 – 2008: Training Consultant, Interaction Associates
2000 – 2008: Manager of IT, Interaction Associates

Products

Probability and Statistics
Grants: Next Generation Courseware—Gates (NGC), UMUC, Community College-OLI

Statistical Reasoning
Grants: NGC, UMUC, CC-OLI

Concepts in Statistics
Grants: NGC, CFAT

200A Introduction to Data Analysis and Interpretation
Grant: VPTL Seed

Healthcare Information Technology Foundations
Grant: Open Professionals Education Network-Gates (OPEN)

Concepts in Computing
Grants: UMUC, CC-OLI

Principles of Computing (Stanford version)
Grant: Kresge

Fundamentals of Philanthropic and Nonprofit Strategy (PACS- Stanford, Paul Brest)
Grant: PACS

E-Learning Design Principles (Ken Koedinger)
CMU

Graphical Causal Models (Richard Scheines)
Grant: CCDM University of Pittsburgh

OPEN Creating Effective Online and Blended Course
Grant: OPEN

Anatomy & Physiology (Respiratory and Urinary units)
Grant: CC-OLI

Principles in Computing (CMU version: Iteration, Recursion)
Grant: Kresge

EXHIBIT A
Steven Moore

A. Professional Preparation

Carnegie Mellon University	Human-Computer Interaction	PhD 2018 - present
Carnegie Mellon University	Educational Technology	M.S 2016
Georgia Institute of Technology	Computer Science	B.S. 2014

B. Appointments

PhD Student, Carnegie Mellon University, HCII	2018 - present
Learning Engineer, Eberly Center	2016 - 2018
Master's Student, Carnegie Mellon University, HCII	2015 - 2016
Full-Stack Web Developer, Westat	2012 - 2016
Undergraduate Student, Georgia Tech	2010 - 2014

C. Publications

Barbara Ericson, **Steven Moore**, Briana Morrison, Mark Guzdial, "Usability and Usage of Interactive Features in an Online Ebook for CS Teachers", *Proceedings of the Workshop in Primary and Secondary Computing Education* (WIPSCE'15), November 09-11, 2015, London, UK

Florian Kistner, Mary Beth Kery, Michael Puskas, **Steven Moore**, Brad A. Myers, "Moonstone: Support for Understanding and Writing Exception Handling Code", *2017 IEEE Symposium on Visual Languages and Human-Centric Computing* (VL/HCC'17), October 2017, Raleigh, NC, USA, pp. 63–71.

Soniya Gadgil, **Steven Moore**, John Stamper (2019). "How does Performance in an Online Primer Predict Achievement in a Future Computer Science Course?", *In Companion Proceedings 9th International Conference on Learning Analytics & Knowledge* (LAK'19). pp. 300-306.

Steven Moore & John Stamper (2019, June). "Decision Support for an Adversarial Game Environment using Automatic Hint Generation", *In International Conference on Intelligent Tutoring Systems* (ITS'19). pp. 44-53.

John Stamper & **Steven Moore** (2019, June). "Exploring Teachable Humans and Teachable Agents: Human Strategies versus Agent Policies and the Basis of Expertise", *In International Conference on Artificial Intelligence in Education* (AIED'19). forthcoming.

D. Synergistic Activity

Computing Curriculum Development — 2016 - present
Assisted in the development of Java and Python online materials

Graduate Teaching Fellow — 2018 - present
Lead microteaching workshops and conduct classroom observations

Student Mentor — 2017 - present
Mentoring capstone groups for the MCDS and METALS program at CMU

Peer Review — 2019
Educational Data Mining (EDM) and Learning Analytics & Knowledge (LAK) Conferences

Cherylee Kushida
Distance Education Program/OER Coordinator
Santa Ana College
1530 W. 17th Street, Santa Ana, CA 97206
Kushida_Cherylee@sac.edu, (714) 564-6766

Professional Preparation

Institution	*Location*	*Major / Dept.*	*Degree & Year*
University of CA, Irvine	Irvine, CA	Mathematics	B.S. 1982
Claremont Graduate University	Claremont, CA	Management, Information Systems	M.B.A. 1985

Professional Experience

2010 – Present	Distance Education and OER Faculty Coordinator, Santa Ana College, Santa Ana, CA
2008 – 2010	Chair, Computer Science Department, Santa Ana College, Santa Ana, CA
1992 – Present	Professor, Computer Science, Santa Ana College, Santa Ana, CA
1984 – 1992	Advisory Systems Engineer, IBM, Norwalk, CA

Synergistic Activities

OER Development

2010	Co-PI	Kaleidoscope Project Next-Generation Learning Challenge (Gates Foundation)
2013	Co-PI	Career Ladders Project (Bill & Melinda Gates Foundation)
2015	Co-PI	Next Generation Courseware Challenge II (Bill & Melinda Gates Foundation)
2016	PI	AB798 Textbook Affordability Program – Phase I (state grant)
2016	PI	OER Degree Initiative (Achieving the Dream)
2017	PI	Zero Textbook Cost Degree Program (state grant)
2018	PI	AB798 Textbook Affordability Program – Phase II (state grant)
2019	PI	Zero Textbook Cost Degree Equity Champion (state grant)
2019	PI	Strong Workforce Program (Local Cross-Sector Industries grant)

EXHIBIT A

David A. Wiley
801-822-9211
http://davidwiley.org/

A. Professional Preparation

Marshall University	Music	BFA	1997
Brigham Young University	Instructional Psychology & Technology	PhD	2000
Utah State University	Instructional Technology	Postdoctoral Fellowship	2001

B. Academic and Professional Appointments

2012 – Present: Chief Academic Officer, Lumen Learning
2012 – Present: Director, Open Education Group, Brigham Young University
2012: Senior Fellow, National Center for Research in Advanced Information and Digital Technologies
2011: OLNet Expert Fellow, The Open University, United Kingdom
2008 – 2013: Associate Professor, Instructional Psychology & Technology, Brigham Young University
2005 – 2008: Founding Director, Center for Open and Sustainable Learning, Utah State University
2005 – 2006: Nonresident Fellow, Center for Internet and Society, Stanford Law School
2004: Visiting Scholar, Educational Technology Expertise Centre, The Open University of the Netherlands
2001 – 2008: Assistant / Associate Professor, Instructional Technology, Utah State University

C. Products

(i) Closely Related Products

Waymaker Personalized Courseware (2014-2017). Available online at http://lumenlearning.com from Lumen Learning. Portland, OR.

Bodily, R., Nyland, R., & **Wiley, D.** (2017). The RISE Framework: Using learning analytics to automatically identify open educational resources for continuous improvement. *International Review of Research on Distance and Open Learning*. http://dx.doi.org/10.19173/irrodl.v18i2.2952

Fischer, L., Hilton, J., **Wiley, D.**, Williams, L., & Xiong, Y. (2017) The Effect of Open Educational Resources (OER) Adoption on Learning in a Community College: A Multilevel Modeling Approach. Concurrent session at The 14th Annual Open Education Conference. Anaheim, CA.

Fischer, L., Hilton, J., Robinson T. J., & **Wiley, D.** (2015). A Multi-Institutional Study of the Impact of Open Textbook Adoption on the Learning Outcomes of Post-Secondary Students. *Journal of Computing in Higher Education.* 10.1007/s12528-015-9101-x

Wiley, D. (February, 2011). Openness, Learning Analytics, and Continuous Quality Improvement. Keynote address at the Educause Learning Initiative 2011 Conference. Washington, DC.

(ii) Other Related Products

Hilton, J., Fischer, L., **Wiley, D.**, & Williams, L. (2016). Maintaining momentum toward graduation: OER and the Course Throughput Rate. *International Review of Research in Open and Distance Learning, 17*(6). http://dx.doi.org/10.19173/irrodl.v17i6.2686

Johansen, J. & **Wiley, D.** (2011). A sustainable model for opencourseware development. *Educational Technology Research & Development, 59*(3), p. 369-382. DOI: 10.1007/s11423-010-9160-7

Caswell, T., Henson, S., Jensen, M., & **Wiley, D.** (2008). Open content and open educational resources: Enabling universal education. *International Review of Research in Open and Distance Learning, 9*(1). http://www.irrodl.org/index.php/irrodl/article/view/469/1001

Recker, M. & **Wiley, D.** (2001). A non-authoritative educational metadata ontology for filtering and recommending learning objects. *Journal of Interactive Learning Environments: Special issue on metadata, 1-17.*

Wiley, D. (2000). Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects* (pp. 3-23). Bloomington, IN: Association for Educational Communications and Technology.

D. Synergistic Activities

1) Program Chair, The Open Education Conference. 2004 – 2017.

2) Guest editor. Duval, E. & **Wiley, D.** (Eds.). (2010). *IEEE Transactions on Learning Technology, 3*(2). Special issue on learning objects and open education.

3) Wiley, D. & Hilton, J. (Eds.). (2009). *International Review of Research on Open and Distance Learning, 10*(5). Special issue on open education and the future of higher education.

4) Guest editor. Roberts, E., Freeman, M., **Wiley, D.**, & Sampson, D. (Eds.). (2005). *Learning Technology 7*(1). Special issue on SCORM sequencing and navigation standards. IEEE Computer Society.

5) "**Wiley** (2000) collated work on the concept of LO [learning objects], which led to significant amounts of activity by educational technologists and software engineers to devise the systems, processes and models to enable educators to design, share and (re)use LO (McGreal, 2006; Weller, Little, McAndrew & Woods, 2006). With the expansion of the Internet and the emergence of the World Wide Web (WWW) it was also **Wiley** (1999) who took another major feature of software engineering - the open licences applied to open source software that enabled community-driven improvement of the software code - and applied it to educational content. **Wiley**'s notion of open content, his first attempts at an open licence and the separate but related developments of the Creative Commons movement and the Massachusetts Institute of Technology OpenCourseWare initiative then led on to the adoption of the term open educational resources at a United Nations Educational, Scientific and Cultural Organization meeting." From *Lane, A. & Mcandrew, P. (2010). Are open educational resources systematic or systemic change agents for teaching practice. British Journal of Educational Technology, 41(6), pp. 952-962. doi:10.1111/j.1467-8535.2010.01119.x*

Students

Stephanie Allen, Sean Duncan, Bekir Gur, Seth Gurell, John Hilton, Tiffany Ivins, Justin Johansen, Aaron Johnson, Jolene Merica, Murat Ozoglu, Mary Stevens, Craig Woll, Andrew Van Schaack

EXHIBIT A

Norman L. Bier

A. Professional Preparation

Indiana University of Pennsylvania	English Literature	B.A.	1998
Indiana University of Pennsylvania	Philosophy	B.A.	1998
Carnegie Mellon University	Philosophy	M.A.	1999

B. Academic and Professional Appointments

2015 – Present: Executive Director, Simon Initiative, Carnegie Mellon University.
2014: Visiting Associate Professor, Hokkaido University, Sapporo, Japan.
2013 – Present: Director, Open Learning Initiative, Carnegie Mellon University.
2010 – 2013: Associate Director, Open Learning Initiative, Carnegie Mellon University.
2002 – 2010: Director, Training and Development, iCarnegie Inc.
2000 – 2002: Lead Course Mentor and Developer, Carnegie Technology Education.
1999 – 2006: Adjunct Professor, Computer and Information Technology, Community College of Allegheny County.

C. Products

(i) Closely Related Products:

Open Learning Initiative Platform (2013-2018). *Software*. Available online at [http://oli.cmu.edu] from OLI, Carnegie Mellon University, Pittsburgh, PA.

IDEA (NSF Award 1418244: Data-Driven Methods to Improve Student Learning from Online Courses) (2014-2016). *Software*. Prototype platform for data-driven design and iterative improvement of online courseware.

Koedinger, K.R., Kim, J., Jia, J., McLaughlin, E.A., & **Bier, N.L**. (2015). Learning is Not a Spectator Sport: Doing is Better Than Watching for Learning From a MOOC. In *Proceedings of the Second (2015) ACM Conference on Learning at Scale*, 111-12.

Bier, N. and Jerome, W. (2012). Learning Data Visualization. *Open Education Annual Conference*. Vancouver, Canada, October 17, 2012.

Bier, N.; Lovett, M. and Seacord, R. (2011). An Online Learning Approach to Information Systems Security Education. In *Proceedings of the 15th Colloquium for Information Systems Security Education (CISSE)*, p.56-62, June 13-15, 2011.

(ii) Other Related Products:

OLI Research Team (2010-2018) Open Learning Initiative Learning Interaction Data for A&P Biology, Concepts in Computing, Psychology, Secure Coding and Statistics Courses. *Datasets*. Available online at Pittsburgh Science of Learning Center, CMU, Pittsburgh, PA.

Koedinger, Kenneth R; McLaughlin, Elizabeth A; Jia, Julianna Zhuxin; **Bier, Norman L.** Is the Doer Effect a Causal Relationship?: How Can We Tell and Why It's Important. *Proceedings of the Sixth International Conference on Learning Analytics & Knowledge*, p388-397, 2016. ACM.

Matsuda, N., Furukawa, T., **Bier, N**., & Faloutsos, C. (2015). Machine Beats Experts: Automatic Discovery of Skill Models for Data-Driven Online Course Refinement. In, *Proceedings of the International Conference on Educational Data* Mining (pp. 101-108). Madrid, Spain.

Kaufman, J.; Ryan, R.; Thille, C. and **Bier, N.** (2013) Open Learning Initiative Courses in Community Colleges: Evidence on Use and Effectiveness. CMU, Pittsburgh, PA.

Bier, N.; Green, C.; Jenkins, M.; Johnson, S. and Stacey, P. (2013) Large Scale OER – A TAACCCT Case Study. *Open Education Annual Conference*. Park City, UT, November 6-8, 2013.

D. Synergistic Activities:

1) Direct collaborative development of open courseware. Direct teams in the development and iterative improvement of over 30 open learning environments, in subjects including Biology, Psychology, Prose Style, Evidence-Based Management, Introduction to Computing, French, Spanish, Anatomy & Physiology and many others. Develop and improve upon platform to deliver courses, simultaneously supporting the enacting of learning design and science principles; ongoing learning research, exhaustive data capture and data-driven instructor support.

2) Develop and expand a Learning Engineering Ecosystem. Define and improve learning engineering process. Integrate and openly release Carnegie Mellon's most effective learning engineering tools as foundational element in developing a large-scale, multi-institutional collaboration. Develop interoperability backbone for integrating tools into a more seamless ecosystem.

3) OPEN: Support Grantees of Trade Adjustment Assistance Community College & Career Training (TAACCCT) Program of the U.S. Department of Labor (DOL): Provide infrastructure support and capacity building to grantees. Lead teams of grantees from multiple community colleges and industry partners in the development, delivery, evaluation and improvement of open educational resources (OER). Work from the project has demonstrated a 7-fold improvement in retention and completion for career pathway learners in the National STEM Consortium.

4) Kaleidoscope: Cross-institutional collaboration to implement and improve open general education courses targeting at-risk student populations for 25 institutions. The project uses a common, embedded assessment process and a closed loop, data-driven, iterative improvement process for course design. Course materials are collaboratively developed and made available to students for zero cost. Studies of the project have found a 10% increase in student outcomes when compared to use of traditional commercial textbooks.

5) **Data-driven design and improvement for instruction:** The *IDEA project (NSF Award 1418244: Data-Driven Methods to Improve Student Learning from Online Courses)* improves the learning effectiveness and efficiency of online courseware, using learning data and an assortment of techniques to provide a dashboard for course improvement. The diagnostic feedback provides assistance with the design and improvement of course design, learning models, activities and interactive instruction. The development of online courseware is often guided primarily by the intuition of the instructor; this project enables simplified approaches to data-driven refinement of learning design and activities. This work targets faculty and instructional designers who may not be experts in data-driven or science-based approaches to instruction, creating a scaffolded interface for data-informed, iterative improvement of technology-enhanced learning resources.

The above activities have been funded through multiple grants from The William and Flora Hewlett, Bill & Melinda Gates, Carnegie, Lumina, Kresge, Walter S. Johnson, Spencer, National Science Foundations, and the Next Generation Learning Challenge.

EXHIBIT A

JOHN C. STAMPER
Office address
School of Computer Science
Carnegie Mellon University
Pittsburgh, PA 15213
(704)-699-2541
http://dev.stamper.org

Professional Preparation

Ph. D. Information Technology. University of North Carolina at Charlotte. May 2010.

Graduate Certificate. Cognitive Science. University of North Carolina at Charlotte. May 2007.

M.B.A. Business Administration and Management. University of Cincinnati. May, 2000.

B.S. Systems Analysis. Miami University. December, 1994.

Relevant Experience

Assistant Professor. Human-Computer Interaction Institute, Carnegie Mellon University. Pittsburgh, PA. 2015 to present.

Systems Scientist. Human-Computer Interaction Institute, Carnegie Mellon University. Pittsburgh, PA. 2009 to 2015.

CEO/Founder. TutorGen, Inc. Fort Thomas, KY. 2012 to Present

Technical Director. Pittsburgh Science of Learning Center DataShop. 2009 to present.

Research Assistant. University of North Carolina at Charlotte. Charlotte, NC. 2004 to 2009.

Vice President, Research and Development. VSI Technologies, Inc. Cincinnati, OH. 1999 to 2004.

Manager of IT. Protocall, Inc. Cincinnati, OH. 1997 to 1999.

Programmer/Analyst. Lehmkuhl and Associates, Cincinnati, OH. 1994 to 1997.

Closely Related Products (5)

Koedinger, K., McLaughlin, E., Stamper, J. (2012). Automated Student Model Improvement. *In Proceedings of the 5th International Conference on Educational Data Mining (EDM 2012).* Chania, Greece. Jun 19-21, 2012. pp. 17-24. **[BEST PAPER Award]**

Stamper, J., Barnes, T., and Croy, M. (2011) Experimental Evaluation of Automatic Hint Generation for a Logic Tutor. In *Kay, J., Bull, S. and Biswas, G. eds. Proceeding of the 15th International Conference on Artificial Intelligence in Education (AIED2011).* pp. 345-352. Springer. **[BEST PAPER Award Finalist]**

Stamper, J., Koedinger, K.R. (2011) Human-machine Student Model Discovery and Improvement Using DataShop. *In Kay, J., Bull, S. and Biswas, G. eds. Proceeding of the 15th International Conference on Artificial Intelligence in Education (AIED2011).* pp. 353-360. Berlin Germany:Springer.

Stamper, J., Barnes, T., and Croy, M. (2010) Enhancing the Automatic Generation of Hints with Expert Seeding. In Aleven, V., Kay, J., and Mostow., J eds. *Proceeding of the 10th International Conference on Intelligent Tutoring Systems(ITS2010),* vol. II, pp. 31-40. Berlin, Germany: Springer Verlag. **[BEST Student Paper]**.

Barnes, T., Stamper, J. (2008). Toward Automatic Hint Generation for Logic Proof Tutoring Using Historical Student Data. In E. Aimeur, & B. Woolf (Eds.) *Proceedings of the 9th International Conference on Intelligent Tutoring Systems (ITS 2008)*, pp. 373-382. Berlin, Germany: Springer Verlag. **[BEST PAPER Award Finalist]**

Other Significant Products (5)

Eagle, M., Corbett, A., Stamper, J., McLaren, B. M., Baker, R., Wagner, A., MacLaren, B., & Mitchell, A. (2016). Predicting individual differences for learner modeling in intelligent tutors from previous learner activities. In *F. Cena, M. Desmarais, D. Dicheva, J. Zhang (Eds.), Proceedings of the 24th Conference on User Modeling, Adaptation and Personalization (UMAP 2016).* New York, NY. (pp. 55-63). **[BEST PAPER Award]**

Barnes, T., Stamper, J. & Croy, M. (2010). Using Markov decision processes for student problem-solving visualization and automatic hint generation. In Romero, C., Ventura, S., Pechenizkiy, M., Baker, R.S.J.d. (Eds.) *Handbook of Educational Data Mining*. Boca Raton, FL: CRC Press.

Koedinger, K.R., Baker, R.S.J.d., Cunningham, K., Skogsholm, A., Leber, B., Stamper, J. (2010) A Data Repository for the EDM community: The PSLC DataShop. In Romero, C., Ventura, S., Pechenizkiy, M., Baker, R.S.J.d. (Eds.) *Handbook of Educational Data Mining*. Boca Raton, FL: CRC Press.

Stamper, J. Barnes, T. (2009) An Unsupervised, Frequency-based Metric for Selecting Hints in an MDP-based Tutor. In *Proceedings of the 2nd International Conference on Educational Data Mining (EDM 2009)*, Cordoba, Spain, pp. 180-189.

Stamper, J. (2006). Automating the Generation of Production Rules for Intelligent Tutoring Systems. In *Proceedings of the 9th International Conference on Interactive Computer Aided Learning (ICL2006)*, Villach, Austria. Kassel University Press.

Synergistic Activities

1. Program Chair of the 7th International Conference on Educational Data Mining (EDM2014) held July 2014 in London, UK.
2. Conference Chair of the 5th International Conference on Educational Data Mining (EDM2012) held June 2012 in Chania, Greece.
3. Co-Chair of the 2010 KDD Cup Competition titled "Educational Data Mining Challenge." This competition challenged teams to build algorithms using machine learning and data mining techniques on existing student log data in order to predict future student performance in an intelligent tutor for middle and high school mathematics.
4. Local Organizing Chair for 3rd International Conference on Educational Data Mining held June 2010 in Pittsburgh PA.
5. NSF East Asian Pacific Summer Institute (EAPSI) Fellow, Sung Kyun Kwan University, Suwon Korea, Summer 2007. This was a summer collaboration with Dr. Yong Se Kim on building intelligent tutors for an international audience.

Thesis Advisor

Tiffany M. Barnes (NC State University)

Students and Postdoctoral Fellows

Tomohiro Nagashima, Nicholas Diana, Michael Eagle, Ran Liu

Kim Thanos, CEO Lumen Learning

Kim Thanos is CEO and co-founder of Lumen Learning. She has a wide range of experiences working in the educational technology and hardware arenas, including roles as Vice President, Technical Services at Campus Pipeline (SunGard Higher Education), and Semiconductor Operations Manager at the Hewlett-Packard Company. Ms. Thanos holds a BA in International Relations from Boston University and an MBA from the Marriott School of Business at Brigham Young University.

EXHIBIT A

Darren Siegel

211 E 8th St
Aspinwall, PA 15215
darrensiegel@cmu.edu
412-418-0747

Experience

Carnegie Mellon University, Pittsburgh, PA
Simon Initiative Lead Architect, December 2016-Present

Lead architect and developer responsible for the technological infrastructure that powers a global, learning engineering ecosystem.

- Led the migration and adoption of modern software development technologies, tools and engineering processes to a team of software and learning engineers
- Removed the barrier to entry for faculty for creating and editing courses by designing and implementing a web-based curriculum authoring system

Viz | General Dynamics Mission Systems, Pittsburgh, PA
Principal Software Engineer May 2009 - April 2014, August 2014-December 2016

Technical lead, architect, and developer focused on distributed software systems used in military, space, and cyber domains.

- Led teams developing the Command Post of the Future (CPOF) - a US Army command and control system used by battlefield commanders in theaters of war.
- Developed a web-application proof of concept orbit determination and collaborative satellite planning system for a National Space Defense Center contract pursuit.
- Coordinated and led the software development recruiting and hiring efforts for a 60+ person engineering team.
- Regular presenter at internal company training seminars, introducing emerging technologies and languages including Elixir, Elm, FRP
- Spent three months deployed to Operation New Dawn, providing field software engineering support in locations in Iraq to ensure successful software upgrade.

WiserTogether Inc, Washington, DC
Senior Member of Technical Staff May 2014 - August 2014

Senior engineer designing and implementing solutions for a healthcare startup.

- Implemented automation for build, release, and cloud based deployments.

Brainstage Inc, Pittsburgh, PA
Lead Software Engineer May 2008 - April 2009

Led the development at a web-based, semantic search, life-sciences startup.

- Developed system prototypes that secured early stage investments
- Designed and built the company's production system that indexed and aggregated

scientific research papers and associated visualizations

Westinghouse Electric Company, Madison, PA
Principal Software Engineer May 2004 - April 2008

Designed, developed, and maintained software systems used in the non-destructive examination and repair of nuclear reactor steam generators.

- Selected as first software engineer company-wide to participate in Design for Six Sigma training. Participated in shaping the ongoing training/certification curriculum.
- Over the course of several yearly releases, developed and maintained ANSER - an HP Unix, C/C++ Motif based 2D/3D visualization software system used to perform eddy current structural analysis.

iCarnegie, Inc., Pittsburgh, PA
Course Developer and Mentor September 2002 - May 2004

Authored course materials for an online software development curriculum.

- Authored course in C++ and Data Structures and Algorithms, encompassing course learning pages, programming examples, exams, and homework assignments.
- Improved quality of courses curriculum-wide through creation of programming example content management and automated test system.

Community College of Allegheny County, Monroeville, PA
Adjunct Faculty September 2002 - December 2002

- Taught a "C++ and Data Structures and Algorithms" course

ARC Technologies, Inc, Yukon, PA
Software Engineer June 1996 - September 2002

Developed a range of software solutions spanning database-driven web applications, inventory tracking, and scientific applications.

- Received patent (US #6691112) for work related to an integrated point-of-sale, web eCommerce system
- Developed a data management system featured in the January 2000 issue of Nuclear Engineering International

Training/Certifications/Other

- ScrumMaster Certified, San Jose, CA, 2006
- Formerly held secret DOD clearance

Education

- Coursework, Machine Learning, Carnegie Mellon University, Pittsburgh, PA
- MS Computer Science, DePaul University, Chicago, IL
- BS Math and Computer Science, California University of PA, California, PA

STATE OF CALIFORNIA
GOVERNOR'S OFFICE
OFFICE *of* PLANNING AND RESEARCH

EDMUND G. BROWN JR.
GOVERNOR

KEN ALEX
DIRECTOR

California Education Learning Lab

REQUEST FOR PROPOSALS 2018-19:

"Improving Equity, Accessibility and Outcomes for STEM Gateway Courses"

Revised on February 8, 2019, with Full Proposal Instructions in Section IV. F, pages 7-10. Other changes have been highlighted.

Request for Proposals Announced	Wednesday, December 12, 2018
Letter of Intent to Submit a Proposal Due	**Monday, January 7, 2019**
Concept Proposals Due	**Tuesday, January 22, 2019**
Notification of Finalists	Tuesday, February 5, 2019
Full Proposals Due	~~**Friday, March 15, 2019**~~ **Friday, March 22, 2019 (new date)**
Selection Committee Meeting (brief public meeting, followed by closed session deliberation)	**Monday, April 15, 2019 (venue TBD)**
Awardees Announced	~~**Monday, April 8, 2019 (estimated)**~~ **Wednesday, April 24, 2019 (new estimated date)**
Projects Commence	June 1 or July 1, 2019
Duration of Projects	36 months
Funding	For 6-9 projects, approximately $1 million to $1.5 million total per project (including indirect costs[1]).

I. California Education Learning Lab

Assembly Bill 1809 (Chapter 33, Statutes of 2018) established the California Education Learning Lab ("Learning Lab") as a competitive grantmaking program for intersegmental faculty teams[2] to incorporate learning science and adaptive learning technology into their curriculum and pedagogy, with the express purpose of increasing learning outcomes and closing equity and achievement gaps

[1] See Item VI.

[2] "Intersegmental faculty teams" refers to a team of faculty from more than one segment of public higher education, e.g., University of California, California State University, California Community Colleges.

in STEM and other disciplines. The Learning Lab is housed in the Governor's Office of Planning and Research, with an annual budget of $10 million. Initial calls for proposals will focus on lower-division online and hybrid courses in STEM. In later years, other disciplines may compete for funds and funds may be used to support professional development and a curated resource library.

II. Learning Science and Adaptive Learning Technologies

"The goal of learning sciences is to better understand the cognitive and social processes that result in the most effective learning, and to use this knowledge to redesign classrooms and other learning environments so that people learn more deeply and more effectively." -- R. Keith Sawyer, Washington University

Learning science is the study of how human learning takes place. Interdisciplinary in nature, drawing from fields such as cognitive science, neuroscience, computer science, education, psychology, sociology, design studies and more,[3] learning science strives to understand how people learn, how to support learning, discipline based learning, and the role of technology in enhancing learning and collaboration.[4] Learning science can cover how people process, gather, and interpret information; how they develop knowledge, skills, and expertise; or the extent to which social and physical context and design environments influence cognition.[5] Scaffolding, inquiry or problem-based learning, collaborative learning, game and simulation-based learning, as well as metacognition are all examples of how teaching methods and approaches to curriculum can be influenced by what we understand about learning. Additionally, strategies linked to social psychology and multicultural education emphasize the importance of attending to students' identity and culture when addressing achievement gaps.

One of the goals of learning science is to create a positive feedback/continuous improvement loop between theories of learning and practice, which results in improved student learning and advances the field of learning science.[6] For the purposes of the Learning Lab, as public higher education strives to educate more students with diverse backgrounds in a rapidly changing world, leveraging, increasing and applying our knowledge of human learning is a challenge we must embrace.

Adaptive learning is defined by statute to mean "a technology-mediated environment in which the learner's experience is adapted to learner behavior and responses." For the purposes of this RFP, adaptive learning technologies will be considered in the broad sense of deploying technology to better understand learner experience/learner gaps and assets, and to modify learning

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[3] Sawyer, R.K. (2006). *The Cambridge Handbook of the Learning Sciences*. Cambridge, U.K.: Cambridge University Press.
[4] Sommerhoff, D., Szameitat, A., Vogel, F., Chernikova, O., Loderer, K. & Fischer, F. (2018). What Do We Teach When We Teach the Learning Sciences? A Document Analysis of 75 Graduate Programs. Journal of the Learning Sciences, 27:2, 319-351. https://doi.org/10.1080/10508406.2018.1440353.
[5] Ibid.
[6] The Simon Initiative Learning Engineering Ecosystem at Carnegie Mellon University emphasizes: 1) building and leveraging cognitive models of expertise to inform the design of effective student-centered instructional materials; 2) collecting rich data on student interactions and learning outcomes; 3) data analysis via state-of-the-art machine learning and analytic methods; 4) data-informed iterative improvement of the instructional materials; and 5) leveraging these assets to drive fresh insights in learning science.
https://chronicle-assets.s3.amazonaws.com/5/items/biz/pdf/SimonLearningEngineeringEcosystem.pdf.

environments, pedagogical approaches and/or available resources to be more inclusive of students most likely to leave the sciences (such as first-generation college-going students and underrepresented students in the sciences) and produce better learning outcomes. The adaptive learning technology approach that is proposed will be considered in the context of all of the other elements in the proposal.

III. Demonstration Projects - Summary

For this RFP, up to $9 million will be provided from the Learning Lab to fund six to nine demonstration projects to support curricular and pedagogical innovations that aim to increase learning outcomes, transform the culture of learning, and close equity and achievement gaps in online and hybrid learning environments within lower division STEM undergraduate curriculum. In order to have the potential for large scale impact, this call will be open to lower-division "gateway" courses in the following disciplines: biology, chemistry, physics, engineering and computational sciences, including computer science, mathematics and statistics. Within the available funds, approximately $1 million to $1.5 million will be available to each awarded demonstration project. Projects are encouraged to develop pedagogical innovations that promote students' sense of belonging in science, students' science identity and connections between science learning and students' personal lives, career aspirations and home communities, leveraging affective components of learning to reduce achievement gaps.

Projects must be co-hosted by a faculty team representing a minimum of two public higher education segments in California. (Example: a faculty member from the California Community Colleges must collaborate with a faculty member from the University of California OR the California State University. Faculty collaboration across all three segments is welcome and encouraged.) Other faculty from private independent/nonprofit institutions and nonfaculty (i.e., professionals operating in a nonfaculty role for the purposes of the project) may participate in the project as well. A strong project will engage many stakeholders iteratively and throughout the duration of the project, as well as lay the foundation for sustainability of innovations and institutional culture change.

Demonstration projects will be selected through a three-stage process involving: (1) submission of letters of intent to submit concept proposals; (2) submission of concept proposals; and (3) submission of full proposals, based on selected concept proposals, from which the final selection of awards will be made. A selection committee will make recommendations for final awards. After awards are announced, Learning Lab will work with awardees to establish an agreement governing the award period, including concrete metrics and goals to track the progress of the demonstration projects, and provide technical assistance.[7]

IV. Applications

A. Application process

Stage 1: Letter of intent to submit a concept proposal (**DUE: Monday, Jan. 7, 2019**)

Applicants should submit a brief letter of intent. The letter should note the expected host institutions and co-principal investigators, provide a (tentative) title of the proposal and a tentative total budget. The letter should also include a brief description of the

[7] Contracting entity will be the Governor's Office of Planning and Research.

proposal and characterize the discipline-specific problem that co-PIs are trying to solve and/or investigate. Please provide institutional data disaggregated by course and student characteristics (e.g., ethnicity, gender, socio-economic status, first-generation college going) on existing campus-, school- or department-specific equity issues that your project is designed to address.

Stage 2: Institutional cover letter and concept proposal (**DUE: Tuesday, Jan. 22, 2019**)
Applicants should submit institutional cover letters and short concept proposals; see sections C and D below.

Stage 3: Full proposal (**DUE: Friday, ~~March 15, 2019~~ March 22, 2019**)
The selection committee selected a subset of submitted concept proposals to move onto the full proposal stage. (21 proposals were invited to the full proposal stage.) For the finalists advancing to this next stage, instructions for submission of the full proposal is in Section F (beginning on page 7). The selection committee will recommend between six and nine final projects for this grant cycle. The Governor's Office of Planning and Research (OPR) will approve and announce the final funding decisions.

For questions, please see the FAQ document or contact learninglab@opr.ca.gov, or go to our webpage (opr.ca.gov/learninglab). Please join our email distribution list to recieve updates directly by sending an email to learninglab@opr.ca.gov.

B. Eligibility

1. Applicant teams must include faculty co-principal investigators (PIs) from at least two public higher education segments. Representation from all three public higher education segments is encouraged. Additional partnerships, such as with private independent/nonprofit institutions and/or industry partners, are also encouraged. All faculty teams must commit to teaching and evaluating the codeveloped or jointly redesigned curriculum or innovative pedagogy during the grant period.
2. Demonstration projects should aim to improve learning outcomes and close equity/achievement gaps for STEM undergraduate students in lower division course series[8] where the mode of learning is online or hybrid, i.e., makes use of both online and in-person interactions as part of the formal course environment or requirements.

C. Institutional Cover Letter (to be submitted with the Concept Proposal)

For each faculty team application, the relevant departments/schools/institutions should provide answers for Section C1, C2 & C3, in a brief (limit one page); minimum Arial 11 font; 0.5 inch margins; no appendices.

1. Host institutions: Identify the institutions that are submitting the proposal and will be responsible for receipt/administration of the grant funds, if awarded.
2. Institutional focus: Describe each department/school/institution's commitment (e.g.,

[8] High school dual enrollees may also be captured as part of this population.

faculty release time, funding, administrative support) to the proposed demonstration project. (Each participating institution should sign the cover letter. Additional demonstration of institutional commitment will be highlighted in the full proposals stage.)

3. Principal investigators: Identify the investigators who will serve as faculty (co-)PIs. Please briefly describe each PI's capacity, including any previous and/or current grant funding received, strength of faculty and student engagement activities, and history of successful intersegmental partnerships.
4. Authorized submission: The Institutional Cover Letter (C1-C3) and the concept proposal (section D) should be submitted electronically to learninglab@opr.ca.gov by the signatories, which must include the department chair AND either the dean, vice chancellor/vice president of research or the provost or equivalent.

D. Concept Proposal

For each application, please provide answers for Section D in a short Concept Proposal: maximum two pages for questions 1-7; maximum 1 page for questions 8-10; minimum Arial 11 font; 0.5 inch margins; no appendices.

1. How will your proposal measure or define success?: Describe what problem you are trying to solve. Please include data/metrics to highlight the problem and elaborate on the description and data provided in your letter of intent. Describe how your proposed project will improve understanding of learning science and/or assessments, and/or effectiveness of pedagogical methods and/or adaptive learning technologies. What will you measure? (For example: increased retention or increased proficiency and performance with STEM; increased conceptual understanding/higher order thinking or passion for STEM careers; increased communication skills, leadership, and teamwork capabilities of STEM students; increased self-efficacy/ability to learn independently; increased facility with the scientific method; increased faculty impact; or reduction of a particular pain point experienced by faculty or students.) How will you evaluate students? How will you evaluate faculty?
2. Project plan: Describe the components and timeline of your proposed project (specific aims and research strategy).
3. Data and adaptive learning technologies: Each proposal should demonstrate its commitment to the use of robust data and technology tools, including adaptive learning technology (see definition above). Please describe how your proposal will use real-time learning outcomes data and adaptive learning technology and other technology tools to improve the pedagogy and/or curriculum.
4. Learning science: Describe how you will use evidence-based pedagogical approaches supported by research from a variety of disciplines. What is innovative about your approach? How will you take an existing approach and experiment with achieving

broader scale?

5. Student engagement: Describe your approach to student engagement, potentially including engagement of students who may not identify as STEM proficient. Examples: How might your approach increase students' sense of belonging, and encourage students' help-seeking behavior from faculty, teaching assistants, other students, technology resources, etc. Will your approach include engagement through active learning, applied learning through a career or workforce pathway lens, and/or highly contextualized learning? How might students drive their own learning and/or the learning of their peers? Will your proposal individualize learning or use metacognition? How often will students receive meaningful and timely feedback, whether through a technology-mediated environment or face-to-face?
6. Culture: How will your proposal impact traditional "classroom" and disciplinary culture? In particular, how will your approach address aspects of classroom or disciplinary culture that are barriers to student learning and to their sense of belonging? How might it encourage a strengthening-assets or growth-oriented approach to student learning and how might it help establish a classroom context in which all students can succeed? How might your proposal take advantage of under-represented communities' cultural strengths to increase their achievements in STEM?
7. Scalability and value analysis: Describe how your work could be scaled, afforded, replicated and/or modified through an open educational resources model? What other dimensions of value can be evaluated in your project? With whom will you partner to do the analysis, what data will you analyze, etc.?
8. Project team: Provide a brief description of the co-PI(s), team, and key collaborators. Describe the nature and strength of any existing collaborations among project team members, and how you will use the expertise of all involved to create a well-balanced collaboration. Describe also how the project team may use external expertise and/or stakeholder input to iterate over the course of the project.
9. Budget overview: Briefly outline how Learning Lab funds (approximately $1 million to $1.5 million) will be used and how other resources may be leveraged including any outside funds or institutional funds. How will you maximize existing structures or resources? Will your innovations place any costs on users? If so, how will these be minimized?

   Note: Learning Lab funds are intended to be used exclusively in California. If the project necessitates the use of Learning Lab funds outside of California, provide a brief justification and estimate of the funding that will leave the state. The amount of funds that can leave the state will be subject to the final award agreement.
10. Common data-sharing/technology platform: Please discuss the potential for using a common data-sharing platform to deliver the course or course series.

E. Submission: Concept proposals, including the institutional cover letter, must be submitted electronically as a single PDF to learninglab@opr.ca.gov by 5:00pm PT on Tuesday, January 22, 2019.

F. Full Proposal - NEW

Of the 42 concept proposals that the Learning Lab received, 21 have been invited to submit full proposals. Please provide answers for Section F in your Full Proposal: maximum 15 pages total, not including appendices or institutional cover letters; minimum Arial 11 font; 0.5 inch margins.

Please note that the questions below are modified versions of the questions contained in the Concept Proposal section. Please read the questions below carefully, using the page length maximums (indicated in parentheses) to expand on your answers from the Concept Proposal and address any new requested or suggested content.

Please include in your Full Proposal submission:

1) Institutional Cover Letter(s) included in your Concept Proposal, updated for content and/or signatories;
2) Full Proposal responses;
3) Appendices, as follows:
   a) Information on additional team members, i.e., statement of qualifications, not covered under Question 8 (maximum 3 pages total);
   b) Budget information (maximum 2 pages total);
   c) Bibliography of key sources (maximum one page total);
   d) Any other supporting documents (maximum 3 pages total);
   e) Any brief letters of support from additional faculty colleagues who are interested in being part of the scaling efforts related to Question 7 below. (Maximum 5 pages for all additional indications of support. This can be a single letter with signatories or individual letters. Please identify name, title and contact information for signatories.)

Updated rubric and suggested templates for additional institutional cover letters (any added since the submission of your Concept Proposal) and Appendix B will be available on March 1, 2019, at http://www.opr.ca.gov/learninglab/.

All submissions are due in full by Friday, March 22nd, 2019, by 5pm. Please email your entire submission in **a single PDF** to learninglab@opr.ca.gov. If you have any questions, please contact learninglab@opr.ca.gov.

General Notes: When responding to the questions below, to the extent possible please describe students and faculty from an asset-based perspective (i.e., building on strengths), rather than a deficit-based perspective (i.e., cataloging what is "wrong" with learners or faculty that needs to be "fixed). Please be as clear as possible about what learners and faculty will do differently based on this project, in both academic and other domains (social, emotional, etc.).

As stated in the "Demonstration Projects – Summary" (Section III), projects are encouraged to develop pedagogical innovations that promote students' sense of belonging in science, students'

science identity and connections between science learning and students' personal lives, career aspirations and home communities, leveraging affective components of learning to reduce achievement gaps. A strong project will engage many stakeholders iteratively and throughout the duration of the project, as well as lay the foundation for sustainability of innovations and institutional culture change.

A. Abstract. A strong proposal will describe the project as succinctly and clearly as possible, contrasting how it differs from the status quo, or what is currently the norm in the discipline or course. (**½** page)

1. How will your proposal measure or define success?: Describe what problem you are trying to solve. Please include data/metrics to highlight the problem**.** What will you measure? (For example: increased retention or increased proficiency and performance with STEM; increased conceptual understanding/higher order thinking or passion for STEM careers; increased communication skills, leadership, and teamwork capabilities of STEM students; increased self-efficacy/ability to learn independently; increased facility with the scientific method; increased faculty impact; or reduction of a particular pain point experienced by faculty or students.) How will you evaluate students? How will you evaluate faculty? Will your project improve understanding of science of learning and/or assessments, and/or effectiveness of pedagogical methods and/or adaptive learning technologies? A strong proposal will describe the learning outcomes to be measured, over what time period, and the validity of these outcome measures with clarity. (1-1½ pages)
2. Project plan: Describe the components and timeline of your proposed project (specific aims and research strategy). A strong proposal will describe in detail the steps to be undertaken and by whom. (1-1½ pages)
3. Data and adaptive learning technologies: Each proposal should demonstrate its commitment to the use of robust data and technology tools, including adaptive learning technology (see definition above). Please describe how your proposal will use real-time learning outcomes data and adaptive learning technology and other technology tools to improve the pedagogy and/or curriculum. (1 page)
4. Science of learning: Describe how you will use evidence-based pedagogical approaches supported by research from a variety of disciplines. What is innovative about your approach? How will you take an existing approach and experiment with achieving broader scale? A strong proposal will demonstrate knowledge of and grounding in the literature of the science of learning, and connect the different parts of the project/interventions to the research cited. If relevant, a strong proposal will describe how the project furthers existing research and/or addresses the gaps in our understanding of human learning, with an explicit hypothesis, analytic framework, research design and evidence gathering. (1 page)

5. Student engagement: Describe your approach to student engagement, potentially including engagement of students who may not identify as STEM proficient. Examples: How might your approach increase students' sense of belonging, and encourage students' help-seeking behavior from faculty, teaching assistants, other students, technology resources, etc. Will your approach include engagement through active learning, applied learning through a career or workforce pathway lens, and/or highly contextualized learning? How might students drive their own learning and/or the learning of their peers? Will your proposal individualize learning or use metacognition? How often will students receive meaningful and timely feedback, whether through a technology-mediated environment or face-to-face? (1 page)
6. Culture: How will your proposal impact traditional "classroom" and disciplinary culture? In particular, how will your approach address aspects of classroom or disciplinary culture that are barriers to student learning and to their sense of belonging? How might it encourage a strengthening-assets or growth-oriented approach to student learning and how might it help establish a classroom context in which all students can succeed? How might your proposal take advantage of under-represented communities' cultural strengths to increase their achievements in STEM? (1 page)
7. Scalability and value analysis: Describe how your work could be scaled or replicated; made affordable for users; and/or modified through an open educational resources model. What other dimensions of value can be evaluated in your project? With whom will you partner to do the analysis, what data will you analyze, etc.? A strong proposal will describe the depth and breadth of institutional support for making successful practices normative within the discipline(s), and how faculty will be encouraged or incentivized to adopt successful practices. A strong proposal will include a proposed plan for broad dissemination and lasting impact. (1–1½ pages)
8. Project team: Provide a brief statement of qualifications of the co-PI(s), team, and key collaborators. Describe the nature and strength of any existing collaborations among project team members, and how you will use the expertise of all involved to create a well-balanced collaboration. Describe also how the project team may use external expertise and/or stakeholder input to iterate over the course of the project. A strong project will demonstrate collaboration with social scientists, behavioral scientists, instructional designers, and/or others with relevant expertise outside of the discipline to be impacted. A strong proposal will also demonstrate meaningful, balanced, near equivalent contributions across the segments represented in the proposal, from design to implementation to evaluation. (1-1½ pages)
9. Budget overview: Briefly outline how Learning Lab funds (approximately $1 million to $1.5 million) will be used and how other resources may be leveraged including any outside funds or institutional funds. How will you maximize existing structures or

resources? Will your innovations place any costs on users? If so, how will these be minimized? (1 page, with more detail allowed as Appendix B, template to be provided by March 1. Please see http://www.opr.ca.gov/learninglab/)
Note: Learning Lab funds are intended to be used exclusively in California. If the project necessitates the use of Learning Lab funds outside of California, provide a brief justification and estimate of the funding that will leave the state. The amount of funds that can leave the state will be subject to the final award agreement.

10. Common data-sharing/technology platform: Please discuss the potential for using a common data-sharing platform to deliver the course or course series. A strong proposal will discuss the robustness of technology approach and interoperability with other systems. (1 page)
11. Information requested by the Selection Committee. Please respond to the request for information in the **individualized summary feedback you received on February 8, 2019**, from the Learning Lab. (1–1½ pages)
12. Accessibility. Please describe your plan for ensuring access for students with disabilities, compliant with your institution's policies. (½ page)

V. Selection

Selection Committee: Learning Lab has recruited an advisory committee, which shall serve as the selection committee to recommend awards. External readers will be recruited to score proposals. Readers may be recommended by the Legislature, public solicitation or academic referral. Selection committee members shall not be deemed to be interested in any contract including any award of Learning Lab funds and will be screened for conflict of interest consistent with National Science Foundation procedures. The names of selection committee members will be provided on the Learning Lab webpage on OPR's website (OPR.ca.gov). The selection committee will use a process consistent with National Science Foundation procedures for reviewing the proposals and making award recommendations. Learning Lab will use a process consistent with National Science Foundation practices to ensure proposals are evaluated in a manner that is fair, equitable, timely and free of bias.

A. Selection criteria: *Section 65059.1 of the Government Code sets forth the following selection rubric, which may be augmented by the Learning Lab and the selection committee:*

- "The potential for reducing achievement and equity gaps in the particular discipline that is the subject of the call for proposals."
- "The depth and breadth of expertise in the particular discipline and deployment of learning science or adaptive learning technologies across the proposal's team members."
- "The prospects for increasing equity and accessibility in quality STEM education and other disciplines that show high initial failure or dropout rates, including scaling access to a newly developed or redesigned course or course series in the future."
- "The potential to incorporate real-time learning outcome data to improve the curriculum."

- "The potential to utilize a common technology platform to deliver the course or course series."
- "The representation of all three public higher education segments on the proposal's faculty team."[9]
- "The inclusion of career education and workforce pathways in the proposal."
- "Opportunities to leverage nonstate funding."
- "The quality of the concrete metrics and goals identified in the proposal."

The Selection Committee will also consider additional factors in reviewing the proposals, such as:

- The degree of innovation in the concepts, approaches or methodologies, assessments, or interventions to improve learning outcomes or reduce equity/achievement gaps.
- The feasibility of the project (can the project plan be achieved within the proposed timeline).
- The quality and extent of student engagement and faculty engagement.
- Approaches to protect privacy and personal information.
- Robustness of technology approach and interoperability with other systems.
- Sharing data across institutions.
- Where the project is located in California in order to balance geographic equity of awards, and diversity of awarded institutions.
- Diverse expertise and background of team members, including complementary expertise from social or behavioral scientists that can contribute to design of the proposal and evaluation.
- The degree to which a clear path to broad dissemination and adoption is envisioned and planned.
- Overall impact to advance learning science and learning outcomes.

B. Results: Applicants that are selected for award will be notified ~~in early to mid-April~~ late April (estimated notification date is April 24). Applicants who are not selected for award will receive a summary statement with perceived strengths and weaknesses of the proposal to inform future submissions for subsequent requests for proposals.

VI. Post-Award Agreements. Applicants of proposals that are selected will be asked to enter into an agreement with the Governor's Office of Planning and Research. The Learning Lab will administer the agreement, which will address project implementation, including the following:

a) **Indirect Costs:** Up to 8 percent in indirect costs are allowed. Total costs (direct plus indirect) are to be within the $1 million to $1.5 million total per project.
b) **Open Educational Resources:** Agree to terms and conditions that require course and course series and technology/platforms enabled with Learning Lab funds to be available as open educational resources.
c) **Start Date:** Initiate work within 30 days of signing the agreement.
d) **Reporting:** Submit progress reports at agreed-upon intervals, including tracking of

[9] The representation of all three public higher education segments is not an eligibility requirement, but the selection committee will weight proposals that span across all three segments, i.e., UC, CSU and community colleges.

milestones and expenditures, participate in conference calls and convening activities, and seek technical assistance from the Learning Lab Advisory Committee or Learning Lab staff. All post-award expectations will be specified in award agreements.

e) **Use of Data:** Investigators and demonstration teams are expected to share data and research findings consistent with academic standards.

f) **Protection of Privacy and Personal Information:** Investigators and demonstration project teams are expected to follow state and federal law to protect privacy and personal information.