CLASSP: Computational Literacy Across Secondary Settings Project
Teacher Quality Partnership Grant
CFDA #84-336S

Table of Contents

Appendices

CLASSP: Computational Literacy Across Secondary Settings Project
Teacher Quality Partnership Grant

CLASSP: Computational Literacy Across Secondary Settings Project represents a major partnership between California State University, Chico with area educational entities, including the School of Education and the colleges of Arts and Sciences; Gridley Unified School District; Live Oak Unified School District; Willows Unified School District; the Butte, Glenn and Sutter County Offices of Education and Butte-Glenn Community College District. CLASSP is a comprehensive reform initiative with the following goals:

Goal 1: Recruit and retain 72 highly-qualified individuals to the teaching profession in high-need rural areas.

Goal 2: Engage selected teacher residents in a year-long full-time teacher residency preparatory curriculum and professional development program that enhances their content knowledge and develops their expertise in computational literacy.

Objective 1: Strengthen the education of future teachers for rural schools, especially in STEM and special education

Object 2: Improve and promote computational literacy practices for teacher residents and mentor teachers.

Objective 3: Improve and promote student computational literacy in secondary settings across content areas (6-12 classrooms)

Goal 3: Provide teacher residents ongoing support that complements their induction support during their novice teaching years to positively impact the academic outcomes of rural public-school students.

Goal 4: Engage in collaborative continuous improvement efforts to positively impact the resident's and mentor's teaching practice.

Goal 5: Develop and sustain the project's partnerships and institutionalize its reforms.

To address these goals, this project will develop and implement an innovative teacher preparation program that builds upon the success of the previous TQP grants. The previously TQP-funded Rural Teacher Residency (RTR) for elementary and special education teachers led to significant changes in our teacher preparation programs and the development of the TQP-funded PRISMS program. The PRISMS Project: Promoting Rural Improvement in Secondary Mathematics and Science addressed two priorities: (1) the development of Next Generation Math Teachers (NGMT), a blended pre-baccalaureate program leading to a bachelor of arts degree in mathematics and a foundational level mathematics credential; and (2) the creation of RiSE: Residency in Secondary Education, a post-baccalaureate master's and credential program for prospective secondary math, science, English and special education teachers with an intensive one-year teacher residency.

Unlike many other states, California does not offer a credential specific to middle school, although there has been some push in that direction over the years. With NGMT and RiSE, we began to conceptualize a program that would take our STEM-related work to a new level. The creation and implementation of NGMT under our current grant underscored the fact that middle schoolers and high schoolers are very different learners with very different needs. The NGMT Program, for example, emphasized the developmental appropriateness of building a strong conceptual foundation in mathematics for middle schoolers rather than the traditional central emphasis on teaching procedural skills.

CLASSP will focus on creating a middle school to high school pipeline of STEM education in a rural setting by capturing the current and future graduates of the NGMT program, as well as candidates pursuing Foundational Level Science credentials to participate in the residency program in partner middle schools. CLASSP will utilize the most successful parts of the RiSE program to develop a new residency program that will focus on computational thinking. During the RiSE Program we began a series of workshops with Argument-Driven Inquiry (ADI) and Argument-Driven Math (ADM). This model aligns with both Common Core and NGSS standards and supports computational thinking. ADI/ADM can be used from elementary level through high school level, so, through CLASSP, we would have the opportunity to examine the effects of beginning this model at the middle school level on students' confidence and performance as they enter high school math and science classes. CLASSP could provide significant data for making a case for providing developmentally appropriate instruction for students by teachers specifically prepared to teach middle school whose transition to high school is facilitated by district communication and use of a shared model. Evaluation of CLASSP could provide strong evidence to support the implementation of a middle school teaching credential in California.

Significance

Computational Literacy Across Secondary Settings Project (CLASSP) is a post-baccalaureate teaching residency program leading to a secondary credential in math, science, English language arts, or special education and a master's degree (Absolute Priority). This program will include classroom-based action research and full-time, intensive clinical experience working with carefully selected mentor teachers trained to use Argument Driven Inquiry (ADI) to promote computational literacy in a co-planning/co-teaching clinical practice. CLASSP will improve and promote computational literacy across the content areas, through an emphasis on computational thinking and argument- driven inquiry in mathematics, sciences, English, and special education (Competitive Preference 1).

CLASSP is designed around innovative approaches to addressing each of these issues: improving computational literacy for 6-12 students, teacher shortages in high demand fields, the need to support all students in content standards, and the need for quality professional development that includes professional learning and inquiry. CLASSP's Logic Model (see page 0) shows how the project will leverage a variety of resources and inputs to build the project components through collaborative activities with partners to achieve intermediate and long-term outcomes to address the issues described above. Professional learning and development activities will focus on five areas: (1) computational literacy, (2) Argument Driven Inquiry (ADI), (3) implementing content standards, (4) literacy development, (5) integrating technology, (6) supporting English learners, and (7) meeting special student needs.

University faculty, K-12 faculty and teacher candidates will be supported in the integration of computational literacy and the standards in their planning and teaching by university and K-12 faculty experts and professional development activities of Argument Driven Inquiry; the Northern California Writing Project; the Chico Math Project; the California Science Project – Inland Northern California; and Butte, Glenn, and Tehama County Offices of Education. Additionally, both general and special education candidates and in-service teachers will develop knowledge and skills required by teachers to work effectively with students with disabilities to meet academic challenges, including literacy development and learning strategies, behavior management, differentiated instruction, use of technology, use of data and research to improve instruction, and content-specific instruction. Professional development and resource support will occur in collaboration with CSU Chico special education faculty; Butte, Glenn and Sutter County Special Education Local Plan Areas (SELPAs); the IRIS Center; and Autism Internet Modules. The intense focus on support strategies and ongoing collaboration between general and special education residents and mentors both in coursework and at the partner school sites will prepare educators for effective IEP teamwork and provide a critical model of support.

Through course work, workshops and coaching built around techniques and resources of Specially Designed Academic Instruction in English (SDAIE), Observation Protocol for Academic Literacies (OPAL), Sheltered Instruction Observation Protocol (SIOP) and lesson study, CLASSP will provide teacher candidates and university and partner K-12 faculty training focused on the knowledge and skills required by teachers to effectively make learning and achievement under the CCSS and NGSS accessible for ELLs. Areas of focus for preparing teachers to fully meet the needs of English Learners will include culturally relevant pedagogy, academic language development, differentiating instruction, creating language-rich classrooms, and integrating literacy skills across the curriculum.

Through several conversations, the partner district superintendents have articulated three specific challenges in hiring and supporting excellence in new teachers: (1) small applicant pools that may not represent the most excellent teachers, particularly in high demand areas; (2) the need for teachers specialized in foundational level math for grades 6-9; and (3) the lack of resources to provide adequate professional development for faculty to effectively implement STEM education.

CLASSP is specifically designed to provide our partners with a new type of teacher for departmentalized middle schools or self-contained classrooms who is well-prepared in content, concepts, pedagogy, and clinical experience to support middle and high school students' computational literacy and argumentation.

In addition, CLASSP will support professional development opportunities, expansion of school-based professional learning communities and regional networks, collaboration with residents and engagement in inquiry and research activities, so that partner LEAs can build local capacity to enhance their in-service teachers' knowledge and skills in instruction, computational literacy, argument driven inquiry, and applications of technology and support of struggling students, including ELLs and those with special needs.

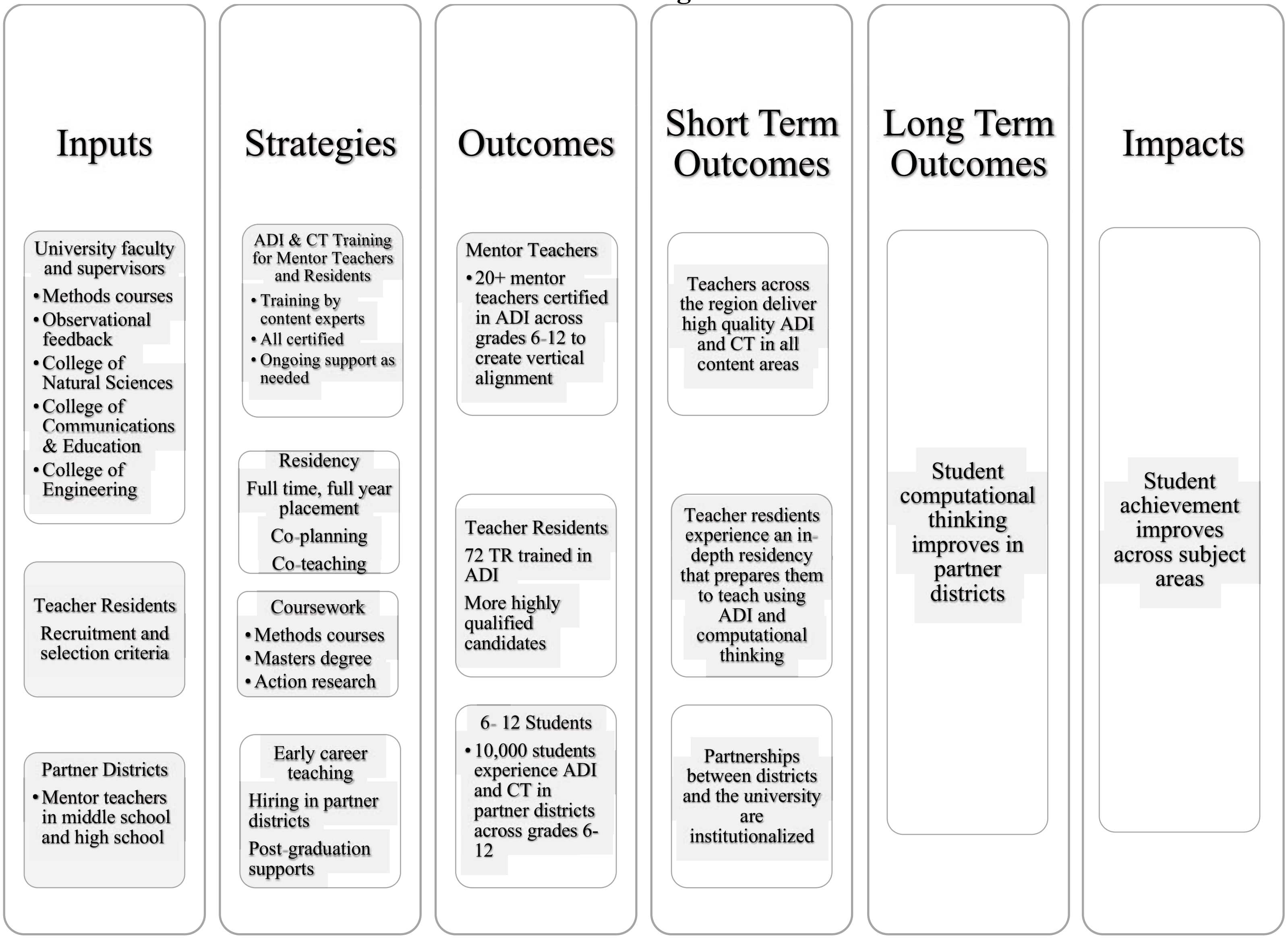
Enhancing the excellence of teachers in our regional schools will have capacity-building benefits for the university as well by improving the quality of clinical placements available to support teacher preparation programs. Moreover, the increased quality and diversity of the regional teaching force will support greater academic achievement for all students. Teachers of color can create a sense of school belonging and community for minority children, increase their academic achievement and provide them real-life examples of future career paths (Bireda & Chait, 2011; Dee, 2004; Schmitz, Nourse, & Ross, 2012). These minority teachers can also help their colleagues to understand the needs of minority children and to engage in culturally relevant teaching. Increased teacher quality and diversity are expected to result in an increase in the number of students from underrepresented groups in the north state going to college and pursuing careers in teaching, Computer Sciences, and STEM-related fields, thereby providing benefits for the university, the region, and the students themselves.

Our partner and regional LEAs still face the common, historical challenges of rural and small-town districts in recruiting and retaining excellent teachers, especially in shortage areas such as STEM and special education due to shrinking tax bases and resources and the inability to pay salaries comparable to urban districts (Dessoff, 2010). The Learning Policy Institute (Carver-

Thomas & Darling-Hammond, 2017; Linda Darling-Hammond, Furger, Shields, & Sutcher, 2016) indicates that enrollment in teacher preparation programs declined 70% in the last decade, with the enrollment in math and science teacher prep programs dropping by 32% and 14% respectively. Between 2012 and 2016, the proportion of mathematics and science teachers entering the field on substandard credentials or permits doubled, going from 20% to nearly 40%, while the number of math and science teachers entering with full credentials dropped from 3,200 to 2,200 over that time frame. Teachers hired on emergency-style credentials are twice as likely to teach in high-poverty schools than in low-poverty schools and three times more likely to teach in high-minority schools than in low-minority schools. While the shortage of teachers in STEM-related fields has been nationally recognized, the shortage of special education teachers is equally if not more acute. The need nationwide for qualified personnel to serve pupils with disabilities has grown along with the increase in the number of children with disabilities to be served. There were more than 6.7 million children being served by IDEA in 2017, about 13% of all school age children. Two types of districts encounter the most serious problems in hiring new teachers to address this increasing need: those in inner cities and those in isolated rural areas (Clewell & Villegas, 2001). Special education teacher shortages have been historically acute in rural communities, where districts may have only one teacher certified to teach special education who may or may not be highly qualified under the federal regulations (Collins et al., 2005; Ludlow, Conner, & Schechter, 2005; Rude et al., 2005).

A primary goal of CLASSP is to increase the availability of well-prepared, highly effective teachers interested in teaching in rural schools, particularly in the high-demand, shortage areas of STEM and special education. The infusion of teacher candidates strategically recruited and prepared through CLASSP to enter the teacher applicant pool will enhance the selectivity of partner and other high-need rural schools in the region in their hiring decisions and support greater diversity and excellence among their faculty. The plan to prepare 72 new secondary STEM, language arts, and special education teachers will meet the needs of our partner districts and increase the hiring of excellent teachers across the broader region. CLASSP will also contribute to the key role being played by the California State University System in preparing 15,000 elementary and 15,000 secondary teachers in STEM subjects in support of the national 100K in 10 Coalition.

CLASSP Logic Model



Description of Program

Absolute Priority: Teaching Residency Program

(I) General Description of Teaching Residency Program

CLASSP will establishment and design a teaching residency program in the high-need subjects areas of mathematics, science, language arts, and special education in both middle and high schools. CLASSP will also place graduates of the teaching residency program in cohorts that facilitate in-program and post-program professional collaboration, both among graduates of the teaching residency program and between such graduates and mentor teachers in the receiving school. Furthermore, we will ensure that teaching residents who participate in the teaching residency program receive effective pre-service preparation, teacher mentoring, and additional support required through the induction program as the teaching residents enter the classroom as new teachers. The teaching residency will incorporate year-long opportunities for enrichment, including clinical learning in classrooms in high-need schools served by the high need local educational agency in the eligible partnership, and identified by the eligible partnership; and closely supervised interaction between prospective teachers and faculty, experienced teachers, principals, other administrators, and school leaders at middle and secondary schools, and providing support for such interaction. Additionally, CLASSP will integrate pedagogy and classroom practice and promote effective teaching skills in the academic content areas of mathematics, science, language arts, and special education while providing high-quality teacher mentoring (see IIa1). The next sections of this proposal demonstrate how we will be accomplishing these goals.

(II) Establishment and Design

(IIa1) Pedagogy, Classroom Practice and Teacher Mentoring

The integration of pedagogy, classroom practice and teacher mentoring will be accomplished through a combination of online, on-campus, and on-site coursework, as well as field-based assignments and learning activities. For the teacher residents (TRs), credential preparation and master's degree coursework will begin during the semester prior to the beginning of the clinical site residency. Integrated with this initial coursework will be early field experiences and learning through service at their school sites to provide opportunities for observing and working in different grade level content and English Language Development (ELD) and special education resource classrooms, and linking theory to rural school and classroom practices. Just prior to the beginning of the residency year, TRs and their mentors will participate in a multi-day workshop focused on co-teaching models, communication styles and coaching, classroom-based action research and positive school environments. During the residency year, TRs will participate in carefully designed learning activities in their program coursework that are closely connected to their classroom experiences. Teacher preparation will be enriched by the inclusion of school site-based professional development activities focusing on computational literacy, integration of technology in instruction, Argument Driven Inquiry (ADI), and best practices in teaching English language learners and students with disabilities, all of which will be available to both TRs and mentor teachers. Both ADI and CSU faculty will provide content workshops and on-site coaching in computational literacy, argument driven inquiry, and effective teaching.

(IIa2) Rigorous Graduate-Level Coursework

Residents will also be engaged in rigorous graduate-level coursework in order to earn their master's degrees while completing their teaching residencies. In addition to extensive literature-based research throughout the program, TRs will work with mentors and administrators at their school sites to identify student needs and related questions, challenges, policies and/or practices in their classrooms. With the support and guidance of university faculty, the TRs will formulate inquiry questions, review literature, and develop inquiry tools and processes to engage in action research that will form the basis for their master's projects. This action research will also provide the framework for the planning, instruction, assessment, data analysis, and reflection required for the California Teacher Performance Assessment (CalTPA). This deep blending of theory, inquiry, and practice will allow TRs to make meaningful connections between current educational theory and research and their daily classroom practice.

CLASSP will prepare prospective and new teachers to understand and use research and data to modify and improve classroom instruction through master’s degree course work, professional development, and field-based action research. Teachers prefer professional development that relates directly to the specific grade level and courses they teach, that is relevant and useful, and that can be put into practice in their classrooms (Beaudoin, Johnston, Jones, & Waggett, 2013; Chval, Abell, Pareja, Musikul, & Ritzka, 2008). This support should also move from a model of professional development, in which teachers participate in activities to obtain knowledge, skills, and qualifications, to a model of professional learning, in which educators engage in cycles of continuous improvement guided by the use of data and active inquiry around authentic problems and instructional practices (Coggshall, 2012; Linda Darling-Hammond, 2015; Desimone, Porter, Garet, Yoon, & Birman, 2002). This inquiry-based approach to teacher development prepares teachers to learn through teaching, to integrate multiple perspectives into instruction and to support students in conducting their own inquiry (L. Darling-Hammond, 2000). In addition, a study by Capraro, Capraro, and Helfeldt (2010) found that participating in an inquiry-based field experience model that included classroom action research significantly increased candidates' self-perceptions of their professional competence as compared to candidates in other models. With the support and guidance of university faculty, the TRs will formulate inquiry questions, review literature, and develop inquiry tools and processes to engage in action research that will form the basis for their master's projects. This action research will also provide the framework for the planning, instruction, assessment, data analysis, and reflection required for the California Teacher Performance Assessment (CalTPA).

(IIa3) Experiences and Learning Opportunities

Experience and learning opportunities alongside a trained and experienced mentor teacher will be a key element of CLASSP. TRs and their mentors will engage in intense collaboration around diagnosing student needs, designing interventions, monitoring student progress, and adjusting instruction and interventions as needed (Friend, DeFries, & Olson, 2008). TRs will support the work of the mentor through co-teaching strategies of assisting, team teaching, parallel teaching, differentiated teaching, and station teaching that allow for intensive individual and small group instruction for struggling or accelerated students. Mentors will undergo initial training to become a trained trainer for ADI, as well as training in co-teaching strategies and cognitive coaching to facilitate support of TRs. (IIa3i) This will ensure that mentor teachers' instruction is closely aligned with residents' coursework. In addition to mentoring TRs, they will be expected to actively engage in regular collaborative meetings by subject area, at their school sites in order to participate with teacher and TR colleagues in continual improvement of their capacity to effectively address computational literacy and to advance learning for all students. Mentors will participate in professional development activities of the project and provide expertise and advice on the development of field-based assignments for program coursework. (IIa3ii) Additionally, mentors will not only serve as teacher coaches during the residency, but they will also support residents through the induction process whenever possible. (IIa3iii) They may choose to receive continuing education and/or graduate credit for their participation and may be relieved from teaching duties, if appropriate, as a result of their additional responsibilities.

(IIa4) Mentor Teacher Criteria

Establishment of clear criteria for the selection of mentor teachers will be done collaboratively between partner districts and schools and the university, but will include appropriate subject area knowledge and teacher effectiveness measures including: (1) effective classroom practice demonstrating deep content knowledge and extensive pedagogy and assessment that includes the use of diagnostic and formative assessments to improve student learning; (2) instruction that engages students with different learning styles; (3) collaboration with colleagues to improve instruction; (4) analysis of gains in student learning based on multiple valid and reliable measures; and (5) appropriate skills in essential content areas of mentor candidates, including literacy, math, and computational literacy.

(IIa5) Cohort Model

Teaching residents will be placed in cohorts to facilitate professional collaboration among residents and mentor teachers. CLASSP will place residents in district level cohorts (both middle schools and high schools) with the goal of placing residents in each content area at each school. Our goal is to place 8 residents at each of the three district partnerships, 4 in middle school and 4 in the high school, totaling 12 placements in the first year and 20 in years 2 - 5.

(IIa6) Admission Goals and Priorities

Partner districts will play a key role in the development of the admissions goals and priorities. The rural partner districts will participate in the selection of candidates for the CLASSP program, including the creation of the admissions criteria, rubric, and interview protocol. Representatives from the districts, along with CSU faculty, will conduct interviews and jointly determine applicants for admission. CLASSP will give special consideration of applicants who reflect the communities in which they will teach and individuals from groups who are underrepresented in the teaching profession. When possible, the partner districts will consider hiring residents who complete the program.

(IIa7) Support After CLASSP/Induction

Support for teacher residents who are hired as teachers of record will be provided through a two-year state-approved induction program based on a coherent model of new teacher development. In addition to the support through induction, CLASSP will continue to invite past residents to attend all summer professional development. This will help to reinforce computational literacy and ADI throughout their teaching process. ADI will also provide support through their online monthly webinars.

University faculty will also serve as content experts, providing needed assistance to new teachers and mentors in the induction programs in the partner school districts. The induction support design that will include improving classroom practice, using technology to support student learning guided by CCSS and NGSS, providing culturally relevant instruction, supporting ELLs and students with disabilities and engaging in classroom inquiry and reflection.

Regular, ongoing, formal and informal meetings between district-based support providers and the participating new teachers will result in attention to these areas and continuous growth to address the needs that arise during the first two years of teaching.

(IIb)Selection of Individuals as Teacher Residents.

(IIb1) Eligible Individual

To be considered for selection as a teacher resident, applicants must be a graduate of a four-year IHE or a mid-career professional from outside the field of education possessing strong content knowledge or a record of professional accomplishment.

(IIb2) Selection Criteria

Each candidate must submit an application to CLASSP that includes evidence of (1) strong content knowledge in field or subject area, as indicated by completion of a state-approved subject matter preparation program with a GPA of 3.0 or above or completion of a bachelor's degree in any content with a GPA of 3.0 or above and passage of the California Subject Exam for Teachers (CSET); (2) strong written skills demonstrated by writing samples; (3) strong verbal skills demonstrated in a structured interview; and (4) strong attributes and dispositions linked to effective teaching and collaboration, described in letters of reference.

(IIc) Provision of stipends or salaries

CLASSP will provide a one-year living stipend to any candidate accepted into the program who requests it. Each applicant requesting the stipend must submit an application that contains information and assurances required by the partnership, as well as agreements that the applicant will: (i) Serve as full-time teacher for a total of not less than 3 academic years immediately after successfully completing CLASSP; (ii) Teach in a high-need school, preferably one served by the eligible, high-need LEA in the partnership when possible and teach in a designated high-need subject or area; (iii) Provide to the eligible partnership a certificate from the chief administrative officer of the high need LEA in which the teacher resident is employed, documenting the employment required under paragraph (c)(3)(i) and (ii) of this priority at the beginning of, and upon completion of, each year or partial year of service; (iv) Meet the requirements to be a highly qualified teacher, as defined in section 612(a)(14)(C) of the IDEA when the applicant begins to fulfill the service obligation under the program; and (v) Comply with the requirements established by the eligible partnership under paragraph (IId) of this priority if the applicant is unable or unwilling to complete the service obligation required by the paragraph (IIc3).

(IId) Repayments

(IId1) Each recipient of a stipend or salary under paragraph (IIc1) of this priority who does not complete or who notifies the partnership that he or she intends not to complete, the service obligation required by paragraph (IIc3) of this priority will be required to repay the stipend or salary to CLASSP together with interest at a rate specified by the partnership in the agreement and in accordance with such other terms and conditions specified by the eligible partnership, as necessary.

(IId2) Other terms and conditions specified by CLASSP will include reasonable provisions for pro-rata repayment of the stipend or salary described in paragraph (IIc1) of this priority, or for deferral of a teaching resident's service obligation required by paragraph (IIc3) of this priority, on grounds of health, incapacitation, inability to secure employment in a school served by the eligible partnership, being called to active duty in the Armed Forces of the United States, or other extraordinary circumstances.

(IId3) CLASSP will use any repayment received under paragraph (d) to carry out additional activities consistent with the purposes of the teaching residency program.

Professional Development Activities

CSU Chico faculty along with ADI and SRI will develop a series of professional development activities for both the mentor teacher and teacher residents in the form of summer professional development, ADI/ADM embedded instructional coaching, ADI/ADM 1-day workshop, and monthly webinars. Activities will focus on computational literacy/data practices (see Competitive Preference 1), ADI/ADM (see Competitive Preference 1), and best practices for the year-long clinical placements. See Appendix J.2 for details on ADI's professional development plan, Appendix I for SRI's statement of work, and the management section for a list of activities and milestones. The professional development for CLASSP will embed the content of computational literacy into a research based instructional model (ADI) that has been shown to improve student's achievement in STEM classrooms (Sampson & Gleim, 2009; Sampson, Grooms, & Walker, 2011; Sampson & Murphy, 2019; Sampson, Murphy, Lipscomb, & Hutner, 2018).

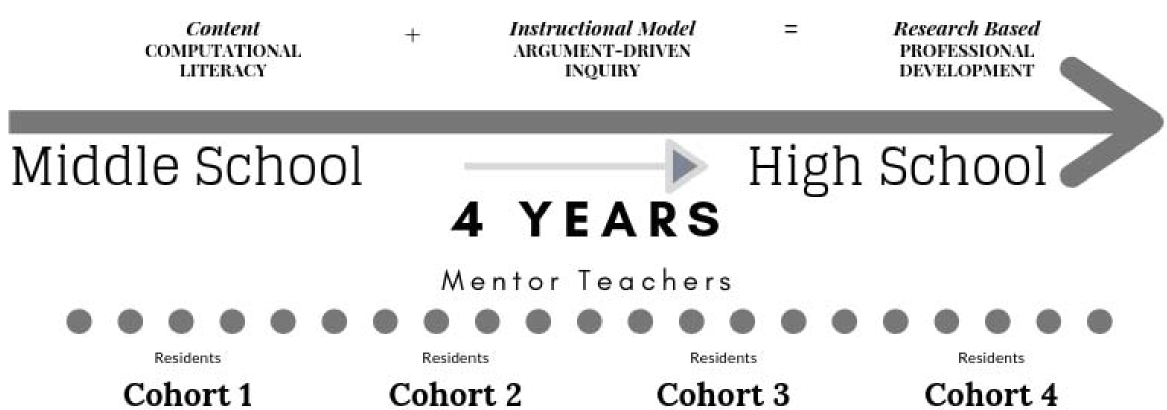


Figure 1. Conceptual Model for CLASSP Professional Development

Summer PD

To build communities of practice, CSU Chico faculty and ADI/ADM will develop a four-day PD where TR and mentor teachers focus on best practices for clinical experiences, building relationships, computational literacy and argument driven inquiry. All inputs, outputs, outcomes, and potential changes based on available data will be shared for continuous improvement.

Embedded Instructional Coaching

ADI/ADM will provide on-site instructional coaching tailored to the needs of each group, school or district. ADI/ADM facilitators will work with educators in their classrooms to help them improve their ADI/ADM instruction. Sometimes all it takes to improve is to watch ADI in action and in context. They can work with educators at their school to choose an ADI investigation and prepare for its implementation. They will then teach the investigation alongside educators on the team, providing the support needed to meet the specific needs of the educators.

Competitive Preference 1: Computational Literacy to Support Computer Science

***Content:* Computational Literacy**

In the President's *Charting a Course for Success: America's Strategy for STEM Education* (2018), the Committee on STEM Education recommends that schools build computational literacy by 1) promoting digital literacy and cyber safety, 2) making computational thinking an integral element of all education, and 3) expanding digital platforms for teaching and learning. CLASSP will focus on the second objective, making computational thinking an integral element of all education, especially mathematics, science, language arts, and special education.

To do this, we must first define computational thinking (CT). According to the President's report, CT "encompasses a set of processes that defines a problem, breaks it down into components, and develops models to solve the problem, then evaluates the result, iterates changes, and does it again" (p. 23). Weintrop et al. (2016) propose a definition of computational thinking for mathematics and science in the form of a taxonomy consisting of four main categories: data practices, modeling and simulation practices, computational problem solving practices, and systems thinking practices. Each of the categories has a subset of five or more practices. See Figure 2.

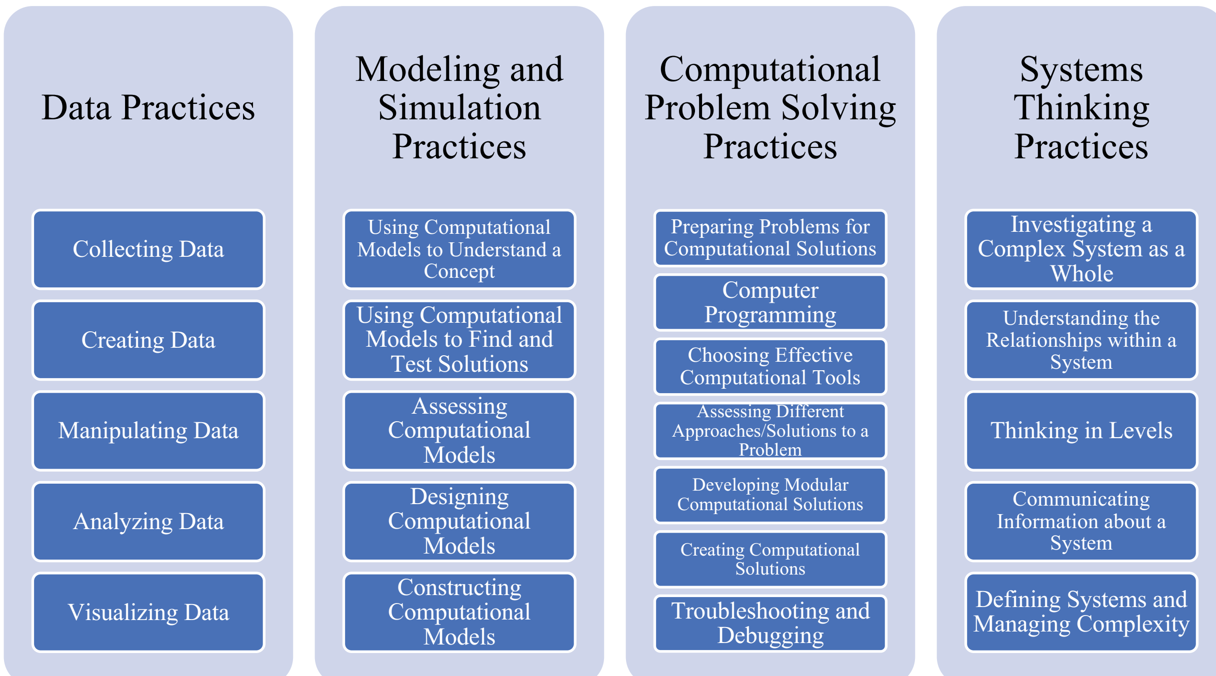


Figure 2. Computational thinking taxonomy.

CLASSP professional development and coursework will focus on "data practices." We will examine how data practices can support the development of computational thinking, which in turn will support the development of computational literacy. By strengthening students experience in data practices in grades 6-12, we will create a foundation of knowledge that will support student's computational literacy.

***Instructional Model:* Argument Driven Inquiry (ADI) & Argument-Driven Mathematics (ADM)**

The National Research Council (2012) published *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas,* with the intent to use the lessons learned from ten years of standards-based science education and the most recent and growing research on the teaching and learning of science to "inform a revision of the standards and revitalize science education" (p. *ix*). The *Framework* explicitly expresses that classroom instruction based on the current research about how people learn looks different than traditional instruction (NRC, 2012). Building on the research referenced for *America's Lab Report: Investigations in High School Science* (NRC, 2006), the *Framework* determined high quality science instruction should involve students learning facts and terms as needed to develop explanations or design solutions rather than memorizing them at the beginning of a unit, using core ideas as tools for understanding or explaining, working in collaborative groups to figure things out rather than relying on the teacher, and answering "why" or "how" questions rather than "what is" or "does it" questions without justifying how they know what they know (NRC, National Research Council, 2012; 2013).

High quality science instruction should involve students *doing* science in ways that are authentic to how professional scientists do science. Literacy and mathematics are critically important to both professional and school science. High quality science instruction should involve students reading and making use of multiple sources to support or refute claims rather than reading single texts from a textbook, writing reports, creating posters, and making presentations instead of answering questions out of a textbook, and using mathematical and computational thinking in order to answer complex questions, rather than using prescribed algorithms (NRC, 2012; NRC, 2013).

Unfortunately, many of the instructional resources available to teachers are not aligned with how we know students learn best, and, of those, many do not adequately integrate literacy or mathematics (NRC, 2012). This is especially true of science lab curricula, which are often so structured that they leave little room for students to make mistakes so that they might learn from them. *Argument Driven Inquiry, or ADI*, is a laboratory instructional model that was designed to make school science look more like professional science and to give students the opportunity to do science the way scientists do. When students complete a lab using the ADI instructional model, they will design and carry out their own investigations, create their own arguments which they will support with evidence, engage in critique with their peers, write authentic reports about their work, and collaboratively review the work of their peers (NRC, 2006; NRC, 2012; Sampson & Gleim, 2009; Sampson et al., 2011).

The Argument-Driven Inquiry (ADI) instructional model was developed as a tool for science teachers. Teachers can use ADI to transform the way they teach labs so students have more opportunities to learn how to use Scientific and Engineering Practices (SEPs), Crosscutting Concepts (CC), and Disciplinary Core Ideas (DCIs) to figure out how things work or why things happen—concepts that are embedded in most, if not all, of today's state and national standards upon which students are assessed (NGSS Lead States, 2013; Sampson & Murphy, 2019; Sampson et al., 2018). ADI also gives students opportunities to learn how to read, write, speak, and listen in science because it makes scientific argumentation the foundation of all laboratory activities. ADI, as a result, makes classroom science more like real science for students and can help them learn more than they typically do from hands-on lab activities (Sampson & Gleim, 2009; Sampson et al., 2011; Sampson & Murphy, 2019).

Reading, writing, language, and mathematics skills are integrally important to professional science and should be part of high-quality science instruction. ADI is designed to be cross curricular because research shows that integrated instructional units are more effective than traditional laboratory instruction and even cultivate greater interest in science (NRC, 2012; NGSS Lead States, 2013). During each ADI lab, students use literacy skills to obtain, evaluate, and communicate scientific information through reading, speaking, listening, and writing. Not only does ADI provide students an opportunity to learn to write, it also uses writing (and reading, speaking, and listening) as a means to help students learn. Literacy instruction does not come at the expense of teaching science content but is instead integral to content instruction in ADI (Sampson et al., 2011; Sampson & Murphy, 2019). Similarly, students will need to creatively use mathematics to solve problems (NGAC and CCSSO, 2010; Schoenfeld, 2015).

This theoretical proposition remains true when examining data from districts that adopt ADI. Districts that adopt ADI see more middle school students pass state science exams. There is also an increase in the percentage of students who score at the highest two levels of proficiency on state standardized tests, such as the State of Texas Assessments of Academic Readiness or STAAR (see Figure 3a TEA, 2017).

These results retain consistency across age levels and subsequent years. Districts that adopt ADI see more high school students pass state end of course exams. For example, students in Texas at an average size school district who took a district Biology End of Course (EOC) exam also scored higher after the district implemented ADI lab investigations. These districts also saw a greater percentage of students scoring in the highest reporting category in the years after adoption (see Figure 3b; TEA 2017).

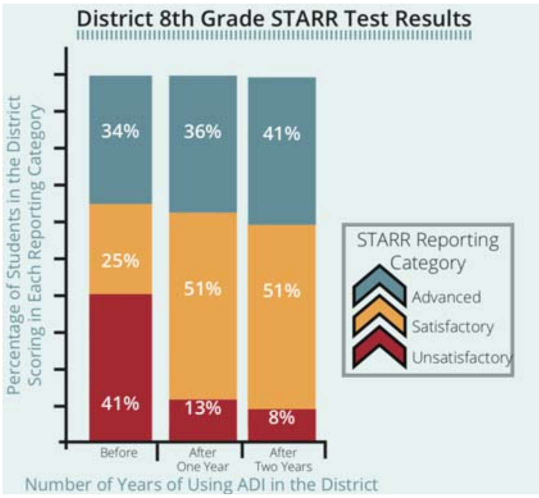


Figure 3a. District 8th grade STAAR test results

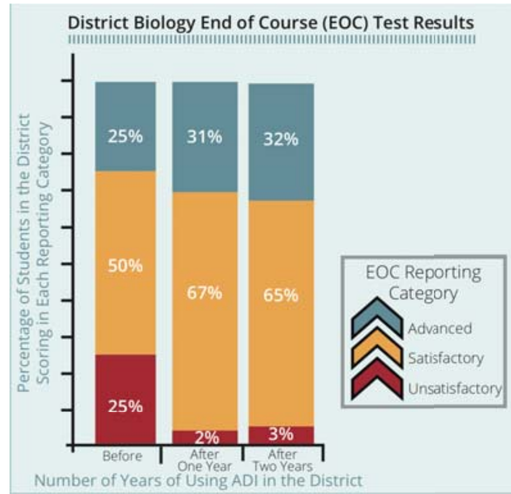


Figure 3b. District Biology EOC test results

Research on ADI supports this as well, especially when compared to districts that do not use ADI. Students in schools that adopt ADI show more growth than students at matched schools that use typical labs (on researcher developed tests of science proficiency). The biggest differences were seen in the types of science content and literacy skills—see Figure 4 (Walker, Sampson, Southerland, & Enderle, 2016).

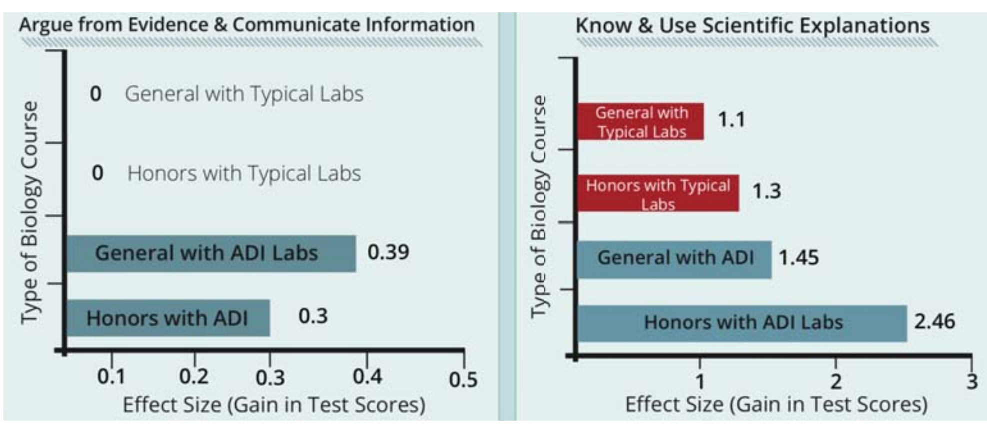


Figure 4. Effect Size (Gain in Test Scores) with ADI labs and typical labs in a Biology Course; Note: 0.2 is considered a 'small' effect size, 0.5 is a 'medium' effect size, and 0.8 a 'large' effect size

The *Argument-Driven Mathematics* (ADM) instructional framework is based upon *Argument-Driven Inquiry in Science*. The ADI Science framework was adapted, as opposed to creating a new framework, to help schools adopt similar instructional approaches in the STEM subjects. ADM is an instructional approach in which students learn the content and engage in mathematical practices, develop and critique the arguments of others, and participate in mathematical communities to reason in pure, STEM, and social contexts. This instructional approach is designed to use mathematics as a way to help students develop literacy (reading, writing, speaking, and listening) skills to "figure things out" instead of just "learning about things" in mathematics. ADM is highly aligned with *Teaching for Robust Understanding (TRU)* and engages students in all of the mathematical practices identified in the Common Core Mathematics Standards (NGAC and CCSSO 2010; Schoenfeld 2015):

The Five Dimensions of Mathematically Powerful Classrooms				
The Mathematics	**Cognitive Demand**	**Access to Mathematical Content**	**Agency, Authority, and Identity**	**Formative Assessment**
The extent to which the mathematics discussed is focused and coherent, and to which connections between procedures, concepts and contexts (where appropriate) are addressed and explained. Students should have opportunities to learn important mathematical content and practices, and to develop productive mathematical habits of mind.	*The extent to which classroom interactions create and maintain an environment of productive intellectual challenge conducive to students' mathematical development. There is a happy medium between spoon-feeding mathematics in bite-sized pieces and having the challenges so large that students are lost at sea.*	*The extent to which classroom activity structures invite and support the active engagement of all of the students in the classroom with the core mathematics being addressed by the class. No matter how rich the mathematics being discussed, a classroom in which a small number of students get most of the "air time" is not equitable.*	*The extent to which students have opportunities to conjecture, explain, make mathematical arguments, and build on one another's ideas, in ways that contribute to their development of agency (the capacity and willingness to engage mathematically) and authority (recognition for being mathematically solid), resulting in positive identities as doers of mathematics.*	*The extent to which the teacher solicits student thinking and subsequent instruction responds to those ideas, by building on productive beginnings or addressing emerging misunderstanding s . Powerful instruction "meets students where they are" and gives them opportunities to move forward.*

Figure 5. The Teaching for Robust Understanding in Mathematics Framework. (Reproduced from Schoenfeld 2015)

The TRU framework, with the belief in the importance of mathematics for all students, recognizes that “equitable classrooms provide all students access to meaningful disciplinary concepts and practices, supporting those students in developing their own understandings and building productive disciplinary identities” (Schoenfeld 2015, p. 14-16). TRU focuses on the mathematical experience in the classroom from the student’s point of view, ensuring all students are active participants in mathematical dialogue (as opposed to few students dominating classroom discourse) and actively grappling with important mathematical ideas (Schoenfeld 2015).

It is within this theoretical mathematical frame as well as the mathematical space within the theoretical frame of Argument-Driven Inquiry (see p. 4-7 above) that ADM was developed. The structure of ADM ensures that students engage in the specific types of interaction with each other, the teacher, and the mathematics that research has shown are effective. As an example, much research exists on the effectiveness of discipline-based writing—learning to write by writing to learn (Boaler & Sengupta-Irving, 2016). In the ADM instructional framework, students partake in this effective learning approach in stages 6 and 8, regardless of the specific math content underlying the ADME. Consistent with ADI investigations, each ADME responds to the five dimensions of TRU in different ways--Figure 5 (Schoenfeld 2015).

Invitational Priority

CLASSP will also be servicing students that reside in a qualified opportunity zone as designated by the Secretary of Treasury under section 1400Z-1 on the Internal Revenue code. Table X provides the census tract number of the qualified opportunity zone. Each school resides in a county that qualifies as “low-income community.”

Table 1. Designated Qualified Opportunity Zones*

State	County	Census Tract Number	Tract Type	ACS Data Source
California	Butte	06007000502	Low-Income Community	2011-2015
California	Butte	06007000604	Low-Income Community	2011-2015
California	Butte	06007001000	Low-Income Community	2011-2015
California	Butte	06007001100	Low-Income Community	2011-2015
California	Butte	06007001200	Low-Income Community	2011-2015
California	Butte	06007001300	Low-Income Community	2011-2015
California	Butte	06007002800	Low-Income Community	2011-2015
California	Butte	06007003001	Low-Income Community	2011-2015
California	Butte	06007003002	Low-Income Community	2011-2015
California	Glenn	06021010100	Low-Income Community	2011-2015
California	Glenn	06021010200	Low-Income Community	2011-2015
California	Sutter	06101050102	Low-Income Community	2011-2015
California	Sutter	06101050201	Low-Income Community	2011-2015
California	Sutter	06101050202	Low-Income Community	2011-2015
California	Sutter	06101050302	Low-Income Community	2011-2015

*This document was updated December 14, 2018, to reflect the final Qualified Opportunity Zone designations for all States. Please note that the below list of designated tracts is not the official list. The official list will be published in the Internal Revenue Bulletin at a later date.

Adequacy of Resources

CLASSP is a comprehensive partnership of educational, community and business partners committed to the success of the project as evidenced by letters of support in Appendix I. Major CSU Chico partners include the College of Communication and Education, the School of Education; the College of Natural Sciences, the Department of Mathematics and Statistics, the Department of Science Education, and the Center for Mathematics and Science Education; the College of Engineering, Computer Science and Construction Management; the College of Humanities and Fine Arts and the Department of English; and the Office of Graduate Studies. The Butte-Glenn Community College District is also a higher education partner.

The three district and six public school partners are Live Oak Unified School District: Live Oak Middle and High School, Willows Unified School District: Willows Intermediate and High School, and Gridley Unified School District: Sycamore Middle School and Gridley High School.

The partner counties include Butte County Office of Education, Glenn County Office of Education, and Sutter County Office of Education. Education agency and program partners include California State University System (CSU); the CSU Center for Educator Quality (EdQ); the Chico Mathematics Project; the California Science Project – Inland Northern California; and the Northern California Writing Project.

Faculty across the two colleges involved in this proposal (College of Communication and Education and College of Natural Sciences) have a long history of collaboration. Faculty from the School of Education and the College of Natural Sciences serve as members of the Mathematics and Science Teaching Initiative (MSTI) program, the Noyce Advisory Committee, and the current TQP-funded grant (PRISMS).

Faculty and administrators from both colleges serve in multiple roles that overlap and provide collaboration and coordination with the PRISMS Project, the Noyce Program, MSTI, Hispanic-Serving Institution (HSI) campus programs, and programs supporting teacher professional preparation and credentialing. The College of Natural Sciences faculty work with SOE faculty as subject matter advisors and are responsible for ensuring all math and science students entering the professional preparation program are subject matter competent.

The Center for Mathematics and Science Education (CMSE) is a Center of Excellence in the College of Natural Sciences and is dedicated to increasing the understanding of mathematics and science at all age levels and serving the educators and students of Northern California. The CMSE leadership team is made up of 1-2 Faculty Director(s) from mathematics and/or science education faculty, and a managing director. The leadership team works with and is guided by an advisory board made up of mathematics and science education faculty from CNS and SOE, 1 faculty from the School of Engineering, 1-2 area K-12 educators, and the CMSE Directors.

CMSE and the advisory board provide a formal setting for collaboration between the STEM Colleges and the SOE at CSU Chico, and solicit input from area K-12 educators.

In addition to this formal collaboration, the SOE and College of Natural Sciences have an extensive history of collaboration on projects to prepare and support K-12 teachers. Including three successful Noyce programs (2007, 2011, 2017) and multiple collaborations on California Postsecondary Education Commission grants. In 2014, the SOE received a Teacher Quality Partnership Grant: PRISMS Project, and faculty from both the SOE (Dr. Oloff-Lewis) and CNS (Dr. Matthews) served as directors for this program.

CLASSP will also coordinate its teacher credential efforts with reform activities taking place in partnership schools. Participating districts and schools have strong leadership and a commitment to reform. They were invited to participate not only based on eligibility criteria, but also for their significant needs and willingness to take on reform efforts on behalf of improving achievement of all students. These districts have local, state, and federal resources to support the project, including funding under Title I and IDEA.

The project will also be closely aligned with funded grants and scholarship programs that support reform efforts and complement CLASSP, including Math Teacher Education Partnership (MTEP); Noyce Scholars Program for STEM Majors; California Math and Science Partnership (CaMSP); Math and Secondary Teaching Initiative (MSTI); CPEC Improving Teacher Quality (ITQ), as well as other grant projects, including Northern California Collaboration for Low Incidence Personnel Preparation (NorCAL CLIPP); and Collaborative Professional Development (CPD) Project in Rural California Schools.

Partnership Resources

CLASSP will build upon the existing resources that have already been established for the PRISMS grant. CLASSP will utilize the same facilities, equipment, supplies, and other resources to meet the needs of the grant. California State University, Chico devotes approximately $3 million annually to the preparation of K-12 teachers. SOE alumni are strong financial supporters and provide funding to meet a variety of needs, including student scholarships. The campus offers a wide variety of resources including technology equipment and support, library, and media holdings and an array of student services to support recruitment and retention of diverse students. Strategies that will ensure the institutionalization of project activities and reforms will be explored with our district partners beginning in year one. Allocating necessary resources, CSU Chico is committed to comprehensive program redesign and implementation that cuts across the university. The structural changes that CLASSP will bring about in teacher preparation programs at the university, partnership activities between the university and the local school districts, the new teacher support programs, and the ongoing professional development activities are all supported by the top leadership of the institutions and will be sustained when the program's federal funding ends.

Management Plan

The management plan of the project includes major roles and a major voice in decision-making for each partner in a collaborative design that builds on the functions of each and brings them together in a comprehensive effort focused on achieving major reforms (see Table 2). Each of the partners is committed to the project and to the integration of its full range of professional development and related activities to create changes in fundamental operations that can be institutionalized and sustained to maximize project effectiveness. The project will establish governance and decision-making structures permitting all partners to plan, implement, and assess the adequacy of project activities. Top-level leaders will be involved from each partner agency, and all partners are committed to data-driven decision-making and reform. K-12 teachers and administrators will have important roles in project design, implementation, and evaluation, including continuous review and revision of the project's activities based on evaluation results.

The regular assessment and evaluation of program components are evidenced in the timeline of CLASSP Activities. In recent efforts, teacher education has turned to improvement science to study reform practices and their impacts. By engaging in short improvement cycles, changes to systems can be introduced and studied on a smaller scale before full implementation. Rather than implementing fast and learning slowly, this approach promotes learning fast to implement well (Bryk, Gomez, Grunow, & LeMahieu, 2015). Throughout the grant, we will use a “learning sprint” approach in which we will collect data, study impact and make goal-directed adjustments throughout the academic year. Additionally, as part of its ongoing state accreditation process, CSU Chico School of Education collects a variety of assessment data each year and reports annually to the CSU Chancellor’s Office and to Title II and biennially to the CCTC on the data analysis and implications for program improvement. CLASSP and its programs will undergo the same scrutiny, as well as annual reports to the TQP funders.

The timeline provided in Table 2 describes the responsibilities, timelines, and milestones of the project and includes procedures for ensuring feedback and continuous improvement and quality of outcomes. The **CLASSP Advisory Board** (see Appendix J.3), the chief decision-making body, will meet two times per year and will be composed of key leaders from LEA, and IHE partners; (b) the **CLASSP Planning Committees** (see Appendix J.3), who are responsible for the development and revision of professional development experiences, evaluation of assessment and feedback data for program improvement and input to the Advisory Board, and ensuring uniform quality in materials designed/produced by the project, and (c) the **Admissions Committee** who select teacher residents for each of the three participating districts.

The program will utilize the efficient, effective management structure that exists from our prior TQP grant and is overseen by the PI. The following team along with district and community college partners will comprise the CLASSP Advisory Board Committee, who will meet two times each year, once each semester. Additional meetings included during the application period. Table 2 below details the timeline for program activities.

Key personnel are highly qualified and have relevant training and experience to support the design, implementation, and continuous improvement of CLASSP.

PI and Project Director: Dr. Jennifer Oloff-Lewis. Responsibilities: oversee program design and implementation; assist in TR selection; coordinate with partners; assist with internal evaluation, including the design and administration of performance and survey data; coordinate with external evaluation team; teach research methods course to TRs; provide fiscal and administrative management; hire, supervise, and evaluate staff; oversee management team and advisory council. Qualifications: Associate Professor, School of Education Assistant Director, and Assessment Coordinator. Teaches research methods course, mathematics methods course, and foundations of education courses. Experience working on a federally-funded residency program (PRISMS) and directing large federal grants, including two NSF Robert Noyce Scholarship grants.

Table 2. CLASSP: Goals, Objectives, Milestones, Timelines, and Responsibilities

Key for Persons Responsible: Project Director (PD); Director of Clinical Experience (CE); Recruitment Coordinator (RC); Computational Thinking Specialist (CST); Continuous Improvement Coordinator (CIC); District Partners (DP); Argument Driven Inquiry (ADI); Chico State University, Chico Faculty (CSUC); Community College Partners (CCP)

Strategies, Activities, and Milestones	Timeline	Responsibility
Goal 1: Recruit, enroll, and place 72 highly-qualified individuals to the teaching profession in high-need rural areas.		
Activity: Recruitment of teacher candidates. Milestone: The number of cumulative teacher candidates recruited in CLASSP	August – Oct Y2-5 Jan – March Y1-4	RC, PD, CE
Activity: Admission and enrollment of teacher candidates in program. Milestone: The number of cumulative teacher candidates enrolled in CLASSP	August – Oct Y2-5 Jan – March Y1-4	PD, CE, DP
Activity: Placement of teacher candidates in district partnerships. Milestone: The number of cumulative teacher candidates placed in district partnerships.	August – Oct Y2-5 Jan – March Y1-4	PD, CE, DP
Goal 2: Engage selected Teacher Residents in a year-long full-time teacher residency preparatory curriculum and professional development program that enhances their content knowledge and develops their expertise in computational literacy.		
Activity: TRs participate in high-quality, evidence-based teacher practices in coursework, clinical experience and MA program. Milestones: Successful completion of MA and teaching credential.	Aug – June Y1 – Y5	CSUC, CIC, CST
Activity: Teacher residents conduct action research in classrooms. Milestone: Completion of MA degree	Jan – June Y2-Y5	CSUC
Objective 1: strengthen the education of future teachers for rural schools, especially in STEM and special education Activity: Educator preparation courses/programs redesigned with special emphasis on computational literacy and best practices in teaching rural students Milestone: Advisory Board meet each semester to review curriculum, course assignments, field/clinical experiences, standards alignment, etc. to provide input for continuous program improvement.	Fall & Spring Y1-Y5	CSUC, PD, CE, CIC, CTS, SRI, ADI
Activity: Teacher residents and mentor teachers attend PD on CT and ADI Milestone: The number of PD activities attended by teacher residents and mentor teachers	Summer, Fall, and Spring Y1 -Y5	CST, ADI, CIC, PD, CSUC
Object 2: Improve and promote computational literacy practices for teacher residents and mentor teachers.	Summer Y1 – Y5	ADI

Activity: Teacher residents and mentor teachers become trained trainers of ADI Milestone: The number of trained ADI trainers		
Objective 3: Improve and promote student computational literacy in secondary settings across the content areas (6-12 classrooms) Activity: Teacher residents and mentor teachers facilitate multiple lessons using ADI/ADM to promote computational literacy. Milestone: The number of lessons taught during a year using ADI/ADM to promote computational literacy.	Fall & Spring Y1 – Y5	ADI, CSUC, PD, CIC, SRI
Goal 3: Provide Teacher Residents ongoing support that complements their induction support during their novice teaching years to positively impact the academic outcomes of rural public-school students.		
Activity: Teacher residents continue work with computational literacy and ADI/ADM. Milestone: The number of teacher residents who complete train the trainer training, return for summer workshops, and participate in online assistance offered by ADI.	June – June yearly	ADI,
Goal 4: Engage in collaborative continuous improvement efforts to positively impact the resident and mentor's teaching practice.		
Activity: Create a Continuous Improvement Committee composed of representatives from each partner entity to examine program performance monthly Milestone: Monthly meetings	Monthly Y1-Y5	CIC, PD, CE, CST, SRI, ADI
Goal 5: Develop and sustain the project's partnerships and institutionalize its reforms.		
Activity: Create an Advisory Board composed of representatives from each partner entity to examine program performance every semester Milestone: Semi-annual meetings	Fall & Spring Y1-Y5	CIC, PD, CE, CST, SRI, ADI, CCP

Computational Thinking Specialist: Dr. Brian Lindaman. Responsibilities: assists with program design and implementation; revise STEM curriculum to integrate computational thinking in three rural communities; coordinate with the Department of Mathematics on the revision and teaching of mathematics methods courses; coordinate with SOE faculty and ADI to support professional development activities in computational thinking. Qualifications: Associate Professor of Mathematics Education in the Department of Mathematics and Director for the Center for Mathematics and Science Education. Twenty years of experience teaching mathematics and mathematics education courses to undergraduate and graduate students. Expertise in creating professional development opportunities for STEM teachers and facilitation of STEM activities which foster computational thinking in children, with an emphasis on coding, robotics, and data analysis at the K-6 and 6-12 grade levels.

Continuous Improvement Coordinator, Dr. Mimi Miller. Responsibilities: assist with program design and implementation; assist in TR selection; coordinate with partners; oversee internal evaluation, including the design and administration of performance and survey data; coordinate with external evaluation team. Qualifications: Professor in the School of Education and accreditation visit team lead for the Board of Institutional Reviewers, California Commission on Teacher Credentialing. Eighteen years of experience teaching pre-service teachers. Expertise in applying improvement science to build and study systems for teacher learning is particularly relevant to this project.

Director of Clinical Experience: Jeff Peek. Responsibilities: Assist in the selection of residents; guide and supervise clinical experiences; coordinate selection of residency placement schools; coordinate selection and training of TMs and supervisors; revise curriculum for residency seminar; oversee supervision and residency seminar. Qualifications: Former high school principal and science teacher. Experience working on a federally-funded residency program (PRISMS) as a content specialist.

Recruitment Coordinator, Cheryl Ordorica. Responsibilities: recruitment, screening, and advising of residents; assist with admission, registration, financial aid, certification applications; manage databases; coordinate with key partners. Qualifications: Relevant experience working as a recruiter for education programs. Experience working on a federally-funded residency program (PRISMS) as recruitment coordinator.

Assessment and Research Assistant. Part-time, the assistant will support CLASSP on research, assessment, and reporting activities. Qualification requirements: experienced with research, data collection, analysis and reporting; and demonstrated technology fluency and ability to complete tasks accurately and on time.

As indicated in the budget, CME and SOE have also allocated staff and time to the project in the form of cost-share including: Field Placement Coordinator; Credential Analyst; Pre-Credential Advisor; and CME Grants Office.

The Evaluation Plan

SRI International, a national nonprofit research organization, will conduct an independent evaluation of CLASSP. The evaluation will measure implementation of ADI instructional practices and strategies for computational thinking (CT), as enacted by residents and their mentor teachers in middle and high-school courses in the partner schools and districts where residents are placed. It will also track graduates into their teaching jobs to learn more about their continued use of the instructional strategies. The evaluation is guided by the following research questions:

1) ***Implementation***. To what degree are mentor teachers and residents using ADI strategies with fidelity in classrooms? Are students given opportunities to develop computational thinking across subjects and grades in partner districts?

2) ***Challenges and supports.*** What challenges do mentor teachers and residents face in implementing ADI instructional practices and strategies that promote computational thinking in classrooms? How do the challenges differ by subject or grade level? To what extent do the supports provided by CSU, Chico meet resident, mentor teacher, and graduated resident/new teacher needs?

3) ***Teacher outcomes.*** To what extent do residents and their mentor teachers continue to use strategies that promote student computational thinking after the co-teaching residency year? Does use vary by subject or grade level?

4) ***Student outcomes.*** Do students' perceptions of and practices involving computational thinking improve over time? How does change vary by partner district, grade level, and subject?

Research Design Overview

To address the research questions, SRI will use qualitative and quantitative methods to document the implementation of CLASSP, measure teacher practices, and assess student attitudes about computational thinking. The following table charts the research topics by each data source and research activity.

Table 3. Research Topics and Data Sources

Research Topics	Implementation		Outcomes	
	Site visits	Resident & mentor teacher logs	Graduate interviews	Student surveys
1) Implementation	X	X		
2) Challenges and supports	X	X		
3) Teacher outcomes		X	X	
4) Student outcomes				X

Data Collection Activities

This section outlines each data collection activity, providing details about the planning, enactment, and analysis of site visits, logs, interviews, and surveys.

Implementation

Site visits. Site visits will provide information about implementation, as well as highlight the structures and supports needed for high-quality residency placements and instructional practices that lead to optimal outcomes. Site visits will occur in the spring of Years 2, 3, and 4 of the project, and involve three different resident cohorts. Site visits will include interviews with CSU, Chico program staff as well as participants from partner districts. Interviewees will include project leadership, university faculty, district leaders, residents, and mentor teachers. SRI will develop semi-structured protocols for each type of interview to gather information on candidate recruitment and selection, mentor teacher selection, professional development, instructional planning, the alignment between coursework and fieldwork, the alignment between district priorities and the project, and ongoing support for participants. Data will be analyzed using a coding system to identify themes and findings will be shared with CSU, Chico program staff through formative feedback.

Resident and mentor teacher logs. Monthly teaching practice logs will be created to measure fidelity to the program and capture details regarding implementation. Development will occur during Year 1 and data collection will begin in Year 2 and continue throughout the project. On a monthly basis, teachers will provide details about program participation, including: 1) attendance at professional development or meetings, 2) the frequency of co-teaching and co-planning, 3) the use of ADI cycles in planning and instruction, and 3) the degree to which computational thinking has been embedded into lessons. Residents and mentor teachers will also answer questions about their perceptions and attitudes related to CLASSP. SRI will work closely with CSU, Chico leadership to determine appropriate fidelity measures and to incentivize participation to reach satisfactory response rates.

SRI will update descriptive statistics each month from teachers' logs to monitor program participation and ADI/computational thinking strategy use, sharing aggregate data with CSU, Chico faculty to use in their continuous improvement analyses. At the end of each school year, SRI researchers will aggregate log data across time points and analyze trends in ADI/computational thinking strategy implementation, illuminating which strategies are used more frequently, for example. SRI researchers will also estimate changes in perceptions and attitudes regarding computational thinking and its application from the beginning to the end of the school year, and conduct correlational analyses using OLS regression to understand how those changes vary for mentor teachers and residents of different subject areas and grade levels.

Teacher outcomes

Graduate interviews. Beginning in Year 3, Researchers will interview CLASSP completers who are in the spring of their first or second year of teaching. The purpose of these interviews is to understand the extent to which the novice teachers continue to implement ADI instructional strategies and embed computational thinking in their teaching. Researchers will develop semi-structured, artifact-driven interview protocols that include questions assessing: 1) the frequency with which teachers across subjects and grade levels use ADI instructional practices and support computational thinking; 2) how they use ADI/CT strategies; 3) any challenges related to implementing ADI/CT in their placements; and 4) their perceptions of the impact of ADI/CT strategies on student learning and engagement. Teachers will be asked to share artifacts (e.g., lesson plans, student work) that demonstrate how they use ADI/CT in their classroom to anchor the interview. Data will be analyzed to answer RQ3. Analyses will also explore challenges, successes, and variation in context that affect the use of ADI and CT in classrooms.

Student Outcomes

Student surveys. CLASSP will distinguish itself by supporting new teachers to embed computational thinking across all subject areas and all secondary (6-12) grade levels. Researchers at SRI International are at the forefront of developing frameworks and tools for assessing practices, concepts, and perspectives related to computational thinking.[1] Working closely with SRI's national leaders in the field of assessment for computational thinking, researchers will develop and pilot a survey during the first and second year that measures the computational perceptions and practices of students in classrooms of residents and mentor teachers participating in the CLASSP. Developing a survey that can be used to measure computational thinking perceptions and practices across content areas and grade levels is

---

[1] For example, Basu, McElhaney, Grover, Harris, & Biswas (2018). *A principled approach to designing assessments that integrate science and computational thinking.* In J. Kay & R. Luckin (Eds.), Rethinking learning in the digital age: Making the learning sciences count; Snow, Rutstein, Basu, (2018). *Considering computational thinking, culture and assessment: Leveraging evidence-centered design to develop authentic assessments of computational thinking practices.* Presented at the 14th annual meeting of the International Society for Design and Development in Education.

necessary as there are currently no valid and reliable measures available for this purpose. Using measures of CT perceptions and practices to understand program impact, as opposed to using more traditional measures of student achievement, such as reading or math standardized achievement scores, is more appropriate to this evaluation because 1) the program logic model posits that we are likely to see changes in student CT before there are changes to academic achievement more and 2) the assessment of CT will be subject and grade level agnostic and so informative across all of the study classrooms.

Key goals of CLASSP include training resident and mentor teachers in how to use ADI and embed computational thinking into their instruction, as well as building capacity and alignment within partner districts. Because the 72 teachers trained by CLASSP will be clustered within middle and high schools across 3 districts, many students will have repeated exposure to teachers with this training over the course of the study. SRI researchers will build a database to track student exposure to ADI/CT-trained teachers each semester and link this data - using a personal student identifier - to survey response data.

All students in secondary grades in the partner districts will complete the SRI developed CT survey at the beginning and end of each academic year, beginning in year 2. Researchers will use a three-level hierarchical linear model (HLM), which can appropriately adjust for student clustering within classrooms and schools (Raudenbush & Bryk, 2002), to estimate how dosage (as measured by the number of semesters a student is taught by a resident and mentor teacher pair participating in CLASSP from year 2 to year 5) is correlated with increases in student computational thinking perceptions and practices. To improve the precision of the estimates, we will include covariates for students (e.g., grade, gender), teachers (e.g., subject), and schools (e.g., school size, urbanicity), that are expected to be related to improvement in computational thinking. Analyses of student outcomes will be conducted once, at the conclusion of the study, using data pooled from year 2 to year 5.

Reporting

SRI will provide formative feedback to CSU, Chico throughout the evaluation, as well as write up a final, summative report at the end of the evaluation. The following table outlines the proposed deliverables.

Table 4. Deliverables

Deliverable	Description	Approximate Date
Fidelity design memo	• Measures of implementation fidelity and data that will be collected as part of site visits and surveys to measure implementation	January 2020
Instrumentation	• Mentor teacher and resident logs • Student survey	June 2020
Implementation memos	• Summary of implementation, including challenges, supports, and educator perceptions	June 2021 June 2022 June 2023
Outcome memos	• Student perceptions of computational thinking • Resident and mentor teacher use of strategies that support computational thinking across classrooms in partner districts • Graduates' continued use of strategies in their teaching positions post-graduation	Summer 2022 Summer 2023
Final report	• Summative review of implementation and outcomes across CLASSP, including outcome data collected during the 2023-24 academic year	August 2024

Staff Qualifications

Ashley Campbell and Daniela Torre Gibney will lead the SRI team. Sara Rutherford-Quach will serve as Project Director. This project will also rely on the expertise of Satabdi Basu in the development of instruments to measure computational thinking (see Appendix H for bios and CVs).

References

Beaudoin, C., Johnston, P., Jones, L., & Waggett, R. (2013). University support of secondary STEM teachers through professional development. *Education, 133*(3), 330-339.

Bireda, S., & Chait, R. (2011). Increasing Teacher Diversity: Strategies to Improve the Teacher Workforce. *Center for American Progress*.

Boaler, J., & Sengupta-Irving, T. (2016). The many colors of algebra: The impact of equity focused teaching upon student learning and engagement. *The Journal of Mathematical Behavior, 41*, 179-190. Retrieved from http://www.sciencedirect.com/science/article/pii/S0732312315300079. doi:https://doi.org/10.1016/j.jmathb.2015.10.007

Bryk, A. S., Gomez, L. M., Grunow, A., & LeMahieu, P. G. (2015). *Learning to improve: How America's schools can get better at getting better*: Harvard Education Press.

Caprano, R. M., Capraro, M. M., Capraro, R. M., & Helfeldt, J. (2010). Do differing types of field experiences make a difference in teacher candidates' perceived level of competence? *Teacher Education Quarterly, 37*(1), 131-154.

Carver-Thomas, D., & Darling-Hammond, L. (2017). Addressing California's Growing Teacher Shortage.

Chval, K., Abell, S., Pareja, E., Musikul, K., & Ritzka, G. (2008). Science and Mathematics Teachers' Experiences, Needs, and Expectations Regarding Professional Development. *Eurasia Journal of Mathematics, Science & Technology Education, 4*(1).

Clewell, B. C., & Villegas, A. M. (2001). Absence Unexcused: Ending Teacher Shortages in High-Need Areas. Evaluating the Pathways to Teaching Careers Program.

Coggshall, J. G. (2012). Toward the Effective Teaching of New College-and Career-Ready Standards: Making Professional Learning Systemic. Research-to-Practice Brief. *National Comprehensive Center for Teacher Quality*.

Collins, B. C., Hawkins, S., Keramidas, C. G., Mclaren, E. M., Schuster, J. W., Slevin, B. N., & Spoelker, D. L. (2005). The effect of No Child Left Behind on rural students with low incidence disabilities. *Rural Special Education Quarterly, 24*(1), 48-53.

Darling-Hammond, L. (2000). May/June How teacher education matters. *Journal of Teacher Education, 51*(3 SRC - BaiduScholar), 166-173.

Darling-Hammond, L. (2015). Frustration. Burnout. Attrition. It's Time To Address The National Teacher Shortage. Retrieved from http://www.npr.org/sections/ed/2016/09/15/493808213/frustration-burnout-attrition-its-time-to-address-the-national-teacher-shortage

Darling-Hammond, L., Furger, R., Shields, P. M., & Sutcher, L. (2016). *Addressing California's Emerging Teacher Shortage: An Analysis of Sources and Solutions*. Retrieved from www.learningpolicyinstitute.org/addressing-ca-teacher-shortage

Dee, T. (2004). Teachers, race and student achievement in a randomized experiment, The Review of Economics and Statistics. *86*(1 SRC - BaiduScholar), 195-210.

Desimone, L. M., Porter, A. C., Garet, M. S., Yoon, K. S., & Birman, B. F. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Educational Evaluation and Policy Analysis, 24*(2 SRC - BaiduScholar), 81-112.

Dessoff, A. (2010). June . Persuading teachers to go rural. *District Administration, 46*(6 SRC - BaiduScholar), 58-60.

Friend, A., DeFries, J. C., & Olson, R. K. (2008). Parental education moderates genetic influences on reading disability. *Psychological science, 19*(11), 1124-1130. Retrieved from http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&DbFrom=pubmed&Cmd=Link&LinkName=pubmed_pubmed&LinkReadableName=Related%20Articles&IdsFromResult=19076484&ordinalpos=3&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVDocSum.

Ludlow, B., Conner, D., & Schechter, J. (2005). Low incidence disabilities and personnel preparation for rural areas: Current status and future trends. *Rural Special Education Quarterly, 24*(3 SRC - BaiduScholar), 15-24.

National Governors Association Center for Best Practices and Council of Chief State School Officers. (2010). *Common Core State Standards*. Retrieved from Washington, DC:

National Research Council. (2006). *America's Lab Report: Investigations in High School Science*. Washington, DC: The National Academies Press.

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press.

National Science and Technology Council. (2018). *Charting a Course for Success: America's Strategy for STEM Education*. Retrieved from Washington, DC: https://www.whitehouse.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf

NGSS Lead States. (2013). *Next Generation Science Standards*. Washington, DC: The National Academies Press.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks: Sage Publications, Inc.

Rude, H., Jackson, L., Correa, S., Luckner, J., Muir, S., & Ferrell, K. (2005). Perceived needs of students with low-incidence disabilities in rural areas. *Rural Special Education Quarterly, 24*(3 SRC - BaiduScholar), 3-14.

Sampson, V., & Gleim, L. (2009). *Argument-Driven Inquiry To Promote the Understanding of Important Concepts & Practices in Biology* (Vol. 71): BIOONE.

Sampson, V., Grooms, J., & Walker, J. P. (2011). Argument-Driven Inquiry as a way to help students learn how to participate in scientific argumentation and craft written arguments: An exploratory study. *Science Education, 95*(2), 217-257. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/sce.20421. doi:10.1002/sce.20421

Sampson, V., & Murphy, A. (2019). *Argument-Driven Inquiry in 3rd grade science: Three-dimensional investigations*. VA: NSTA Press.

Sampson, V., Murphy, A., Lipscomb, K., & Hutner, T. (2018). *Argument-Driven Inquiry in earth-space science: Lab investigations for grades 6-10*. VA: NSTA Press.

Schmitz, S., Nourse, S., & Ross, M. (2012). Increasing Teacher Diversity: Growing Your Own Through Partnerships. *Education, 133*(1).

Schoenfeld, A. H. (2015). Thoughts on scale. *ZDM, 47*(1), 161-169. Retrieved from https://doi.org/10.1007/s11858-014-0662-3. doi:10.1007/s11858-014-0662-3

Texas Education Agency. (2017). Assessment results: STAAR aggregate data. . Retrieved from http://tea.texas.gov/student.assessment/results

Walker, J. P., Sampson, V., Southerland, S., & Enderle, P. J. (2016). Using the laboratory to engage all students in science practices. *Chemistry Education Research and Practice, 17*(4), 1098-1113.

Weintrop, D., Beheshti, E., Horn, M., Orton, K., Jona, K., Trouille, L., & Wilensky, U. (2016). Defining Computational Thinking for Mathematics and Science Classrooms. *Journal of Science Education and Technology, 25*(1), 127-147. Retrieved from https://doi.org/10.1007/s10956-015-9581-5. doi:10.1007/s10956-015-9581-5