Computational Literacy Across Secondary Settings (CLASS) Program

A Teacher Quality Partnership (TQP) Grant Evaluation

Final Implementation and Outcomes Report

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Prepared for:
Jennifer Oloff-Lewis
California State University, Chico
400 W 1st St.
Chico, CA 95929

Prepared by:
Ela Joshi
Douglas Gagnon
Erin Smith
SRI Project Number: 100585

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Executive Summary

In 2019, California State University (CSU), Chico was awarded a five-year Teaching Quality Partnership (TQP) grant to implement the Computational Literacy Across Secondary Settings (CLASS) program. The goal of this program was to recruit, prepare, and retain highly qualified individuals into the teaching profession, with a focus on high-need rural areas. A major focus of the program was the implementation of Argument Driven Inquiry (ADI) and integration of computation thinking (CT) into teacher instruction. During this time (2020–24), SRI International served as the external evaluator for the grant. This final report presents highlights and key insights from data collection activities that occurred throughout the program.

To evaluate the CLASS program, SRI researchers analyzed program outcomes, including teacher and student outcomes. SRI used a correlational study design to estimate the relationship between students' assignment to CLASS pairs and students' CT skills, confidence in CT practices, and interest in future careers in a computer science field. To understand students' relationship with CT, SRI administered a student CT instrument to collect baseline and outcome data. SRI also collected annual data on program implementation and program participants' experiences from 2020–21 through 2023–24, focusing on the use of ADI and CT practices. Data collection included a mentor survey, monthly questionnaires for teachers, and interviews with program participants and support staff.

The major findings of this report were as follows:

Program Implementation

Use of ADI and CT

- ADI Implementation
  - Across all years, teachers understood the key principles of ADI.
  - The majority of pairs implemented all expected ADI stages each spring. However, pairs selected specific ADI stages to implement.
  - Teachers reported some challenges with ADI implementation, including a lengthy planning and implementation process and difficulties preparing students to complete ADI activities.
  - There was some variation in ADI implementation by subject.
  - From interviews, science pairs consistently felt that ADI aligned closely with their content area, while pairs teaching special education consistently reported needing more modifications to ADI lessons to meet their students' needs.

- CT Implementation
  - Across years, teachers struggled to define CT, though teachers' reported use of CT practices remained consistently high.

CLASS Program Supports

- CLASS Training and Supports for Teachers and Supervisors
  - Mentors and residents completed trainings with fidelity, and all related indicators were met across all years.
  - In three out of four years, the fidelity indicators related to supports received by supervisors were met.
  - Across years, most participants found the ADI summer training helpful, especially activities in which they experienced an ADI lesson as a student and planned an ADI lesson themselves.
  - Increased communication from the CLASS program bolstered residents' experiences over the years.
  - Residents received wraparound supports such as a peer community and mental health supports.
  - Residents, mentors, supervisors, and CLASS program staff alike noted that the extensive requirements of the CLASS program can be demanding.
  - Overall, supervisors were positive about the supports they received from the program. Over the years, the CLASS program enhanced supports for supervisors.
  - Program leaders incorporated feedback year to year to improve training and add additional supports, leading mentors to better understand their responsibilities and feel more prepared in their roles in later years.
  - A few principals expressed wanting more information on the CLASS program, and opportunities to participate in resident supervision and observation.
- ADI Coaching Supports for Residents
  - The amount of time pairs worked with the ADI coach varied over the course of the year and by cohort.
- ADI Supervisor Supports for Residents
  - In one of three years measured, supervisors met the fidelity indicator related to providing residents ongoing supports in ADI.
  - In general, supervisors were found to be somewhat helpful with respect to supporting ADI implementation.

- Mentor Supports for Residents
  - The fidelity indicators related to the availability of mentor teachers in a range of subjects were met for one out of the four subjects in all four years. However, the indicator on mentors' longitudinal participation was not met.
  - While mentors had prior experience in implementing activities related to CLASS program concepts, their level of confidence implementing these activities stayed relatively constant over time.
  - Residents said they benefitted from working with a mentor teacher for the duration of a school year.
- Coursework and Action Research
  - A key component of the CLASS program is for residents to complete their master's degree in the span of a year. All or almost residents completed their degree, meeting the indicator of implementation fidelity in all four years.
  - All residents completed their action research projects. Residents reported feeling supported throughout the process.
  - Residents noted that completing the action research study helped them contextualize their teaching.
  - Both residents and CLASS program alumni reported action research as having a positive influence on their teaching practices.

Use of Co-Planning and Co-Teaching Strategies

- Throughout the program, residents reported co-planning and co-teaching with their mentors and gradually assumed greater ownership of instruction over time.
- Co-teaching strategy preference varied from year to year with pairs doing one teach, one observe and team teaching more often than other strategies.
- Generally, mentors and residents found that there were many benefits to co-teaching and co-planning, while a few pairs experienced some unique challenges specific to certain classes and subject areas.
- Overall, mentors and residents found the co-teaching model to be helpful in their growth as new teachers.

Teacher Outcomes

Residents' Preparedness to Teach

- CLASS program staff, mentors, and principals had largely positive impressions of residents and were generally more well prepared than the typical teacher candidate.

Teachers' Attitude Toward ADI and CT

- Mentors and residents alike saw the benefits of implementing ADI, including in student engagement, critical thinking skills, and deeper classroom discussions.

Residents' Continued Use of ADI and CT

- Overall, alumni were positive about ADI and its continued use in the classroom.

Student Outcomes

Students Familiarity With CT Strategies

- We observed that students used CT practices "sometimes" on average.

Growth in CT Skills, Confidence, and Interest

- There were small, positive differences in students' abilities and perceptions of CT among those who had greater exposure to CLASS pairs, although these differences were not statistically significant.

The report closes with a discussion of program strengths and the implications of the correlational study. The discussion also expands on the integration of ADI and CT into teacher practice, the benefits of the yearlong clinical experience for residents, and the overall strengths of the CLASS program.

Acknowledgements

Conducting an evaluation of a teacher preparation program requiring original data collection during the COVID-19 pandemic was a challenging enterprise. The success of this project, including all products and findings resulting from the evaluation, reflects the efforts and commitment of many more contributors than those represented in the author list.

We are indebted to the teachers, administrators, faculty, and students who agreed to participate in this evaluation and who responded to multiple data collection requests during the COVID-19 pandemic. We thank participating teachers for their meticulous efforts in engaging in monthly and yearly data collection activities and students in one school for completing two iterations of a student instrument.

We are grateful to the CSU, Chico team including Jennifer Oloff-Lewis, Jamie Linn Gunderson, Mimi Miller, Brian Lindaman, Cheryl Ordorica, and Lexi Kornblum, who provided invaluable partnership throughout the evaluation. The CSU, Chico team implemented the CLASS program with teachers and contributed to the development of the study design, program logic model, and fidelity measures.

This report is the culmination of five years of evaluation research by a team at SRI International (SRI). We extend our sincere gratitude to current and former SRI colleagues who contributed in several ways to the conception, design, and execution of this study: Andrew Praturlon, Ashley Campbell, Christine Korbak, Daniela Torre-Gibney, Leilani Lopez, Mary McCracken, Sara Rutherford-Quach, Satabdi Basu, Tasbita Reham, and Xavier Fields. We also appreciate the contributions of Charles Harding and Bonnee Groover to the editing and production of this report.

The authors assume full responsibility for any errors or omissions.

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Introduction

In 2019, California State University (CSU), Chico was awarded a five-year Teaching Quality Partnership (TQP) grant to strengthen educator preparation. The grant includes funding for a program in partner schools called the Computational Literacy Across Secondary Settings (CLASS) program. The goal of CLASS is to recruit, prepare, and retain highly qualified individuals into the teaching profession, particularly in high-need rural areas. In CLASS, teacher candidates (residents) complete a yearlong residency with a mentor teacher while completing coursework toward their teaching credential and a master's degree. Mentors and residents used co-teaching strategies throughout their year together. CLASS includes a focus on the use of classroom-based action research, Argument Driven Inquiry (ADI), and computational thinking (CT) to promote problem-solving and research skills in students and aims to bring teachers from diverse backgrounds into rural settings (see Appendix A. for additional details on ADI stages and CT practices). To support residents and mentors, the CLASS program provided teachers ongoing professional development. Residents also receive support from an ADI coach and from a designated supervisor—an expert teacher coach—throughout the school year. Over the course of five years, the CLASS program graduated four cohorts of resident teachers to bring teaching and learning support to rural students in residency classrooms and professional development benefits to mentor teachers and resident supervisors.

The TQP grant also supported an independent evaluation of the CLASS program to examine program implementation and outcomes the program with respect to students' CT skills, their confidence in CT practices, and their interest in future careers in a computer science field, using a correlational design. This report presents the results of CLASS program implementation from the 2020–21 through the 2023–24 school years. We first describe the key components of the CLASS program, then we present the research design and data and methods used. Following, we present findings on the fidelity of program implementation and other programmatic outcomes, teacher outcomes, and student outcomes. The report concludes with a discussion of findings and areas of opportunity.

Argument Driven Inquiry (ADI) is an instructional model that emphasizes student research, communication, and revision to aid learning. When students engage with the ADI instructional model, they will design and carry out their own investigations, create their own arguments that 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 (National Research Council, 2006, 2012; Sampson & Gleim, 2009; Sampson et al., 2011).

Computational thinking (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" (National Science and Technology Council, 2018, p. 23) through "data-practices, modeling and simulation practices, computational problem-solving practices, and systems thinking practices" (Weintrop et al., 2016).

CLASS Program Background and Design

In 2019, CSU, Chico was awarded the TQP grant to implement the CLASS program and contracted SRI to conduct the program evaluation. During the 2019–20 school year, CSU, Chico developed program components and SRI developed the evaluation plan. The CLASS program builds on CSU, Chico's successes in preparing teachers through the PRISMS Project: Promoting Rural Improvement in Secondary Mathematics and Science, and RiSE: Residency in Secondary Education, a post-baccalaureate master's and credentialing program for prospective math, science, English, and special education teachers with an intensive, one-year teacher residency. CLASS continues the RiSE program's initiation of a CT and ADI-focused residency and creates a pipeline for STEM teachers in secondary grades.

The CLASS program aims to recruit and retain highly qualified individuals to the teaching profession in high-need rural areas. As the program serves a relatively rural region, it strives to strengthen the pipeline of teachers—particularly in the areas of science, technology, engineering, and mathematics (STEM) and special education—to nearby schools (Collins et al., 2005; Dessoff, 2010). To meet this goal, CLASS engaged residents in a yearlong, full-time teacher residency, consisting of master's and credentialing coursework, professional development, mentoring, and coaching, to enhance residents' content knowledge and to develop mentors' and residents' expertise in CT and ADI (see Appendix A. for details on ADI stages and CT practices). In doing so, the program aims to strengthen the education of future teachers for rural schools, especially in STEM and special education, and improve computational literacy for teachers and students in secondary settings.

Logic Model

The program logic model (Exhibit 1) describes the contextual factors, inputs, key components, outputs, and the short- and long-term outcomes associated with the CLASS program. CSU, Chico faculty, supervisors, mentor teachers, and the ADI education program provide human resources and program materials. CSU, Chico faculty and supervisors and ADI staff provide professional development, co-teaching structures, and other associated aspects of the teacher preparation program. The CLASS program posits that with these resources, training, and ongoing supports, mentors and residents will use ADI stages in their classes and other practices aimed at helping students apply CT practices. Over time, the CLASS program is anticipated to result in changed teacher and student attitudes toward CT and ADI instruction, improved collaboration among teachers, improved student skill and confidence in CT practices, and greater interest in future careers in a computer science field.

Exhibit 1. Logic model for the Computational Literacy Across Secondary Settings (CLASS) program

Inputs

Resident Teachers
- CSU, Chico selection criteria
- RTs in 4 subject areas: ELA, Math, Science, or Special Education
- RTs placed in grades 6–12
- Residency stipend

University Supervisor Recruitment
- CSU, Chico selection criteria

University Faculty
- Partner faculty in CSU, Chico's School of Education teach methods courses to RTs

Mentor Teachers
- CSU, Chico selection criteria
- Placement in grades 6–12
- MTs in 4 subject areas: ELA, Math, Science, and Special Education
- 4-year commitment to serve as a mentor teacher

ADI Instructional Model
- 7-stage process
- ADI field-tested lab lesson plans and materials

Key Components

Professional Development
- MT/RT and supervisor summer ADI/CT training
- MT/RT and supervisor multi-day training in summer on co-teaching and co-planning
- Ongoing support through RT winter/spring site-based ADI training and CLASS monthly meetings
- Support for RTs to be hired post-residency in partner districts
- Regular, evidence-based feedback to RTs from university supervisors on ADI
- Trained to provide evidence-based feedback to residents using the CORE rubric

Clinical Work
- RTs in a full-time classroom placement for 1 school year with a MT certified in ADI

Resident Teacher Coursework
- Master's degree courses
- Action research project focused on ADI implementation
- Methods courses include CT practices and/or ADI instructional strategies

Outputs

Mentor Teachers
- 20+ MTs certified as ADI trainers across grades 6–12 to create vertical alignment
- MTs and RTs engage in collaborative meetings
- MTs provide RTs feedback and pedagogical support
- MT/RT pairs implement 2 ADI units per year (fall and spring)

Resident Teachers
- 72 RTs trained to implement ADI
- 72 RTs trained as ADI trainers
- MT/RT pairs implement 2 ADI units per year (fall and spring)
- MTs and RTs engage in collaborative meetings
- RTs collect student data on ADI project

Students
- 10,000 students experience ADI and CT in partner districts across grades 6–12

Short-Term Outcomes

Mentor Teachers
- Use of CT (data practices and systems thinking)
- Use of ADI instructional strategies
- Increased frequency of co-teaching/co-planning while integrating ADI
- Improved attitude toward co-teaching/co-planning

Resident Teachers
- Use of CT (data practices and systems thinking)
- Use of ADI instructional strategies
- Increased frequency of co-teaching/co-planning while integrating ADI
- Improved attitude toward co-teaching/co-planning

Students
- Increased ability to apply CT (using data practices and systems thinking)

Long-Term Outcomes

Mentor Teachers
- Improved attitudes about and efficacy toward CT and ADI instruction

CLASS Program Graduates
- Frequently collaborate with colleagues
- Improved attitudes about and efficacy toward CT and ADI instruction
- Continued use of:
  - CT (data practices and systems thinking)
  - ADI instructional strategies[b,c]

Students
- Improved achievement on CT skills
- Improved attitudes about and perceptions of CT
- Greater familiarity with CT practices
- Greater interest in pursuing a career in the field of computer science

Contextual Factors
- Teachers and students can meet synchronously or asynchronously.
- Teachers have time, school leader support, and a willingness to implement ADI instruction as designed and participate in professional development.
- Students have sufficient proficiency in related science and CT concepts to be able to engage with ADI lessons with appropriate teacher scaffolding and/or teachers of all subjects can differentiate for students with varying levels of prior proficiency in science, math, or CT.
- Teachers have established classroom management procedures and a culture that allow for project-based learning and engagement with new materials pedagogies.
- MTs and RTs have a collaborative relationship.
- Availability of partner districts in rural areas.

Program Description

Recruitment

Resident Recruitment. In spring 2020, CSU, Chico recruited the first cohort of residents in ELA, math, and science. Residents began onboarding and professional development activities in summer 2020 and began their residency working with their mentor teacher in fall of the 2020–21 school year.

Starting with Cohort 2, CSU, Chico recruited residents in four subjects: ELA, math, science, and special education. However, as residents pursing a master's degree and a credential in special education need additional coursework to complete the degree and certificates, these residents were recruited in fall 2020 and began their coursework in spring 2021, beginning their residency in fall 2021. Also in spring 2021, CSU, Chico recruited cohort two residents in ELA, math, and science. All residents began their onboarding and professional development in summer 2021 and began their residencies in the fall of the 2021–22 school year. The recruitment timeline for Cohort 2 was repeated for Cohorts 3 and 4.

To recruit residents to the CLASS program, CSU, Chico conducted targeted, structured outreach. Over the years, the CLASS program team expanded outreach efforts to accommodate the larger recruitment targets and to identify a more diverse audience. To recruit residents, the CLASS program team conducted marketing both within the CSU, Chico campus and outside of it. Campus outreach included circulating program information to students and staff; making presentations to classes, affinity groups (e.g., the CSU, Chico Cross-Cultural Leadership Center), and university leaders; and networking with campus leaders and organizations. To reach beyond campus, the CLASS program team conducted marketing on social media through Instagram posts and YouTube videos, as well as by working with a digital marketing firm.

Residents participated in a rigorous application and selection process, including submitting statements of interests and transcripts and participating in an interview. For their participation, CLASS residents received a stipend, and the opportunity to earn their teaching credential and master's in one year. After their yearlong residency, residents were expected to continue teaching for three years, ideally in a high-need and/or rural area.

Mentor, School, and Supervisor Recruitment. To recruit schools and mentors, CSU, Chico contacted principals directly, especially those who had long established connections with CSU, Chico through past programs such as PRISMS and RiSE. Mentors learned about the program through both formal communications (e.g., principal referral) as well as through informal word of mouth and prior connections through past programs. When selecting mentors, the CLASS program team and principals looked for not just teachers who had strong classroom pedagogy, but also teachers who would be good co-teachers and teachers whose personalities would fit well with those of the residents. When recruiting schools and districts to participate in the CLASS program, CSU, Chico targeted their recruitment efforts toward schools in town/rural areas that serve large populations of students who have been historical underserved, such as students of color and/or students who were eligible to receive free or reduced-price lunch.

When recruiting supervisors, some supervisors were invited to apply per the CSU, Chico job posting by the CLASS program team or were recruited to participate in CLASS as they were already supervisors in the CSU, Chico system.

Over the five years of the program, the study recruited 59 residents (54 completed), 33 mentors, and 12 supervisors, who worked across 9 schools in 5 districts in the areas surrounding CSU, Chico.

Professional Development

Each summer, residents, mentors, and supervisors participated in mandatory trainings on ADI, CT, co-teaching, and the residency model. In June of 2020–23, new mentors participated in a four-day "train-the-trainer"-style ADI workshop, during which they learned the fundamentals of ADI and how to train another teacher to use it. Mentors participated only once, in the first year they became a mentor. In July, residents, mentors, and supervisors were invited to participate in a four-day training covering several aspects of the residency. Two days focused on ADI, with mentors supporting their residents in learning about ADI, a half day dedicated to CT, and one and a half days centered on co-teaching strategies (see Appendix B for descriptions of co-teaching strategies). Cohort 1 and 2 residents completed a four-day “train-the-trainer” ADI workshop in the June following graduation, while Cohort 3 and 4 residents completed this workshop in the January prior to graduation.[1]

Supervisors were supported in their work by attending summer trainings with mentors and residents through check-ins with the CLASS program team, and through materials and resources provided by the team. Throughout the program, CSU, Chico made continuous improvements to the supports offered to supervisors. Starting in the 2021–22 school year, the CLASS program provided additional learning opportunities to supervisors to build ADI content knowledge and improve supervisors’ ability to support residents with respect to ADI. Supports were further enhanced in the 2022–23 school year; supervisors met bi-monthly with CLASS program staff for guidance on scoring and paperwork, how to observe residents, and other special topics. Training topics included pedagogy, CLASS components, and how to provide supports for diverse groups of students. Supervisors also received training and supports from either the CLASS program or CSU, Chico School of Education around universal design for learning, multi-tiered system of supports, English language learners, trauma-informed practices, and classroom observations.

Mentors and residents were expected to attend all professional development sessions and work with the ADI coach. CLASS program mentor-resident pairs (referred to as “CLASS pairs”) were

[1] Residents’ “train-the-trainer” ADI workshop was moved from June to January due to feedback from Cohort 1 and 2 residents who said they would have preferred to receive the training sooner in order to implement it with their students.

expected to implement at least one ADI cycle each semester and use CT practices in their instruction. Residents were also expected to be observed by their supervisor six times per semester, where each supervision cycle included a pre-observation and a post-observation conference between the resident and the supervisor, and occasionally with the mentor present.

Clinical Work

Residents received hands-on supports from their assigned mentor through a full-time clinical placement in a rural, high-need classroom. The mentor was certified in implementing ADI. Residents worked closely with their mentor to plan and deliver instruction. Over the course of the year, mentors and residents were expected to co-plan and co-teach courses, with the resident taking on more teaching responsibilities as the year progressed.

Resident Teacher Coursework

Finally, residents completed master's degree coursework through CSU, Chico over the course of the school year. As part of the coursework, residents completed a yearlong action research project focused on implementing ADI with students. Residents were expected to complete their credentialing and master's coursework, including an action research project focused on ADI implementation and CalTPA requirements.

Research Design

Overview

SRI researchers analyzed program outcomes, including the fidelity of program implementation, and teacher and student outcomes. To examine students' outcomes, SRI researchers also used a correlational study design to estimate the relationship between grade 9–11 students' assignment to CLASS pairs and students' CT skills, confidence in CT practices, and interest in future careers in a computer science field.

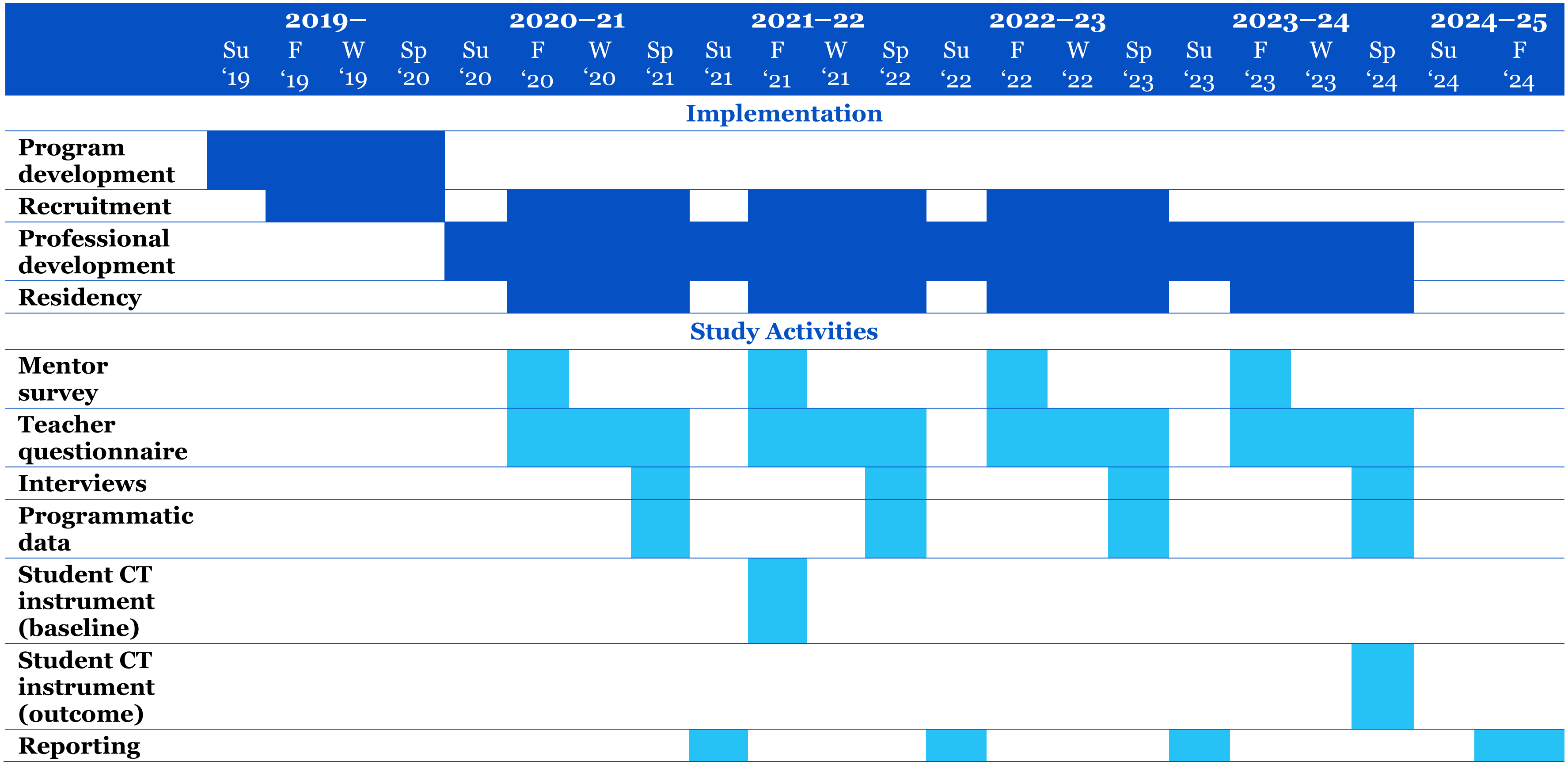
SRI collected annual data on program implementation and program participants' experiences from 2020–21 through 2023–24. Data collection included a mentor survey, monthly questionnaires for residents and mentors, interviews with program participants and support staff, and programmatic data. SRI also administered a student CT instrument to collect baseline and outcome data.

Over the course of the four-year program, 9 schools (7 high schools and 2 middle schools) spanning 5 districts participated in the study. All schools were in nonurban (town) areas. Schools served predominantly students of color (40%–80%) and students eligible for free or reduced-price lunch (45%–80%; U.S. Department of Education, 2024).

Timeline of Program Implementation and Evaluation

Exhibit 2 displays the timeline for program development, implementation, and study activities.

Exhibit 2. CLASS program grant timeline



Note. Su = summer; F = fall; W = winter; Sp = spring; CT = computational thinking. The exhibit displays the timeline of program implementation, including program development and recruitment, CLASS mentors' and residents' participation in professional development, and their participation in the residency; and the timeline of study activities, including data collection and reporting.

Research Questions

The report answers the following research questions:

Program Implementation

(1) How are CLASS pairs integrating ADI with the co-teaching model?

- How frequently do mentors and residents use strategies that promote ADI and CT? Does use vary by subject area?
- Are mentors and residents implementing the ADI instructional model with fidelity?
- What challenges do mentors and residents face in implementing ADI and CT?

(2) What ADI and CSU, Chico supports are most helpful to mentors and residents?

- How do mentors support residents in their classrooms?
- How do residents perceive the quality of the feedback they receive from mentors?

(3) To what extent are CLASS pairs co-planning and co-teaching?

- What do mentors and residents perceive as the benefits and challenges of co-teaching and co-planning?

Teacher Outcomes

(4) To what extent are residents prepared to serve as classroom teachers?

(5) What are mentors' and residents' attitudes toward using ADI and CT?

- How do attitudes vary by subject area?

(6) To what extent do residents continue to use strategies that promote ADI and CT after the co-teaching residency year?

- Does this vary by subject area?

Student Outcomes

(7) To what degree are students familiar with strategies associated with CT practices?

(8) Is students' exposure to CLASS pairs related to their growth in CT skills?

- Does this vary based on the subject area of their assigned CLASS pairs?

(9) Is students' exposure to CLASS pairs related to improvement in their confidence in CT practices and their interest in future careers in a computer science field?

- Does this vary based on the subject area of their assigned CLASS pairs?

Given the mixed-methods nature of this study, we answered each research question using one or more data sources. Exhibit 3 displays the data sources used to answer each research question. Each data source is described in detail in the section following.

Exhibit 3. Mapping research questions to data sources

	Fidelity of Program Implementation	Interviews	Teacher Questionnaire	Student CT Instrument	MT Survey
Program Implementation					
1.How are CLASS pairs integrating ADI with the co-teaching model?					
How frequently do mentors and residents use strategies that promote ADI and CT? Does use vary by subject area?		X	X		
b. Are MTs and RTs implementing the ADI instructional model with fidelity?	X				
c. What challenges do MTs and RTs face in implementing ADI and CT?		X			
2. What ADI and CSU, Chico supports are most helpful to MTs and RTs?		X	X		X
How do mentors support residents in their classrooms?	X	X			X
b. How do residents perceive the quality of the feedback they receive from mentors?		X			
3. To what extent are CLASS pairs co-planning and co-teaching?		X	X		
a. What do mentors and residents perceive as the benefits and challenges of co-teaching and co-planning?		X			
Teacher Outcomes					
4. To what extent are residents prepared to serve as classroom teachers?		X			
5. What are mentors' and residents' attitudes toward using ADI and CT?		X			
a. How do attitudes vary by subject area?		X			
6. To what extent do residents continue to use strategies that promote ADI and CT after the co-teaching residency year?		X			
a. Does this vary by subject area?		X			
Student Outcomes					
7. To what degree are students familiar with strategies associated with CT practices?				X	
8. Is students' exposure to CLASS pairs related to their growth in CT skills?				X	
a. Does this vary based on the subject area of their assigned CLASS pairs?				X	
9. Is students' exposure to CLASS pairs related to improvement in their confidence in CT practices and their interest in future careers in a computer science field?				X	
a. Does this vary based on the subject area of their assigned CLASS pairs?				X	

Note. Exhibit 3 uses abbreviations for computational thinking (CT), mentor teacher (MT), Argument Driven Inquiry (ADI), and resident teacher (RT).

Data and Methods

We used qualitative, descriptive, and correlational methods to understand program implementation and examine outcomes.

Data Sources

We collected data from five data sources between the 2020–21 and 2023–24 school years: (1) program implementation data collected annually each spring; (2) interviews with program leaders, support staff, teachers, and principals conducted each spring; (3) a mentor teacher survey administered each fall; (4) a teacher questionnaire administered monthly to mentors and residents each year; and (5) a student computational thinking instrument administered in fall 2021 (baseline) and spring 2024 (outcome). We describe each of the data sources in detail below.

Program Implementation Data

The SRI research team worked with CLASS program staff to collect annual data on program implementation to assess fidelity of program implementation. Over the course of four years, the SRI team collected data on the program itself, along with each of these CLASS program groups:

- Supervisors
- Mentor teachers
- Resident teachers
- Instructors

Instrument

We collaboratively determined three key components of program implementation in alignment with the CLASS program logic model: professional development, clinical work, and coursework (see Exhibit 1). For each component, we developed indicators to assess whether the component was implemented with fidelity. For each indicator, we defined a threshold of the percentage of individuals that had to meet, or a number of activities that the program had to implement, in order for the indicator to be considered met. We examined a total of 16 fidelity indicators across three components: professional development, clinical support, and coursework. We describe each implementation fidelity indicator and the thresholds to meet each indicator below (see Appendix C for details on each indicator).

Professional Development. Staff from the CLASS program and the ADI organization provided mentors, residents, and supervisors ongoing professional development and supports to implement ADI, CT, and co-teaching. The indicators for professional development capture the extent to which mentors, residents, and supervisors participated in the professional development and for supervisors, the extent to which they observed ADI lessons for their assigned residents. To meet implementation fidelity for the professional development component, the program-level threshold had to be met for each of the following 10 indicators:

- Mentors obtain ADI certification.
- Residents obtain ADI certification.
- Mentors and residents participate in required training on ADI.
- Mentors and residents participate in ADI coaching sessions.
- Supervisors attend the CT or co-teaching portions of the summer training.
- Supervisors receive ADI training.
- CSU, Chico provides professional development on CT.
- Mentors and residents attend professional development on CT.
- Residents participate in co-teaching training in summer.

  Supervisors observe ADI lessons for residents.

Clinical Work. Another core feature of the CLASS program is the clinical supports; residents co-teach with mentors in their subject area and use ADI stages in their classrooms. The implementation fidelity indicators for clinical work capture the extent to which there are sufficient numbers of mentors in each subject area to support a range of residents and the extent to which CLASS pairs implement ADI cycles in their classrooms. To meet implementation fidelity for the clinical work component, the program-level threshold had to be met for each of the following two indicators:

- Mentors are available in science, math, ELA, and special education.
- CLASS pairs complete ADI cycles.

Coursework. Finally, CLASS residents were expected to complete rigorous coursework. The implementation fidelity indicators capture the extent to which residents completed coursework to earn their master's degree, completed an action research project with a focus on ADI and student outcomes, and had courses that taught ADI and/or CT practices. To meet fidelity of implementation for the coursework component, the program-level threshold had to be met for each of the following four indicators:

- Residents complete their master's degree.
- Residents complete an action research project.
- Residents' action research project focuses on student outcomes and ADI.
- Single-subject coursework contains evidence of CT and/or ADI strategies.

Data Collection

SRI researchers collected program implementation data from CLASS program records and the monthly questionnaire. SRI researchers also collected data on professional development from

CLASS program records of attendance, certification completion, and supervisor observations. The research team collected data on clinical work from annual mentor rosters and from teacher self-reported data on ADI implementation collected from teacher questionnaires (see below). SRI researchers collected data on coursework from CLASS program records. SRI researchers also analyzed residents' action research abstracts to determine whether the project focused on student outcomes and ADI and examined course syllabi of single-subject courses for evidence of CT and/or ADI strategies.

Analysis

The sample used to assess implementation fidelity was composed of mentors, residents, and supervisors who completed the CLASS program in a given school year. Teachers or supervisors who exited midyear were excluded from calculations.

To analyze the fidelity of program implementation, SRI researchers first determined whether each teacher and/or pair met the individual-, pair-, or course-level threshold for a given indicator. Next, researchers calculated the percentage of individuals, pairs, or courses that met the program-level threshold for adequate implementation. If the percentage was greater than or equal to the program-level threshold, we considered the indicator to be met. We repeated this process for each indicator to determine whether a given component was met. We considered a given component to be met if all indicators in the component were met with fidelity. We repeated this process annually.

Interviews

To understand participants' experiences with the program, in each spring of 2021, 2022, 2023, and 2024, researchers conducted virtual interviews with program participants.

Data Collection

SRI selected interviewees to gather perspectives across a range of subject areas, schools, districts, and grade levels. To triangulate across respondents' experiences, the research team interviewed pairs of mentors and residents, residents' supervisors, and building principals, though this interview triangulation was not always possible. In spring of 2022, 2023, and 2024, researchers also interviewed graduates from the prior years' cohorts (graduates from Cohorts 1–3). Interviews lasted about one hour and were conducted over Zoom. While interview guides evolved over time to reflect changing program needs and priorities, questions generally addressed program participants' experiences with the recruitment, training, and support for mentors and residents; participants' experiences in the program; and participants' feedback on the program (see Appendix D for interview protocol). In total, researchers conducted 58 interviews across residents (including resident alumni), mentors, principals, supervisors, CLASS program staff, instructors over the course of four school years. Exhibit 4 describes the number of interviewees by role that SRI researchers interviewed each year.

Exhibit 4. Number of interviews per year

Role	Cohort 1 (Spring 2021)	Cohort 2 (Spring 2022)	Cohort 3 (Spring 2023)	Cohort 4 (Spring 2024)	Total
Residents	4	4	4	0	12
Mentors	4	4	3	0	11
Principals	3	1	2	0	6
Supervisors	2[a]	4	4	0	10[a]
Alumni	n/a	2	2	3	7
CSU, Chico Instructors	3[a]	0	2	0	5[a]
ADI Coach	1	0	0	0	1
CLASS Program Administrators	2	2	2	0	6
Total					58

Note: Spring 2021 indicates interviews conducted at the end of the 2020–21 school year. Between spring 2021 and spring 2024, SRI interviewed 47 unique interviewees. Eleven participants were interviewed twice. Five residents were interviewed twice, once when they were residents and again when they were alumni in following years.[a] In Cohort 1, one person was acting as both a supervisor and an instructor and are counted in just the instructor row.

Analysis

All interviews were recorded and transcribed using Zoom's built-in functionality. In addition, SRI researchers took detailed notes during each interview. Interview data were compiled into common categories aligned to the logic model, such as co-teaching, implementation of ADI and CT, and training and supports. The research team then systematically identified and refined themes across interview data through a collaborative, iterative process.

Teacher Questionnaire

To understand the implementation and use of ADI and CT practices in the classroom and the extent to which pairs were utilizing these practices, SRI developed and administered a monthly questionnaire to all mentors and residents.

Instrument

SRI administered a monthly researcher-developed teacher questionnaire to collect information around teachers' co-planning and co-teaching practices, ADI training, supports, and the implementation and use of CT and ADI with students (see Appendix E for the teacher questionnaire). The questionnaire contained both fixed-choice and open-ended questions across three sections. The questionnaire asked about teachers' instructional practices such as co-planning and co-teaching, and use of ADI and CT. Residents were asked if they ever asked their supervisor for help with ADI and the extent to which the support was helpful. Residents were asked to share example ADI lessons and/or ADI student work samples. In Cohort 4, teachers were also asked about the monthly implementation of computational systems thinking (CST) practices. Finally, in the first two years of the study, when several schools were engaging in remote or hybrid learning models, we also asked about instructors' primary lesson format to capture additional context about their implementation.

Data Collection

From 2020 through 2024, researchers collected implementation data from monthly questionnaires completed by each cohort. Residents and mentor teachers were asked to complete nine questionnaires—one for each month of teaching. Questionnaires were an electric survey that could be completed with a phone or computer, and teachers received $10 for each questionnaire they completed. Monthly questionnaires were sent out on the first weekday of each month and left open for eight days, during which teachers received two reminders. In months when schools had break, questionnaires were open for an extended amount of time to accommodate various holidays. The administration window for the last questionnaire was also extended to give teachers time to complete it before summer break started.

Analysis

Each year, the SRI research team calculated descriptive statistics and analyzed data at the teacher- and pair-level each month, semester, and year. For ADI, CT, and CST, we calculated aggregated statistics on the number of steps pairs completed for a given process, and the percentage of pairs completing the stages at least once per semester, and at least once per year. As mentors and residents reported on shared implementation, most items were analyzed at the pair level, where a pair was counted as having completed a given activity if at least one person from the pair reported completing the activity in a given month. Data for a pair were averaged together to calculate a pair-level statistic. Exhibit 5 displays the number of pairs in the analytic sample by cohort year and subject.

Exhibit 5. Number of pairs by cohort year and subject

	Subject			
Cohort	**Math/Science**	**ELA**	**Special Education**	**Total Pairs**
Cohort 1 (2020–21)	2	5	0	7
Cohort 2 (2021–22)	9	6	4	19
Cohort 3 (2022–23)	8	4	4	16
Cohort 4 (2023–24)	6	4	3	13
TOTALS	**25**	**19**	**11**	**55**

Note. Exhibit displays the number of pairs by cohort and subject. A pair was defined as a mentor-resident pairing that participated in the study for the duration of the school year. If a resident exited the CLASS program in the middle of the school year, they were excluded from the analysis. If a resident switched to a new mentor in the middle of the school year, the new mentors' data were used to calculate pairwise results while only the resident's data were used to calculate pairwise statistics in months the resident worked with their former mentor. Math and science pairs were counted as one group due to small sample sizes in Cohort 1.

Questionnaire responses came from all participating schools and districts. Across cohorts, teachers had high annual response rates on the teacher questionnaire ranging from 74 to 90 percent. Since teachers worked in mentor-resident pairs, most of the data analysis was done at the pair level, where a pair was counted as having completed a given activity if at least one person from the pair reported completing the activity. When calculated at the pair level, annual questionnaire response rates ranged from 91 to 98 percent across cohorts.

We calculated descriptive statistics for co-teaching and co-planning, examining the average hours of planning by month and teacher type, the types of strategies used by pairs, and the hours residents spent per week teaching in different formats by semester. Average response for co-planning and co-teaching activities were analyzed year over year. All questions were analyzed at the pair level, except for supervisor helpfulness for residents who reported receiving supervisor support on ADI. We analyzed the number of pairs who worked with or contacted an ADI coach in a given month or at least once during the school year, as well as average hours per month pairs worked with an ADI coach. For ADI, CT, and CST, we examined frequency of implementation by semester, and ADI steps and CT/CST practices completed, monthly, and year over year for ADI and CT.

Mentor Teacher Survey

Mentor teachers were asked annually to complete a brief survey to allow the SRI research team to better understand mentor teacher demographics and their prior experiences implementing ADI and CT, working with resident teachers, and attendance at previous trainings administered by CSU, Chico.

Instrument

SRI researchers developed and administered a short survey to understand the extent to which mentors had experience with implementing ADI and CT activities, asking mentors about their courseload, including the grades and subjects they teach; the courses in which they implement ADI; their teaching practices, such as the types and frequency of activities they ask students to complete; their confidence in implementing data-centered or project-based activities; and their prior professional development on ADI and CT skills. The survey also asked mentors about their demographic information (see Appendix F for mentor teacher survey).

Data Collection

The mentor teacher survey was administered by the SRI research team once annually in September of each school year. The survey was administered electronically. Mentors could complete the survey via their laptop or phone. Mentors were provided one week to complete the survey and received up to three reminders to complete the survey. Between 88 and 100 percent of mentors responded to the survey in any given year.

Analysis

Each year, the SRI research team calculated descriptive statistics for each item on the survey. We calculated average responses for each Likert scale item, in addition to mentor average years of teaching and mentoring experience. For experiences around ADI and CT and engaging students in these practices, we calculated changes year over year. Finally, we calculated the number of classes, on average, that mentors were planning on co-teaching with their resident in the upcoming school year and how many of these classes they were planning to use ADI. We examined changes in both the descriptive statistics and mentor teachers' experience with programmatic concepts year over year.

Student Computational Thinking Instrument

To measure high-school students' ability to apply CT, their confidence in CT practices, and their interest in future careers in a computer science field, the SRI research team drew from the Weintrop et al. (2016) framework for defining CT for math and science classrooms.

Instrument

SRI researchers created and administered a student CT instrument. The instrument had two parts—an assessment and a survey. The assessment was designed to measure students' skill in CT practices by asking students to solve problems applying their knowledge of these practices. The survey portion contained individual items asking about students' use of CT practices when problem-solving and items composing factors related to students' confidence in CT and interest in future careers in a computer science field (see Appendix G for instrument and scoring rubrics).

Data Collection

SRI researchers recruited one high school that had CLASS program teachers for all four years of the study to administer the instrument. The research team worked with a school liaison who helped with data collection. The liaison received a small stipend each year. To obtain baseline data, the instrument was administered electronically to all grade 9–10 students attending the school in fall 2021. To obtain outcome data, the instrument was readministered to these students, who were now in grades 11–12, in spring 2024. Teachers were instructed to provide students approximately one full class period, or at least 30 minutes, to complete the instrument. The instrument was voluntary and students and/or their caregivers could opt out of the students' responses being used in the study. Students did not receive payment for completing the instrument.

In addition to administering the assessment, SRI collected student rosters of all students in the school from 2021–22, 2022–23, and 2023–24, as well as rosters of all students enrolled in course that contained a CLASS pair. These rosters served three purposes: First, they allowed researchers to create an intent-to-treat sample of students who had been exposed to any CLASS pair between 2021–22 through 2023–24 and the number of pairs they had in this time (CLASS students) and students who had never had any CLASS pair (comparison students); second, they allowed SRI to identify students' continuous enrollment in the high school during the study years; and third, they allowed researchers to gather control variables such as grade and student sex as reported in the school database.

Analysis

Creating the Analytic Sample. Using these rosters, researchers created the analytic sample of students who were continuously enrolled in the study high school between 2021–22 and 2023–24, for whom complete baseline and outcome data were available, and who were able to be matched to the rosters. Students who did not meet these conditions were excluded from the sample. A student was considered to have completed the instrument if they had answered at least 50 percent of the items on the assessment portion of the instrument, including providing their name and ID. If a student completed the instrument more than once, we kept only the first instance in the sample. Of the 576 grade 9–10 students enrolled in the school that we were able to follow from the 2021–22 through the 2023–24 school years, 147 completed both the baseline and outcome instrument.

Scoring and Variable Creation. The assessment portion of the instrument was scored using a researcher-created rubric. Students could earn 1 to 2 points per question, depending on item difficulty. Students who skipped an item were assigned a 0 for the item. Students' responses to the open-ended item were scored using a rubric on a scale of 0–6. Scores were then halved to reduce the weight of a students' open-ended responses in their overall score, and added to students' total assessment score. The assessment score was then converted to a percentage of points earned out of total possible points.

The survey portion of the instrument had two constructs aligned to expected outcomes per the CLASS program logic model. These constructs were students' confidence in using CT practices and students' interest in future careers in a computer science field. The factor on students' confidence in using CT practices captures items on students' confidence in their ability to use computers to solve problems, while the factor on students' interest in future careers in a computer science field captures students' desire to learn about and pursue jobs using computers to solve problems.

Each construct is a single factor and contains four items. Both factors were on a five-point Likert scale with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to neither agree nor disagree, 4 equal to agree, and 5 equal to strongly agree. Both factors showed strong internal consistency (Cronbach's alpha ranged from 0.72 to 0.88 in both fall 2021 and spring 2024; see Appendix H for more information on each factor).

In addition to these constructs, the survey portion of the student instrument also included 13 items about students' familiarity with CT practices and problem-solving strategies using data from the student survey. Students responded to these items on a five-point Likert scale, with 1 equal to never, 2 equal to rarely, 3 equal to sometimes, 4 equal to often, and 5 equal to always.

To estimate exposure to CLASS pairs, using rosters information, the research team first created a binary variable equal to 1 for whether a student was ever exposed to at least one CLASS pair between 2021–22 and 2023–24. To explore variation by dosage, we created a categorical variable equal to the number of CLASS pairs students were exposed to between 2021–22 and 2023–24. Courses in which a special education pair pushed into a general education were counted as exposure to a CLASS pair. Thus, students in a course taught by a CLASS pair with a push-in special education CLASS pair was considered to be exposed to two pairs for that course. The dosage variable ranged from 0 pairs, 1 pair, 2 pairs, or 3+ pairs. Similar to the binary treatment variable, the dosage variable equaled 0 for comparison students (i.e., those who were not exposed to any pairs). For more details on how variables were constructed and for definitions on each variable, see Appendix H.

Exhibit 6 displays the descriptives for the student analytic sample.

Exhibit 6. Analytic sample

Variable	% Sample
Number of CLASS Pairs	
0 pairs	26.5%
1 pair	27.9%
2 pairs	24.5%
3+ pairs	21.1%
At least one pair	73.5%
Grade Student Took Baseline Assessment	
Grade 9	72%
Grade 10	28%
Student Sex	
Female	55%
Male	45%

Note. N = 147. Exhibit displays the percentage of students in the analytic sample in each category. For variable definitions, see Appendix H.

Variation by Subject. To examine variation by subject, we created binary variables equal to 1 if a student ever had a CLASS pair in ELA, math, or science, and 0 otherwise. These variables were created for treatment students only. For instance, students for whom the variable “ever ELA” is 1 were exposed to at least 1 ELA CLASS pair, and students for whom this variable is 0 were only ever exposed to math or science CLASS pairs.[2]

[2] We excluded examining students receiving special education services because we were unable to identify comparison students receiving special education services, as this was not a variable we collected from the school.

Exhibit 7 displays the descriptives for the subgroup analytic sample.

Exhibit 7. Student assignment to CLASS pairs, by subject

Subject Area	% Sample
Ever ELA CLASS Pair	43%
Ever Math CLASS Pair	63%
Ever Science CLASS Pair	43%

Note. N = 103. Exhibit displays the percentage of students in the subgroup analytic sample who ever had exposure to one or pairs in a given subject area. The sample excludes comparison students (n = 39) and students who only ever had a special education CLASS pair (n = 5). For variable definitions, see Appendix H.

Examining Students' Familiarity with CT. We calculated mean values for the 13 items measuring CLASS students' familiarity with using CT practices when problem-solving. Mean values were calculated using spring 2024 outcome survey data by averaging Likert-scale responses for students exposed to 1, 2, or 3+ CLASS pairs. We used spring 2024 data as these responses reflect students' familiarity following exposure to CLASS pairs.

Estimating Differences in Outcomes. To estimate the relationship between students' exposure to CLASS pairs and their growth in CT skills, we used an OLS model, controlling for student characteristics to allow for residual covariate adjustment and robust standard errors. The predicted outcome measure on student i is given as:

$$(1)\quad y_i = \beta_0 + X_i\beta_1 + \beta_2 Prior_i + \beta_3 Treatment_i + e_i$$

Equation 1 predicts the continuous student outcomes of percentage points earned on the assessment, their confidence in CT, and their interest in future careers in computer science field (represented by y_i) for student i, accounting for pre-treatment controls. X_i is a vector of student covariates, namely, student sex and grade the student took the baseline assessment. $Prior_i$ is a measure of student i's baseline score for a given outcome. Baseline measures were centered within the sample means to increase interpretability of the intercept and treatment indicators. We first include $Treatment_i$ using the binary indicator for "at least one CLASS pair" (where 0 represents comparison students). In these models, the coefficient on β_3 represents the difference in the outcome for students who were assigned to 1 pair compared to those who were assigned to 0 pairs (i.e., comparison students).

To examine variation by dosage, we reran Equation 1, replacing $Treatment_i$ with the categorical measure of "number of CLASS pairs," equal to 0, 1, 2, or 3+ CLASS pairs (where 0 again represents comparison students). In models using the categorical variable, the reference category is exposure to 1 CLASS pair. The vector of coefficients on β_3 represents the difference in the outcome for students who were assigned to 0, 2, or 3+ CLASS pairs compared to those who

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Additionally, the overall number of students exposed to CLASS pairs teaching special education was small, making it difficult to derive useful conclusions from the data.

were assigned to 1 pair. Additional t-tests were conducted to examine significant differences between students exposed to 2 versus 3 pairs, 0 versus 2 pairs, and 0 versus 3+ pairs.

To examine variation in outcomes based on subject area of CLASS pairs, the research team estimated Equation 2 using a subsample of only CLASS students, excluding those who only ever had special education pairs.

$$(2)\ y_i = \beta_0 + X_i\beta_1 + \beta_2 Prior_i + \beta_3 Treatment_i + \beta_4 Subject_i + e_i$$

Equation 2 builds on Equation 1 by adding in, one by one, binary indicators equal to 1 for whether CLASS students were ever exposed to a CLASS pair in a given subject. β_4 represents the difference in a given outcome for students ever exposed to a CLASS pair in a given subject, controlling for student covariates (X_i), baseline score for a given outcome ($Prior_i$), and number of CLASS pairs ($Treatment_i$).

Findings

The following section reports on findings in the three main program focus areas: program implementation, teacher outcomes, and student outcomes.

Program Implementation

First, we examined how CLASS pairs integrated ADI and CT into their classroom teaching; the extent to which pairs used co-planning and co-teaching strategies; and the constellation of supports provided to residents, mentors, and supervisors through the CLASS program. We observed that much of the program was implemented with fidelity; residents implemented ADI, CT, co-planning, and co-teaching. The CLASS program bolstered supports provided over the years, and residents, mentors, and supervisors alike were satisfied with program supports. Moreover, residents gradually assumed greater ownership of instruction over time.

Use of ADI and CT

Pairs were expected to implement at least one ADI cycle each semester, as well as to use CT practices in their instruction. An ADI cycle was defined as completing all seven ADI stages at least once, in any order.[3] While there was no threshold for using CT steps, pairs were expected to use CT practices in their classrooms to the extent possible.

First, we examined how frequently mentors and residents used strategies that promoted ADI and CT and whether mentors and residents implemented the ADI instructional model with fidelity (for details on the extent to which each indicator was met, see Appendix C). We also

[3] In the 2020–21 school year, the ADI cycle had eight stages. From the 2021–22 through the 2023–24 school years, the ADI organization modified the cycles such that each cycle had seven stages.

examined variation in implementation by subject area, adaptations, and challenges experienced when implementing ADI stages and CT practices.

ADI Implementation

Across all years, teachers understood the key principles of ADI. The fidelity indicator for ADI implementation was met in two of the four years.

In general, teachers' understanding of ADI concepts was aligned with ADI principles. Interviews highlighted that mentors typically thought of residents as the experts in ADI and allowed them to take the lead in implementing ADI. For instance, mentors reported that residents would share ideas with them on how to implement ADI and would put ADI lessons together. Two mentors mentioned "loving" residents' ideas on ADI implementation.

In three of the four years, residents were clear on the expectation to implement at least one ADI cycle per semester, while in one year, all residents were aware that they were to try and integrate ADI stages as best as possible but were not clear that there was an expectation to implement one full cycle per semester. Supervisors reported that residents' awareness of ADI increased over time; supervisors said that the checkboxes on ADI stages on the pre-observation form helped residents be more intentional about using ADI in their lessons because residents had to explain which ADI stage(s) they used in each observation. One supervisor explained:

> *"So, we talk about in the pre-conference how their co-planning is going…If there's any questions or concerns we talk about ADI, even if it's not an ADI lesson, we talk about what stage it could fall under. Then we talk about the co-teaching and usually pick a co-teaching model...and why they chose that particular one. How do they think that's going to improve student learning?"*

The majority of pairs implemented all expected ADI stages each spring. However, pairs selected specific ADI stages to implement.

Across years, monthly questionnaire data indicated that all pairs implemented at least some ADI by the spring semester, with most pairs implemented all of the expected stages at least once.

Exhibit 8 displays the percentage of ADI stages that pairs completed in each spring; the majority of pairs completed at least one full ADI cycle.[2] For instance, in spring 2024, 12 pairs, or 92 percent, completed all seven ADI stages at least once.

Exhibit 8. Percentage of ADI stages completed by pairs each spring

Number of ADI Stages Completed	Number of Pairs			
	Spring 2021	Spring 2022	Spring 2023	Spring 2024
Exactly 0 Stages	0	0	0	0
Exactly 1 Stage	0	0	0	0
Exactly 2 Stages	0	0	0	0
Exactly 3 Stages	0	5%	0	0
Exactly 4 Stages	0	0	6%	0
Exactly 5 Stages	0	0	6%	0
Exactly 6 Stages	0	0	6%	8%
Exactly 7 Stages	29%	95%	81%	92%
Exactly 8 Stages*	71%	n/a	n/a	n/a
Total Pairs	7	19	16	13

*Note: Exhibit displays the number of pairs who completed a given number of ADI stages in the spring of each year. A pair was considered to have completed a stage if at least one teacher in the pair reported implementing a given stage at least once. Stages did not need to be completed in order. We examine spring ADI implementation data as teachers' comfort and understanding of ADI implementation was greater compared to the fall semester, in which teachers were implementing ADI for the first time. *In the 2020–21 school year, there were a total of eight ADI stages, while in the 2021–22 through 2023–24 school years there were a total of seven ADI stages*

However, pairs typically did not implement a full ADI cycle from start to finish. More often, they would implement separate ADI stages, tending to implement certain stages more than others and skipping stages at times. Exhibit 9 displays the percentage of pairs who completed a given stage at least once each spring. While most pairs tried each stage at least once, pairs were slightly more likely to skip the "reflect" and "report" stages.

Exhibit 9. Percentage of pairs completing an ADI stage each spring

ADI Stage	Percentage of Pairs		
	Spring 2022	Spring 2023	Spring 2024
Task	100%	100%	100%
Ideas	100%	100%	100%
Plan	100%	100%	100%
Do	100%	100%	100%
Share	95%	100%	100%
Reflect	95%	94%	100%
Report	95%	88%	92%
Total Pairs	19	16	13

Note: Exhibit displays the percentage of pairs who completed a given ADI stage each spring. A pair was considered to have completed a stage if at least one teacher in the pair reported implementing a given stage at least once. Spring 2021 data were not included as the ADI model had eight stages at the time, and these stages do not map directly to the seven ADI stages in spring 2022 through spring 2024. Examining patterns from spring 2021 reveals that all pairs completed seven of the eight stages at least once. The stage skipped by a few pairs was "report."

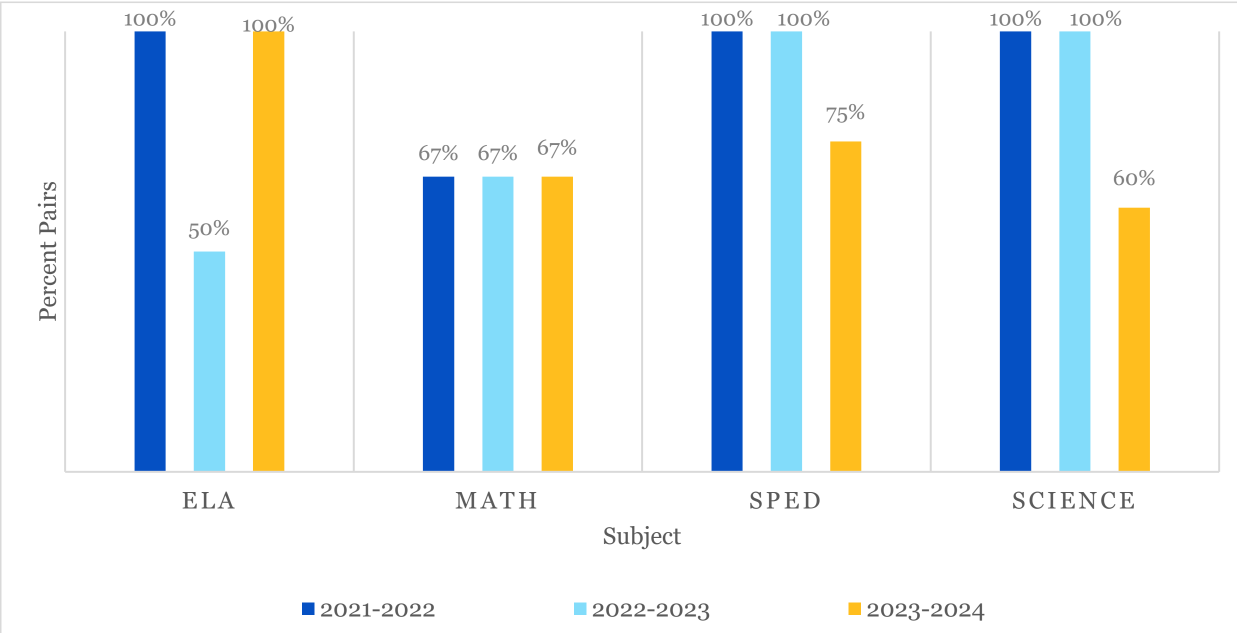
Teachers reported some challenges with ADI implementing, including a lengthy planning and implementation process and difficulties preparing students to complete ADI activities.

Teachers reported needing some time to learn about ADI and figure out how to integrate the stages into their lessons. Across subjects, teachers reported an ADI cycle to be time-consuming to plan and to implement, taking anywhere from one to four weeks. A few teachers also reported that ADI lessons did not always fit neatly into their curriculum and sometimes felt like an add-on. Teachers also shared that their students needed time and scaffolding to grapple with the exploratory approach used in ADI, which differs from more traditional lesson formats in that there are “no right answers.” In addition, given that ADI lessons took many days, teachers shared about the challenge of navigating student absences, especially with respect to the data collection stage.

There was some variation in ADI implementation by subject.

We examined the percentage of pairs by subject who implemented at least one complete ADI cycle in the spring of each year from 2021–22 through 2023–24 (see Exhibit 10). The 2020–21 year was not excluded due to small samples of pairs in math, science, and special education and due to ADI stages not aligning with those in subsequent years. In two of the three years examined, all pairs in ELA, special education, and science taught at least one ADI cycle, while only two thirds of math pairs completed a full ADI cycle in the spring of each year. Fewer pairs implemented a full ADI cycle in the 2023–24 school year.

Exhibit 10. Percentage of pairs that completed at least one ADI cycle (all steps) in spring of each year by subject



Note: Exhibit displays the percentage of pairs for each subject area who reported implementing at least one ADI cycle in 2021–22 through 2023–24. Data from 2020–21 were excluded as there were no special education CLASS pairs and a small number of math/science CLASS pairs, and the number and sequence of ADI stages differed from those in the remaining study years. SPED = special education. ELA = English language arts.

From interviews, science pairs consistently felt that ADI aligned closely with their content area while pairs teaching special education consistently reported needing to modify ADI lessons to meet their students' needs.

In general, interviews indicated that science pairs reported being able to take ADI lessons and implement them directly in their classroom. In contrast, special education teachers needed to modify and scaffold the steps to accommodate student needs. Special education teachers simplified language and steps to make ADI lessons more accessible to students.

In some years, math residents reported needing additional supports implementing ADI, for instance, wanting more examples of what ADI can look like in math subjects; in other years, ELA residents reported needing more supports and guidance understanding how to implement ADI lessons in their classes. Math and ELA teachers alike noted a desire for more tailored, content-specific supports for ADI.

Furthermore, both math and ELA pairs reported making adaptations to ADI lessons in their subject area. For instance, ELA teachers engaged their students in text analysis rather than data analysis, and combined some ADI stages to streamline steps they felt were repetitive and/or time-intensive. In the 2022–23 year, ELA residents reported needing more supports implementing ADI and even reported receiving messaging that ADI is not made for English. This perception may explain the lower implementation in this school year.

CT Implementation

Across years, teachers struggled to define CT, though teachers' reported use of CT practices remained consistently high.

In general, teachers did not have a strong awareness or understanding of the term "computational thinking." In earlier years of the grant, teachers had limited awareness of the term CT and did not always recall receiving training on CT; teachers' familiarity with CT practices and ability to define CT practices increased somewhat over time as the CLASS program bolstered the professional development provided around CT. By 2023, teachers defined CT as "thinking like a computer" or "logical thinking."[4]

Yet most teachers report using CT. Across years, all or almost all pairs reported implementing at least some CT practices, though usage ranged from none to a few times a week. Exhibit 11 displays the percentage of pairs who reported completing CT steps each spring. In the latter three years of the grant, about half to three fourths of pairs completed all six steps, while in the first year, no pairs completed all six steps in spring. Interview data suggested that pairs did not seem to be intentional in their usage and felt what they were already doing in their lessons constituted CT implementation.

Exhibit 11. Percentage of pairs who implemented CT steps in the spring of each year

Number of CT Steps Completed	Percent of Pairs			
	Spring 2021	Spring 2022	Spring 2023	Spring 2024
Exactly 0 Steps	0	0	0	0
Exactly 1 Step	0	0	0	0
Exactly 2 Steps	0	0	6%	0
Exactly 3 Steps	8%	5%	6%	0
Exactly 4 Steps	4%	11%	13%	8%
Exactly 5 Steps	0%	21%	13%	92%
Exactly 6 Steps	75%	63%	60%	0
Total Pairs	8	19	16	13

Note: Exhibit displays the percentage of pairs who completed a given number of CT steps each spring. A pair was considered to have completed a CT step if at least one teacher in the pair reported implementing a given step at least once. Steps did not need to be completed in order.

Similar to ADI, pairs were more likely to complete some CT steps than others. As shown in Exhibit 12, the least-used steps across years were "using statistics and/or probability to analyze

[4] In 2023–24, the CLASS program made concerted effort to provide residents' professional development on CT throughout the year, including sessions on how CT relates to ADI. However, the study did not conduct interviews with residents in spring 2024 and is thus unable to report on residents' understanding of CT or computational systems thinking practices in spring 2024.

data and/or draw conclusions" (Analyze Data); "using computer-based tools (e.g., Excel, Tuva, CODAP), to identify patterns or anomalies in data, data trends over time, categorize data, or demonstrate relationships within data fields" (Patterns with Technology); and "producing appropriate data visualizations (e.g., graphs, tables, charts, dashboards) to convey information gathered during analysis" (Data Visualization).

Exhibit 12. Percentage of pairs completing a CT step each spring

Computational Thinking Practice	Percent of Pairs			
	Spring 2021	Spring 2022	Spring 2023	Spring 2024
Data Collection Method	100%	100%	100%	100%
Collect Data	100%	100%	100%	100%
Analyze Data	43%	89%	88%	69%
Patterns with Technology	43%	63%	63%	69%
Interpret Data	100%	95%	81%	85%
Data Visualization	86%	95%	88%	92%
Total Pairs	7	19	16	13

Note: Exhibit displays the percentage of pairs who completed a given CT step each spring. A pair was considered to have completed a step if at least one teacher in the pair reported implementing a given step at least once.

In the 2023–24 school year, the CLASS program added an additional focus on computational systems thinking practices. Exhibit 13 shows the percentage of pairs who completed a given computational systems thinking practice at least once each semester. In fall 2023, all but one pair completed each practice at least once, while in spring 2024, almost all pairs completed each practice.[3]

Exhibit 13. Percentage of pairs implementing each CST step in fall and spring 2024

Computational Systems Thinking Practice	Percent of Pairs	
	Fall 2023	Spring 2024
Investigating a Complex System	92%	100%
Understanding Relationships in Systems	92%	100%
Thinking in Levels	92%	100%
Communicate About a System	92%	92%
Define Systems	92%	100%
Total Pairs	13	13

Note: Exhibit displays the percentage of pairs who completed a given CST step each semester. A pair was considered to have completed a step if at least one teacher in the pair reported implementing a given step at least once in the semester.

CLASS Program Supports

During summer, residents, mentors, and supervisors participated in mandatory trainings on ADI, co-teaching, the residency model, and CT. In June of each summer, new mentors were invited to participate in a four-day "train-the-trainer"-style ADI workshop, in which they learned the fundamentals of ADI and became certified to train another teacher to use it. In July of each year, residents, mentors, and supervisors were invited to participate in a four-day training covering several aspects of the residency: Two days focused on ADI, with mentors supporting their residents in learning about ADI concepts; one and a half days centered on co-teaching strategies; and a half day was dedicated to CT. Cohort 1 and 2 residents completed a four-day "train-the-trainer" ADI workshop in June following graduation to attain their ADI certification, while Cohort 3 and 4 residents completed this workshop in the January prior to graduation.[5]

Throughout the year, residents received ongoing training and support from the CLASS program through monthly check-ins, feedback from their supervisor through observations, guidance from an ADI coach, and master's program coursework, as well as daily supports from their mentor teacher. In addition, residents were expected to complete master's coursework, an action research project focused on ADI implementation, and other teacher certification requirements as part of the program.

Below, we describe the extent to which residents accessed these supports and the degree to which residents found the supports helpful in fulfilling CLASS program requirements.

[5] The CLASS program moved the train-the-trainer ADI workshop to attain certification from June to January to provide residents more timely training on ADI, per residents' feedback.

CLASS Program Training and Supports for Residents, Mentors, and Supervisors

Mentors and residents completed trainings with fidelity and all related indicators were met across all years.

The fidelity of implementation analysis includes indicators for whether a significant proportion of mentor and resident teachers participated in the mandatory summer trainings. All indicators regarding mentor and resident participation in trainings were met in all years, including the program offering and teachers completing trainings on ADI, CT, and co-teaching; teachers participating in ADI coaching; and teachers attaining an ADI certification.

In three out of four years, the fidelity indicators related to supports received by supervisors were met.

The fidelity of implementation analysis included indicators for whether a significant proportion of supervisors participated in the mandatory summer trainings. In three of the four years, both indicators were met, including completion of summer training on ADI, CT, and/or co-teaching.

Across years, most participants found the ADI summer training helpful, especially activities in which they experienced an ADI lesson as a student and planned an ADI lesson themselves.

Interviews indicated that overall, participants found the summer training useful, with the most useful components being learning how to facilitate an ADI lesson and experiencing an ADI lesson as a student. For instance, one resident said:

> *"I thought the in-person training was really, really valuable…we had to act as students through the process of ADI and then we have to act as teachers through the process as well, and I thought that was a really good way to be training, instead of them just kind of dumping information on us."*

A few teachers provided subject-specific feedback on improving the summer training, including wanting differentiated opportunities for science residents to learn about ADI as the activities for science resident teachers felt similar between the first and second day of the training, while math and ELA teachers expressed wanting to see more examples in their subjects.

Increased communication from the CLASS program bolstered residents' experiences over the years.

The program launched at the beginning of the COVID-19 pandemic. Like many institutions at the time, the program operated virtually, making effective communication a challenge. As a result, participants in the first two cohorts experienced difficulty understanding program requirements or attending meetings scheduled during the school day.

However, as the program transited to in-person programming in Cohort 3, CLASS program staff emphasized how face-to-face programming has improved the supports that CLASS program staff are able to provide residents. Sharing a meal and asking about personal lives has helped build relationships among residents and the CLASS program staff.

Residents received wraparound supports such as a peer community and mental health supports.

The cohort model, strong community, consistent communication around program requirements, and CLASS network were emphasized as strengths of the program by residents and alumni. Residents emphasized the strong peer community as well as a larger network of supports from CLASS and supervisors. Alumni shared that the cohort model fostered a familial feel with shared comradery, and supportive CLASS program faculty members helped guide them throughout the program. One resident described the supports they received from the CLASS program community:

> *"The biggest thing for me was the support from the staff or the advisors, and then also my classmates, like, you know, class. This cohort has been a very tightknit group. We're all very supportive. We're always checking in on each other...Have you been doing any ADI, or you know we were always talking about different things that we can be doing to implement ADI, or even like I tried doing this and it didn't work. So we provide feedback...It has really been like that sense of community that has really helped me through this program."*

Participants also highlighted the wraparound supports the CLASS program provided to help residents navigate the rigorous coursework and the challenges of being a new teacher. These include CLASS program staff advocating for self-care, connecting students with campus resources like counseling, providing trauma-informed and anti-racism trainings, and providing individualized supports as needed. The CLASS program also had an improvement plan model in place for residents that might need additional support.

Nevertheless, residents, mentors, supervisors, and CLASS program staff alike noted that the extensive requirements of the CLASS program can be demanding.

Residents, supervisors, and mentors noted that the CalTPA exams are particularly time-consuming and requested supports for residents to prepare for these exams, such as days off from their teaching schedule or a temporary reduction in coursework requirements during especially hectic times.

Residents suggested that the program or CSU, Chico offer more remote mental health services and offer after-hours seminar support. One alum suggested additional training on establishing classroom environments independently (as most residents followed their mentor teachers' system).

Overall, supervisors were positive about the supports they received from the program.

Supervisors were supported in their work by attending summer trainings with mentor and resident teachers through check-ins with the CLASS program team, and through materials and resources provided by the team. Supervisors found the CT trainings, roadmap document, and trainings on conducting classroom observations particularly helpful. Supervisors also cited as a benefit CLASS program staff members' availability to support them through unique situations with residents. Additionally, mentors and residents alike said that the monthly emails on CLASS activities and tasks helped them navigate the rigors of the program.

Over the years, the CLASS program enhanced supports for supervisors.

The CLASS program enhanced supports to supervisors over the duration of the program to support them in completing their supervisory duties. Overall, supervisors reported supports being more robust over the years. In later years, supervisors met bi-monthly with CLASS program staff for guidance on scoring and paperwork, observing residents, and other special topics. Support and training topics included professional development around pedagogy, CLASS components, and how to provide supports for diverse groups of students. Supervisors found monthly professional development meetings helpful, collaborative, and engaging. Supervisors also mentioned receiving training and supports from either the CLASS program or CSU, Chico School of Education around universal design for learning, multi-tiered system of supports, English language learners, trauma-informed practices, and classroom observations.

Mentors felt more prepared from year to year with added supports and trainings.

Initially, mentors did not feel adequately prepared to serve as mentors, with one mentor expressing interest in "more training on what it means to be a mentor and the steps you need to take to gradually release your classroom and how to involve them." Relatedly, some mentors believed that it would be helpful to have a better sense of the expectations of being a mentor, with one mentor suggesting that a "year overview" document would be useful in that regard. For example, one mentor suggested providing mentor teachers with an overview document mapping our key tasks, requirements, and activities for the entire year.

In later years of the program, mentors felt satisfied with the supports they received. Program leaders incorporated mentors' feedback year to year to improve training and add additional supports. In later years, mentors reported having a better understanding of their responsibilities and feeling more prepared in their roles.

A few principals expressed wanting more information on the CLASS program, and opportunities to participate in resident supervision and observation.

Principals expressed a desire to learn more about the program to help inform mentor and resident matches, to support residents, and to generally know more about what is happening in their building regarding the CLASS program. Principals have preferences and perceptions of who in their building might be good fits to be mentors and would like the opportunity to share these ideas with the CLASS program. Principals wanted more regular status updates and communication about CLASS program recruitment, selection, and program requirements (e.g., materials, meeting with CLASS program staff), especially leading up to the beginning of the school year so they know what to expect from their participation in the program. Relatedly, some principals reported wanting clarity on expectations for working with the resident in their building such as knowing if principals can conduct classroom observations of their residents.

ADI Coaching Supports for Residents

The amount of time pairs worked with the ADI coach varied over the course of the year and by cohort.

Questionnaire data show that 100 percent of pairs worked with an ADI coach at least once in Cohorts 1–3, and 85 percent of pairs in Cohort 4. In general, most pairs worked with a coach in November, January, and/or February, though a few pairs worked with a coach in other months as well. In Cohort 3, there were no months in which no pairs worked with an ADI coach; in contrast, there were five such months in Cohort 4. The duration of the meetings with the ADI coach were also highest among Cohort 3; in months where pairs reported working with an ADI coach, Cohort 1 pairs reported working with the coach an average of 1.7 hours a month, Cohorts 2 and 4 an average of 2 hours a month, and Cohort 3 an average of 2.8 hours per month.[6]

In months where pairs report working with an ADI coach, pairs report working an average of 2.8 hours a month with the coach. In contrast, last year, pairs reported working an average of 2 hours a month with their ADI coach.

Supervisor Supports for Residents

For the last two years, the CLASS program provided more structured supports to supervisors to build ADI content knowledge and improve supervisors' ability to support residents with respect to ADI. SRI researchers collected monthly feedback regarding residents' experiences with accessing supervisor supports on ADI. Experiences could include feedback residents received from their supervisor pre- or post-observation or any other communication with their supervisor regarding ADI.

In one of three years measured, supervisors met the fidelity indicator related to providing residents ongoing supports in ADI.

The fidelity of implementation analysis included an indicator for whether supervisors observed their assigned residents teaching ADI at least once per semester. In the three years this indicator was measured, supervisors the indicator was met in one of the three years.

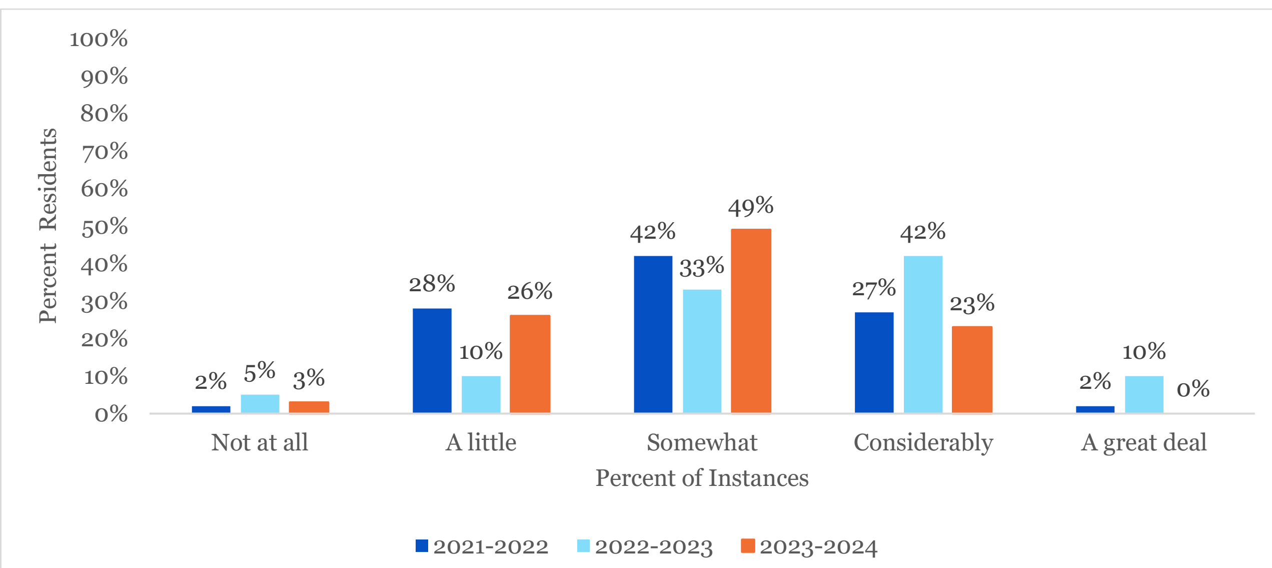
[6] Statistics on average hours per month working with a coach were calculated by creating a within-pair average of hours worked with coach using data from months in which at least one person from the pair reported working with an ADI coach.

In general, supervisors were found to be somewhat helpful with respect to supporting ADI implementation.

Residents were more likely to access support on ADI implementation from a supervisor as time went on: While about 80–85 percent of residents accessed this support at least once in Cohorts 2 and 3, 100 percent of residents accessed this support in Cohort 3. Within a year, the percentage of residents who accessed supervisor support on ADI varied from month to month. In general, residents were most likely to access supervisor support on ADI in fall (September–November) and early spring (February), and the least likely in winter (December–January) and the end of spring (April–May). In general, between 40 and 50 percent of residents received supervisor support on ADI in a given month.

Whenever a resident reported accessing supervisor support on ADI, they were also asked to describe the helpfulness of the support on a five-point Likert scale. Exhibit 14 displays residents' perceived helpfulness of supervisor supports over time. Among the times residents' requested supervisor support on ADI implementation, residents found a third to a half of these instances "somewhat" helpful. In two of the three years this support was measured, only a quarter found the support "considerably" helpful, and between 0 and 10 percent found the support "a great deal helpful." In general, Cohort 3 residents were more likely to report supervisor support in ADI implementation as helpful.

Exhibit 14. Helpfulness of supervisor support on ADI



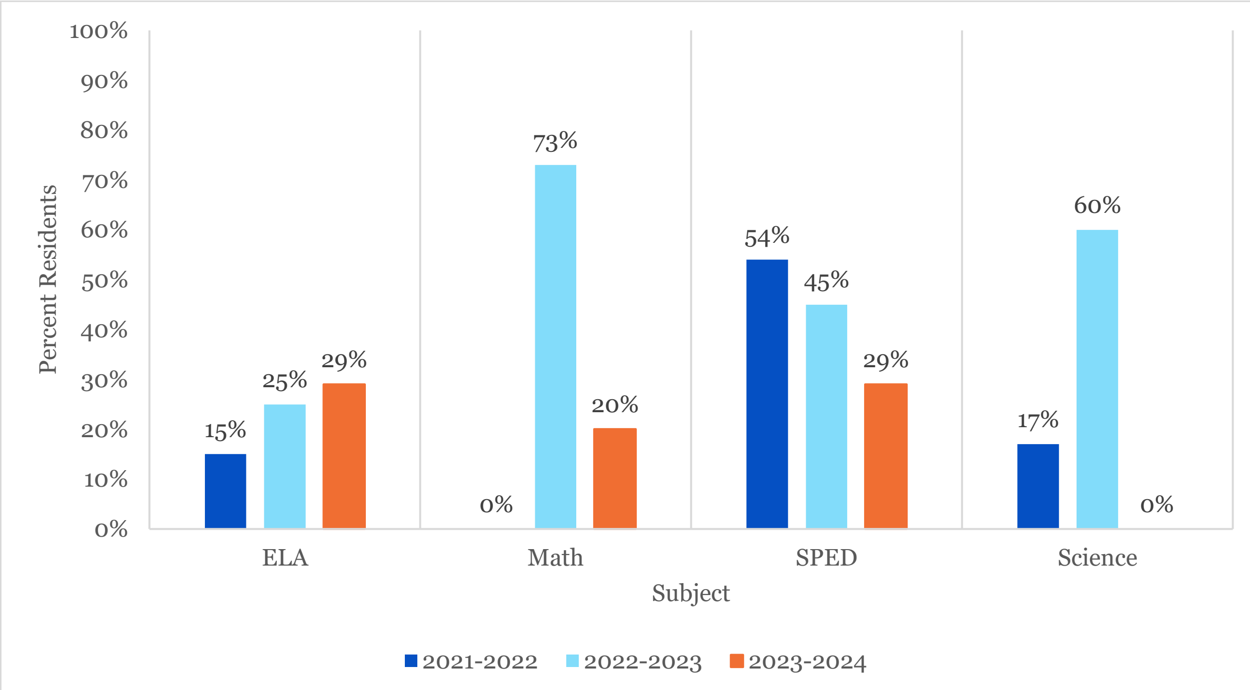
Note: Residents rated supervisor helpfulness on a five-point Likert scale ranging from "not at all helpful" to "a great deal" helpful. Exhibit shows how helpful residents found instances in which they received support from their supervisor on ADI.

Findings from interviews corroborate these survey results. Generally, both residents and mentors felt that supervisors supported residents in improving their instructional practice, such as feedback on building relationships with students, classroom management, or building assessments, and offered objective feedback. As one resident shared, “If there are things that I need addressed that I feel I can’t, our supervisor is a good ally to assist with that just so I can make sure my relationship with my mentee doesn’t suffer too much. Sometimes it’s helpful to hear a different voice.” Residents also shared that supervisors offered encouragement and support. A few residents wanted more actionable and constructive feedback from supervisors about their instruction.

With respect to support for ADI, mentor and resident teachers felt supervisors’ helpfulness improved over time. By spring 2023, interviews revealed that both mentors and residents found supervisor support in ADI to be helpful, in contrast to spring 2022 when perceptions were mixed. Mentors and residents expressed appreciation for supervisors’ support in ADI, and residents cited supervisors as a source of ADI support, in addition to the CLASS program and their ADI coach.

Next, we examined variation in supervisor helpfulness in ADI by subject by observing the percentage of instances in which residents received supervisor ADI support that were rated as “considerably” or “a great deal” helpful in a given year and subject. As shown in Exhibit 15, ELA residents were least likely to report this support as helpful. Math and science residents found supervisor support helpful in one out of three years. Special education residents perceptions of supervisors’ helpfulness in ADI decreased over time.

Exhibit 15. Percentage of residents reporting supervisor support as helpful over time, by subject



Note: Residents rated supervisor helpfulness on a five-point Likert scale ranging from "not at all helpful" to "a great deal" helpful. Exhibit shows how helpful residents found instances in which they received support from their supervisor on ADI in each year this indicator was measured (2021–22 through 2023–24), by subject. Exhibit displays the percentage of residents who reported instances they received support as "considerably" or "a great deal" helpful.

Mentor Supports for Residents

The fidelity indicators related to the availability of mentor teachers in a range of subjects were met for one out of the four subjects in all four years. However, the indicator on mentors' longitudinal participation was not met.

The fidelity of implementation analysis included an indicator for whether the CLASS program recruited sufficient mentor teachers to support residents in different subject areas. The program recruited at least three mentors in ELA in all four years, and at least three mentors in math, special education, and science in three of the four years.

In 2023–24, the fidelity of implementation analysis also examined mentor teachers' tenure in the program. Thirty-one percent of the 29 mentors participated in at least three years, missing the threshold of 80 percent.[7] The gap in meeting this indicator can be explained by several extenuating circumstances, including mentors being recruited in later years as program expanded, mentor turnover due to personal reasons, unavailability of suitable resident matches, or schools opting to leave the program midway.

[7] In calculating this indicator, we use a sample of 29 mentors who participated in the program without exit. Mentors who exited midyear were exited from the sample.

Mentors' level of confidence implementing activities related to the CLASS program stayed relatively consistent over time.

When selecting mentors, the CLASS program team and principals of participating schools looked for teachers who had strong classroom pedagogy (including prior experience in practices related to CLASS program concepts), who would be good co-teachers and whose personalities would fit well with those of the residents.

Exhibit 16 displays mentors' prior experience implementing activities related to CLASS program concepts. Across cohorts, the majority of mentors reported having implemented most of the activities. Mentors were least likely to report implementing the following activities, though the percentage of mentors implementing these activities increased over time: using computer-based tools to identify patterns or anomalies in data, using computer-based tools to identify data trends, and using statistics/probability to analyze data/draw conclusions. These findings mirror pairs' lower implementation of comparable CT steps.

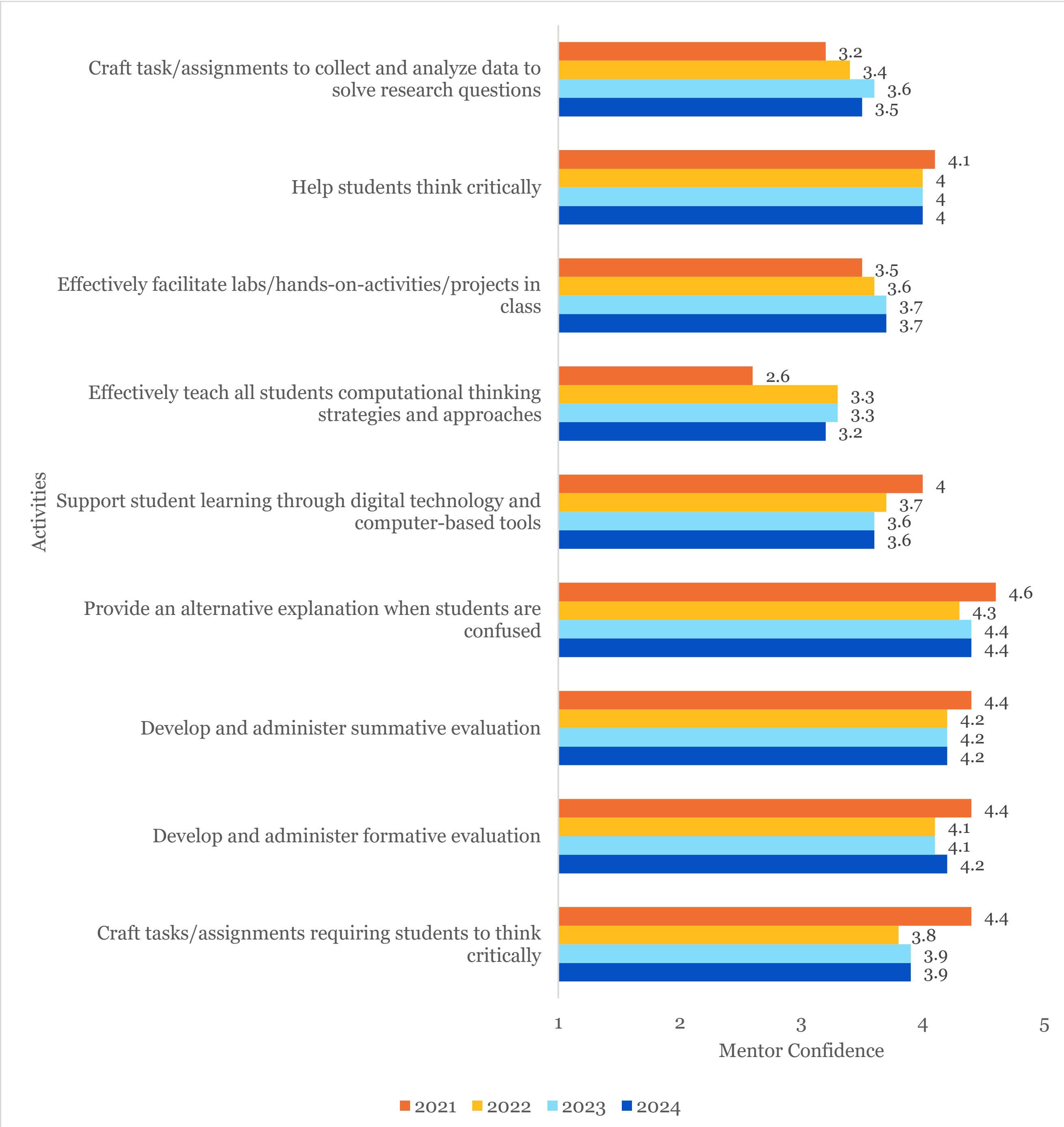
Exhibit 16. Percentage of mentors reporting prior experience with practices related to CLASS program concepts

Instructional Practice History	2021	2022	2023	2024
Use computer-based tools to identify patterns or anomalies in data	13%	39%	57%	54%
Use computer-based tools to identify data trends, categories, or relationships	13%	39%	57%	54%
Use statistics/probability to analyze data/draw conclusions	38%	78%	86%	85%
Write short persuasive texts (1–4 pages)	75%	72%	64%	54%
Interpret data for making predictions or drawing conclusions	75%	72%	65%	62%
Develop method for collecting data to answer a question	88%	83%	100%	100%
Collect data to answer research question	88%	89%	100%	100%
Conduct labs/hands-on activities/projects in class	88%	83%	93%	92%
Complete tasks/assignments with no obvious solution	100%	100%	86%	85%
Complete tasks/assignments requiring critical thinking	100%	100%	100%	100%
Complete tasks/assignments requiring at least one week to complete	100%	94%	93%	92%
Use computer-based tools for projects or class work	100%	100%	100%	100%
Work in small groups	100%	94%	100%	100%
Decide on their own procedures for solving complex tasks	100%	89%	100%	100%
Peer review with classmates	100%	89%	100%	100%
Produce data visualizations to convey information	100%	89%	100%	100%
Engage in a whole-class discussion	100%	100%	100%	100%

Note: Each year, the mentor survey asked mentors to think about their classroom instruction in the prior year and asked how frequently they asked students to engage students in the activities related to CLASS program concepts. Exhibit displays the percentage of mentors who asked their students to complete a given activity at least once in the prior year.

Mentors were also asked their level of confidence in implementing activities related to CLASS concepts on a five-point Likert scale ranging from "not at all confident" to "extremely confident." While mentors had prior experience in implementing activities related to CLASS program concepts, their level of confidence implementing these activities stayed relatively constant over time (see Exhibit 17). Across years, on average, mentors rated their level of confidence in these activities as "somewhat" to "quite" confident. Mentors were less confident in implementing activities related to analyzing data, leading labs or hands-on activities, effectively teaching CT strategies, and supporting students in learning through digital technology. Mentors were more confident in activities related to helping students think critically, providing alternative explanation, and developing and administrative formative and summative evaluations. Mentors' level of confidence stayed consistent in these activities over the years, except in "effectively teaching all students computational thinking strategies and approaches,” where mentors reported level of confidence increased from an average of 2.6 in 2021 (just over “slight confident”) to an average of 3.3 (just over “somewhat confident”).

Exhibit 17. Mentor teachers' confidence in implementing instructional practices related to CLASS program concepts



Note: Each year, the mentor survey asked mentors their confidence in implementing activities related to CLASS program concepts. Mentors responded on a five-point Likert scale with 1 equal to "not at all confident," 2 equal to "slightly confident," 3 equal to "somewhat confident," 4 equal to "quite confident," and 5 equal to "extremely confident." Mentors could also select "not applicable." Exhibit displays the mean value of mentors' responses each year, excluding mentors who selected "not applicable."

Residents said they benefitted from working with a mentor teacher for the duration of a school year.

Several residents said that the experience of working alongside a mentor daily for a full school year helped prepare them for teaching full-time and what it would be like to have their own classrooms. Residents felt mentors provided consistent feedback on their teaching and modeled effective planning and teaching. One resident shared how their mentor helped them be reflective about their practice, sharing:

> *"The biggest thing is they've helped me with being a really reflective teacher, which I think gives me a really good advantage for the next few years…That's something we talk about even mid-lesson: They'll stop me and be like, 'Hey, this is something you might think about.' Then I've started to get into that habit of, oh, maybe that didn't work so well, let me try different questioning method."*

Residents also appreciated that the feedback from mentors was constructive, immediate, and actionable.

Coursework and Action Research

A key component of the CLASS program is for residents to complete their master's degree in the span of a year.

All or almost residents completed their degree, meeting the indicator of implementation fidelity in all four years.

Residents felt courses were valuable to their growth, especially courses on research methods (which supported completion of their action research projects) and courses on content-specific pedagogy and practical teaching skills. For instance, one resident vocalized that the professors they have had made the content relevant, saying:

> *"We'll learn something about assessments and then it's like we're applying that, like the next day or the next week and our residency and you know, seeing how that worked, and so I feel like everything has been like directly applicable."*

Central to residents' teaching methods courses was the inclusion of activities and opportunities for residents to learn how to implement ADI and/or CT practices with their students. The associated fidelity of implementation indicator, which measured whether at least 75 percent of the four methods courses taken by residents in ELA, math, or science included ADI and/or CT strategies, was met in two of the three years the indicator was measured. ADI was mentioned in residents' methods courses typically in the context of resident teachers' action research projects. A few residents expressed wanting more research supports throughout the year, such as a refresher methods course in spring prior to collecting data.

All residents completed their action research projects. Residents reported feeling supported throughout the process.

Residents' action research projects focused on a question specific to their placement classroom(s) and required residents to include a focus on data collection and ADI in their examination. Action research projects required residents to formulate inquiry questions, review literature, develop inquiry tools, and analyze data. The deep blending of theory, inquiry, and practice aimed to allow residents to make meaningful connections between current educational theory and research and their daily classroom practice (Capraro et al., 2010).

All residents completed their action research projects, meeting the fidelity indicator in all four years. Residents were aware that they needed to use ADI in their action research projects and measure student outcomes. However, the program only met this requirement in two of the four years. Residents felt supported by their research methods professor in deciding on a topic and fine-tuning their projects; by research advisors in completing the IRB process; by mentor teachers in implementing assessments to students; and by the ADI coach in identifying appropriate ADI stages for their action research.

Residents noted that completing the action research study helped them contextualize their teaching.

In collecting data for the action research study, residents expressed learning how to better interpret assessment results and increased their understanding of students' learning process. Residents described these benefits even before they had completed their projects. For example, one resident explained how their action research pushed them to go through the reflection process of identifying what factors impacted higher test scores. The resident then listened to their students and was able to tailor teaching strategies to the class. Another resident said the action research project gave them a "reality check" in what it was like "to be a student learning things for the very first time."

Student engagement was perceived as an important outcome in action research projects.

To complete their action research projects, residents examined data from surveys, scores on rubrics, student interviews, and/or classroom observations. In addition to examining changes to students' academic outcomes (e.g., writing or argumentation skills), many projects focused on a range of student outcomes including student engagement, students' mental orientations toward problem-solving (i.e., how students were approaching a problem), social-emotional learning, student confidence, and student learning identities, among others.

Both residents and CLASS program alumni reported action research as having a positive influence on their teaching practices.

In collecting and analyzing data for their projects, residents and alumni mentioned that the action research project provided them insights on how to adjust their teaching practices to support and engage more students in their learning experiences. Residents mentioned they enjoyed the collaborative research process with peers and the built-in feedback loops to catch mistakes. One alum also highlighted that the outcomes of their project had allowed them to make text technology more enjoyable for students this year.

Use of Co-Planning and Co-Teaching Strategies

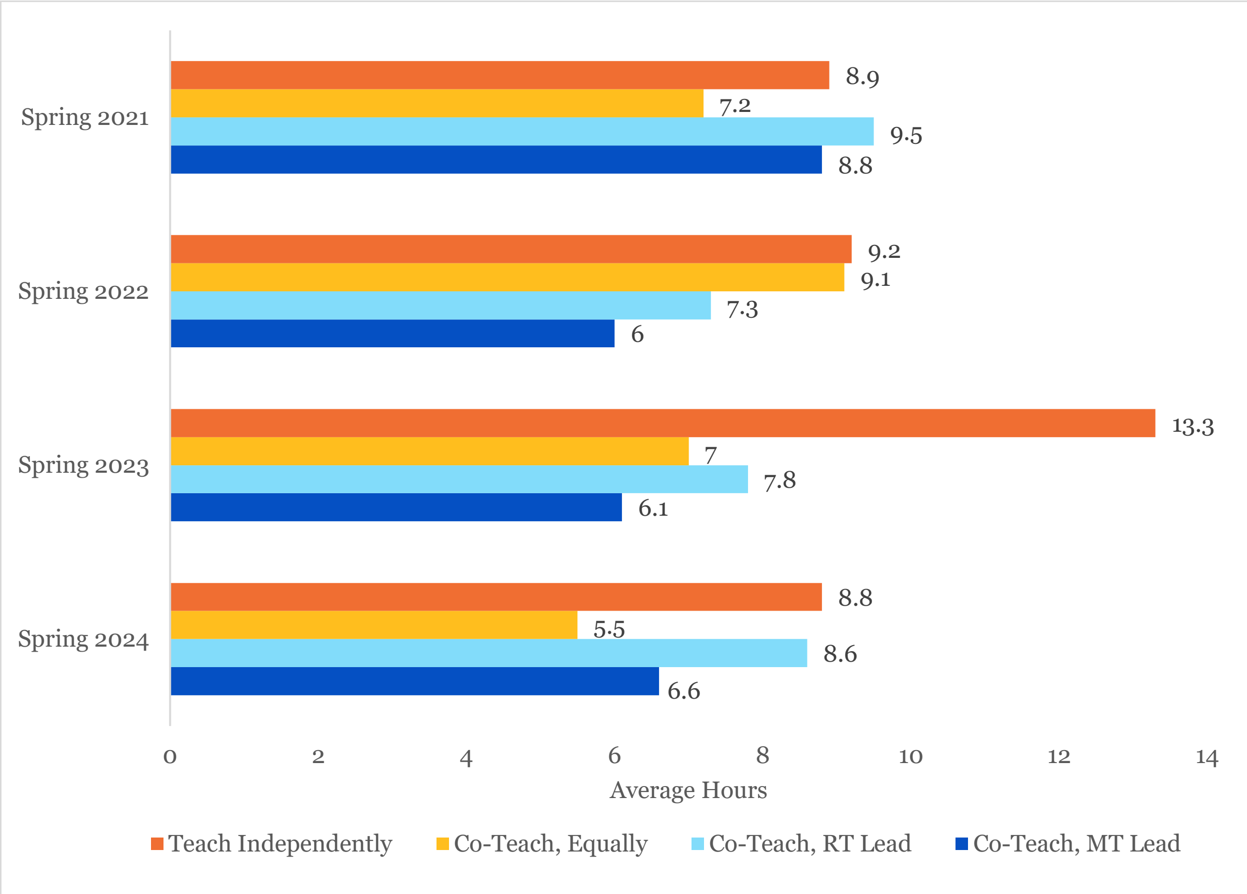
As part of the CLASS program, residents and mentors were expected to co-plan and co-teach courses, with the resident taking on more teaching responsibilities as the year progressed.

Throughout the program, residents reported co-planning and co-teaching with their mentors and gradually assumed greater ownership of instruction over time.

First, we examined the extent to which pairs were co-planning and co-teaching each month. Both residents and mentors reported collaborating closely with their partner. In the first three years of the program, log data corroborated interview findings that residents reported that they slowly took over ownership of lesson planning with their mentor teaching providing feedback. Across the program, pairs reported co-planning anywhere from 15.9 to 21.5 hours a month. Although there were no clear patterns as to why some months had higher hours of co-teaching than others, from September to December there was a decline in reported hours of co-planning. In interviews, residents reported slowly taking over more responsibility of lesson planning, with the majority of CLASS alumni reporting doing some co-planning with teachers in their schools after the program.

Pairs were also asked about the frequency of using different co-teaching strategies throughout the school year. Exhibit 18 displays the average hours residents reported teaching using different teaching formats in the spring of each year. In three of the four years, residents reported teaching independently more hours per week than any other type of teaching format. The average hours of independent teaching reported by residents reached a crescendo in Year 3 (13.3 hours), with Year 4 being more consistent with Years 1 and 2. Across years, the hours residents reported co-teaching equally or co-teaching with the resident leading increased in the spring as well, while mentor-lead instruction decreased.

Exhibit 18. Average hours residents reported teaching using different teaching formats in the spring semester of each year

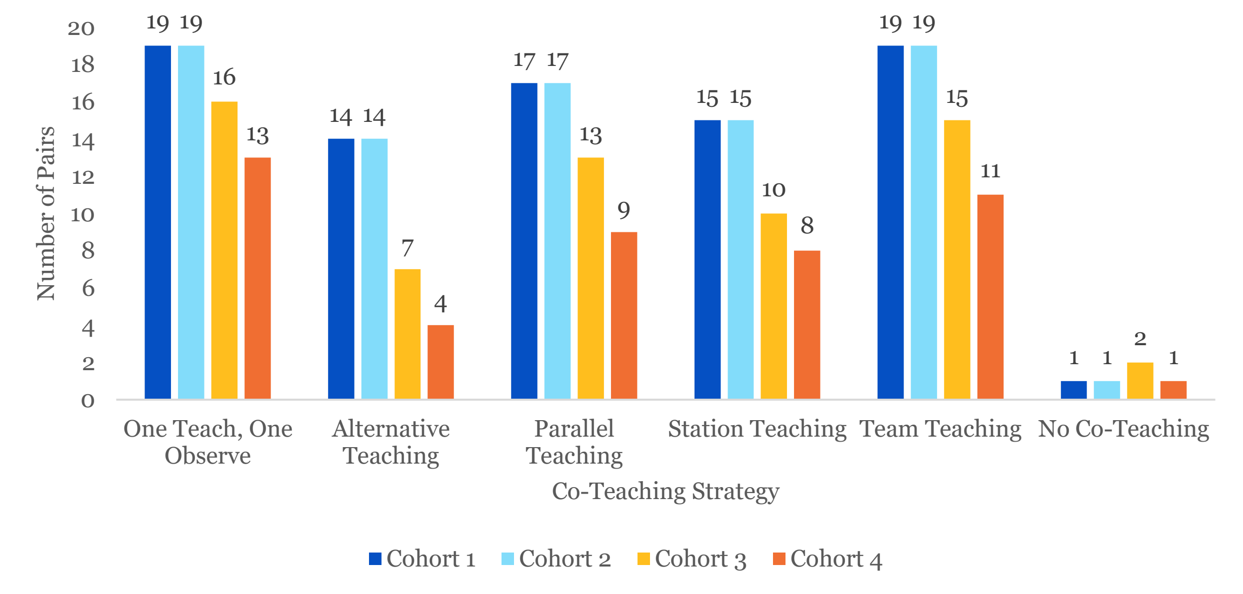


Note: Bars represent the average number of hours per week that teacher residents reported teaching using different instructional formats. Averages shown by semester. RT = resident teacher; MT = mentor teacher.

Co-teaching strategy preference varied from year to year with pairs doing one teach, one observe and team teaching more often than other strategies.

Pairs were asked to report on the types of co-teaching strategies utilized each month. Exhibit 19 shows the types and frequency of co-teaching strategies pairs utilized each year. All pairs throughout the program tried one teach, one assist; one teach, one observe; with most pairs trying team teaching. Fewer pairs tried alternative (differentiated) teaching or station teaching.

Exhibit 19. Number of pairs who reported ever using a co-teaching strategy, by cohort



Note: Exhibit displays the number of pairs who ever reported using a given co-teaching strategy in a given school year, by cohort. Because pairs may have tried different co-teaching strategies throughout the school year and not just in spring, we report data from the full school year and not just from spring.

Residents were mostly positive about their relationships with their mentor teachers. Pairs worked together closely with residents assuming more ownership in planning as the year progressed. Mentors worked to scaffold and eventually gradually release teaching responsibilities to residents through various tactics. Teachers reported co-teaching to bolster resident confidence, with residents taking over some classes nearly completely in the spring once they were comfortable.

Generally, mentors and residents found that there were many benefits to co-teaching and co-planning, while a few pairs experienced some unique challenges specific to certain classes and subject areas.

We sought to understand what mentors and residents perceive as the benefits and challenges of co-teaching and co-planning. The CLASS program's intentional mentor and resident matching process was mostly successful. There were one to two instances each year where pair incompatibility arose, but CLASS was efficient and successful in reassigning residents who were able to continue their teaching in another room with a different mentor. In one year, there were some difficulties in the co-planning between special education teachers and content area teachers, as special education teachers often push into general education classes.

Overall, mentors and residents found the co-teaching model to be helpful in their growth as new teachers.

Residents appreciated the immediate feedback from their mentors as well as an opportunity to observe veteran teachers and high-quality teaching in the classroom, and they felt that co-teaching helped prepare them for day-to-day responsibilities required of teachers. One resident in Year 2 described it as being “thrown into the deep end but with a life jacket.” Residents also expressed appreciation in learning best practices to create a safe learning environment, how to work with other teachers, and how to make learning more accessible for a diverse student population. Lastly, mentors said they also valued what they learned from their residents, while residents said the mentor teachers were invaluable in helping them build their confidence as first-year teachers.

Teacher Outcomes

Next, we examined the extent to which residents were prepared to lead their own classrooms due to their participation in the CLASS program, mentor and resident teachers’ attitudes toward ADI stages and CT practices, and residents’ continued use of ADI and CT as alumni. In generally, CLASS participants were highly positive about the program and felt residents were more prepared than traditional teacher candidates to lead their own classrooms. While alumni recognized the benefits of ADI, few continued implementing them, citing challenges with accessing ADI materials, insufficient time as first-year teachers, or a misalignment between ADI requirements and students’ needs.

Residents’ Preparedness to Teach

In order to understand the effectiveness of the program, SRI asked interview participants the extent to which they felt residents were prepared to serve as classroom teachers.

CLASS program staff, mentors, and principals had largely positive impressions of residents and were generally more well prepared than the typical teacher candidate.

Participants pointed out that there were some areas in which residents would need to grow over time. These areas included classroom management tactics, completing IEP paperwork independently, handling challenging student behaviors, setting work boundaries, and leading parent-teacher conferences. Alumni who were interviewed also echoed these sentiments and wished that the CLASS program had covered more behavior management. Other participants mentioned that time management and IEP caseload advice in the program would also be beneficial to residents.

Though mentors and supervisors pointed out typical areas of growth, throughout the program, participants also expressed positive impressions of residents’ ability to have their own classroom. Principals saw the CLASS program as a pipeline to bring strong teachers into their schools. Principals also said that it was helpful to have residents in their classrooms, noting that they drove the use of ADI and brought a new lens to methods of instruction. Participants also described residents as well equipped in lesson planning, pedagogy, organization, and professionalism, with recent alumni and graduating residents agreeing. Instructors were impressed by residents in the CLASS program, with one instructor saying, "To me…it's a showpiece or an exemplar…When I look at CLASS, I think of them as like a shining star in the constellation of what we do, so I couldn't say enough about the excellence of that program." Residents felt that the co-teaching model and overall experience of the CLASS program prepared them to lead their own classrooms as strong second-year teachers.

Teachers' Attitudes Toward ADI and CT

As ADI and CT were central components of the CLASS program, SRI also sought out to understand teachers' attitudes toward ADI and CT throughout the years.

Mentors and residents alike saw the benefits of implementing ADI, including in student engagement, critical thinking skills, and deeper classroom discussions.

In earlier years of the program, some teachers were more skeptical about the utility of ADI. However, as the years progressed more teachers started seeing the benefits as well as how the tenants of ADI often organically aligned to what was already occurring in classrooms. Additional benefits of ADI included mentors mentioning that ADI was a good way to structure lessons, supervisors pointing out that it provides important pedagogical tools, and residents saying that ADI helped them be more hands-on and pushed students outside of their comfort zones. When it came to variation of attitudes across subjects, ADI aligned better with science, but other subject teachers mentioned that ADI allowed for more open-minded approaches, such as using more writing in math.

Teachers' felt that the presentation and reflection components of CT offered benefits to instruction. In particular, teachers shared that the reflection component allowed students to digest their findings as well as helped students be aware that what they are learning in school is important.

Residents' Continued Use of ADI and CT

As ADI and CT are central components to the CLASS program, the SRI team sought to understand the extent to which residents continue to use strategies that promote ADI and CT after their teaching residency year. SRI interviewed alumni in spring of 2022, 2023, and 2024 to better understand how teachers were using ADI and CT in their own classrooms and if usage varied by subject area.

Overall, alumni were positive about ADI and its continued use in the classroom. Teachers did not always continue to use CT. Although the alumni voiced that ADI was a good way to engage students, the teachers expressed that they almost never implemented a full cycle and instead made adaptations and chose certain steps that supported their everyday lessons and student learning goals. As residents, teachers expressed the desire for more ADI resources and examples, which continued to be a theme with alumni. The CLASS program does continue to provide ADI support to alumni teachers who are interested through office hours, although in Year 4 teachers were unaware this support existed.

In all three years in which SRI interviewed alumni, participants mentioned that lack of time was a constraint in continuing to implement ADI. Alumni who were teaching math or ELA expressed that it was harder to implement ADI in these settings but that they used certain steps as best they could. Science teachers conveyed excitement in implementing ADI steps, as "ADI is actually meant for science." Other teachers mentioned challenges with low student motivation and ability and expressed that large, high-need, diverse student populations made ADI a lower priority. In spring 2024, graduates mentioned that a lack of ADI materials and resources such as kits, whiteboards, and lanyards made it hard to implement certain ADI cycles. The lack of resources were a source of frustration for the alumni interviewed in spring 2024, as the program had agreed to provide ADI materials to new teachers. However, grant funding fell through, and CLASS was unable to supply the materials for ADI implementation.

Student Outcomes

Finally, we estimated students' use of CT strategies using a computer to solve problems, the relationship between exposure to CLASS pair(s) and students' outcomes, and variation in students' outcomes by CLASS pairs' subject area. We observed that students used CT practices "sometimes," on average. We observed no relationship between exposure to CLASS pair(s) and students' outcomes, and no differences by subject area.

Student Familiarity with CT Strategies

First, we examine the degree to which students are familiar with strategies associated with CT practices. In this section, we present descriptive for CLASS students' familiarity with CT practices and problem-solving strategies using data from the spring 2024 student survey (i.e., at outcome). Survey items were on a Likert scale of 1 through 5, with 1 equal to never, 2 equal to rarely, 3 equal to sometimes, 4 equal to often, and 5 equal to always. Exhibit 20 displays means for each survey item as measured in spring 2024 by CLASS pair exposure.

Exhibit 20. Outcomes descriptives for students' familiarity with computational thinking practices, by number of class pairs

When using a computer to solve a problem, I...	Mean Students			
	0 Pairs	1 Pair	2 Pairs	3+ Pairs
create a list of steps to solve the problem	3.6	3.4	3.3	3.3
try to simplify the problem by ignoring details that are not needed	3.3	3.8	3.6	3.7
look for patterns in the problem	4.1	4.0	3.6	3.8
break the problem into smaller parts	3.6	3.4	3.2	3.8
follow my gut feeling	3.3	3.4	3.0	3.3
work with others to solve different parts of the problem at the same time	3.4	3.2	3.0	3.3
look for how information can be collected, stored, and analyzed to help solve the problem	3.7	3.6	3.6	3.5
store, update, and retrieve values to solve the problem	3.8	3.5	3.4	3.5
make improvements one step at a time and work new ideas in as I have them	3.6	3.9	3.6	3.7
ask others for help	3.4	3.4	3.3	3.2
share my programs with others and look at others' solutions for ideas	3.8	3.4	3.2	3.2
do not reflect on or revise my initial solution because a computer is always correct.	3.5	3.5	3.4	3.1
try to automate and generalize the solution	3.1	3.3	3.1	3.5

Note. The student survey asked students, "When using a computer to solve a problem, I…". Students answered each item on a 5-point Likert scale ranging from 1 through 5, with 1 equal to never, 2 equal to rarely, 3 equal to sometimes, 4 equal to often, and 5 equal to always. Exhibit displays the means for CLASS students (i.e., students who were exposed to 1, 2, or 3+ CLASS pairs) and comparison students (i.e., students who were exposed to 0 CLASS pairs) for each survey from the outcomes survey, administered in spring 2024. This timepoint was selected to examine CLASS students' familiarity with CT practices following their exposure to CLASS pairs compared to comparison students' level of familiarity.

As shown in Exhibit 20, by spring 2024, both comparison students and students exposed to CLASS teachers used each CT practice "sometimes," on average. A few practices were used "sometimes" or "often," on average, such as "simplifying problems by ignoring details that are not needed," "looking for patterns in the problems," and "making improvement one step at a time and working on new ideas as they have them." In general, there were no clear patterns in students' familiarity with CT practices and the number of CLASS pairs they were exposed to.

Growth in CT Skills, Confidence, and Interest

Next, we present results from our correlational analyses on three outcomes from the student instrument: students' growth in their CT skills (as measured by students' scores on the assessment) and students' confidence in CT practices and students' interest in future careers in a computer science field (as measured by two factors).

Exhibit 21 and Exhibit 22 provide baseline and outcome data for the student outcomes for students exposed to at least one CLASS pair and for comparison students, and Exhibit 23 and Exhibit 24 provide these data for students exposed to 1, 2, or 3+ CLASS pairs and comparison students. Baseline and outcome data include unadjusted means and standard deviations. The factors were on a Likert scale of 1 through 5, with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to neither agree nor disagree, 4 equal to agree, and 5 equal to strongly agree.

As observed in Exhibit 21 and Exhibit 22, comparison students' scores, on average, decreased from baseline to outcome, for each outcome, while CLASS students' scores, on average, increased or stayed the same from baseline to outcome, for each outcome. As shown in Exhibit 23 and Exhibit 24, greater exposure to CLASS pairs was associated with greater gains in assessment scores from baseline to outcome. For instance, students exposed to 0 pairs saw a decrease in their average assessment score from baseline to outcome of 1.9 percentage points, while students exposed to 3+ pairs saw an increase in their average assessment score of 3 percentage points. We observed similar patterns for students' confidence in CT practices and interest in future careers in a computer science field.

However, the magnitude of differences is small. There are little to no differences in students' confidence in CT practices and interest in future careers in a computer science field, though there is a very small, positive change in these outcomes for students exposed to 3+ CLASS pairs.

Exhibit 21. Baseline descriptives for student outcomes analysis, by treatment status (binary)

Outcome Variable	Comparison Students 0 Pairs		CLASS Students At Least 1 Pair	
	Mean	*SD*	Mean	*SD*
Percentage points on assessment	46.9%	13.6	43.1%	13.8
Confidence in CT practices	3.7	0.6	3.5	0.7
Interest in future careers in a computer science field	3.3	0.7	3.3	0.9

Note. SD = standard deviation. The student outcomes analytic sample includes 147 students, 108 of whom are CLASS students and 39 of whom are comparison students. Exhibit presents unadjusted, unweighted means and standard deviations at baseline that are not adjusted using model covariates. The treatment variable is a binary indicator for exposure to at least one CLASS pair.

Exhibit 22. Outcome descriptives for student outcomes analysis, by treatment status (binary)

Outcome Variable	Comparison Students 0 Pairs		CLASS Students At Least 1 Pair	
	Mean	*SD*	Mean	*SD*
Percentage points on assessment	45.0%	16.4	44.4%	14.7
Confidence in CT practices	3.6	0.7	3.5	0.9
Interest in future careers in a computer science field	3.3	0.8	3.4	1.0

Note. SD = standard deviation. The student outcomes analytic sample includes 147 students, 108 of whom are CLASS students and 39 of whom are comparison students. Exhibit presents unadjusted, unweighted means and standard deviations of outcomes that are not adjusted using model covariates. The treatment variable is a binary indicator for exposure to at least one CLASS pair.

Exhibit 23. Baseline descriptives for student outcomes analysis, by treatment status (categorical)

	Comparison Students		CLASS Students					
	0 Pairs		1 Pair		2 Pairs		3+ Pairs	
Outcome Variable	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Percentage points on assessment	46.9%	13.6	45.8%	14.0	40.0%	12.6	43.2%	14.6
Confidence in CT practices	3.7	0.6	3.5	0.8	3.7	0.7	3.5	0.7
Interest in future careers in a computer science field	3.3	0.7	3.3	0.9	3.2	0.9	3.3	0.8

Note. SD = standard deviation. The student outcomes analytic sample includes 147 students, 108 of whom are CLASS students and 39 of whom are comparison students. Exhibit presents unadjusted, unweighted means and standard deviations at baseline that are not adjusted using model covariates. The treatment variable is a categorical variable for exposure to 1, 2, or 3+ CLASS pairs, and 0 otherwise.

Exhibit 24. Outcome descriptives for student outcomes analysis, by treatment status (categorical)

	Comparison Students		CLASS Students					
	0 Pairs		1 Pair		2 Pairs		3+ Pairs	
Outcome Variable	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Percentage points on assessment	45.0%	16.4	45.0%	16.7	42.3%	12.8	46.2%	14.2
Confidence in CT practices	3.6	0.7	3.4	0.9	3.6	0.9	3.7	0.9
Interest in future careers in a computer science field	3.3	0.8	3.3	1.0	3.5	1.1	3.4	1.0

Note. SD = standard deviation. The student outcomes analytic sample includes 147 students, 108 of whom are CLASS students and 39 of whom are comparison students. Exhibit presents unadjusted, unweighted means and standard deviations of outcomes that are not adjusted using model covariates. The treatment variable is a categorical variable for exposure to 1, 2, or 3+ CLASS pairs, and 0 otherwise.

Exhibit 25 shows the estimated relationship between exposure to at least one CLASS pair and students' assessment score, confidence in CT practices, and interest in future careers in a computer science field. The coefficient on the model estimating students' assessment score is measured in percentage points, while the coefficient on the models estimating students' confidence in CT practices and interest in future careers in a computer science field is measured in Likert-scale points. We find that the relationship between assignment to CLASS pairs and all three student outcomes—students' growth in CT skills, students' confidence in CT practices, and students' interest in future careers in a computer science field—was not significant. For instance, controlling for students' grade at baseline and sex, exposure to any number of CLASS pairs is associated with a 0.8 percentage-point increase in students' assessment score compared to students without exposure to any CLASS pairs. This difference was not significant at the $p < 0.05$ level.

Exhibit 25. Correlational estimates of exposure to at least one CLASS pairs on student outcomes

	Coefficient	Standard Error	Test Statistics	*p* Value
Percentage points on assessment				
At least one CLASS pair	0.8	2.4	0.3	0.7
Confidence in CT practices				
At least one CLASS pair	0.0	0.2	-0.2	0.9
Interest in future careers in a computer science field				
At least one CLASS pair	0.1	0.2	0.4	0.7

Note. This exhibit shows results from OLS regression models. The models estimate the relationship between students' exposure to CLASS pairs and each student outcome. Factors are in Likert-scale points ranging from 1 to 5. The sample includes 147 students (109 CLASS students and 39 comparison students). Models include student-level covariates. Models control for students' baseline score for a given outcome, student sex, and student grade when taking the baseline instrument. The estimate is the unstandardized regression coefficient for the categorical treatment variable, namely, students' exposure to CLASS pairs. The test statistic is the t-statistic from the student's t-test. p values are those associated with the impact estimate and test statistic. No estimates were statistically significant at the p = 0.05 level, including t-tests comparing coefficients for 2 CLASS pairs vs. 3+ CLASS pairs, 0 CLASS pairs vs. 2 CLASS pairs, and 0 CLASS pairs vs. 3+ CLASS pairs.
$^*p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$

Exhibit 26 displays the estimated relationship between the number of CLASS pairs a student had and students' outcomes. Again, we observe no significant differences across the number of CLASS pairs a student was exposed to. For instance, controlling for students' grade at baseline and sex, exposure to 0 CLASS pairs was associated with a 0.6 percentage-point decrease in students' assessment score compared to students with exposure to 1 CLASS pair. This difference was not significant at the $p < 0.05$ level. Similarly, exposure to 3+ CLASS pairs was associated with 1.6 percentage-point increase in students' assessment score compared to students with exposure to 1 CLASS pair. Again, this difference was not significant at the $p < 0.05$ level.

Exhibit 26. Correlational estimates of exposure to different numbers of CLASS pairs on student outcomes

	Coefficient	Standard Error	Test Statistics	*p* Value
Percentage points on assessment				
0 pairs	-0.6	2.8	-0.2	0.8
2 pairs	-1.1	3.0	-0.4	0.7
3+ pairs	1.6	3.1	0.5	0.6
Confidence in CT practices				
0 pairs	0.1	0.2	0.6	0.5
2 pairs	0.1	0.2	0.4	0.7
3+ pairs	0.2	0.2	1.2	0.2
Interest in future careers in a computer science field				
0 pairs	0.0	0.2	0.2	0.8
2 pairs	0.3	0.2	1.2	0.2
3+ pairs	0.1	0.2	0.6	0.6

Note. This exhibit shows results from OLS regression models. The models estimate the relationship between students' exposure to CLASS pairs and each student outcome. Factors are in Likert-scale points ranging from 1 to 5. The sample includes 147 students (109 CLASS students and 39 comparison students). Models include student-level covariates. Models control for students' baseline score for a given outcome, student sex, and student grade when taking the baseline instrument. The estimate is the unstandardized regression coefficient for the categorical treatment variable, namely, students' exposure to CLASS pairs. The test statistic is the t-statistic from the student's t-test. p values are those associated with the impact estimate and test statistic. No estimates were statistically significant at the p = 0.05 level, including t-tests comparing coefficients for 2 CLASS pairs vs. 3+ CLASS pairs, 0 CLASS pairs vs. 2 CLASS pairs, and 0 CLASS pairs vs. 3+ CLASS pairs.
$^*p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$

Further, we examined variation in students' growth in CT skills, their confidence in using CT practices, and their interest in pursuing a career in a computer science field by the subject area of the CLASS pair(s) students were exposed to. Running our main models on a subset of treatment students (excluding students who only ever had special education CLASS pairs) who were exposed to CLASS pairs in math, ELA, and science yielded null results. Exposure to a CLASS pair in a particular subjected yielded no significant differences in students' outcomes compared to CLASS students who were never exposed to CLASS pairs in that subject.

Discussion

The CLASS program successfully prepared 55 residents over the course of four years, providing an important supply of highly prepared teachers, often in shortage area subjects, to the region.

A major focus of the CLASS program is the integration of ADI and CT into teacher practice. Results of this evaluation show that ADI components were usually implemented with fidelity. Even more importantly, CLASS program staff made year-to-year adjustment in supports for residents, mentors, and supervisors around the incorporation of ADI, with participants generally becoming more comfortable with ADI over time. Additionally, several of the alumni residents we interviewed discussed how they continue to incorporate aspects of ADI into their classroom and, in a couple of instances, that the use ADI was a point of discussion with their new colleagues. In the case of CT, we find that teachers are generally less comfortable defining and implementing these practices. However, at the same time teachers also regularly reported using CT practices in their instruction. One possible explanation for this may be that because ADI was a more direct focus in the CLASS program, and because many of the concepts of ADI and CT overlap to some degree, it could be that teachers incorporated CT concepts into their existing paradigms of applying ADI.

Resident teachers clearly benefitted from the wraparound supports and yearlong clinical experience of the CLASS program. Mentors, supervisors, and principals regularly reported that CLASS residents were more well prepared than were teacher candidates that they had observed from more traditional pathways. Residents consistently commented on the benefits of having a full year to learn from and develop relationships with their mentor as well as members of their cohort. The gradual release model of the CLASS program—whereby mentors and residents co-teach from Day 1, but with residents gradually taking on more responsibility over the year—was implemented with fidelity, and residents regularly reported the importance of co-teaching and the ability to lead more instruction as the year progressed.

Although we found small, positive differences in students' abilities and perceptions of CT among those who had greater exposure to CLASS pairs, these differences were not statistically significant. There are a number of considerations in interpreting these results. First, the CT assessment was only administered in a single CLASS school; it could be that all students in this school already had relatively high exposure to learning CT concepts. This was also not a randomized study, so students assigned to CLASS pairs may be systematically different from those who were not. Alternatively, because the dosage is relatively small—most students' exposure to CLASS only amounted to a CLASS pair or two over the course of the three years, and CT was not a primary focus of their instruction—it seems likely that any effect on CT was too small to measure.

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Appendices

Appendix A. ADI Stages and Computational Thinking Practice Definitions

Argument Driven Inquiry

Argument-Driven Inquiry (ADI) is an instructional model that emphasizes student research, communication, and revision to aid learning. When students engage with 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 (National Research Council, 2006, 2012; Sampson & Gleim, 2009; Sampson et al., 2011). Teachers were asked to identify which ADI activities their students completed in a given month, if the teachers indicated they had implemented any ADI with students. The seven stages are defined below.

ADI Stages

- *Task* = Introduce a phenomenon to figure out and the task to complete
- *Ideas* = Highlight some ideas that students can use during the investigation
- *Plan* = Students create, share, and revise a plan for collecting and analyzing data
- *Do* = Students collect the data they need and then make sense of it
- *Share* = Students create, share, critique, and revise evidence-based arguments
- *Reflect* = Students discuss ways to use core ideas and practices in the future
- *Report* = Students write, share, critique, and revise reports about what they figured

Computational Thinking

Computational thinking (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" (National Science and Technology Council, 2018, p. 23), through "data-practices, modeling and simulation practices, computational problem-solving practices, and systems thinking practices" (Weintrop et al., 2016). Teachers were asked to report which CT data practices and CT systems practices students engaged in each month.

Computational Thinking Data Practices

- *Data Collection Method* = Develop a method for collecting data to answer a question
- *Collect Data* = Collect data to answer a research question
- *Analyze Data* = Use statistics and/or probability to analyze data and/or draw conclusions

- *Patterns w/Tech* = Use computer-based tools (e.g., Excel, Tuva, CODAP), to identify patterns or anomalies in data, data trends over time, categorize data, or demonstrate relationships within data fields
- *Interpret Data* = Interpret datasets, data models, and/or data visualizations to make predictions, draw conclusions, and/or answer questions
- *Data Viz* = Produce appropriate data visualizations (e.g., graphs, tables, charts, dashboards) to convey information gathered during analysis

Computational Systems Thinking Practices

- *Investigating Complex System* = Investigating a complex system as a whole
- *Understanding Relationships in Systems* = Understanding the relationship within a system
- *Think in Levels* = Thinking in levels
- *Communicate About a System* = Communicating information about a system
- *Define Systems* = Defining systems and managing complexity

Appendix B. Descriptions of Co-Teaching Strategies

Strategy	Definition/Example
One Teach, One Observe*	One teacher has primary responsibility while the other gathers specific observational information on students or the (instructing) teacher. The key to this strategy is to focus the observation—where the teacher doing the observation is observing specific behaviors. **Example:** One teacher can observe students for their understanding of directions while the other leads.
One Teach, One Assist*	An extension of one teach, one observe. One teacher has primary instructional responsibility while the other assists students with their work, monitors behaviors, or corrects assignments. **Example:** While one teacher has the instructional lead, the person assisting can be the "voice" for the students when they do not understand or are having difficulties
Station Teaching*	The co-teaching pair divides the instructional content into parts—each teacher instructs one of the groups, groups then rotate or spend a designated amount of time at each station—often an independent station will be used along with the teacher-led stations. **Example:** One teacher might lead a station where the students play a money math game, and the other teacher could have a mock store where the students purchase items and make change.
Parallel Teaching*	Each teacher instructs half the students. The two teachers are addressing the same instructional material and presenting the material using the same teaching strategy. The greatest benefit to this approach is the reduction of student-to-teacher ratio. **Example:** Both teachers are leading a question-and-answer discussion on specific current events and the impact they have on our economy.
Supplemental Teaching	This strategy allows one teacher to work with students at their expected grade level, while the other teacher works with those students who need the information and/or materials retaught, extended, or remediated. **Example**: One teacher may work with students who need reteaching of a concept while the other teacher works with the rest of the students on enrichment.
Alternative (Differentiated) Teaching*	Alternative teaching strategies provide two different approaches to teaching the same information. The learning outcome is the same for all students; however, the avenue for getting there is different. **Example:** One instructor may lead a group in predicting prior to reading by looking at the cover of the book and the illustrations, etc. The other instructor accomplishes the same outcome but with their group; the students predict by connecting the items pulled out of the bag with the story.
Team Teaching*	Well-planned, team-taught lessons exhibit an invisible flow of instruction with no prescribed division of authority. Using a team-teaching strategy, both teachers are actively involved in the lesson. From a students' perspective, there is no clearly defined leader—as both teachers share the instruction, are free to interject information, and available to assist students and answer questions. **Example:** Both instructors can share the reading of a story or text so that the students are hearing two voices.

Note: Strategies marked by an asterisk were asked about on the monthly teacher questionnaire. Furthermore, these strategies are not hierarchical—they can be used in any order and/or combined to best meet the needs of the students in the classroom.

Appendix C. Fidelity of Program Implementation: Components and Indicators

Implementation Fidelity Matrix							
Concept	Description	Activities	Project Threshold	Indicator Met? 2021	Indicator Met? 2022	Indicator Met? 2023	Indicator Met? 2024
Key Component 1: Professional Development							
1. Argument Driven Inquiry	1. Structured in-person training for MTs and RTs	*Mentors:* 4 days ADI summer training, i.e., train-the-trainer cert	70% of MTs obtaining ADI certification	100%	89%	100%	100%
			70% of RTs obtaining ADI certification	86%	100%	100%	100%
		Mentor and Resident Pairs: 2 days ADI training with RT (part of the 4-day summer training) 1 day winter ADI PLC (virtual in 2021–22) *Residents:* Post-graduation summer training for ADI certification	70% of MTs/RTs participating in at least 70% of their required days of in-person/virtual training on ADI	100%	92%	100%	92%
	2. Ongoing coaching for MT/RT pairs	*Mentor and Resident Pairs:* Participate on-site ADI coaching session	70% of MT/RTs pairs participate in at least 1 coaching session	86%	95%	100%	100%

Implementation Fidelity Matrix							
Concept	Description	Activities	Project Threshold	Indicator Met? 2021	Indicator Met? 2022	Indicator Met? 2023	Indicator Met? 2024
	3. Training for supervisors	*Supervisors:* Participate in at least some training with residency pair	80% of supervisors attend at least 1 of the CT or co-teaching portions of the summer training	83%	67%	100%	100%
		Supervisors: Receive any training in ADI	80% of supervisors receive some ADI training	100%	56%	86%	100%
2. Computational Thinking	1. Support from partner departments within CSU, Chico	*Mentor and Resident Pairs:* ½ day of PD on CT during summer training for MTs and RTs	CSU, Chico Provides ½ day of PD on CT	½ day provided	½ day provided	½ day provided	½ day provided
			70% MTs/RTs attend	79%	97%	100%	92%
3. Clinical Support	1. Summer training	*Residents:* 1.5 days training before residency program launches	70% of RTs participating in 1.5 days of co-teaching training in summer	86%	100%	100%	100%
	2. Ongoing support	Supervisors observe RTs teaching ADI	80% of RTs have at least 1 ADI lesson observed each semester by their supervisor	n/a[1]	68%	88%	75%
Key Component 2: Clinical							
1. Mentor Teachers (MTs)	1. Across content areas	Mentor teachers available in science, math, ELA and special	At least 3 MTs in math	False	True	True	True
			At least 3 MTs in science	False	True	True	True

Implementation Fidelity Matrix							
Concept	Description	Activities	Project Threshold	Indicator Met? 2021	Indicator Met? 2022	Indicator Met? 2023	Indicator Met? 2024
		education to support range of RTs	At least 3 MTs in ELA	True	True	True	True
			At least 3 MTs in special education	False	True	True	True
	2. MTs participation	Mentor teachers participation in the program[2]	80% of MTs participate in at least 3 years	n/a	n/a	n/a	31%
2. ADI Implementation	1. Use ADI in classrooms	*Mentor and Resident Pairs:* Pairs complete one ADI cycle per semester (fall and spring)	70% of RT/MT pairs implementing at least 1 ADI cycle per semester (fall/spring) [a cycle is defined as doing each step in the cycle at least once per semester]	71%	90%	69%	69%
Key Component 3: Coursework							
1. Master of Education	1. Four additional courses	*Residents:* Complete four additional courses to earn a master's degree	70% of RTs complete master's degree	100%	95%	100%	100%
2. Action Research Project	1. RTs complete an independent study project	*Residents:* Complete an action research project	70% of RTs complete action research project	100%	100%	100%	92%
		Residents:	70% of RTs focusing on student	71%	68%	63%	83%

Implementation Fidelity Matrix							
Concept	Description	Activities	Project Threshold	Indicator Met? 2021	Indicator Met? 2022	Indicator Met? 2023	Indicator Met? 2024
		Collect student data and include aspects of ADI in research project, including a focus on student outcomes	outcomes and ADI components (when student engagement is counted as an outcome)				
	2. ADI/CT Coursework	CT and/or ADI strategies are evidenced in methods courses in syllabus	75% of single-subject courses contain evidence of CT and/or ADI strategies	n/a[3]	75%	75%	25%

Note: This exhibit shows each component of the fidelity of implementation analysis and the indicators within each component. Each year, SRI ran the analysis on the given number of cohort teachers participating in the study. Green indicates an indicator was met.

[1]In the 2020–21 school year, the program did not collect information on the number of resident-taught ADI lessons that were observed by a CLASS supervisor.

[2]In the inception of the program, the original indicator for mentor teacher retention year over year was written as "80% of mentor teacher participate in all 4 years of the program." There were 29 mentors who participated in at least one full year of the program. Of these 29 mentors (MTs), one MT participated all 4 years, 8 MTs participated in 3 years of the program, 8 MTs participated in 2 years of the program, and 12 MTs participated in 1 year. This indicator was ultimately calculated for how many teachers participated in at least 3 years of the program, yielding 31%.

[3]In the 2020–21 school year, the program did not collect syllabi from single-subject courses to evaluate if there was evidence of CT or ADI strategies present.

Appendix D. Interview Protocols

Project Director Interview Protocol

Resident Teacher Recruitment

1. How many residents will you have next year?
    a. How were they recruited? (Probe: Selection criteria, outreach channels)
    b. What were the selection processes?
    c. Did you probe residents on their commitment to teach in a rural and/or low-income setting? If so, what did that look like?

Mentor Teacher Recruitment

2. Have you found mentor teachers for all of the candidates?
    a. Which subject areas have been hardest to fill mentor roles? Why do you think that is?
3. How were mentor teachers identified?
   Listen for:
    - Principal recommendation
    - E-mail recruitment
    - Teachers who have had teacher candidates in their classrooms before
    - Minimum years of experience
    - Completion of an application and/or interview
    - Pairing with residents
4. What selection criteria were used to select MTs?
   Listen for:
    - Effective classroom practice, deep content knowledge, use of assessments
    - Instruction that engages students with different learning styles
    - Collaboration with colleagues to improve instruction
    - Analysis of gains in student learning based on multiple valid and reliable measures
    - Appropriate skills in essential content areas of mentor candidates, including literacy, math, and computational literacy
    - Pairing with residents

Supervisor Recruitment

5. How are supervisors recruited?
    a. What characteristics are you looking for in a supervisor?
       Listen for:
        - Past CSU faculty
        - Retired teachers in the districts
        - Referral process
        - Subject area competence
        - Adult learner/coaching skills
        - An understanding of ADI/CT

Supervisors

6. Once hired, how closely do you work with supervisors?
    a. *Listen for:* training, meetings, challenges
7. What kinds of supports do you provide?
    a. What skills or topics do you provide support on? How did you decide on these skills or topics?
    b. Are there new or discontinued supports this year? If so, what are they, and why did you decide to offer/not offer these additional supports?

i. *Listen for:* supervisor workshops [ask to Cheryl/Lexi?]; process for supervisors to submit observation paperwork; alignment on supervisors applying scoring rubrics

c. Are there any supports you have discontinued or made changes to?
d. How do you offer these supports?

Listen for:

- *Frequency of supports*
- *How supports designed*
- *How supports delivered*
- *Who provides supports*

8. How have supervisors responded to the supports?
   a. Have you noticed changes in supervisors' practice?

Mentor Teacher and Teacher Resident Training (Jamie)

9. Can you tell us about the training that CSU, Chico held or facilitated for mentor teachers and resident teachers?
   a. Joint summer training for pairs?
   b. ADI training for mentor teachers (summer and winter)?
   c. Co-teaching training for mentor teachers?
   d. Are there other areas where pairs could use additional support?
   e. Are you planning any changes for next summer?

Resident Experience (both)

10. What feedback have you received from residents this year?
    a. *Listen for:* workload, mentor teachers, supervisors, ADI, CT
11. What challenges do residents face in staying in the program?
12. In what ways, if any, is the program helping to support retaining resident teachers in the program?
    a. To what extent do these supports address the challenges residents may face in staying in the profession?
    b. Does the program offer residents supports in finding new placements, if residents are not planning on continuing in their current placement school?
13. Does the program collect any data around residents' future professional plans? What kinds of data does the program collect? How does the program use these data?

Looking Forward (both)

14. What changes do you anticipate for next year?
15. Looking back on the 2022–23 school year, what were the greatest successes?

<u>Chico Instructor Interview Protocol</u>

Background

1. What is your current job at CSU?
   a. How long have you been in this position?
2. Tell me about your courses.
   a. What is the focus?
   b. What are the central assignments/activities candidates must complete?
   c. Do you ever observe your candidates in the field?
3. Do you have any other roles outside of course instructor (e.g., supervisor)?

CLASS Program Knowledge

4. Please share your understanding of the CLASS program.
5. In what ways, if any, do you interact with CLASS program staff? School staff?
   a. Is the CLASS residency well known throughout the Department?
   b. Is information about the CLASS residency shared at staff meetings or other staff events?
   c. Do you participate in any ADI trainings?

    d. Do you participate in any resident trainings?

CLASS Program Elements in Methods Courses

6. What course(s) do you teach that have CLASS residents?
    a. How were instructors selected to teach CLASS courses?
7. (Depending on whether they seem to grasp ADI and CT, share an overview of what it is) Do you incorporate ADI or CT in your classes?
    a. If so, how do you incorporate ADI/CT in the coursework?
    b. Probe for specific examples, prompts might include:
        - Collecting data
        - Making graphic representations of data
        - Interpreting data
        - Applying data
        - Creating arguments from data
8. Are ADI strategies, like those we've been discussing, something that would fit well within your course?
    a. Why or why not?
9. What support have you received from CLASS program staff to help residents implement ADI and/or CT instruction?
    a. *Listen for:* attendance at workshops; RT luncheons
    b. Has this support been beneficial? Why or why not?
    c. What additional ADI/CT supports would you like to receive?
10. To what extent does learning ADI/CT support teacher residents' preparation as instructors?

Co-Teaching

11. Thinking about the course(s) you teach, to what extent is there alignment between the coursework and clinical work in their placement schools?
    a. Are there opportunities for candidates to complete assignments related to their clinical work?
    b. To what extent do residents get to implement strategies for co-teaching?
12. What supports does CSU's teacher preparation program provide teacher residents?
    a. Has the content of trainings been shared with you?
    b. Do you receive feedback about the residents' experiences in their clinicals?
    c. Is there any information you'd like to have that you are not receiving?

Experiences/Outcomes

13. Overall, what is your perception of the CLASS resident candidates?
    a. How do they compare to traditional teacher candidates or other students you have worked with?
    b. Have you observed any changes in residents' preparation or skills as a result of participating in the CLASS program?
14. Have you received any feedback from residents on how helpful the CLASS program has been in their training and preparation?
15. Overall, what is your perception of the CLASS program?
    a. What is going well?
    b. What is unique about the program?
    c. If you could make any changes to the program for next year, what would you suggest?
16. Will you continue teaching courses for teacher residents in CLASS? Why or why not?

Principal Interview Protocol

Background

1. How long have you been at this school?
2. What are your typical avenues for recruiting teachers?
3. What is your typical teacher turnover rate?
4. How many teacher candidates does your school typically have in your school in a given year?
    a. Have you had residents before?
    b. Residents from other programs?

CLASS Program

5. [For new principals only] How did you learn about the CLASS program?
    a. What interested you in participating?
    b. How is this different from other student teaching programs?
    c. In what ways does the CLASS program align with the school's goals or priorities?
    d. Are you familiar with Argument Driven Inquiry and computational thinking? (it's okay to not be too familiar, we are just checking)
    e. Please share your understanding of the program.
6. How do you identify teachers that will serve as mentors?
    Listen for:
    - Self-nominating
    - Years of experience
    - Subject area
    - Course-specific
    - Receive list of requests from CSU
7. Do you play a role in selecting residents?
    a. If yes, what is the process?
    b. If no, what would you want to look for in potential residents?
8. Have you observed any mentor-resident pairs teaching in your school? If yes:
    a. Tell me about the lesson you saw (*Listen for:* differentiation, small groups, team teaching, ADI/CT)

Supports and Feedback

9. What supports does the CLASS program provide to your mentor-resident pairs?
    a. Has the content of trainings been shared with you?
    b. Do you receive feedback about the mentors or residents in your building?
    c. Is there any information you'd like to have that you are not receiving?
10. Does CSU, Chico solicit your feedback on the quality and skills of residents placed in your school? If so, how?
11. What are some of the challenges mentor-resident pairs face that you know of?
12. What relationship do you have with CLASS program supervisors? Do you work with them directly?
    a. What benefits do they provide to resident teachers?

Experiences/Outcomes

13. Overall, what is your perception of the resident candidates?
    a. How do CLASS residents compare to traditional teacher candidates? *Listen for:* preparation, fit, contributions to school, participation in staff responsibilities
14. Do you see benefits to your students from having a resident in their classroom? If yes, please describe.
15. Do you see benefits to your school community from having a CLASS resident? If yes, please describe.

   a. How do these benefits compare to those your school community may experience from having other teacher candidates in your school?
16. Do you anticipate hosting any CLASS residents in the upcoming school year?
   a. If yes, will the same mentor teachers serve again?
17. Overall, what is your perception of the CLASS teacher residency program?
   a. If you could make any changes to the program for next year, what would you suggest?

<u>Supervisor Interview Protocol</u>

Background

1. What is your current job (CSU or otherwise)? For which subject areas do you have expertise?
2. How did you become a supervisor in the CLASS program?
   Listen for:
   - Teach at CSU
   - Retiree
   - Recruited for special expertise in a subject area
3. Have you served as a supervisor prior to this year?
   a. How many years?
   b. How many candidates?
   c. Same subject?
4. How many teacher candidates do you supervise?
   a. In which subject areas? Grades?
   b. How many CLASS residents?

Supervisor Supports / Knowledge of CLASS Components

5. What supports or trainings does the CLASS program provide for your supervision?
   a. PROBE: During summer; during fall/spring; supervisor workshop?
   b. What supports have you received on conducting observations?
      i. *Listen for:* guidance on scoring; completing and submitting paperwork
   c. What ADI-specific supports have you received?
   d. What CT-specific supports have you received?
   e. How helpful have you found these supports?
6. To what degree have you been involved, or informed about, the expectations for the inclusion of ADI and/or CT in resident instructional practices?
   a. Did you receive training or materials?
   b. Have the program faculty shared information with you?
   c. Have the residents discussed this with you?
   Listen/probe for: supervisor feedback/perceptions of ADI and CT
7. What is the purpose of ADI/CT trained mentor and residents in the school?
   a. How does ADI/CT training for the residents compare to trainings or PD received by other teacher candidates you have supervised?
   b. Do you know if ADI has been integrated into the school more broadly?

Feedback to Residents

8. What are the duties of a supervisor?
   Listen for:
   - Frequency of evaluation
   - Relationship with resident and school principal
   - Observation and rating using the CORE rubric
9. How many times per semester do you observe teacher candidates? What is the observation process?
   a. What opportunities are there for pre- and post-conferences?

   b. What feedback do you give to the resident? Examples?
   c. Do you collaborate with mentor teachers on feedback?
10. What is the process for documenting observation data and sharing it with Chico?
   a. How easy or difficult is this process to navigate?
   b. [If returning supervisor] Have you noticed any changes to this process since last year?
   c. In what ways could this process be improved?
11. How broadly do you share your feedback about the candidate?
   Listen for:
   - Mentors
   - Principals
   - CLASS program staff
12. (if not covered already) How do you interact with mentor teachers?
   a. Do you ever discuss ADI, specifically, with mentors?
13. Have you observed any lessons where the mentor-resident pair has taught part of the ADI cycle?
   IF YES:
   a. How did the mentor and resident teacher interact with students during the lesson?
   b. Have you noticed in changes in the mentor or resident teachers' practices related to their participation in ADI/CT trainings?
   c. Have you noticed changes in student engagement or skills?
   Listen for:
   - To what extent lesson was co-taught / Role of mentor and resident during the lesson
   - Differences in teaching practices between mentor and resident
   - Supports mentor provided resident
   - Challenges during the lesson
   IF NO:
   Ask a–c above, framing about teaching more generally rather than specific to ADI.
14. What are some of the common challenges for residents?
   a. How have they been handled or resolved?
   b. Do you play a role in mediating differences of opinion between residents and their mentor teachers?

Looking Forward

15. Do you plan to serve as a supervisor next year?
   a. If yes, how many residents will you supervise?
   b. What subject areas?
16. Are you involved in efforts to retain teacher residents and mentor teachers?
   a. If yes, how do you support efforts to retain teacher residents or mentor teachers?
   b. Do you anticipate any challenges in retaining teacher residents or mentor teachers?
17. If you could make any changes to the program for next year, what would you suggest?

Mentor Teacher Interview Protocol

Background

1. Tell me about your teaching experience in terms of how long you've been teaching, how long you've been at this school, and what grades/subject you teach.
2. [If not previously interviewed] Have you been a mentor teacher before (student teacher or resident from earlier program)?

3. [If not previously interviewed] How did you learn about the CLASS program and what made you decide to participate?
    a. Was there an application process?
4. (If returning mentor) What made you decide to serve as a mentor teacher again?
5. What was the process for becoming a mentor this year?

Training and Supports

6. What is your understanding of Argument Driven Inquiry (ADI)?
    a. What does it mean to incorporate ADI in your subject area?
7. Please tell me a bit about the training and support you received around using ADI in your classroom.
    a. What training did you attend?
    b. What was the focus?
    c. Did you receive any subject-specific training or support? From whom?
    d. What supports did you receive from the ADI coach?
    e. What aspects of the training did you find particularly useful?
    f. Were there any aspects of the training that you think should be changed?
8. What is the expectation for use of ADI in this program?
    a. Do you feel prepared to teach ADI cycles?
9. What is your understanding of computational thinking (CT)?
10. Has CSU, Chico provided any training on incorporating CT into your lesson planning or instruction?
    a. If yes, please describe. *Listen for:* summer training; training/professional learning during the year.
11. Are there any supports you would like to have that you don't currently receive?

Co-Teaching and Residency

12. What does co-teaching look like in your classroom?
    a. Do you plan together?
    b. How has co-teaching in your classroom changed over time?
13. How well does ADI fit in with your current curriculum?
    a. Have you had to make any adjustments or modifications when teaching ADI in your class(es)?
14. Please give an example of an ADI unit you have implemented in your classroom.
    a. What was the focus of the lesson?
    b. Which steps in the cycle did you implement?
    c. How have students responded to the lesson/student engagement?
    d. What challenges or successes have you had in incorporating ADI?
    e. Probe: Specific adjustments/modifications made to ADI when implementing.
15. What are the benefits and challenges to implementing ADI in your classroom?
    a. Have you noticed changes in student engagement when implementing ADI?
    b. Have students increased their ability to apply ADI techniques?
    c. How have you modified ADI to address challenges?
16. Do you plan on continuing to implement ADI after you conclude your participation in the CLASS program? Why/why not?
    a. Which components are you most likely to use after the grant ends? Why these components?
    Listen for:
        - Teachers don't have time, school leader support, and/or willingness to implement ADI instruction as designed
        - Students don't have sufficient proficiency in related science and CT concepts to be able to engage with ADI lessons with appropriate teacher scaffolding
        - Classroom management

- Poor relationship with resident
- ADI difficult to integrate with subject

17. Do you incorporate CT into your instruction?
    a. If yes, what has it looked like?
    b. What are the benefits and challenges in incorporating CT?
18. How would you rate your resident's instructional practice and classroom management skills?
    a. How have they changed over time?
    b. If you have had other candidates, how do they compare to other candidates?
    c. Now at the end of the year, how does the resident compare to a new teacher?
    d. Ability to implement ADI?
    e. Ability to encourage CT?
19. Are there any areas in which you feel your resident was/is not well prepared to teach?
20. How often does the supervisor visit your class? Observe?
    a. Does the supervisor share feedback with you about the candidate? Or about co-teaching in your classroom?
    b. Are you asked for feedback on the candidate?
    c. How does the supervisor help you with ADI implementation?
    d. What are the supervisor's strengths? What are their growth areas?
21. Are there any supports you feel your resident would benefit from that aren't currently offered?

Moving Forward

22. Do you plan to serve as a mentor teacher next year? Why or why not?
23. What changes would you suggest for the CLASS program moving forward?

Resident Teacher Interview Protocol

Background

1. Start by telling us about your teacher residency position. What grades/subjects to do you teach?
2. How did you find out about the CLASS program?
3. What appealed to you about the CLASS Program?
   Listen for:
   - In-class experience
   - Working with a mentor
   - Interest in teaching in rural area
   - Interest in co-teaching
   - Stipend
   - Belief it would improve job prospects after graduation
   - Master's degree
4. What was the application process for entering the CLASS program?

Training

5. Please tell me about the training and support you received around using ADI in your classroom.
   a. What training did you attend?
   b. What was the focus?
   c. Did you receive any subject-specific training or support? From who?
   d. What supports did you receive from the ADI coach?
   e. What aspects of the training did you find particularly useful?
   f. Were there any aspects of the training that you think should be changed?
6. What is the expectation for use of ADI in this program?
   a. Do you feel prepared to teach ADI cycles?

7. What is your understanding of computational thinking (CT)?
8. Has CSU, Chico provided any training on incorporating CT into your lesson planning or instruction?
    a. If yes, please describe. *Listen for:* summer training; training/professional learning during the year; Cohort gatherings.
    b. Have you implemented CT into your instruction?

CLASS Program

9. Tell me about your co-teaching experience. What does it mean to co-teach?
    a. Do you participate in lesson planning? Describe.
    b. What does a typical week look like in terms of instruction?
    c. What portion of teaching do you conduct in each class? Do you ever have sole responsibility for instruction?
    d. How has your role in the classroom changed over time?
10. What is your understanding of Argument Driven Inquiry (ADI)?
    a. What does it mean to incorporate ADI in your subject area?
11. To what degree have you incorporated ADI cycles into your planning and teaching this year?
    a. What challenges or successes have you had in incorporating ADI?
    b. Please share an example of an ADI unit you have implemented.
    c. Have you had to make any adjustments or modifications when teaching ADI in your classes?
    d. How would you describe student engagement during lessons that incorporate ADI?
    e. Can you envision using ADI once the CLASS program ends? Why or why not? Which components?
12. How would you describe your mentor's attitude toward ADI lessons?
13. How frequently do you ask students to work with data (e.g., collect data, manipulate data, draw conclusions, etc.)?
14. Tell me about the coursework for this program and how it relates to your residency experience.
    a. How do your courses integrate information related to ADI?
15. Can you tell me about your action research project?
    a. Does your project include any student data?
    b. What is the expectation around using ADI in your project?
    c. In what ways have you incorporated ADI into your project?
    d. What supports have you received on your research project?
        Listen for: support from faculty, research advisor, mentor teacher, peers, supervisors, from ADI coach (Monica)
    e. How has the process gone?

    Listen for:
    - Topic selection and relevance to their context
    - How action research/inquiry process has impacted their teaching
16. Has participating in CLASS program prepared you to teach your own classroom?
    a. Do you anticipate continuing to use ADI in your own classroom?

Supports from MT, Supervisor, and Chico

17. To what extent has your co-teacher helped you grow as a teacher?
    a. Does your co-teacher provide regular feedback?
    b. Does your co-teacher model effective teaching?
18. What support do you receive from your CSU supervisor?
    a. How often does your supervisor observe you and provide feedback?
    b. Does your supervisor provide specific feedback on ADI integration? CT?

    c. How helpful is this feedback?
    d. How has feedback from your supervisor impacted your practice?
    e. Is there any additional support you would like your supervisor to provide?
19. How clearly does CSU, Chico communicate requirements and deadlines for the CLASS program?
20. Are there any supports that would be helpful, but were not offered to you?
    a. In-school supports?
    b. Supports from Chico?
21. Overall, what has gone well with your CLASS program participation this year? What has been challenging?

Looking Forward

22. If a position were open, would you teach in this school? District?
23. Where do you plan to teach next fall?
    a. Do you want to teach in a rural setting? A low-income setting?

<u>Graduate (still teaching) Interview Protocol</u>

Background

1. What is your current role?
    a. How long have you been working in this role/in this school?
    b. What subjects/grades do you teach?
    c. Could you describe the population of students in your school?

Reasons for Current Position

2. [if not known already] Is this the same school/district as your CLASS placement?
3. [if not in the same school/district as their CLASS placement] What influenced your decision to not continue teaching in your placement school?
    a. What did this position offer that teaching in your placement school/district did not?

Teaching in their Current Role

Now we'd like to learn the extent which you are implementing any of strategies you learned in the CLASS Program.

4. Do you ever plan for and implement Argument Driven Inquiry (ADI) in your classroom? In what ways? How often?
    a. [if yes] What made you want to continue including ADI lessons and skills?
        i. Which components of ADI have you implemented the most? Why?
        ii. What challenges have you faced in implementing ADI in your classroom? Have you tried to access ADI supports (e.g., office hours with ADI staff)?
    b. [if not] What made you decide to not continue with ADI?
5. Do you plan for and implement computational thinking (CT) in your classroom? In what ways? How often?
    a. [if yes] What made you want to continue including CT lessons and skills?
    b. [if not] What made you decide to not continue with CT?
6. Have you introduced ADI or CT to colleagues? Why or why not?
7. Do you ever collaborate with other teachers for lesson planning or instruction (i.e., co-teach)?
    a. Can you give an example of how you collaborate with other teachers?
    b. How do you decide when to collaborate with other teachers for lesson planning or instruction?

Influence of CLASS

Next, we would like to learn about the extent to which the CLASS program helped prepare you for your current role.

8. In what ways did the CLASS program prepare you for your current role?

    a. Probe: ADI, CT, co-teaching, support from supervisor, CSU Chico coursework, experience in placement school, classroom management
9. In what ways did the CLASS program shape your desire to stay in the teaching profession?
10. How does your current experience teaching compare with your experience teaching as a resident in the CLASS program?

Feedback on CLASS

11. What supports did CLASS offer to help you transition to your current role?
12. What additional supports could the CLASS program offer to better support residents in transitioning to full-time teaching roles?
13. Is there anything you wish you had known before starting the CLASS program?
14. Is there anything you wish you had known before starting teaching?
15. Would you recommend the CLASS program to folks interested in entering the teaching profession? Why or why not?
16. To what extent do you think participation in the CLASS program influenced your professional goals? In what ways?

Looking Ahead

17. Are you planning to continue teaching next fall? Where? Why or why not?

Graduate (not teaching) Interview Protocol

Background

1. What is your current role?
    a. How long have you been working in this role/organization
    b. What are your key role responsibilities?

Reasons for Current Position

2. What influenced your decision to not continue teaching in this year?
3. What influenced your decision to work in your current position?
    a. What did this position offer that teaching did not?
4. Are you planning to return to teaching sometime? Why or why not?

Feedback on CLASS

5. Is there anything you wish you had learned in the CLASS program that would have better prepared you to be a classroom teacher?
    a. Probe: ADI, CT, Co-teaching, support from supervisor, CSU Chico Coursework, experience in placement school, classroom management
6. Did you received any support from the CLASS program for transitioning to a teaching career?
    a. What additional supports could the CLASS program offer to better support residents as they transition to the classroom?
7. Is there anything you wish you had known before starting the CLASS program?
8. Is there anything you wish you had known before starting teaching?
9. Would you recommend the CLASS program to folks interested in entering the teaching profession? Why or why not?
10. To what extent do you think participation in the CLASS program influenced your professional goals? In what ways?

Wrap-Up

11. Is there anything else you'd like to share about your experience in the CLASS program?

Appendix E. Teacher Questionnaire

Welcome to the Monthly Questionnaire for the CLASS Program

In 2019, California State University, Chico was awarded a Teaching Quality Partnership (TQP) grant to strengthen educator preparation through the CLASS program. SRI International is administering this monthly questionnaire to mentor and resident teachers as part of the external evaluation for this federal grant.

It is not our goal to evaluate individual teachers or to monitor teachers' compliance with any school, state, or district program. Instead, we will be using the research data to understand your experience working with your partner teacher and providing instruction to promote computational literacy and Argument Driven Inquiry (ADI), as well as how CSU, Chico can better support your needs.

The monthly questionnaire will take approximately 5–10 minutes to complete during most months. In some months, it may take longer. We will treat the information you provide in a confidential manner and will not share your responses with anyone at your school, in your district, or with anyone else outside the research team.

The risks for participating in this study are minor. Possible risks include discomfort answering some of the questions or possible loss of confidentiality. If you are uncomfortable with any questions, you do not have to answer them. There are no consequences if you choose not to answer a question. Your participation is voluntary, and if you decide to participate and change your mind, you may stop at any time. You will not personally benefit from this study. Your participation will help CSU, Chico understand how the CLASS program has been implemented and how to better support resident teachers and mentor teachers in the future.

You will receive $10 for each questionnaire you complete, up to $90. Stipends will be distributed as Amazon gift cards at the end of this school year. Please note that Amazon requires that we share your mobile number or email with them to purchase and send you your gift card. If you do not agree that we may share this information with Amazon, you will not receive a gift card, but may still complete the monthly questionnaires.

If you agree to participate in the questionnaires this year, please select "Yes, I agree to proceed" below and then click the "Next" button. If you decline to participate in the questionnaires this year, please select "No, I decline to participate" and then "Submit" on the next page, after which you will not receive future monthly questionnaires.

If this explanation leaves you with any unanswered questions, please ask and obtain answers before proceeding. If you have questions later, please contact the Principal Investigator, [NAME], at [EMAIL]. If you have any questions regarding your rights as a participant in the study, you may contact Solutions IRB (the body that oversees our protection of study participants) at (855) 226-4472 or participants@solutionsirb.com.

Consent: Do you consent to participate in the monthly questionnaires this year?

- Yes, I agree to proceed.
- No, I decline to participate.

HEADER: <MONTH> Questionnaire

Directions: Please respond to the following questions based on instruction from **<START_MDY> through <END_MDY>.**

Please note that the monthly questionnaire link will close on <DATE>.

[Text included in 2020–21 and 2021–22 administration only to account for instructional changes due to the COVID-19 pandemic] *We understand instructional practices may be in flux due to changes brought on by COVID-19, and may change throughout the year. Please answer to the best of your ability to help document instructional practices each month, however they may occur.*

[Item included in 2020–21 and 2021–22 administration only to account for instructional changes due to the COVID-19 pandemic] Which of the following best describes how you delivered instruction this month?

a. Instruction was completely in person.
b. Instruction was completely online.
c. Instruction was hybrid: some instruction was online and some was in person.
d. My school did not provide any instruction.
e. Other

1. **This month, about how many hours did you co-plan with your <mentor/resident> teacher?** Co-planning is any time you spend working together with your mentor/resident teacher to develop lesson plans, assignments, or strategies for delivering instruction together.
   a. (dropdown with 0–50 hours)

2. **This month, which co-teaching strategies did you use in your classroom with your < mentor/resident> teacher?** *(mark all that apply):*
   a. One Teach, One Assist
   b. One Teach, One Observe
   c. Station Teaching
   d. Parallel Teaching
   e. Alternative (Differentiated) Teaching
   f. Team Teaching
   g. Other, please describe: _______________
   h. We did not use any co-teaching strategies
   i. I don't know what these strategies are

3. [Residents only] **This month, about how many hours *per week* did you do the following** (dropdown 0–):
   a. Deliver instruction independently
   b. Co-teach, equally with my mentor teacher
   c. Co-teach, with my mentor teacher leading most of the instruction
   d. Co-teach, where I lead most of the instruction

4. This month, did you work with a coach from ADI?
    a. (Yes/No)
    [Ask items 4b and 4c, only if response to Q4a is "yes"]

    b. [2020–21 through 2023–24 only] In what ways did you connect with the ADI coach this month? (select all that apply)
        - By phone
        - E-mail
        - Virtual chat
        - In-person meeting
        - Classroom observation
        - Organized professional development webinar/group meeting
        - Other, please describe:

    c. In total, about how many hours did you spend connecting with the ADI coach?
        - (Drop down 1-15 hours)

5. [Residents only] This month, have you received any support from your supervisor on implementing ADI? *(Support can include feedback you received from your supervisor pre- or post-observation or any other communication with your supervisor)*
    a. Yes/No
    b. [If yes] To what extent did support from your supervisor help you implement ADI more effectively into your lessons?
        - Likert scale 1–5:
            1. Not at all
            2. A little
            3. Somewhat
            4. Considerably
            5. A great deal

6. [Residents only] Please describe any other supports you may have accessed last month to implement ADI (e.g., speaking with a colleague, instructor, etc.)

7. This month, how often did you ask students to engage in any of the following computational thinking data practice activities?

	Never	A few times this month	Once per week	More than once per week	Every class period
a. Develop a method for collecting data to answer a question					
b. Collect data to answer a research question					
c. Use statistics and/or probability to analyze data and/or draw conclusions					
d. Use computer-based tools (e.g., Excel, Tuva, CODAP), to identify patterns or anomalies in data, data trends over time, categorize data, or demonstrate relationships within data fields					
e. Interpret datasets, data models and/or data visualizations to make predictions, draw conclusions, and/or answer questions					
f. Produce appropriate data visualizations (e.g., graphs, tables, charts, dashboards) to convey information gathered during analysis					
g. Other, please describe ______________					

8. [2023–24 administration only] This month, how often did you ask students to engage in any of the following computational systems thinking activities?

	Never	A few times this month	Once per week	More than once per week	Every class period
a. Investigating a complex system as a whole					
b. Understanding the relationships within a system					
c. Thinking in levels					
d. Communicating information about a system					
e. Defining systems and managing complexity					

9. Did your students engage in any ADI activities in the past month?
    a. Yes
    b. No. My students did not engage in an ADI cycle this month. [End survey if only this item is selected]

10. [Skip pattern if Q9 is yes] How many times this month did students engage in each stage of the ADI cycle in your classroom? (select all that apply)

	None	1 time	2 times	3 times	4 times	5 or more times
a. **Task** – Introduce a phenomenon to figure out and the task to complete						
b. **Ideas** – Highlight some ideas that students can use during the investigation						
c. **Plan** – Students create, share, and revise a plan for collecting and analyzing data						
d. **Do** – Students collect the data they need and then make sense of it						
e. **Share** – Students create, share, critique, and revise evidence-based arguments						
f. **Reflect** – Students discuss ways to use core ideas and practices in the future						
g. **Report** – Students write, share, critique, and revise reports about what they figured						

11. [If any answer other than "none" selected on at least one subitem in Q10] Briefly describe (1–3 sentences) how your students engaged with the ADI cycle:

12. [Residents only] Please attach related lesson plans and a sample of student work for the ADI activities you described. You may take a photo of the lesson plan or student work or may

attach other forms of electronic copies. **IMPORTANT: Please remove or cover all student names before uploading.**

Please upload a copy of your lesson plans or student work here. You may take a photo or attach other forms of electronic copies. *If you would like to upload multiple documents, please either combine them into a single PDF or upload them as a zip file. If you have any questions regarding file uploads, please reach out to [SRI Research Coordinator] at [EMAIL]. Please remove all student names before submitting.*

[BREAK]

If you are ready to submit, please proceed. If you would like to double-check or change your responses, you may navigate with the backwards arrow below.

Appendix F. Mentor Teacher Survey

CLASS Program Mentor Teacher Survey

In 2019, California State University, Chico was awarded a Teaching Quality Partnership (TQP) grant to strengthen educator preparation through the CLASS Program. SRI International is conducting this survey of mentor teachers as part of the external evaluation for this federal grant.

It is not our goal to evaluate individual teachers or to monitor teachers' compliance with any school, state, or district program. Instead, we will be using the research data to understand your experience working with teacher residents and providing instruction to promote computational literacy and Argument Driven Inquiry (ADI), as well as how CSU, Chico can better support your needs.

The survey will take approximately 15 minutes to complete. We will treat the information you provide in a confidential manner and will not share your responses with anyone at your school, in your district, or with anyone else outside the research team.

When you are ready to begin the survey, please select "Yes, I agree to proceed" below and then click the "Next" button. If you decline to participate in this survey, please select "No, I decline to participate" and then "Submit" on the next page, which will turn off future email reminders. If this explanation leaves you with any unanswered questions, please ask and obtain answers before proceeding. If you have questions later, please call the Principal Investigator, [NAME], at [PHONE NUMBER]. If you have any questions regarding your rights as a participant in the study, you may contact Solutions IRB (the body that oversees our protection of study participants) at (855) 226-4472 or participants@solutionsirb.com.

Consent: Do you consent to participate in this survey?

- ❍ Yes, I agree to proceed.
- ❍ No, I decline to participate.

Instruction in 2022–23

Please tell us a little about your instruction for the 2022–23 school year.

1. What grade level(s) are you teaching in the 2022–23 school year? *Please make sure to include grades you will teach in either the fall or spring semesters.* (Select all that apply)
    a. 6
    b. 7
    c. 8
    d. 9
    e. 10
    f. 11
    g. 12
    h. Other. Please specify: ____

2. What subject(s) will you co-teach with the teacher resident from CSU, Chico in the upcoming school year? (Select all that apply)
    a. English language arts
    b. Math (includes algebra, statistics, geometry, calculus, etc.)
    c. Science (includes physics, physical science, chemistry, biology, anatomy, etc.)
    d. Social studies (includes social science, history, psychology, economics, etc.)
    e. Technology (includes computer studies, graphic design, computer science, etc.)
    f. Special education
    g. Other. Please specify: ____

3. Which of the following best describes your school's course schedule?
    a. We use a traditional schedule where students attend each of their courses daily.
    b. We use a block schedule where students take a few of their courses a day.
    c. We use a mixed schedule where students have a block schedule on some days and a traditional schedule on others.
    d. Other _____________

4. In which courses do you plan to implement Argument Driven Inquiry investigations (select all that apply)
    [Pre-populate response options to reflect items selected in Q1 and Q2]

5. How many days per week do you teach each class in which you will implement ADI?
    [Pre-populate a table with all of the courses selected in Q4]
    a. Open response from 1–5

6. About how many minutes per week will you teach each class in which you will implement ADI? (e.g., a 40-minute class taught 5 times a week is 200 minutes per week).
    a. [Pre-populate a table with all of the courses selected in Q3]
    b. Open response from 1–1,200 minutes

Professional Development

Please tell us about your professional development (PD) and instructional practice in the last year.

7. During the last 12 months, not including your training at CSU, Chico this summer, how much professional development (including in-person, web-based, professional reading, etc.) have you had that included the following topics?

	None	1 day or less	2–5 days	More than 5 days
a. Computational thinking (i.e., leveraging a computer or computing power to systematically solve problems)				
b. Argument Driven Inquiry				
c. Data literacy or data science				
d. Teaching students to collect data				
e. Teaching students to analyze data				
f. Teaching students to make visual displays of data				
g. Teaching students to develop an argument				

Instructional Practice

8. Think about your in-class instruction during the 2021–22 school year (last year). How frequently did you ask students to:

	Daily	Weekly	Once a month	A few times a year	Never
a. Complete tasks or assignments for which there was no obvious solution					
b. Complete tasks or assignments that require critical thinking					
c. Complete tasks or assignments that require at least one week to complete					
d. Use computer-based tools for projects or class work					
e. Work in small groups					
f. Decide on their own procedures for solving complex tasks					
g. Develop a method for collecting data to answer a question					
h. Collect data to answer a research question					
i. Conduct labs/experiments/hands-on activities/project-based learning in the classroom					
j. Engage in peer review with classmates (orally, written, using a rubric, etc.)					
k. Produce data visualizations (e.g. graphs, tables, charts, dashboards) to convey information gathered during analysis					
l. Engage in a whole-class discussion					
m. Write short persuasive texts (1–4 pages)					
n. Use statistics and/or probability to analyze data and/or draw conclusions					
o. Use computer-based tools (e.g. Excel, Tuva, CODAP), to identify patterns or anomalies in data					
p. Use computer-based tools (e.g. Excel, Tuva, CODAP) to identify data trends over time, categorize data, or demonstrate relationships within data fields					
q. Interpret datasets, data models, and/or visualizations for making predictions or drawing conclusions					

Beliefs About Teaching

9. In your teaching, how confident are you in doing the following? Please mark one choice for each practice.

	Not at all confident	Slightly confident	Somewhat confident	Quite confident	Extremely confident	N/A
a. Craft tasks or assignments that require students to think critically						
b. Develop and administer formative evaluation (quick write, exit slip, concept mapping, research plan, etc.)						
c. Develop and administer summative evaluation (unit assessment, final report or project, mid-term exam, etc.)						
d. Provide an alternative explanation or example when students are confused						
e. Support student learning through the use of digital technology (e.g., computers, tablets, smart boards) and computer-based tools						
f. Effectively teach all students computational thinking strategies and approaches						
g. Effectively facilitate labs/experiments/hands-on activities/project-based learning in the classroom						
h. Help students think critically						
i. Craft task or assignments that require students to collect and analyze data to solve research questions						

Background

Below, we have a few questions about your background. This information is used to understanding how teachers with different backgrounds experience and implement ADI and computational practices.

10. How many years (including the current year) have you been teaching? *Count any partial years as one full year. If this year is your first year of teaching, please select "1 year."*
    a. (dropdown 1–40 years)

11. How many years have you served as a mentor teacher, including the upcoming school year, using a non-co-teaching approach? *(e.g., teacher candidate observes for a period, gradually assumes more responsibility in the classroom, then solo-teaches for a period)*
    a. (dropdown 1–40 years)

12. How many years have you served as a mentor teacher, including the upcoming school year, using a co-teaching approach? *(e.g., you and the teacher candidate collaborate to plan and implement lessons; teacher candidate teaches in some capacity on most days)*
    a. (dropdown 1–40 years)

13. Which of the following best describes you:
    a. Male
    b. Female
    c. I prefer to self-describe_____
    d. I prefer not to answer

14. What is the highest degree you have earned? *Select one.*
    a. High school or less
    b. Associate degree
    c. Bachelor's degree
    d. Master's degree
    e. Educational Specialist diploma (Ed.S.)
    f. Ph.D., M.D., or J.D.
    g. Other _________

15. Which of the following choices describes your race/ethnicity? *Select all that apply.*
    a. American Indian or Alaska Native
    b. Asian or Asian American
    c. Black or African American
    d. Latino/a, Latinx, Hispanic, or Spanish origin
    e. Middle Eastern or North African
    f. Native Hawaiian or Pacific Islander
    g. White
    h. I prefer to self-describe: ________
    i. I choose not to share
    j. I am not sure

If you are ready to submit, please click the forward arrow. If you would like to double-check or change your responses, you may navigate with the backwards arrow below.

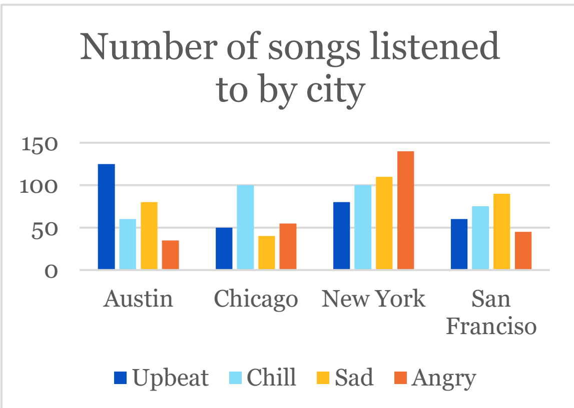
Appendix G. Student Computational Thinking Instrument

CLASS Program: High School Assessment on Computational Thinking

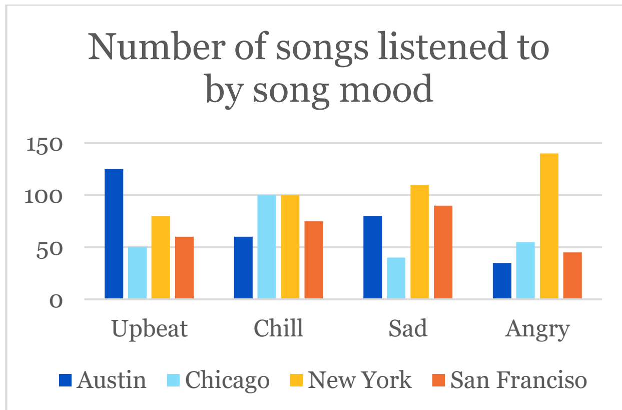
ASSESSMENT

1a. Using Graph 1 and Graph 2, please answer the following questions:

Graph 1:



Graph 2:

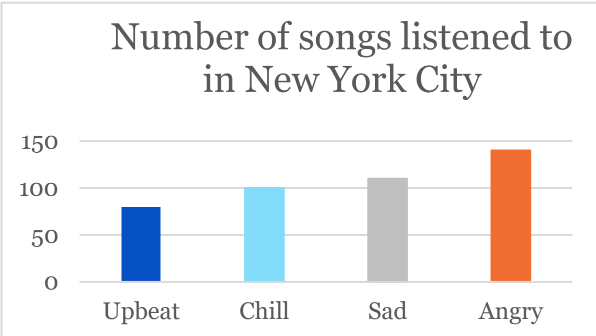


i. Do Graph 1 and Graph 2 show the same information?
   - Yes
   - No

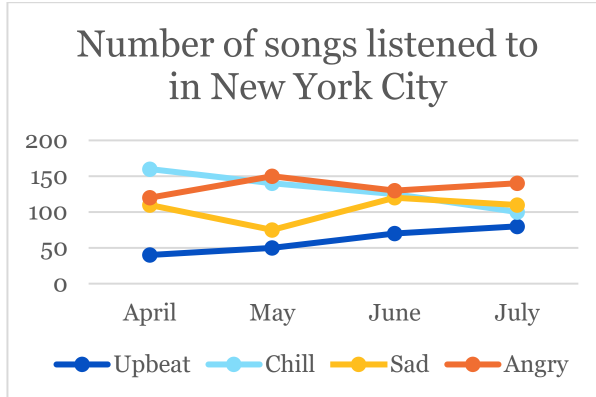
ii. Which graph would it be easier to find the information to help decide in which city to release an angry song?
   - Graph 1
   - Graph 2

iii. Which graph would it be easier to find the information to decide which song mood is most popular in San Francisco?
   - Graph 1
   - Graph 2

Graph 4:



Graph 5:



b. Which of the following statements can you infer from Graph 4, Graph 5, or both? Select all that apply.

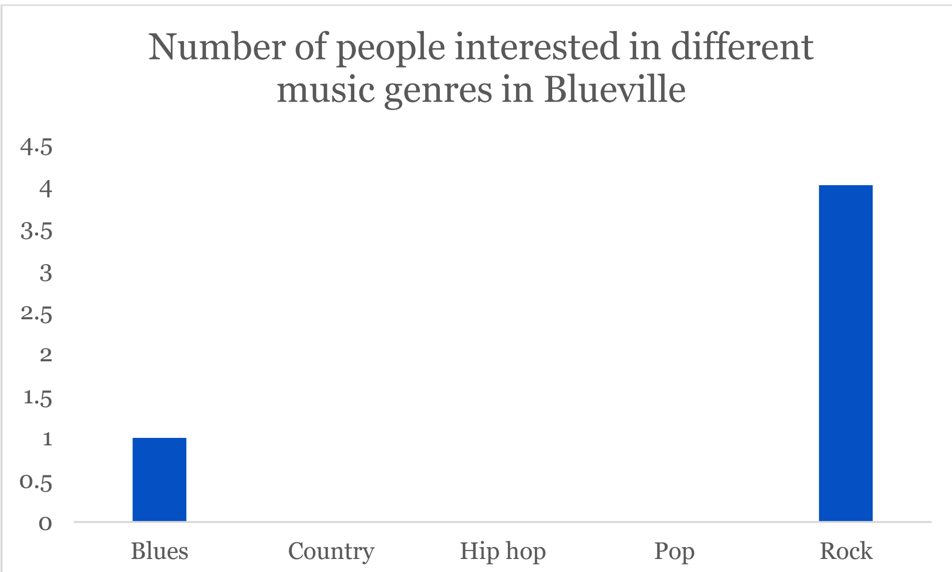
- ☐ Both Graphs 4 and 5 show the same information
- ☐ Graph 4 shows the same information as April in Graph 5
- ☐ Graph 4 shows the same information as July in Graph 5
- ☐ Upbeat songs are getting more popular over time in New York
- ☐ Chill songs are getting more popular over time in New York

2. Kirk works for an event management company. He wants to determine what artist to book in a concert venue in Blueville. To do this, Kirk first wants to find out what type of music would be of most interest to the people in Blueville.

Blueville is a small town with a population of about 10,000 people.

The concert venue can house 270 people.

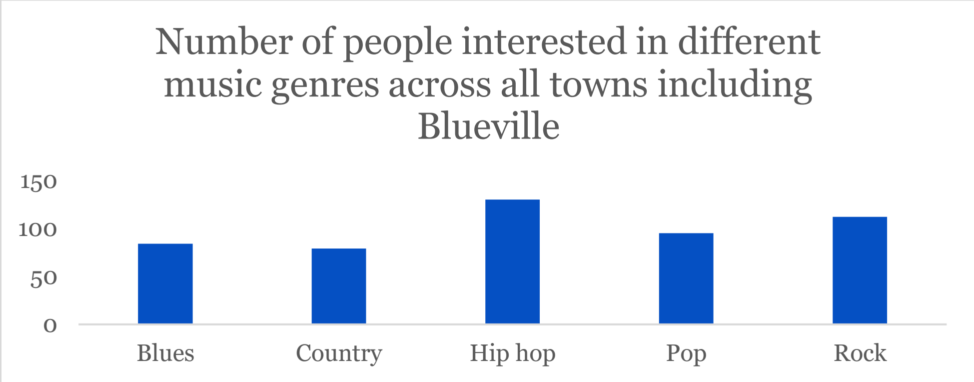
Kirk surveys 5 people. Based on the responses (see chart below), Kirk decides to organize a rock concert.

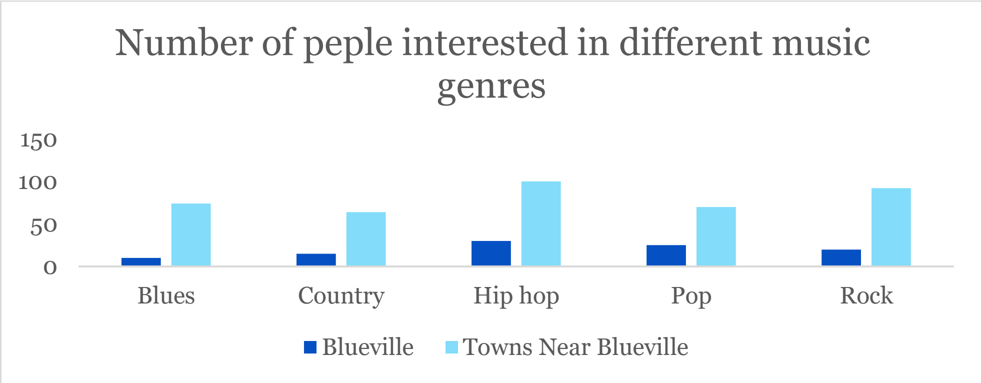


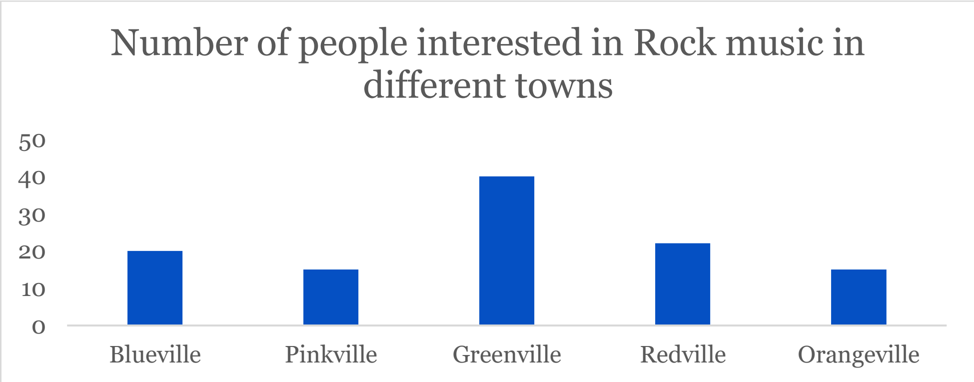
a. Do you agree with how Kirk investigated what type of concert would be of most interest in Blueville?

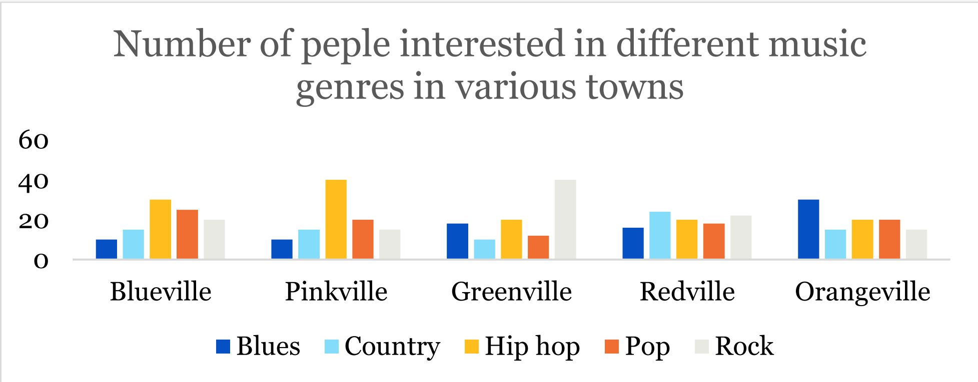
- Yes, I completely agree with how Kirk investigated interest in a concert
- No, I do not agree with Kirk's investigation. Kirk should have interviewed all 10,000 people in Blueville.
- No, I do not agree with Kirk's investigation. Kirk should have interviewed 270 people since the concert venue can house 270 people.
- No, I do not agree with Kirk's investigation. Kirk should have interviewed a higher percentage of the Blueville population.

b. Kirk surveys other towns near Blueville to gather information about their interest in different music genres. Which graph below would best help Kirk find out which towns in the area are most interested in the same genre of music as Blueville?









3. A global music streaming app collects detailed data from its users. Sarah wants to use this data to create a NYCListens app. Sarah's app will keep track of all the people from New York that listen to songs, what songs they listen to, and how often they listen to those songs. The app will summarize the information monthly.

a. What data MUST Sarah's NYCListens app collect from the global music streaming app to track the number of listeners in NYC who listened to certain songs in the last month? Select all that apply.

Remember: Sarah needs to pay for every field of data her app collects and does not want to spend more than she needs to.

- the day of the week of the listen (e.g., Friday)
- a unique ID number for each listener
- the date of each listen (e.g., January 5, 2019)
- the exact address of the listener
- the city in which the listener was located
- the title and artist of the song
- the type of cell phone the listener owns
- the name of the listener
- the kind of headphones the listener used

b. How would Sarah's app use the data she collected to figure out the number of listeners in April 2019 in New York City for the song "Raspberry Plains"?

____

____

____

c. Naomi is an artist who also wants to purchase data from the global streaming app to help her plan her next performance. Naomi wants to perform in a place where a lot of people like her music. For each type of data listed below, decide whether the data would help Naomi decide where to perform her show, and if the data would help her learn what her most popular songs are.

Naomi can use each type of data by itself, or she can combine it with other data.

	Data collected by global streaming app	Would the data help Naomi decide where to perform her show?	Would the data help determine what Naomi's most popular songs are?
i	The city each listener lives in	• Yes • No	• Yes • No
ii	Number of times each listener listened to each of Naomi's songs	• Yes • No	• Yes • No
iii	Number of Naomi's songs each listener has downloaded	• Yes • No	• Yes • No

4. The school science club is planning a field trip for its student members. The science club president Camila has asked each club volunteer to come up with a list of possible places to visit for a field trip. The following information needs to be collected for each venue:

- Location of the venue
- Cost of admission
- Wheelchair accessibility

Three volunteers Ken, Naomi, and Lani have each collected some information. The president, Camila, combines their information, as shown below, and tries to plan a field trip.

Volunteer name	**Venue**	**Location of venue**	**Cost per student ($)**	**Wheelchair Accessibility**
Ken	Ocean Institute	Zip code: 94011	25	It is wheelchair accessible
Ken	Natural History Museum	Zip code: 94089	20	It is wheelchair accessible
Ken	State wildlife area	Zip code: 93035	20	It is not wheelchair accessible
Naomi	Science museum	45 miles from school	30	No
Naomi	Eden Laboratories	56 miles from school	15	Yes
Naomi	Arthur park	40 miles from school	20	Yes
Naomi	Botanical Garden	71 miles from school	20	No
Lani	Ardent refineries	San Anne County	300 for a group of 10–15 students	It is not wheelchair accessible
Lani	Observatory	Williamson County	250 for a group of 10–15 students	It is wheelchair accessible
Lani	Rose Garden	Granada County	150 for a group of 10–15 students	It is wheelchair accessible
Lani	Zeon Laboratories	Mayville County	200 for a group of 10–15 students	It is not wheelchair accessible

a. Camila writes the following computer instruction to find field trip venues that are wheelchair accessible:

IF *Wheelchair Accessibility* = “Yes”
SELECT *Venue*

What results does Camila get? Select all of the venues that would be returned using the computer instructions above.

- ❑ Ocean Institute
- ❑ Natural History Museum
- ❑ State wildlife area
- ❑ Science museum
- ❑ Eden Laboratories
- ❑ Arthur park
- ❑ Botanical Garden
- ❑ Ardent refineries
- ❑ Observatory
- ❑ Rose Garden
- ❑ Zeon Laboratories

b. Which of the following can help Camila get the names of all 6 venues that are wheelchair accessible? Select all that apply.

i. Camila should modify the data for the “Wheelchair accessibility” field so that it says “Yes” wherever it now says “It is wheelchair accessible.” Camila does not need to make any change to her computer instructions.

ii. Camila should modify the data for the “Wheelchair accessibility” field so that it says “It is wheelchair accessible” wherever it now says “Yes.” Camila does not need to make any change to her computer instructions.

iii. Camila does not need to modify the data. Camila should only change her computer instructions to say:
IF *Wheelchair Accessibility* = “It is wheelchair accessible”
SELECT *Venue*

iv. Camila does not need to modify the data. Camila should only change her computer instructions to say:
IF *Wheelchair Accessibility* = “Yes” OR *Wheelchair Accessibility* = “It is wheelchair accessible”
SELECT *Venue*

c. Camila now wants to generate a list of the venues that **cost less than $25 per student** **and** are also **less than 50 miles away from the school**. She writes the following computer instruction to generate this information.

IF (*Cost per student ($)* < 25 AND *Location* < 50 miles from school)
SELECT *Venue*

What results does Camila get? Select all of the venues that would be returned using the computer instructions above.

- ❑ Ocean Institute
- ❑ Natural History Museum
- ❑ State wildlife area
- ❑ Science museum
- ❑ Eden Laboratories
- ❑ Arthur park
- ❑ Botanical Garden
- ❑ Ardent refineries
- ❑ Observatory
- ❑ Rose Garden
- ❑ Zeon Laboratories

5. A school principal is working on assigning 9 students to 3 after school clubs called Club A, Club B, and Club C. Each student listed their first, second, and third choice of clubs. Each student will only join one club. Each club can have at most 3 students.

Below are the students' choices:

Student Name	**1st choice**	**2nd choice**	**3rd choice**
Ajay	A	B	C
Bella	A	B	C
Cammy	B	A	C
Diego	A	B	C
Eva	A	C	B
Gabby	C	A	B
Juan	C	B	A
Luis	A	C	B
Neil	C	A	B

a) If each student was assigned his or her 1st choice club, would this solve the problem?

- ☐ Yes, because everyone gets their first choice
- ☐ Yes, because all clubs have the same number of people
- ☐ No, too many people want to be in club A
- ☐ No, not enough people want to be in club C

Below is one method the principal could use to solve the problem:

Method #1:

Step 1: Start with Ajay. Do Steps 2 through 4, then move to the next student alphabetically on the list and repeat.

Step 2: If the student's 1st choice club has an opening, then assign the student to that club.

Step 3: If the student's 1st choice club is full, then check their 2nd choice. If their 2nd choice has an opening, then assign the student to their 2nd choice club.

Step 4: If their 2nd choice is full, then assign them to their 3rd choice club.

b) Use Method #1 to determine which student will be in which club. Drag the names for the students that would be selected for each club into the corresponding boxes in the tables below:

	Club A	**Club B**	**Club C**
Method #1: Student Names	Ajay (1) Bella (1) Diego (1)	Cammy (1) Luis (3) Neil (3)	Eva (2) Gabby (3) Juan (1)

Below is another method the principal could use to solve the problem:

Method #2:

Step 1: Make 3 lists, with one for each club. Put students on the list for their 1st choice club.

Step 2: Start with the list for Club A, do Steps 2a through 2c. Then repeat for Club B and Club C.

Step 2a: If there are 3 or fewer students on this list, move to the list for the next club. If there are no more clubs, then move to Step 3.

Step 2b: If there are more than 3 students on this list, then find a student on this list whose 2nd choice list has fewer than 3 students. Move the student into the list for their 2nd choice club.

Step 2c: Go back to Step 2a.

Step 3: Assign the students to clubs based on the lists.

c) Use Method #2 to determine which students will be in which clubs.

Here are the lists after Step 1 of Method #2:

List for Club A	List for Club B	List for Club C
Ajay Bella Diego Eva Luis	Cammy	Gabby Juan Neil

Apply Step 2 and Step 3 to the list above. Write the names for the students that would be selected for each club using Method #2 in the corresponding boxes below:

	Club A	**Club B**	**Club C**
Method #2 Student Names			

d) Would each of the methods (Method #1 and Method #2) solve the problem?

- ☐ Yes
- ☐ No

e) Choose which method would make the most students happy with their club assignment.

- ☐ Method #1, because more people have their first choice club
- ☐ Method #1, because fewer people have their second choice club
- ☐ Method #2, because more people are in Club A
- ☐ Method #2, because fewer people have their third choice club

SURVEY ITEMS

How do you use a computer to solve problems?

People use computers to solve many problems. Computers help you solve problems *systematically*. This means they help you:

- Break a big problem into smaller parts
- Find and use patterns in solving the problems
- Create steps to solve the problem

When you were solving the problems in this quiz, you may have used some of these strategies. Think about how you might use computers to solve problems similar to the ones you just completed as you answer the remaining questions below.

Scale: *Likert scale ranging from 1 through 5, with 1 equal to never, 2 equal to rarely, 3 equal to sometimes, 4 equal to often, and 5 equal to always*.

6. When using a computer to solve a problem I…

a. create a list of steps to solve the problem
b. try to simplify the problem by ignoring details that are not needed
c. look for patterns in the problem
d. break the problem into smaller parts
e. follow my gut feeling
f. work with others to solve different parts of the problem at the same time
g. look for how information can be collected, stored, and analyzed to help solve the problem
h. store, update, and retrieve values to solve the problem
i. make improvements one step at a time and work new ideas in as I have them
j. ask others for help
k. share my programs with others and look at others' solutions for ideas
l. do not reflect on or revise my initial solution because a computer is always correct.
m. try to automate and generalize the solution

Scale for 7–11: *Likert scale of 1 through 5, with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to neither agree nor disagree, 4 equal to agree, and 5 equal to strongly agree.*

Remember, **computers help you solve problems systematically**. Hover over the blue text to view a definition.

Indicate how much you agree with each of the sentence below:

7. Confidence

a. I feel confident about my ability to use computers to systematically solve problems.
b. I am sure I could do advanced work using computers to systematically solve problems.
c. I think I could handle difficult problems involving computers to systematically solve problems.
d. I'm not good at using computers to systematically solve problems.

8. Enjoyment

a. I enjoy using computers to systematically solve problems.
b. Using computers to systematically solve problems makes me nervous.
c. Using computers to systematically solve problems is difficult.
d. I feel comfortable using computers to systematically solve problems.

9. Importance and Perceived Usefulness

a. I will be able to get a good job if I learn to use computers to systematically solve problems.
b. I will use computers to systematically solve problems in many ways throughout my life.
c. Using computers to systematically solve problems is of no relevance to my life.
d. Taking classes that emphasize use of computers to systematically solve problems is a waste of time.

10. Motivation to Succeed

a. When a problem arises with using computers to systematically solve problems that I can't immediately solve, I stick with it until I have the solution.
b. I like using computers to systematically solve problems.
c. When I am working on a problem using computers to systematically solve problems that I can't immediately understand, I want to work harder to get it.
d. Figuring out problems that use computers to systematically solve problems do not interest me.

11. Perceptions of Future Careers in CT

a. I want to learn more about different jobs that use computers to solve problems.
b. I plan to use computers to solve problems in my future career.
c. If I do well now in using computers to solve problems, it will help me in my future career.
d. I am interested in jobs that use computers to solve problems.

Assessment Closed Item Scoring Rubric

Q#	Letter	Roman numeral	Single vs. Multi Select	Answer	Points
1	a	i	Single	Yes (answer choice 1)	1 point
		ii	Single	Graph 2 (answer choice 2)	1 point
		iii	Single	Graph 1 (answer choice 1)	1 point
	b		Multi	Graph 4 shows the same information as July in Graph 5 AND Upbeat songs are getting more popular over time in New York (answer choices 3 and 4)	2 points = both correct answer choices and no other choices selected 1 point = selected exactly 1 correct answer choice and no other answer choices; OR selected both correct answer choices and exactly one incorrect answer choice 0 points = not 2 points response and not 1 point response and not missing (i.e., not skipped)
2	a		Single	No, I do not agree with Kirk's investigation. Kirk should have interviewed a higher percentage of the Blueville population. (answer choice 4)	1 point
	b		Multi	Graph 4 (graph d; answer choice 4) "Number of people interested in different music genres in various towns" (answer choice 4) – full score (answer choice 3) – partial score [partial as this is a plausible response]	2 points – answer choice 4 (graph d) 1 point – answer choice 3 (graph c) 0 points – answer choices 1, 2, or missing
3	a		Multi	a unique ID number for each listener the date of each listen (e.g., January 5, 2019) the city in which the listener was located the title and artist of the song (answer choices 2, 3, 5, 6)	2 points = selected all 4 correct answer choices and no other choices selected 1.5 points = selected exactly 3 correct answer choices and no other answer choices; OR selected all 4 correct answer choices and exactly one incorrect answer choice 1 point = selected exactly 2 correct answer choices and no other answer choices; OR

Q#	Letter	Roman numeral	Single vs. Multi Select	Answer	Points
					selected exactly 3 correct answer choices and exactly 1 incorrect answer choice; OR selected exactly 4 correct answer choices and exactly two incorrect answer choices 0.5 points = selected exactly 1 correct answer choice and no other answer choices; OR selected exactly 2 correct answer choice and exactly 1 incorrect answer choice; OR selected exactly 3 correct answer choices and exactly two incorrect answers OR selected exactly 4 correct answer choices and exactly three incorrect answers 0 points = otherwise (anything that is not a 1, 2, 3, or 4 point response)
	b		n/a	Open-ended response	Max of 3 points. *Note: Score the open ended item out of 6 points (see open ended rubric), then halve the score so the item is out of 3 points.*
	c	i	Single	Yes / No	2 points (1 for each correct answer)
		ii	Single	Yes / Yes	2 points (1 for each correct answer)
		iii	Single	Yes / No	2 points (1 for each correct answer)
4	a		Multi	Eden Laboratories AND Arthur park (answer choices 5, 6)	2 points = both correct answer choices and no other choices selected 1 point = selected exactly 1 correct answer choice and no other answer choices; OR selected both correct answer choices and exactly one incorrect answer choice 0 points = otherwise
	b		Multi	Camila should modify the data for the "Wheelchair accessibility" field so that it says "Yes" wherever it	2 points = both correct answer choices and no other choices selected

Q#	Letter	Roman numeral	Single vs. Multi Select	Answer	Points
				now says "It is wheelchair accessible." Camila does not need to make any change to her computer instructions. AND Camila does not need to modify the data. Camila should only change her computer instructions to say: IF *Wheelchair Accessibility* = "Yes" OR *Wheelchair Accessibility* = "It is wheelchair accessible" SELECT *Venue* (answer choices 1 and 4)	1 point = selected exactly 1 correct answer choice <u>and</u> no other answer choices; OR selected both correct answer choices <u>and exactly</u> one incorrect answer choice 0 points otherwise
	c		Multi	Arthur park (answer choice 6)	1 point = selected correct answer and no other answer choices 0 points if selected correct answer and at least one incorrect answer OR Did not select correct answer
5	a		Single	No, too many people want to be in Club A (answer choice 3)	1 point
	b		Multi	<u>Club A</u> Ajay Bella Diego <u>Club B</u> Cammy Luis Neil <u>Club C</u> Eva Gabby Juan	2 points for placing all 9 students in the correct club using Method #1: **Club A:** Ajay, Bella, Diego **Club B:** Cammy, Luis, Neil **Club C:** Eva, Gabby, Juan OR 1 point for placing 7 or 8 out of the 9 students in the correct club using Method #1. 0 points if students only put 6 or fewer students in the correct club
	c		Multi	There are a few possible answer choices: <u>Club A</u> [1 of Ajay, Bella, or Diego] Eva	2 points for placing all 9 students in the correct club using Method 2: **Club A:** [1 of either Ajay, Bella, or Diego], Eva, Luis

Q#	Letter	Roman numeral	Single vs. Multi Select	Answer	Points
				Luis <u>Club B</u> Cammy [2 of Ajay, Bella, and Diego AND NOT whoever is in Club A already] <u>Club C</u> Gabby Juan Neil	**Club B:** Cammy, [2 of either Ajay, Bella, or Diego—NOT whoever is in Club A] **Club C:** Gabby, Juan, Neil 1 point for placing 7 out of the 9 students in the correct club using Method 2.
	d		Single	Yes (answer choice 1)	1 point
	e		Single	Method #2, because fewer people have their third choice club (answer choice 4)	1 point

Assessment Open-Ended Item Scoring Rubric

Question 3b: A global music streaming app collects detailed data from its users. Sarah wants to use this data to create a NYCListens app. Sarah's app will keep track of all the people from New York that listen to songs, what songs they listen to, and how often they listen to those songs. The app will summarize the information monthly. **How would Sarah's app use the data she collected to figure out the <u>number of listeners</u> in April 2019 in New York City for the song "Raspberry Plains"?**

Desired computational response:

1. *Counter = 0*
2. *Repeat for each song listen{*
    3. If(city = NYC) AND (date contains April 2019) AND (Song = Raspberry Plains) {
        4. If (ID not counted before) {
    5. Counter ++} } }

6. Display value of Counter

	Part 1: Correctly Checking Parameters						Part 2: Identify What to Check and What to Count			Total	
	Date (April 2019)		Location (NYC)		Song (Raspberry Rains)						
	Mention use of *Date* var?	Checks *date* = April 2019?	Mentions use of *Location* var?	Checks location (*city*) = NYC?	Mention use of *song* var?	Checks *song* = Raspberry Plains?	Mention Unique ID?	That you want to count or add the IDs?	Check all song listens (for loop)	Points	Percent
Max Possible Points	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	6	100%

Part 1

- Correctly checking parameters - Being specific about a parameter means specifying both the variable and its value. If a student just mentions the variables to track and not the values, it would be only half a point for each condition.
- 1 point for each parameter – 0.5 points for mentioning the variable and 0.5 points for mentioning the value of the variable.
    - *Date*
        - 0.5 – mentions use of any date variable, even if it is incorrect
        - 0.5 – correctly checks that specific date = April 2019
    - *Location*
        - 0.5 – mentions any location (e.g., city, area, state, zip code) variable
        - 0.5 – identifies "New York City" or "NYC" specifically
    - *Song*
        - 0.5 – mentions "song," even if it's not specifically a variable. "It," "the music," "the artist," or "the genre" is not specific enough to count; neither is vague mention of "app will track songs" because it does not indicate checking for a specific song.
        - 0.5 – identifies "Raspberry Plains" specifically
- 0 points for anything else (e.g. vague, partial, or non-response).
    - If no date var mentioned, = 0 points
    - If does not check date is April 2019, mentions checking a vague date (e.g. "that month") or a partly complete date (e.g., "April") = 0 points

Part 2

- Identifying what to check and what to count.
- Indication of a for loop (for each song listen) – some understanding that you need to be repeatedly checking the same things for each song listen. Vague response would be indicating need for repetition but not describing repetition for each song listen.
- Check to see if the listener has already listened to this song (or is already included) – and some indication that you only want to count up the unique listeners.
    - 3 points they specify that:
        - (1) you are looking for a unique ID (you do not want to count a ID twice),
        - (2) you want to count or add all of these IDs (or unique listeners, **<u>not</u>** generic "listener"), and
        - (3) you need to check all the song **<u>listens</u>** (indicate the for loop and repeated check for each song listen)
    - 2 points – for only 2 of the above
    - 1 point – for only 1 of the above
    - 0 points otherwise

Appendix H. Variable Definitions

Variable Name	Type	Source	Definition
			Treatment Variables
At least one CLASS pair	Binary	Rosters	This is a binary variable equal to 1 if student was exposed to at least one CLASS pair (treatment) and 0 otherwise (comparison).
Number of CLASS pairs	Ordinal	Rosters	This is a categorical variable equal to the number of CLASS pairs a student was assigned to between 2021–22 and 2023–24. The variable has values of 0 pairs (comparison students), 1 pair, 2 pairs, or 3+ pairs. Note: We counted exposure to special education CLASS pairs pushing into another CLASS pairs' classroom as exposure to two pairs.
			Student Covariates
Grade student baseline student computational thinking instrument	Binary	Student instrument	This is a binary variable equal to 1 if the student took the computational thinking instrument in grade 9 and 0 if they took the instrument in grade 10.
Sex	Binary	Rosters	This is a binary variable equal to 1 if student was listed as female on the school rosters and 0 if the student was listed as a male. Note: The categories listed here are not inclusive of students' sexual orientation and gender identities; however, the student instrument did not collect information on students' preferred identifies from students (Charles and Lynn Schusterman Family Philanthropies, n.d.). Information on students' sex was provided by the students' high school enrollment data and does not necessarily reflect how the student identifies in terms of their sexual orientation or gender identity.
Percentage points earned on assessment at baseline	Continuous	Student assessment	This is a continuous variable ranging from 0% to 100% representing students' percent score on the baseline assessment.
Factor: Confidence in CT practices at baseline	Continuous	Student survey	This is a continuous factor variable constructed using 4 survey items measured on a 5-point Likert scale, with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to neither agree nor disagree, 4 equal to agree, and 5 equal to strongly agree. The factor measures students' responses at baseline. For a student to have a value for the factor, the student must have answered at least 75% of items, or 3 out of 4 items, in the factor. The factor had high internal consistency, with a Cronbach's alpha value of 0.75 at baseline.
Factor: Interest in future careers in a computer science field at baseline	Continuous	Student survey	This is a continuous factor variable constructed using 4 survey items measured on a 5-point Likert scale, with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to neither agree nor disagree, 4 equal to agree, and 5 equal to strongly agree.

Variable Name	Type	Source	Definition
			The factor measures students' responses at the baseline. For a student to have a value for the factor, the student must have answered at least 75% of items, or 3 out of 4 items, in the factor. The factor had high internal consistency, with a Cronbach's alpha value of 0.84 at outcome.
Outcome Variables			
Percentage points earned on assessment at outcome	Continuous	Student assessment	This is a continuous variable ranging from 0% to 100% representing students' percent score on the outcomes assessment.
Factor: Confidence in CT practices at outcome	Continuous	Student survey	This is a continuous factor variable constructed using 4 survey items measured on a 5-point Likert scale, with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to neither agree nor disagree, 4 equal to agree, and 5 equal to strongly agree. The factor measures students' responses at the outcome. For a student to have a value for the factor, the student must have answered at least 75% of items, or 3 out of 4 items, in the factor. The factor had high internal consistency, with a Cronbach's alpha value of 0.72 at outcome.
Factor: Interest in future careers in a computer science field at outcome	Continuous	Student survey	This is a continuous factor variable constructed using 4 survey items measured on a 5-point Likert scale, with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to neither agree nor disagree, 4 equal to agree, and 5 equal to strongly agree. The factor measures students' responses at the outcome. For a student to have a value for the factor, the student must have answered at least 75% of items, or 3 out of 4 items, in the factor. The factor had high internal consistency, with a Cronbach's alpha value of 0.89 at outcome.
Subgroup Variables			
Ever ELA CLASS pair	Binary	CLASS program data	This is a binary variable equal to 1 if a CLASS student was exposed to at least one CLASS pair in ELA and 0 if they never were exposed to a CLASS pair in ELA. Note: This variable was created using a sample of treatment students and excluded students who only were exposed to CLASS pairs in special education.
Ever science CLASS pair	Binary	CLASS program data	This is a binary variable equal to 1 if a CLASS student was exposed to at least one CLASS pair in science and 0 if they never were exposed to a CLASS pair in science. Note: This variable was created using a sample of treatment students and excluded students who only were exposed to CLASS pairs in special education.
EVER math	Binary	CLASS program data	This is a binary variable equal to 1 if a CLASS student was exposed to at least one CLASS pair in math and 0 if they never were exposed to a CLASS pair in math. Note: This variable was created using a sample of treatment students and excluded students who only were exposed to CLASS pairs in special education.

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Silicon Valley
(SRI headquarters)
333 Ravenswood Avenue
Menlo Park, CA 94025
1.650.859.2000

Washington, DC
1100 Wilson Boulevard
Suite 2800
Arlington, VA 22209
1.703.524.2053

education@sri.com

www.sri.com/education-learning/